The topic of the lesson

“Mastitis and breast abscess.”

According to the evidence-based data from UpToDate extracted March of 19, 2020

Provide a conspectus in a format of .ppt (.pptx) presentation of not less than 50 slides containing information on:

1. Classification
2. Etiology
3. Pathogenesis
4. Diagnostic
5. Differential diagnostic
6. Treatment

With 10 (ten) multiple answer questions.
Lactational mastitis

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All topics are updated as new evidence becomes available and our peer review process is complete.


INTRODUCTION

Lactational mastitis is a condition in which a woman's breast becomes painful, swollen, and red; it is most common in the first three months of breastfeeding. Initially, engorgement occurs because of poor milk drainage, probably related to nipple trauma with resultant swelling and compression of one or more milk ducts. If symptoms persist beyond 12 to 24 hours, the condition of infective lactational mastitis develops (since breast milk contains bacteria); this is characterized by pain, redness, fever, and malaise [1].

Issues related to lactational mastitis will be reviewed here. Issues related to other breast infections are discussed separately. (See "Nonlactational mastitis in adults" and "Primary breast abscess" and "Breast cellulitis and other skin disorders of the breast".)

EPIDEMIOLOGY

Lactational mastitis has been estimated to occur in 2 to 10 percent of breastfeeding women [2]. The incidence of mastitis requiring hospitalization is low; in one cohort including 136,459 new mothers, 127 women were hospitalized for mastitis, an incidence of 9 per 10,000 deliveries [3].

The risk of recurrence of mastitis in women with prior history of lactational mastitis is higher than in women with no prior history.

ETIOLOGY

Lactational mastitis often occurs in the setting of the following breastfeeding problems, which typically result in prolonged engorgement or poor drainage [4]:

- Partial blockage of milk duct; reduced drainage results in stagnant milk distal to the obstruction
- Oversupply of milk
Organisms grow in the stagnant milk, resulting in infectious mastitis [1]. Infection can progress to local abscess formation if not treated promptly. Effective management and prevention of recurrence depends on resolution of the above factors.

Risk factors for lactational mastitis include prior history of mastitis, poor milk drainage, cracked nipples, use of cream on nipples (particularly antifungal cream), and using a breast pump [4,5].

The pathogenesis of lactational mastitis is complex and may include poorly understood interactions between the mammary-associated microbiota and host-specific genetic factors [6].

The risk of developing lactational mastitis can be reduced by frequent, complete emptying of the breast and by optimizing breastfeeding technique [7].

MICROBIOLOGY

Most episodes of lactational mastitis are caused by Staphylococcus aureus. Methicillin-resistant S. aureus (MRSA) has become an important pathogen in cases of lactational mastitis [2,8]; in one study including 127 women hospitalized for mastitis, MRSA was the most common pathogen isolated from women with mastitis alone (24 of 54 specimens) or mastitis and abscess (18 of 27 specimens).

Less frequent pathogens include Streptococcus pyogenes (group A or B), Escherichia coli, Bacteroides species, Corynebacterium species, and coagulase-negative staphylococci (eg, Staphylococcus lugdunensis).

In one study, milk was cultured from 192 women with mastitis and 466 breast milk donors (controls); two organisms, S. aureus and group B streptococci, were recovered significantly more frequently from women with mastitis than controls [1]. S. aureus has been widely reported as a causative organism in mastitis [9-11].

CLINICAL MANIFESTATIONS

Lactational mastitis is a condition in which a woman's breast becomes painful, swollen, and red (picture 1); it is most common in the first three months of breastfeeding. Initially, engorgement occurs because of poor milk drainage, probably related to nipple trauma with resultant swelling and compression of one or more milk ducts.
If symptoms persist beyond 12 to 24 hours, the condition of infective lactational mastitis develops (since breast milk contains bacteria) [1]. Infective lactational mastitis typically presents as a firm, red, painful, swollen area of one breast associated with fever >38.3°C in a nursing mother; milk secretion may be diminished. Systemic complaints may include myalgia, chills, malaise, and flu-like symptoms.

In the early stages, the presentation can be subtle with few clinical signs; patients with advanced infection may present with a large area of breast swelling with overlying skin erythema. Reactive axillary lymphadenopathy may be associated with axillary pain and swelling.

**DIAGNOSIS**

The diagnosis of mastitis is based on clinical manifestations; laboratory tests are not needed.

Culture of the breast milk can be useful to guide selection of antibiotics; it is particularly important in the setting of infection that is severe, hospital acquired, or unresponsive to initial empiric antibiotics [7,12]. Blood cultures are warranted in the setting of severe infection (eg, hemodynamic instability, progressive erythema) but are otherwise not routinely necessary.

Imaging is useful if lactational mastitis does not respond within 48 to 72 hours to supportive care and antibiotics. Ultrasound is the most effective method of differentiating mastitis from breast abscess [13-17]. (See "Primary breast abscess".)

**DIFFERENTIAL DIAGNOSIS**

- **Severe engorgement** – Engorgement occurs due to interstitial edema with onset of lactation or at other times with accumulation of excess milk. Mastitis may be distinguished from severe engorgement in that engorgement is bilateral, with generalized involvement [2]. Engorgement is not typically associated with systemic symptoms of fever and myalgia. (See "Common problems of breastfeeding and weaning", section on 'Engorgement'.)

- **Breast abscess** – Mastitis can progress to local abscess formation if not treated promptly. A tender fluctuant area is suggestive of an abscess [18]. Ultrasonography is the most effective method of differentiating mastitis from a breast abscess and also facilitates guided drainage (image 1) [13-17]. (See "Primary breast abscess".)

- **Plugged duct** – A plugged duct is a localized area of milk stasis within the milk duct that causes distention of mammary tissue. Symptoms include a palpable lump with tenderness. A plugged duct may be distinguished from mastitis and breast abscess by the absence of systemic findings. (See "Common problems of breastfeeding and weaning", section on 'Plugged ducts'.)

- **Galactocele** – A galactocele (also known as a milk retention cyst) is a cystic collection of fluid that is
The differential diagnosis of nonlactational mastitis is discussed separately. (See "Nonlactational mastitis in adults".)

**TREATMENT**

**Clinical approach** — Initial management of nonsevere lactational mastitis consists of symptomatic treatment to reduce pain and swelling (nonsteroidal inflammatory agents, cold compresses) and complete emptying of the breast (via ongoing breastfeeding, pumping, and/or hand expression); cessation of lactation is not required [7,10-12,14,18,19]. (See "Common problems of breastfeeding and weaning", section on 'Engorgement' and "Common problems of breastfeeding and weaning", section on 'Plugged ducts'.)

Management of infective lactational mastitis (lactational mastitis with persistent symptoms beyond 12 to 24 hours, with fever) consists of the above measures in addition to administration of antibiotic therapy with activity against *S. aureus* [9,10,12,13,19-28]. (See 'Antibiotic therapy' below.)

Data on treatment of lactational mastitis are limited. One observational study noted that emptying of the breast increased the rate of good outcome to 50 percent and significantly reduced the duration of symptoms; the addition of antibiotics to breast emptying increased the rate of good outcome to 96 percent [10].

If there is no clinical improvement within 48 to 72 hours, evaluation with ultrasound imaging to determine if there is an underlying abscess should be pursued. (See "Primary breast abscess".)

**Antibiotic therapy** — Culture of the breast milk can be useful to guide selection of antibiotics; it is particularly important in the setting of infection that is severe, hospital acquired, or unresponsive to appropriate antibiotics [7,12]. Blood cultures are warranted in the setting of severe infection (eg, hemodynamic instability, progressive erythema) but are otherwise not necessary.
Empiric therapy for lactational mastitis should include activity against *S. aureus* [10,19]:

- In the setting of nonsevere infection in the absence of risk factors for methicillin-resistant *S. aureus* (MRSA) (**table 1**), outpatient therapy may be initiated with **dicloxacillin** (500 mg orally four times daily) or **cephalexin** (500 mg orally four times daily) [19]. In the setting of beta-lactam hypersensitivity, **erythromycin** 500 mg twice daily is preferred. **Clindamycin** 450 mg orally three times per day may also be used although caution is warranted because of the risk of *Clostridioides* (formerly *Clostridium*) *difficile* colitis.

- In the setting of nonsevere infection with risk for MRSA (**table 1**), effective antibiotics include **trimethoprim-sulfamethoxazole** (TMP-SMX; 1 double-strength tablet orally twice daily) or **clindamycin** (450 mg orally three times daily).

  TMP-SMX may be used in women who are breastfeeding healthy full-term infants who are at least one month old. TMP-SMX should be avoided in women who are breastfeeding newborn infants (<1 month old) or infants with glucose-6-phosphate dehydrogenase deficiency, and it should be used cautiously in women who are breastfeeding infants who are jaundiced, premature, or ill [29]. (See "**Trimethoprim-sulfamethoxazole: An overview**, section on 'Pregnancy and breastfeeding'.)

  - In the setting of severe infection (e.g., hemodynamic instability, progressive erythema on antibiotics), empiric inpatient therapy with **vancomycin** (15 to 20 mg/kg/dose every 8 to 12 hours, not to exceed 2 g per dose) should be initiated; therapy should be tailored to culture and sensitivity results. Gram stain results demonstrating gram-negative rods should prompt empiric antibiotic therapy with a third-generation cephalosporin or a combination beta-lactam-beta-lactamase agent.

The optimal length of therapy is not certain; 10 to 14 days may reduce the risk of relapse, but shorter courses (5 to 7 days) can be used if the response to therapy is rapid and complete. In patients with severe mastitis or abscess, once there are signs of clinical improvement with no evidence of systemic toxicity, antibiotics may be transitioned from parenteral to oral therapy.

**PREVENTION**

For pregnant women with a history of lactational mastitis, administration of a **Lactobacillus** probiotic during late pregnancy may reduce the likelihood of lactational mastitis. In one randomized trial that included 108 pregnant women with history of infectious mastitis after previous pregnancies, women who received oral *Lactobacillus salivarius* PS2 had a lower incidence of mastitis than those who received placebo (25 versus 57 percent) [6].

It is unknown whether administration of probiotic therapy would be beneficial for pregnant women with no history of lactational mastitis.
RECURRENT

Recurrent mastitis is uncommon but can result from inappropriate or incomplete antibiotic therapy and/or failure to correct problems with breastfeeding technique associated with incomplete milk drainage. Inflammatory breast carcinoma should be considered in the setting of mastitis that recurs repeatedly in the same location and/or does not respond to antibiotic therapy. (See 'Differential diagnosis' above.)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "Patient education: Common breastfeeding problems (The Basics)")
- Beyond the Basics topic (see "Patient education: Common breastfeeding problems (Beyond the Basics)"

SUMMARY

- Infective lactational mastitis is an infection of the breast associated with pain, redness, fever, myalgia, and malaise that occurs in the setting of breastfeeding. It is most common during the first six weeks postpartum. (See 'Introduction' above.)
- Lactational mastitis often occurs in the setting of the breastfeeding problems that result in prolonged engorgement or poor drainage. (See 'Etiology' above.)
- Lactational mastitis typically presents as a firm, red, tender, swollen area of one breast associated with fever >38.3°C in a nursing mother. Systemic complaints may include myalgia, chills, malaise, and flu-like symptoms. (See 'Clinical manifestations' above.)
- The diagnosis of infective mastitis is based on clinical manifestations. Culture of the breast milk can be useful to guide selection of antibiotics; it is particularly important in the setting of infection that is severe, hospital acquired, or unresponsive to initial antibiotics. Imaging is useful if lactational mastitis
The differential diagnosis of lactational mastitis includes severe engorgement, plugged duct, galactoceles, breast abscess, and inflammatory breast cancer. Most episodes of lactational mastitis are caused by *Staphylococcus aureus*. Methicillin-resistant *S. aureus* (MRSA) has become an important pathogen in cases of lactational mastitis.

Initial management of nonsevere lactational mastitis consists of symptomatic treatment to reduce pain and swelling (nonsteroidal inflammatory agents, cold compresses) and complete emptying of the breast (via ongoing breastfeeding, pumping, and/or hand expression). Management of infective lactational mastitis (lactational mastitis with persistent symptoms beyond 12 to 24 hours, with fever) consists of the above measures in addition to administration of antibiotic therapy with activity against *S. aureus*.

**REFERENCES**


7. Department of child and adolescent health and development. Mastitis: Causes and management. World Health Organization 2000. http://whqlibdoc.who.int/hq/2000/WHO_FCH_CAH_00.13.pdf (Access does not respond within 48 to 72 hours to supportive care and antibiotics. The differential diagnosis of lactational mastitis includes severe engorgement, plugged duct, galactoceles, breast abscess, and inflammatory breast cancer. Most episodes of lactational mastitis are caused by *Staphylococcus aureus*. Methicillin-resistant *S. aureus* (MRSA) has become an important pathogen in cases of lactational mastitis. Initial management of nonsevere lactational mastitis consists of symptomatic treatment to reduce pain and swelling (nonsteroidal inflammatory agents, cold compresses) and complete emptying of the breast (via ongoing breastfeeding, pumping, and/or hand expression). Management of infective lactational mastitis (lactational mastitis with persistent symptoms beyond 12 to 24 hours, with fever) consists of the above measures in addition to administration of antibiotic therapy with activity against *S. aureus*.
Lactational mastitis - UpToDate


Topic 798 Version 28.0
Lactational mastitis

Lactational mastitis right breast.

*Courtesy of J Michael Dixon, MD. Reproduced with permission from NHS Lothian.*

Graphic 126606 Version 1.0
Ultrasound appearance of a breast abscess

This image shows an abscess in the breast using ultrasound.

*Courtesy of Michael J Dixon, MD.*

Graphic 62711 Version 3.0
It is important to rule out inflammatory breast cancer if a suspected breast infection does not respond to antibiotics.

*Courtesy of Michael J Dixon, MD.*

Graphic 65383 Version 3.0
Clinical presentation of inflammatory breast cancer

The characteristic "peau d'orange" appearance of the breast skin, which is similar to the appearance of the skin of an orange, is apparent.


http://www.TheOncologist.com

Graphic 70894 Version 3.0
Inflammatory breast cancer

Courtesy of Sofia D Merajver, MD, PhD.

Graphic 82220 Version 2.0

Contributor Disclosures

Risk factors for methicillin-resistant *Staphylococcus aureus* (MRSA) infection

**Health care-associated risk factors include:**

- Recent hospitalization
- Residence in a long-term care facility
- Recent surgery
- Hemodialysis

**Additional risk factors for MRSA infection include:**

- HIV infection
- Injection drug use
- Prior antibiotic use

**Factors associated with MRSA outbreaks include:**

- Incarceration
- Military service
- Sharing sports equipment
- Sharing needles, razors, or other sharp objects

Contributor Disclosures


Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

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Conflict of interest policy
Nonlactational mastitis in adults

INTRODUCTION

Mastitis refers to inflammation of the breast tissue that may or may not be accompanied by infection. Mastitis does not necessarily occur during lactation, is not always accompanied by microbial infection, and may not resolve with antibiotics. Forms of nonlactational mastitis include periductal mastitis and idiopathic granulomatous mastitis.

Issues related to nonlactational mastitis in adults will be reviewed here; issues related to lactational mastitis are discussed separately. (See "Lactational mastitis".)

PERIDUCTAL MASTITIS

Periductal mastitis is an inflammatory condition of the subareolar ducts; the cause is unknown. Periductal mastitis primarily affects young women but can occur in men as well.

The majority of patients with periductal mastitis are smokers. It has been postulated that smoking is associated with damage of the subareolar ducts, with tissue necrosis and subsequent infection [1,2]. The toxic substances in cigarette smoke may damage the ducts directly or there may be a localized hypoxic effect. In a study of 139 patients with the clinical or pathologic diagnosis of periductal mastitis, 89 percent were smokers (as compared with 39 percent of age-matched controls). The breast concentrates substances in cigarette smoke; cotinine, a nicotine derivative, has higher concentrations in subareolar ducts than in plasma [3-6].

Periductal mastitis is also associated with squamous metaplasia, which is likely a consequence of ongoing inflammation. It has been suggested that squamous metaplasia may lead to partial duct obstruction with subsequent dilatation and secondary inflammation and infection [2,6,7]. However, as normal ducts are blocked by keratin, it is the author's view that duct obstruction, duct dilatation, and squamous metaplasia are not precursors of periductal inflammation or relevant etiologic factors.
Clinical manifestations — Periductal mastitis is an inflammatory condition of the subareolar ducts that usually presents with periareolar inflammation [1,2,8,9]. Secondary infection of inflamed ducts can occur, leading to duct damage and subsequent rupture with abscess formation (picture 1). Such abscesses often drain spontaneously at the edge of the areola. Recurrent abscesses and a draining fistula (ie, communication between a major subareolar duct and the skin) (picture 2A-D) can occur [3,6,10-12]. (See 'Subareolar abscess and periareolar fistula' below.)

Differential diagnosis — Periductal mastitis must be distinguished from duct ectasia, which usually affects older women and is characterized by distension of subareolar ducts with fibrosis [13]. Duct ectasia is associated with creamy or cheesy nipple discharge and nipple inversion (picture 3) [14]. The dilated subareolar ducts may be apparent clinically and visible on imaging [15,16].

Originally, duct ectasia and periductal mastitis were considered part of the same clinical syndrome and the two terms were used interchangeably. However, duct ectasia is an age-related phenomenon and is not associated with significant periareolar inflammation or infection. Few women with duct ectasia have a history of prior periductal mastitis.

Periductal mastitis must also be differentiated from breast cancer. (See "Diagnostic evaluation of women with suspected breast cancer".)

Microbiology — Cultures are positive for pathogenic or potentially pathogenic organisms in 62 to 85 percent of cases [17-19]. In a series of 29 patients with periductal mastitis, pathogenic or potentially pathogenic organisms were observed more frequently in patients with nipple discharge and a periareolar mass than in patients with nipple discharge only (83 versus 27 percent, respectively) [17].

The most common organisms are staphylococci, enterococci, anaerobic streptococci, Bacteroides, and Proteus.

Management

Periductal mastitis — Periductal mastitis is usually a chronic problem. In the setting of purulent nipple discharge, Gram stain and culture should be obtained. Approximately half of the cases resolve with antibiotic therapy together with needle aspiration or incision and drainage of any associated abscess [7]. Patients with repeated episodes of periareolar infection warrant surgical treatment with excision of diseased ducts [20]. (See 'Subareolar abscess and periareolar fistula' below.)

Empiric antibiotic therapy for periductal mastitis consists of amoxicillin-clavulanate (875 mg orally every 12 hours). Reasonable alternative regimens include dicloxacillin (500 mg orally four times daily) or cephalexin (500 mg orally four times daily; with metronidazole [500 mg orally three times daily] if anaerobes are suspected) [18,21]. If risk for methicillin-resistant Staphylococcus aureus (MRSA) is high (table 1), trimethoprim-sulfamethoxazole (one double-strength tablet orally twice daily) or doxycycline (100 mg orally twice daily) is an appropriate regimen. In the setting of beta-lactam hypersensitivity, clindamycin (300 to 450 mg orally three times daily) is a reasonable alternative [17,18]. Therapy should...
be tailored to results of Gram stain and culture when available.

The optimal length of therapy is not certain; a 5- to 7-day course can be used if the response to therapy is rapid and complete; if necessary, the duration may be extended to 10 to 14 days.

Smoking cessation is helpful for reducing the risk of repeat infection [3].

**Subareolar abscess and periareolar fistula** — The management of subareolar abscess consists of antibiotic therapy and abscess drainage. Needle aspiration or incision and drainage of an abscess is associated with recurrence of subareolar abscess in up to half of patients [3,7]. Infection recurs because these procedures do not remove the underlying periductal mastitis [1-4,22]. In one study, 33 of 67 cases of subareolar abscess were treated successfully with needle aspiration and antibiotics; the other 34 patients required definitive duct excision to healthy tissue [7]. Similar results have been reported in other clinical series [23].

The management of periareolar fistula is laying open the fistula or excision of the fistula tract, usually combined with a total duct excision [6-8,23,24]. Multiple ducts may be involved with multiple skin openings in some patients; all need to be resected for cure [25,26].

Total ductal excision can often be performed with local anesthesia and sedation or under general anesthesia as an outpatient procedure. The preferred surgical approach is via a circumareolar incision at the 6 o'clock position, unless a previous scar exists, in which case the scar can be reopened. Dissection is performed underneath the areola and down either side of the major ducts. Curved tissue forceps can be passed around the ducts to facilitate delivery of the ducts into the incision. The ducts are then divided from the undersurface of the nipple and a 2 cm portion of duct is removed (picture 2A-D).

The back of the nipple must be cleared of all ducts right up to the nipple skin, as infection may recur unless all residual diseased ducts are removed. Sutures rarely, if ever, need to be placed behind the nipple to maintain eversion of the nipple. If the nipple does not evert after resection of the diseased ducts, further dissection and division of fibrous tissue may be required. Subcutaneous tissue can be closed with fine interrupted absorbable sutures and the skin is closed with a running subcuticular absorbable suture. Patients should understand that this procedure results in reduced nipple sensitivity in almost 40 percent of cases [27].

Antibiotic treatment for periductal mastitis should be initiated at the time of surgery and be continued postoperatively until all signs of infection have resolved. (See ‘Periductal mastitis’ above.)

**IDIOPATHIC GRANULOMATOUS MASTITIS**

Idiopathic granulomatous mastitis (IGM), also known as idiopathic granulomatous lobular mastitis, is a rare benign inflammatory breast disease of unknown etiology [1,22,28-33]. IGM occurs most commonly in parous young women, often within a few years of pregnancy; it can also occur in nulliparous women. There is no increased risk of subsequent breast cancer in patients with IGM.
There may be an association between IGM and *Corynebacterium kroppenstedtii* infection especially, but not exclusively, with the histologic pattern termed cystic neutrophilic granulomatous mastitis (CNGM) [34-38]. Other *Corynebacterium* species have also been associated with IGM. In addition, mastitis due to *C. kroppenstedtii* has been associated with elevated prolactin levels [39]. Although antibiotics targeting *Corynebacterium* are often prescribed for IGM, there is no clear evidence that this approach alters the course of disease. Thus, corynebacteria may not be the causative factor in all patients with IGM.

**Clinical manifestations** — IGM may present as a peripheral inflammatory breast mass; it can also present as multiple simultaneous areas of peripheral (and rarely central) infection with abscesses and/or overlying skin inflammation and ulceration (picture 4) [1,28-32]. Nipple retraction, sinus formation, peau d'orange–like changes, and axillary adenopathy may accompany these findings [40-43]. Women with IGM may develop repeated abscesses over weeks to months. These findings may be confused with breast abscess or malignancy [28]. Ultrasound examination typically demonstrates a solid mass, often with one or more abscesses. Mammography may be suggestive of malignancy [44-49].

**Diagnosis** — The diagnosis of IGM is established via core needle biopsy of a solid mass. The biopsy should be sent for Gram stain, bacterial culture, acid-fast bacilli stain and culture, fungal stain and culture, and histopathology. The microbiology laboratory should be alerted to clinical concern for *Corynebacterium*.

Biopsy findings typically demonstrate granulomatous lesions centered on the breast lobule.

It is also reasonable to obtain a serum prolactin level, given a possible pathogenic link between hyperprolactinemia and IGM [39].

The differential diagnosis includes conditions such as tuberculosis, foreign body reaction, granulomatosis with polyangiitis, histoplasmosis, or rarely sarcoidosis, which may also induce a granulomatous mastitis. These etiologies should be identified on biopsy and/or microbiologic testing.

**Management**

**Initial approach** — Often, no specific management is necessary for IGM. It is a self-limiting inflammatory condition that resolves slowly; complete resolution may take 5 to 20 months [50,51]. Surgical excision for IGM is often followed by slow wound healing and is not advocated. In a series of 120 women with IGM, most cases resolved spontaneously without surgical intervention or medications [51]. In some cases, treatment is warranted for infection or symptom control.

IGM complicated by secondary infection and abscess usually resolves with antibiotics and drainage [8,22,28,30]. Antibiotic selection should be dictated by culture and susceptibility testing. We generally start an antibiotic regimen used for periductal mastitis after specimens are collected for testing and then adjust based on microbiology results. Oral regimens are generally appropriate. (See 'Periductal mastitis'
If only *Corynebacterium* is recovered, the optimal management approach is uncertain. In such cases, we suggest treatment with *doxycycline* (100 mg orally twice daily) or *trimethoprim-sulfamethoxazole* (one double-strength tablet containing 160 mg *trimethoprim* and 800 mg sulfamethoxazole every 12 hours) [34,37]. The optimal length of therapy is also uncertain; a 5- to 7-day course can be used if the response to therapy is rapid and complete. If necessary, the duration may be extended to 10 to 14 days. While these antibiotics treat acute infection, there is little evidence that antibiotics shorten the time to full resolution of granulomatous lobular mastitis.

Localized pain may be managed with nonsteroidal anti-inflammatory drugs (NSAIDs). Routine use of steroids or *methotrexate* is not warranted; these therapies can reduce swelling but may not alter the natural history of the condition, especially in those with small localized lesions. Discontinuation has been associated with rebound inflammation [28,46,52-56].

**Persistent or refractory symptoms** — The optimal management of patients with persistent symptoms and progression of IGM despite antibiotics (if infection is present) and/or NSAIDs is uncertain and UpToDate contributors differ in their approach. Some contributors find that treatment with steroids with or without *methotrexate* in this situation can be useful to reduce fever, pain, swelling, and possibly deformity. However, others do not use these agents, as there are no controlled studies demonstrating that they alter the natural history of the condition. Expectant management with observation has resulted in resolution of IGM in several small series [30,51,57]. The contributors who do use steroids in this setting base the approach on the size and severity of the lesion. In patients with painful, small (<5 cm) unilateral lesions with small amounts of drainage or ulceration, treatment with *prednisone* (0.5 mg/kg/day) may be initiated. In patients with multiple lesions, lesions ≥5 cm in diameter, bilateral lesions, or disease with significant cutaneous ulceration, drainage, or fistulas, treatment with prednisone (0.5 to 1 mg/kg/day) may be initiated, with or without methotrexate (10 to 15 mg orally per week, along with daily *folic acid* supplementation) [33,52,54,56,58,59].

Patients treated with steroids should begin tapering when erythema and pain have resolved (usually after about four weeks). *Prednisone* is tapered gradually over 8 to 12 weeks. If flares occur during tapering in patients on steroids alone, *methotrexate* (10 to 15 mg per week) may be added. If flares occur during tapering in patients on steroids and methotrexate, small increases in the methotrexate dose (by 2.5 to 5 mg every few weeks) is appropriate. Once clinical remission has been achieved, the methotrexate dose should be reduced monthly; many patients are able to discontinue therapy within 12 months [60].

Monitoring the lesions with weekly photographs may be helpful. Repeat ultrasonography may be useful if there is suspicion for new lesions or abscess reaccumulation.

**SUMMARY**

- Mastitis refers to inflammation of the breast tissue that may or may not be accompanied by infection.
Mastitis does not necessarily occur during lactation, is not always accompanied by microbial infection, and may not resolve with antibiotics. Forms of nonlactational mastitis include periductal mastitis and idiopathic granulomatous mastitis. (See 'Introduction' above.)

- Periductal mastitis is an inflammatory condition of the subareolar ducts that usually presents with periareolar inflammation. Secondary infection of inflamed ducts can occur, leading to duct damage and subsequent rupture with abscess formation. A draining fistula (ie, communication between a major subareolar duct and the skin) can also develop. (See 'Clinical manifestations' above.)

- In the setting of purulent nipple discharge, Gram stain and culture should be obtained. Cultures are positive for pathogenic or potentially pathogenic organisms in 62 to 85 percent of cases. The most common organisms are staphylococci, enterococci, anaerobic streptococci, Bacteroides, and Proteus. (See 'Microbiology' above.)

- Periductal mastitis is usually a chronic problem. Approximately half of cases resolve with antibiotic therapy together with needle aspiration or incision and drainage. Patients with repeated episodes of periareolar infection warrant surgical treatment with ductal excision. (See 'Management' above.)

- Idiopathic granulomatous mastitis (IGM), also known as idiopathic granulomatous lobular mastitis, is a rare benign inflammatory breast disease of unknown etiology. IGM is most commonly seen in parous young women, often within a few years of pregnancy, although it can occur in nulliparous women. There is no increased risk of subsequent breast cancer in patients with IGM. (See 'Idiopathic granulomatous mastitis' above.)

- The diagnosis of IGM is established via core needle biopsy of a solid mass. IGM associated with a localized infection usually resolves with antibiotics and drainage. Surgical excision for IGM is often followed by slow wound healing and is not advocated. The optimal management of persistent symptoms is uncertain and approaches differ. (See 'Diagnosis' above and 'Management' above.)

REFERENCES


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Periareolar abscess. Large incisions are not necessary for the drainage of a breast abscess.

*Courtesy of Michael J Dixon, MD.*

Graphic 76304 Version 3.0
A mammary duct fistula is a communication between a subareolar duct and the skin, usually in the periareolar area. This patient has bilateral fistulae.

*Courtesy of Michael J Dixon, MD.*

Graphic 78199 Version 4.0
Fistulotomy

The treatment for a mammary duct fistula is surgical, by means of excising or opening up the fistula. This results in a scar across the nipple and areola and is not the preferred treatment.

*Courtesy of Michael J Dixon, MD.*

Graphic 58118 Version 5.0
Fistulectomy can be performed with an incision across the nipple, directly over the fistula.

*Courtesy of Michael J Dixon, MD.*

Graphic 65757 Version 5.0
Post-fistula excision with a circumareolar incision

Fistulectomy through a circumareolar incision produces a satisfactory cosmetic outcome and is the preferred approach.

*Courtesy of Michael J Dixon, MD.*

Graphic 75481 Version 5.0
Nipple inversion associated with duct ectasia

Nipple retraction associated with duct ectasia is symmetrical and central, usually involving the nipple but not the areola.

Graphic 57055 Version 1.0
Risk factors for methicillin-resistant *Staphylococcus aureus* (MRSA) infection

<table>
<thead>
<tr>
<th>Health care-associated risk factors include:</th>
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<td>■ Hemodialysis</td>
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<td>■ Injection drug use</td>
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<td>■ Prior antibiotic use</td>
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<tr>
<td>■ Military service</td>
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<tr>
<td>■ Sharing sports equipment</td>
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<td>■ Sharing needles, razors, or other sharp objects</td>
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**Idiopathic granulomatous mastitis (IGM)**

(A) IGM at presentation with skin ulceration.

(B) IGM following spontaneous resolution nine months later.

*Courtesy of Michael J Dixon, MD.*

Graphic 51199 Version 6.0

**Contributor Disclosures**

J Michael Dixon, MD Nothing to disclose

Kenneth M Pariser, MD Nothing to disclose

Anees B Chagpar, MD, MSc, MA, MPH, MBA, FACS, FRCS(C) Consultant/Advisory Boards: Protean BioDiagnostics [Breast cancer].

Daniel J Sexton, MD Grant/Research/Clinical Trial Support: Centers for Disease Control and Prevention; National Institutes of Health [Healthcare epidemiology]. Consultant/Advisory Boards: Magnolia Medical Technologies [Medical diagnostics]; National Football League [Infection prevention]; Johnson & Johnson [Mesh-related infections]. Equity Ownership/Stock Options: Magnolia Medical Technologies [Medical diagnostics].

Meg Sullivan, MD Grant/Research/Clinical Trial Support: Gilead Sciences [Pre-exposure prophylaxis for contraception (Tenofovir)]. Consultant/Advisory Boards: Gilead Sciences [Pre-exposure prophylaxis for contraception (Tenofovir)].

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Primary breast abscess

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MD Deputy Editors: Meg Sullivan, MD, Wenliang Chen, MD, PhD

All topics are updated as new evidence becomes available and our peer review process is complete.


INTRODUCTION

A breast abscess is a localized collection of inflammatory exudate (ie, pus) in the breast tissue. Breast abscesses develop most commonly when mastitis or cellulitis does not respond to antibiotic treatment, but an abscess can also be the first presentation of breast infection. It is an uncommon problem in breastfeeding with a reported incidence of 0.1 percent [1]; the incidence among women with antibiotic-treated mastitis is 3 percent [2]. Breast abscess can develop de novo (ie, primary; no inciting disease) or it can occur as a complication of another disease process (ie, secondary) such as periductal mastitis, skin infection over the breast, or granulomatous lobular mastitis.

Issues related to primary breast abscess will be reviewed here. Issues related to mastitis, cellulitis, and postoperative complications of breast surgery are discussed separately. (See "Lactational mastitis" and "Nonlactational mastitis in adults" and "Breast cellulitis and other skin disorders of the breast" and "Mastectomy: Indications, types, and concurrent axillary lymph node management", section on 'Complications' and "Breast conserving therapy", section on 'Complications'.)

ETIOLOGY AND RISK FACTORS

Primary breast abscesses develop as a complication of mastitis [3]. In a review of 89 patients with primary breast abscesses requiring surgical intervention, 14 percent were complications of lactational mastitis and 86 percent were complications of nonlactational mastitis [4]. The incidence of breast abscesses ranges from 0.4 to 11 percent of lactating mothers [1]. Breast abscesses in nonlactating women occurred more commonly in African Americans, obese patients, and smokers.

Risk factors for development of breast abscess as a complication of lactational mastitis include maternal age >30 years, first pregnancy, gestational age ≥41 weeks, and tobacco use [1,5,6]. Risk factors for a staphylococcal abscess in lactating mothers in one study identified problems with breastfeeding (odds ratio 5.0) and being a mother employed outside her home (odds ratio 2.74) as risk factors [7].
In a retrospective study of 68 patients all with breast abscess, smoking was a significant risk factor for the development of an abscess (odds ratio 8.0, 95% CI 3.4-19.4) [8]. Of the 68 cases, over half (54 percent) needed multiple surgical treatments and 22 of these were heavy smokers. Five patients developed fistulas and all were heavy smokers. In another retrospective study of 89 patients with any type of breast abscess, 39 women (43 percent) were heavy smokers [4]. The majority of patients who developed recurrent abscesses were smokers (77 percent). Smoking was the only factor significantly associated with abscess recurrence.

Nonlactational abscesses may be classified as central, peripheral, or skin associated (figure 1). Central abscesses are usually due to periductal mastitis. Peripheral abscesses are less common than central abscesses and are sometimes associated with underlying disease states such as diabetes, rheumatoid arthritis, steroid treatment, and trauma. (See "Nonlactational mastitis in adults", section on 'Periductal mastitis'.)

**MICROBIOLOGY**

Most primary breast abscesses are caused by *Staphylococcus aureus*. Methicillin-resistant *S. aureus* is becoming an increasingly important pathogen in cases of lactational and nonlactational mastitis [4]. Risk factors for *S. aureus* are summarized in the following table (table 1).

Less frequent pathogens include *Streptococcus pyogenes*, *Escherichia coli*, *Bacteroides* species, *Corynebacterium* species, coagulase-negative staphylococci (eg, *S. lugdunensis*), *Pseudomonas aeruginosa*, *Proteus mirabilis*, and anaerobes [9].

Patients with recurrent breast abscess have an increased incidence of mixed flora and anaerobic infection [4].

**CLINICAL FEATURES AND DIAGNOSIS**

Patients with primary breast abscess present with localized, painful inflammation of the breast associated with fever and malaise, along with a fluctuant, tender, palpable mass. The time course is variable; mastitis and abscess may present concurrently or abscess may develop 5 to 28 days following treatment for mastitis [2].

The diagnosis of breast abscess should be suspected based on clinical manifestations (localized inflammation of the breast associated with fever and a fluctuant, tender, palpable mass). The diagnosis is established via ultrasonography demonstrating a fluid collection [10-12]. Ultrasound imaging may be used for guided aspiration of the collection (image 1) [10].

For women who are lactating, culture of the breast milk is useful to guide selection of antibiotics; it is particularly important in the setting of infection that is severe, hospital acquired, or unresponsive to initial
antibiotics [13,14].

Blood cultures are warranted in the setting of severe infection (eg, hemodynamic instability, progressive erythema) but are otherwise not routinely necessary.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of breast abscess includes:

- In lactating women:
  - Plugged duct – A plugged duct is a localized area of milk stasis within the milk duct that causes distention of mammary tissue. Symptoms include a palpable lump with tenderness. A plugged duct may be distinguished from mastitis and breast abscess by the absence of systemic findings. (See "Common problems of breastfeeding and weaning", section on 'Plugged ducts'.)
  - Galactocele – A galactocele (also known as a milk retention cyst) is a cystic collection of fluid that is usually caused by an obstructed milk duct. Galactoceles present as soft cystic masses; they are not tender and are not associated with systemic manifestations. Ultrasonography may demonstrate a simple milk cyst or a complex mass. The diagnosis can be made on the basis of the clinical history and needle aspiration, which yields a milky substance. (See "Common problems of breastfeeding and weaning", section on 'Galactoceles'.)

- In any women with an abscess:
  - Inflammatory breast cancer – Inflammatory breast cancer should be considered if a breast infection does not resolve with appropriate treatment. Clinical manifestations include skin thickening due to edema, erythema, and peau d'orange appearance (picture 1). It is often associated with axillary lymphadenopathy. The diagnosis is established via biopsy. (See "Inflammatory breast cancer: Clinical features and treatment".)

TREATMENT

Management of primary breast abscess consists of drainage and antibiotic therapy [3,10,11,15-17].

Drainage — Options for breast drainage include needle aspiration and surgical drainage [18].

The clinical approach depends in part on the state of the overlying skin (figure 2). Aspiration of the abscess under ultrasound guidance using local anesthesia is the preferred method of management if the overlying skin is not ischemic (see 'Needle aspiration' below) [10-12,17]. If the overlying skin is compromised (eg, ischemia or pressure necrosis of the skin), or in cases in which the abscess is not responsive to needle aspiration and antibiotic therapy, surgical drainage will be required [19,20]. (See 'Surgical drainage' below.)
Male breast abscesses are treated similarly, via aspiration or incision and drainage under local anesthetic (Picture 2).

**Needle aspiration** — Needle aspiration is an appropriate initial approach for abscess drainage when the overlying skin is normal (i.e., erythematous but not ischemic) [21-24]. The use of ultrasound guidance ensures complete drainage and facilitates aspiration of loculated areas as well as collections that may not be appreciated on physical exam. Needle aspiration should be repeated every two or three days until no collection remains. Two to three aspirations are sufficient in many cases, although larger collections may require up to six aspirations (Figure 2).

Infiltration and irrigation with local anesthetic reduces pain; use of epinephrine reduces subsequent bleeding and bruising. Local anesthetic is infiltrated via a puncture site positioned a few centimeters away from the abscess. One percent lidocaine with 1:200,000 epinephrine at a maximum dose of 7 mg/kg is injected into the skin and through the breast tissue to the edge of the abscess cavity using a 21-gauge needle. If the visible pus is not particularly thick, it can be aspirated with the same needle. Aspirated material should be sent for culture. Once the pus is aspirated, the syringe is changed and the abscess cavity is lavaged with the same local anesthetic. Irrigation with local anesthetic to dilute the pus is continued until all the pus is aspirated and the aspirate from the cavity comes back clear.

If the pus is thick, local anesthetic is injected gently into the abscess cavity and aspiration is attempted. If the pus cannot be aspirated, remove the syringe and needle. After waiting for the local anesthetic and epinephrine to take effect (at least seven or eight minutes), a 19- or 17-gauge needle is advanced along the anesthetized track into the cavity to wash the abscess with local anesthetic and dilute the pus. Over 40 mL of local anesthetic can be used safely in most adults (and up to 50 mL in a patient that weighs just over 70 kg). Larger volumes are safe providing that the local anesthetic that is irrigated into the cavity is later aspirated. However, too much local anesthetic injected into the abscess cavity increases the pressure in the abscess and can be painful. (See "Subcutaneous infiltration of local anesthetics" and "Local anesthetic systemic toxicity").

The patient should be re-examined every two to three days and the cavity imaged with ultrasound and aspiration repeated in a similar manner until there is no further fluid visible in the abscess cavity or the fluid aspirated is serous [10,11,17].

The usual sequence is that, at the second aspiration, the pus is thinner and it subsequently turns to serous fluid. Few abscesses require more than two or three aspirations. The majority of lactating breast abscesses can be managed in this manner (Picture 3).

For cases in which the abscess is unresponsive to the combination of repeated drainage and antibiotics, surgical intervention is indicated.

An option to recurrent aspiration is to place a pigtail catheter into the abscess under ultrasound guidance. In a study of 34 patients, this produced resolution in all and appears a safe option to repeated aspiration.
Primary breast abscess - UpToDate

[25]. The catheter must remain in the breast for a few days.

In a proof-of-concept study, 36 lactational breast abscesses (diameter 75±29 mm) were evacuated with a vacuum-assisted breast biopsy system under ultrasound guidance, irrigated, and followed by catheter drainage for 4.4±1.3 days [26]. There was no recurrence at two months, but two patients had to discontinue breast feeding because of milk fistulas (see 'Milk fistula' below). We are concerned, however, about the high complication rate and requirement for drainage in every patients with this approach.

Surgical drainage — Surgical mini incision and drainage is warranted in the setting of overlying skin ischemia (picture 4A-D and figure 3 and picture 5) or pressure necrosis (picture 4B), and for cases in which the abscess is not responsive to needle aspiration or catheter drainage and antibiotics [19,20]. In addition, incision and drainage is appropriate if the skin overlying the abscess is very thin and shiny (picture 4A-D and figure 3 and picture 5), if it appears that the abscess is about to burst through the skin, or if the overlying skin is necrotic (picture 4B and figure 2).

Incision and drainage can be performed with local anesthetics in most cases in the office or outpatient clinic [19,20]. If the skin is very thin, it is infiltrated with 1 percent lidocaine with 1:200,000 epinephrine. Care should be taken not to inject too much local anesthetic into the abscess cavity prior to drainage, as this increases pressure in the abscess and in the office causes pain.

Following adequate local anesthesia, a small stab incision should be made through the thinned skin and pus drained. The abscess cavity should then be irrigated with local anesthetic and epinephrine solution until all the pus is evacuated. Abscess material should be sent for culture. The patient should be re-examined every two or three days until the wound closes and no further pus is visible either on direct inspection or on ultrasound.

In the setting of skin necrosis overlying the abscess, the necrotic skin should be excised and the cavity irrigated with local anesthetic and epinephrine solution to drain the pus. The abscess cavity should then inspected every two or three days and irrigated as appropriate.

Large incisions are not necessary to drain breast abscesses. An incision over an abscess does not need to be dependent. In our experience, drains or packing are not necessary [10,11].

In a randomized trial of 45 patients with lactational abscess, 40 percent of the patients treated with needle aspiration required subsequent incision and drainage [22]. In the patients randomized to incision and drainage, 70 percent were unhappy with the cosmetic appearance. In another study of 50 patients with abscesses (including 31 who were lactating), aspiration alone was successful in 39 (78 percent) [27]. Risk factors for failure of needle aspiration included abscess >5 cm in diameter, unusually large volume of aspirated pus, and delay in treatment.

Antibiotics — Empiric antibiotic therapy for primary breast abscess should include activity against *S. aureus*; therapy should be tailored to results of Gram stain and culture results when available.

- In the setting of nonsevere infection in the absence of risk factors for methicillin-resistant *S. aureus*
Primary breast abscess - UpToDate

The presence of a subareolar breast abscess with a retracted nipple or a breast abscess associated with hidradenitis suppurativa should raise the possibility of anaerobic infection, and coverage for anaerobes should be included in the antibiotic regimen; options include use of amoxicillin-clavulanic acid (in the absence of MRSA), clindamycin (300 to 450 mg orally three times daily) may be used.

- In the setting of nonsevere infection with risk for MRSA (table 1), outpatient therapy with trimethoprim-sulfamethoxazole (1 to 2 tabs orally twice daily) or clindamycin (300 to 450 mg orally three times daily) may be initiated.

- In the setting of severe infection (eg, hemodynamic instability, progressive erythema), empiric inpatient therapy with vancomycin (15 to 20 mg/kg/dose every 8 to 12 hours, not to exceed 2 g per dose) should be initiated; therapy should be tailored to culture and sensitivity results. Gram stain results demonstrating gram-negative rods should prompt empiric antibiotic therapy against these organisms with a third-generation cephalosporin or a combination beta-lactam–beta-lactamase agent.

The presence of a subareolar breast abscess with a retracted nipple or a breast abscess associated with hidradenitis suppurativa should raise the possibility of anaerobic infection, and coverage for anaerobes should be included in the antibiotic regimen; options include use of amoxicillin-clavulanic acid (in the absence of MRSA), clindamycin, or dicloxacillin with the addition of metronidazole [9].

The optimal length of antibiotic therapy is not certain; 10 to 14 days following drainage is likely appropriate.

**ROLE OF BREASTFEEDING**

In the setting of lactational infection, milk drainage (either by breastfeeding or pumping) is important for resolution of infection and relief of discomfort [10,14,28]. One randomized trial of lactational infection noted that emptying of the breast resulted in reduction in the duration of symptoms and improved outcome [29].

A breast abscess or infection associated with prior lactation is not a contraindication to subsequent breastfeeding. Women should be encouraged to continue breastfeeding following breast infection, even in the setting of incision and drainage. If there is difficulty with breastfeeding because the incision interferes with nursing on the affected breast, the infant cannot relieve breast fullness, or the mother is too unwell to continue feeding, then it may be appropriate to advise stopping breast feeding. If the woman wants to continue to breast feed despite these issues, hand expression or breast pumping can be effective for maintaining the milk supply until breastfeeding can resume. Nursing should continue on the unaffected breast.

**COMPLICATIONS**
Complications include recurrent infection, poor cosmetic outcome, mammary duct fistula, milk fistula, and antibioma. Recurrent infection is more common in the setting of nonlactational abscess, diabetes, and tobacco use [30]. Cosmetic outcome is more likely to be poor in the setting of delayed treatment (picture 6).

**Mammary duct fistula** — A mammary duct fistula is a communication between a major subareolar duct and the skin, usually in the periareolar region (picture 7A-D) [31]. It can occur after incision and drainage of a central breast abscess caused by periductal mastitis or it can occur after spontaneous drainage of a periareolar inflammatory mass. (See "Nonlactational mastitis in adults", section on 'Subareolar abscess and periareolar fistula'.)

Patients who develop mammary duct fistula usually have a history of recurrent periareolar inflammation, including recurrent abscess formation, as well as a history of tobacco use [10,11,32]. Occasionally there is more than one external opening at the areolar margin and this can be from a single duct or multiple ducts.

**Milk fistula** — A milk fistula is a tract between the skin and a lactiferous duct associated with surgical intervention for a breast abscess while a woman is lactating, resulting in milk draining through the skin of the breast [33,34]. Development of a milk fistula is rare in the setting of aspiration or mini-incision and drainage and occurs more commonly in the setting of extensive surgical drainage with placement of large drains (which is rarely necessary).

A milk fistula usually resolves spontaneously; if persistent, it usually resolves with cessation of lactation. The baby can be weaned from the involved breast and continue to nurse from the other breast; this requires assistance from a lactation specialist in most cases. (See "Common problems of breastfeeding and weaning".)

**Antibioma** — Patients with a breast abscess treated with repeated courses of antibiotics can develop a chronic, sterile, walled-off abscess or antibioma. This may be treated in a similar manner to other breast abscesses but can take longer to resolve. Excision is not warranted and may delay wound healing.

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**SOCIETY GUIDELINE LINKS**

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Evaluation of breast problems".)

**SUMMARY AND RECOMMENDATIONS**

- A breast abscess is a localized collection of pus in the breast tissue. Primary breast abscesses develop when mastitis does not respond to antibiotic treatment. (See 'Introduction' above.)

- Most primary breast abscesses are caused by *Staphylococcus aureus*. Methicillin-resistant *S.
**aureus** infections are increasingly common. Patients with recurrent breast abscess have an increased incidence of mixed flora and anaerobic infection. (See 'Microbiology' above.)

- Management of primary breast abscess consists of drainage and antibiotic therapy. (See 'Treatment' above.)

- We suggest that initial drainage be performed by needle aspiration with ultrasound guidance (Grade 2C). Surgical drainage is indicated for patients who present with compromise of the overlying skin and for patients who do not respond to aspiration (figure 2). (See 'Drainage' above.)

- Empiric antibiotic therapy for primary breast abscess should include activity against *S. aureus*; therapy should be tailored to results of Gram stain and cultures results when available. (See 'Antibiotics' above.)

- In the setting of lactational infection, milk drainage (either by breastfeeding or pumping) is important for resolution of infection and relief of discomfort. Women should be encouraged to continue breastfeeding following breast infection. (See 'Role of breastfeeding' above.)

- We suggest that breastfeeding continue during treatment for lactation-associated breast infections (Grade 2C). If there is difficulty with breastfeeding, hand expression or breast pumping can be effective for maintaining the milk supply until nursing can resume. (See 'Role of breastfeeding' above.)

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**REFERENCES**


Mastitis refers to inflammation of the breast tissue that may or may not be accompanied by infection. This drawing depicts the most common types and locations of breast infections.

Graphic 68275 Version 2.0
### Risk factors for methicillin-resistant *Staphylococcus aureus* (MRSA) infection

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</table>
Ultrasound appearance of a breast abscess

This image shows an abscess in the breast using ultrasound.

Courtesy of Michael J Dixon, MD.

Graphic 62711 Version 3.0
Inflammatory breast cancer

It is important to rule out inflammatory breast cancer if a suspected breast infection does not respond to antibiotics.

*Courtesy of Michael J Dixon, MD.*

Graphic 65383 Version 3.0
## Management of breast abscess[1]

<table>
<thead>
<tr>
<th>Skin findings</th>
<th>Initial interventions</th>
<th>Ongoing management</th>
</tr>
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<tbody>
<tr>
<td>Red but normal</td>
<td>Ultrasound-guided aspiration with local anaesthetic</td>
<td>Repeat aspiration every 2 to 3 days until no more pus</td>
</tr>
<tr>
<td>Thin with or without necrosis</td>
<td>Mini incision and drainage</td>
<td>Irrigate with local anaesthetic and epinephrine solution every 2 to 3 days until no more pus</td>
</tr>
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Reference:


Courtesy of J Michael Dixon, MD. Reproduced with permission from NHS Lothian.

Graphic 127138 Version 1.0
Male breast abscess

Before and after treatment of a male breast abscess with incision and drainage.

*Courtesy of Michael J Dixon, MD.*

Graphic 63826 Version 2.0
Lactating breast abscess before and after needle aspiration

If the overlying skin is normal, aspiration under ultrasound guidance is the preferred method of management.
(A) This shows appearance at presentation.
(B) This shows appearance following treatment with aspiration and antibiotics.

Courtesy of Michael J Dixon, MD.
Lactating breast abscess with skin compromise

When the overlying skin is thinned or necrotic, the best procedure is incision and drainage.

_Courtesy of Michael J Dixon, MD._

Graphic 68502 Version 3.0
Breast abscess with skin necrosis

When the overlying skin is thinned or necrotic, the optimal procedure is excision of the necrotic skin, which allows the abscess to drain.

Courtesy of Michael J Dixon, MD.

Graphic 60139 Version 4.0
Incision and drainage for breast abscess

Large incisions are not necessary to drain breast abscesses.

_Courtesy of Michael J Dixon, MD._

Graphic 79340 Version 3.0
Results after incision and drainage of breast abscess

Results one week post incision and drainage.

Courtesy of Michael J Dixon, MD.

Graphic 59342 Version 3.0
Surgical drainage of a breast abscess

Skin compromise necessitates incision and drainage. Note pus can be drained adequately though a small skin incision.

Courtesy of Michael J Dixon, MD.

Graphic 63472 Version 3.0
Periareolar abscess. Large incisions are not necessary for the drainage of a breast abscess.

*Courtesy of Michael J Dixon, MD.*

Graphic 76304 Version 3.0
Consequences of treatment delay for breast abscess

Breast abscess where there was a delay (A) at diagnosis and (B) poor cosmetic outcome due to delay in treatment.

_Courtesy of Michael J Dixon, MD._

Graphic 62468 Version 3.0
A mammary duct fistula is a communication between a subareolar duct and the skin, usually in the periareolar area. This patient has bilateral fistulae.

*Courtesy of Michael J Dixon, MD.*

Graphic 78199 Version 4.0
The treatment for a mammary duct fistula is surgical, by means of excising or opening up the fistula. This results in a scar across the nipple and areola and is not the preferred treatment.

Courtesy of Michael J Dixon, MD.

Graphic 58118 Version 5.0
Fistulectomy can be performed with an incision across the nipple, directly over the fistula.

*Courtesy of Michael J Dixon, MD.*

Graphic 65757 Version 5.0

**Contributor Disclosures**

J Michael Dixon, MD  Nothing to disclose  Anees B Chagpar, MD, MSc, MA, MPH, MBA, FACS, FRCS(C)  Consultant/Advisory Boards: Protean BioDiagnostics [Breast cancer].  Daniel J Sexton,
Post-fistula excision with a circumareolar incision

Fistulectomy through a circumareolar incision produces a satisfactory cosmetic outcome and is the preferred approach.

_Courtesy of Michael J Dixon, MD._

Graphic 75481 Version 5.0

**Contributor Disclosures**

_J Michael Dixon, MD_ Nothing to disclose  
_Anees B Chagpar, MD, MSc, MA, MPH, MBA, FACS, FRCS(C)_ Consultant/Advisory Boards: Protean BioDiagnostics [Breast cancer].  
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_Wenliang Chen, MD, PhD_ Nothing to disclose

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Conflict of interest policy
INTRODUCTION

Breast cellulitis is a skin infection that occurs as a result of bacterial entry via breaches in the skin barrier. Issues related to breast cellulitis and other skin disorders of the breast will be reviewed here. Issues related to breast abscess and lactational mastitis are discussed separately, as are issues related to breast reconstruction. (See "Primary breast abscess" and "Lactational mastitis" and "Overview of breast reconstruction".)

BREAST CELLULITIS

Epidemiology — Breast cellulitis is relatively uncommon. A prospective study including 3762 patients evaluated in a dedicated breast center during a 14-month interval found that 0.6 percent presented with erythema of the breast and, of those 22 patients, only 2 had cellulitis [1]. Among patients managed for breast cancer with breast-conserving surgery and radiation therapy, breast cellulitis occurs in 1 to 8 percent of patients [2-7].

Risk factors for breast cellulitis include [1-5,7-9]:

- Breast conservation treatment for breast cancer (breast conserving surgery and radiation therapy) (picture 1)
- Prior breast cellulitis or infection
- Breast surgery within previous 30 days (surgical site infection)
- Lactation
- Trauma (eg, bites, nipple piercing, tattoos)
- Lesions in breast skin (eg, eczema, intertrigo, dermatitis, epidermolysis bullosa)

Risk factors for breast cellulitis complicating breast conserving surgery include hematoma formation, postoperative bruising, breast edema, large resected volume, and the need for multiple seroma
Breast cellulitis and other skin disorders of the breast - UpToDate

Microbiology — Beta-hemolytic *Streptococcus* is an important cause of breast cellulitis [3,9,10]. Group B beta-hemolytic streptococci have a proclivity to produce soft tissue infections in the setting of venous and/or lymphatic compromise [11]; one case control study noted breast cancer was a risk factor for the development of group B beta-hemolytic streptococcal infection [12].

*Staphylococcus aureus*, including methicillin-resistant *S. aureus* (MRSA), can also be an important pathogen.

Clinical manifestations — Clinical manifestation of breast cellulitis include pain, diffuse erythema, tenderness, and warmth [2,4,5,8,13,14]. Pain can occur before the erythema. Systemic symptoms such as fever or chills are uncommon, occurring in only 6 of 50 cases in one series [4]. The physical examination of the breast demonstrates localized or diffuse erythema, edema, marked tenderness, and warmth. Axillary nodes can be enlarged and tender. Spread of infection along lymphatic pathways (lymphangitis) is also seen (picture 2).

Diagnosis — The diagnosis of breast cellulitis is made based on clinical manifestations [6,15-20]. The evaluation includes obtaining a clinical history to assess for trauma, underlying skin condition, breastfeeding, and previous breast surgery, breast cancer diagnosis, and/or local radiation treatment. A breast examination should be performed to assess the extent of erythema and swelling as well as for presence of tender and/or enlarged axillary lymph nodes.

No laboratory testing is required. Blood cultures are warranted in patients with rapidly progressive local changes of infection and/or evidence of systemic infection that includes hemodynamic instability, fever, chills, or malaise; otherwise, blood cultures are not necessary.

Radiographic imaging is useful if there is clinical suspicion of an underlying fluid collection, abscess, malignancy, or if there is no clinical improvement within 48 hours of treatment with antibiotic therapy. Ultrasound may demonstrate skin and subcutaneous edema; mammography may demonstrate mild skin thickening [21]. Magnetic resonance imaging (MRI) may demonstrate skin thickening and separation or septation of subcutaneous adipose tissue [22].

Differential diagnosis — Breast cellulitis must be distinguished from other inflammatory processes of the breast. Disruption of cutaneous lymphatics and/or circulation in the absence of an infectious process, such as a malignancy or an inflammatory process, can lead to a diffuse pattern of erythema that mimics cellulitis [23-25].

- **Breast abscess** — A breast abscess is a localized collection of pus in the breast tissue. Patients with breast abscess present with localized painful inflammation of the breast associated with fever and malaise, along with a fluctuant, tender, palpable mass. The diagnosis is based on clinical manifestations and ultrasonography. (See "Primary breast abscess".)

- **Skin abscess overlying the breast** — Skin abscesses involving the skin overlying the breast are
usually related to an infected epidermoid cyst or related to hidradenitis suppurativa. (See 'Epidermoid cyst' below and 'Hidradenitis suppurativa' below.)

- **Inflammatory breast cancer** – Inflammatory breast cancer (IBC) should be considered if infection does not resolve with antimicrobial treatment. IBC may be distinguished by clinical manifestations of skin thickening due to edema, erythema, and peau d'orange appearance (picture 3 and picture 4 and picture 5). It is often associated with axillary lymphadenopathy. The diagnosis is established via biopsy. (See "Inflammatory breast cancer: Clinical features and treatment").

- **Other breast malignancy** – Comedo ductal carcinoma in situ can become infected and present with inflammation or an abscess [26]. In addition, advanced breast cancer can present with skin ulceration, malodorous necrosis, and secondary infection. These diagnoses are established via biopsy. (See "Diagnostic evaluation of women with suspected breast cancer").

- **Paget disease of the breast** – Paget disease of the breast (PDB) is a scaly, raw, vesicular, or ulcerated lesion that begins on the nipple and can spread to the areola (picture 6). The diagnosis is established by biopsy; the pathologic hallmark is the presence of malignant intraepithelial adenocarcinoma cells (Paget cells) within the epidermis of the nipple. Most cases are associated with an underlying invasive or noninvasive breast cancer. (See "Paget disease of the breast").

- **Superficial thrombophlebitis of the breast** – Superficial thrombophlebitis of the breast, also known as Mondor disease, is a self-limiting disease involving the superficial veins of the breast and anterior chest wall (picture 7) [27]. Clinical manifestations include a thickened, tender cord with pain, erythema, and swelling; the syndrome can occur following surgery, core biopsy of the breast, radiation treatment, trauma, or unrelated to any antecedent event [28-33]. The condition usually resolves in four to six weeks with symptomatic treatment using analgesics.

- **Morphea** – Morphea (localized scleroderma) is an idiopathic inflammatory skin disorder associated with fibrosis (picture 8). It may be associated with radiation therapy (picture 9), trauma, breast implants, or autoimmune disease [34]. The initial sign of morphea is often abrupt onset of an erythematous patch or edematous plaque. Some patients may note pain or itching at the site prior to the development of a clinically evident lesion. Clinical manifestations include inflammation with hyperpigmentation, retraction, skin thickening, and fibrosis extending into the subcutaneous adipose tissue [35]. (See "Pathogenesis, clinical manifestations, and diagnosis of morphea (localized scleroderma) in adults").

- **Postoperative dermal lymphedema** – Postoperative dermal lymphedema presents with cutaneous erythema and induration in the absence of tenderness, fever, or leukocytosis [3,28,36]. The breast involvement may be localized or diffuse. Lymphedema is a manifestation of lymphatic obstruction, which can occur following surgery alone or in conjunction with radiation treatment for breast cancer [37,38]. Clinical evaluation and surveillance are adequate; a biopsy should be performed if malignancy is suspected.
Breast cellulitis and other skin disorders of the breast - UpToDate

- Radiation-induced dermatitis – Clinical manifestations of radiation-induced dermatitis include erythema, edema, pigment changes, epilation, and dry or moist desquamation (picture 10). These findings are strictly confined to the irradiated region and are not associated with fever or leukocytosis [28]. The diagnosis is established based on clinical manifestations. (See "Radiation dermatitis".)

- Radiation-induced fibrosis – Radiation-induced fibrosis can develop as a late effect of radiation treatment. Clinical manifestations include induration, thickening, and lymphedema in the skin and subcutaneous tissue of the breast. The diagnosis is established based on clinical manifestations. (See "Clinical manifestations, prevention, and treatment of radiation-induced fibrosis".)

- Spontaneous gangrene of the breast – Spontaneous gangrene of the breast with secondary infection can occur [15]. This is very rare; risk factors include diabetes and renal failure (picture 11). Spontaneous gangrene of the breast has also been reported in some patients within the first few days of receiving large doses of warfarin (picture 12) [39]. (See "Warfarin and other VKAs: Dosing and adverse effects", section on 'Skin necrosis'.)

- Bite wound – Clinical manifestations of bite wound infections may include tenderness, erythema, swelling, purulent drainage, lymphangitis, and fever. Management of human bites includes wound care, antibiotic therapy, and tetanus vaccination. (See "Human bites: Evaluation and management", section on 'Management'.)

Treatment

Clinical approach — Management of cellulitis includes symptomatic relief and antibiotic therapy. Nonsteroidal anti-inflammatory agents (eg, ibuprofen) along with cold compresses or ice packs reduce local pain and swelling.

Patient with uncomplicated cellulitis may be treated with oral dicloxacillin (500 mg orally every six hours) or cephalexin (500 mg orally every six hours). In the setting of beta-lactam allergy, clindamycin (300 mg to 450 orally every eight hours) may be administered. Drawing around the area cellulitis to assess response is a valuable indicator of progress (picture 13).

Patients with rapidly progressing erythema (picture 13) or signs of systemic toxicity warrant treatment with oxacillin (2 g intravenously every 6 hours) or cefazolin (1 to 2 g intravenously every 8 hours). In the setting of beta-lactam allergy, vancomycin (15 to 20 mg/kg/dose every 8 to 12 hours, not to exceed 2 g per dose) or clindamycin (600 mg intravenously every 8 hours) may be administered. In the setting of risk for MRSA (table 1), vancomycin (15 to 20 mg/kg/dose every 8 to 12 hours, not to exceed 2 g per dose) is warranted. (See "Methicillin-resistant Staphylococcus aureus (MRSA) in adults: Treatment of skin and soft tissue infections".)

Once there is evidence of clinical improvement, treatment should be continued with oral therapy (dicloxacillin 500 mg oral every six hours or cephalexin 500 mg orally every six hours). Clindamycin (450 mg orally every eight hours) is an option in patients who are allergic to beta-lactam antibiotics; it is associated with increased risk for Clostridioides (formerly Clostridium) difficile infection. Patients with
known or suspected MRSA infection may continue treatment with clindamycin, **trimethoprim-sulfamethoxazole** (1 double-strength tab orally twice daily), or **linezolid** (600 mg orally twice daily) (table 2).

For patients who have received recent chemotherapy and/or are neutropenic, the antibiotic regimen must be broadened to include coverage for aerobic gram-negative bacilli, including *Pseudomonas aeruginosa*. (See "Treatment of neutropenic fever syndromes in adults with hematologic malignancies and hematopoietic cell transplant recipients (high-risk patients)")

The optimal duration of oral antibiotic therapy is uncertain; 5 to 14 days is appropriate for most patients, but the duration may be tailored based on individual clinical circumstances. Longer durations may be warranted in patients with breast cellulitis after breast-conserving surgery and radiotherapy. In general, antibiotics are continued until the clinical signs of infection have resolved, including pain, fever, erythema, and edema. Frequently, patients report improvement in pain before there is a noticeable decrease in erythema and swelling.

In the absence of clinical response to antibiotic therapy within 48 to 72 hours, ultrasound should be performed to assess for abscess. Alternative diagnoses such as inflammatory breast cancer should also be considered.

**Recurrent cellulitis** — Patients with breast cellulitis are at risk for recurrent infection. The antibiotic management of a recurrent episode should be guided by microbiologic data obtained during a prior episode, if any. Otherwise, the choice of antibiotic therapy is the same as the approach to treatment of an initial episode of cellulitis (table 2). Chronic dermatologic conditions that predispose to cellulitis should be treated aggressively, and the skin should be kept as clean and dry as possible.

For some patients with multiple recurrent episodes, long-term suppressive antibiotic therapy may be appropriate. Management of these patients should be done in concert with infectious disease specialists or others with extensive expertise in the management of patients with breast cellulitis. Penicillin skin testing may be reasonable in patients with a history of penicillin allergy to determine if a beta-lactam can be used for long-term suppressive therapy. (See "Penicillin skin testing".)

**SKIN DISORDERS OF THE BREAST**

Some skin disorders of the breast may be associated with cellulitis [40].

**Eczema** — Eczema is characterized by thickened skin, increased skin markings (lichenification), and excoriated and fibrotic papules. The diagnosis is established based on clinical manifestations. Patients with eczema involving the skin overlying the breast may develop secondary cellulitis (picture 14). (See "Atopic dermatitis (eczema): Pathogenesis, clinical manifestations, and diagnosis").

**Epidermoid cyst** — An epidermoid cyst is a discrete, freely movable nodule. The diagnosis of
epidermoid cyst is based upon clinical appearance and palpation. These cysts are common within the skin of the breast and can become secondarily infected (picture 15). (See "Overview of benign lesions of the skin", section on 'Epidermoid cyst'.)

Hidradenitis suppurativa — Hidradenitis suppurativa is a chronic inflammatory condition of the apocrine sweat glands; it can be associated with infection and abscess formation of the axilla or skin of the lower half of the breast (picture 16) [15,26,41-44]. Lesions frequently contain both aerobic and anaerobic bacteria. (See "Hidradenitis suppurativa: Pathogenesis, clinical features, and diagnosis".)

Intertrigo — Intertrigo refers to inflammation at the site of two closely opposed skin surfaces (intertriginous area), often due to moisture and maceration (picture 17) [45,46]. The diagnosis is based on clinical manifestations. Intertrigo can be a recurrent problem in women with large ptotic breasts that make contact with the chest wall, usually affecting the skin of the lower half of the breast.

Pilonidal sinus — A pilonidal sinus is a cavity in the skin with a narrow opening on the surface that contains hair and skin debris. Pilonidal sinuses affecting the nipple have been described in hairdressers and sheep shearers and occur as a result of small pieces of cut hair that accumulate in clothing and penetrate the skin, causing inflammation and infection [15,42,47-50].

Piercing — Nipple rings can cause subareolar breast abscess and recurrent nipple infections, particularly in smokers (picture 18) [51]. In a study of 68 patients with a primary breast abscess, nipple piercing was a risk factor for a subareolar breast abscess (odds ratio [OR] 20, 95% CI 2.01-204.28) in addition to smoking (OR 11, 95% CI 4.41-29.94). (See "Body piercing in adolescents and young adults", section on 'Localized infection'.)

SUMMARY

- Patients with breast cellulitis present with a tender, warm, erythematous, and edematous breast. (See 'Clinical manifestations' above.)

- Beta-hemolytic Streptococcus is an important cause of breast cellulitis. Staphylococcus aureus, including methicillin-resistant S. aureus, can also be an important pathogen. (See 'Microbiology' above.)

- Patients with uncomplicated breast cellulitis may be treated with empiric oral antibiotic therapy. Patients with signs of systemic toxicity or rapidly progressing erythema should be treated with parenteral antibiotics. In the absence of clinical response to antibiotic therapy within 48 to 72 hours, ultrasound should be performed to assess for abscess. Alternative diagnoses such as inflammatory breast cancer should also be considered. Duration of therapy is usually 5 to 14 days, depending on response to treatment. (See 'Clinical approach' above.)

- Treatment of recurrent cellulitis should be guided by microbiologic data (if available). Otherwise, the approach to antibiotic selection is the same as for an initial episode of cellulitis. Chronic dermatologic
conditions that predispose to cellulitis should be treated aggressively, and the skin of the lower breast should be kept as clean and dry as possible. (See 'Recurrent cellulitis' above.)

- Some skin disorders of the breast may be associated with cellulitis. (See 'Skin disorders of the breast' above.)

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REFERENCES


Breast cellulitis following breast cancer treatment

Cellulitis of the right breast treated previously for breast cancer by a wide excision and whole breast radiotherapy.

Courtesy of J Michael Dixon, MD. Reproduced with permission from NHS Lothian.

Graphic 120785 Version 1.0
Extensive cellulitis and lymphangitis.

Courtesy of J Michael Dixon, MD. Reproduced with permission from NHS Lothian.

Graphic 120786 Version 1.0
Inflammatory breast cancer

It is important to rule out inflammatory breast cancer if a suspected breast infection does not respond to antibiotics.

*Courtesy of Michael J Dixon, MD.*
Clinical presentation of inflammatory breast cancer

The characteristic "peau d'orange" appearance of the breast skin, which is similar to the appearance of the skin of an orange, is apparent.


http://www.TheOncologist.com

Graphic 70894 Version 3.0
Inflammatory breast cancer

Courtesy of Sofia D Merajver, MD, PhD.

Graphic 82220 Version 2.0
Various presentations of Paget disease of the breast are represented here. Paget disease is typified by erythematous, scaly, and weeping "eczema" that involves the nipple. Discoloration, depigmentation, and desquamation of the nipple and areola are sometimes seen.


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Mondor disease of the breast

Mondor disease. Thrombophlebitis of the thoracoepigastric vein causes retraction of the lateral portion of the breast, which crosses to the midline at the inferior areolar margin and is accompanied by a palpable cord.

Circumscribed morphea

An indurated inflammatory plaque with central hypopigmentation and peripheral erythema is present in this patient with circumscribed morphea.

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Graphic 73769 Version 5.0
Radiation induced morphea left breast.

*Courtesy of J Michael Dixon, MD. Reproduced with permission from NHS Lothian.*

Graphic 120787 Version 1.0
Radiation induced dermatitis of breast

Radiation induced dermatitis with significant erythema and edema.

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Graphic 120788 Version 1.0
Gangrene of breast

Gangrene of the breast is rare but can occur in women with diabetes and renal failure.

*Courtesy of Michael J Dixon, MD.*

Graphic 80652 Version 2.0
Tuberculosis of the breast often presents with both breast and axillary sinuses.

*Courtesy of Michael J Dixon, MD.*

Graphic 68120 Version 3.0
Breast cellulitis following excision and radiotherapy

Cellulitis post wide excision and radiotherapy.

*Courtesy of J Michael Dixon, MD. Reproduced with permission from NHS Lothian.*

Graphic 120789 Version 1.0
### Risk factors for methicillin-resistant *Staphylococcus aureus* (MRSA) infection

<table>
<thead>
<tr>
<th>Health care-associated risk factors include:</th>
</tr>
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<tbody>
<tr>
<td>- Recent hospitalization</td>
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<tr>
<td>- Residence in a long-term care facility</td>
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<tr>
<td>- Recent surgery</td>
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<tr>
<td>- Hemodialysis</td>
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</table>

<table>
<thead>
<tr>
<th>Additional risk factors for MRSA infection include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- HIV infection</td>
</tr>
<tr>
<td>- Injection drug use</td>
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<tr>
<td>- Prior antibiotic use</td>
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</tbody>
</table>

<table>
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<tr>
<th>Factors associated with MRSA outbreaks include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Incarceration</td>
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<tr>
<td>- Military service</td>
</tr>
<tr>
<td>- Sharing sports equipment</td>
</tr>
<tr>
<td>- Sharing needles, razors, or other sharp objects</td>
</tr>
</tbody>
</table>
## Options for empiric oral therapy for treatment of both methicillin-resistant *Staphylococcus aureus* (MRSA) and beta-hemolytic streptococci

<table>
<thead>
<tr>
<th>Antibiotic agent</th>
<th>Adult dose</th>
<th>Pediatric dose (children &gt;28 days)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td>300 to 450 mg orally three times daily</td>
<td>40 mg/kg per day orally divided in three or four doses</td>
</tr>
<tr>
<td>Amoxicillin PLUS</td>
<td>500 mg orally three times daily</td>
<td>25 to 50 mg/kg per day orally divided in three doses</td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>1 double-strength tablet orally twice daily</td>
<td>8 to 12 mg trimethoprim component/kg per day orally divided in two doses</td>
</tr>
<tr>
<td>Amoxicillin PLUS</td>
<td>500 mg orally three times daily</td>
<td>25 to 50 mg/kg per day orally divided in three doses</td>
</tr>
<tr>
<td>Doxycycline¶</td>
<td>100 mg orally twice daily</td>
<td>≤45 kg: 4 mg/kg per day orally divided in two doses &gt;45 kg: 100 mg orally twice daily</td>
</tr>
<tr>
<td>Amoxicillin PLUS</td>
<td>500 mg orally three times daily</td>
<td>25 to 50 mg/kg per day orally divided in three doses</td>
</tr>
<tr>
<td>Minocycline¶</td>
<td>200 mg once, then 100 mg orally twice daily</td>
<td>4 mg/kg orally once, then 4 mg/kg per day divided in two doses</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600 mg orally twice daily</td>
<td>&lt;12 years: 30 mg/kg per day orally divided in three doses ≥12 years: 600 mg orally twice daily</td>
</tr>
<tr>
<td>Tedizolid</td>
<td>200 mg orally once daily</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Pediatric doses should not exceed the usual adult doses shown.

* Dosing for neonates provided separately. (Refer to the UpToDate table on treatment of cellulitis in neonates.)
¶ Not recommended for children <8 years of age.


Graphic 76937 Version 10.0
**Eczema of the breast**

Cellulitis of the breast can be a consequence of an overlying skin abnormality such as eczema.

*Courtesy of Michael J Dixon, MD.*

Graphic 50819 Version 2.0
It is common for epidermal inclusion cysts of the breast to become infected, requiring incision and drainage.

*Courtesy of Michael J Dixon, MD.*

Graphic 66484 Version 4.0
Hidradenitis suppurativa of the breast and axilla

(A) Hidradenitis suppurativa of the lower breast.
(B) Hidradenitis suppurativa affecting the axilla.

Courtesy of Michael J Dixon, MD.

Graphic 64307 Version 3.0
Intertrigo

Intertrigo before and after skin care. The patient was on antifungal creams for one month with no improvement prior to the top photo. The lower photo shows the effect of simply keeping the skin clean and dry.

Courtesy of Michael J Dixon, MD.

Graphic 65405 Version 2.0
Nipple ring infection

Nipple rings can cause problems with recurrent infections.

Courtesy of Michael J Dixon, MD.

Graphic 63150 Version 3.0

Contributor Disclosures

J Michael Dixon, MD  Nothing to disclose  Larry M Baddour, MD, FIDSA, FAHA  Consultant/Advisory Boards: Boston Scientific [Cardiovascular device infection (Subcutaneous implantable cardioverter-defibrillator)].  Anees B Chagpar, MD, MSc, MA, MPH, MBA, FACS, FRCS(C)  Consultant/Advisory Boards: Protean BioDiagnostics [Breast cancer].  Daniel J Sexton, MD  Grant/Research/Clinical Trial Support: Centers for Disease Control and Prevention; National Institutes of Health [Healthcare epidemiology]. Consultant/Advisory Boards: Magnolia Medical Technologies [Medical diagnostics]; National Football League [Infection prevention]; Johnson & Johnson [Mesh-related infections]. Equity Ownership/Stock Options: Magnolia Medical Technologies [Medical diagnostics].  Meg Sullivan, MD  Grant/Research/Clinical Trial Support: Gilead Sciences [Pre-exposure prophylaxis for contraception (Tenofovir)]. Consultant/Advisory Boards: Gilead Sciences [Pre-exposure prophylaxis for contraception (Tenofovir)].

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Conflict of interest policy
Common problems of breastfeeding and weaning

Author: Jeanne Spencer, MD  Section Editors: Steven A Abrams, MD, Jan E Drutz, MD  Deputy Editor: Alison G Hoppin, MD

All topics are updated as new evidence becomes available and our peer review process is complete.


INTRODUCTION

Breastfeeding is universally recognized as the normative and preferred method of infant feeding. Mothers and infants who do not breastfeed have greater short- and long-term health risks. (See "Infant benefits of breastfeeding" and "Maternal and economic benefits of breastfeeding".)

For many women, difficulties in breastfeeding result in early termination of breastfeeding before the recommended period of time. However, with accurate advice and treatment, most of these difficulties can be overcome, and breastfeeding can be successfully sustained for longer periods.

Common problems associated with breastfeeding and their management are reviewed here. The initiation of breastfeeding and immediate postpartum evaluation of mothers and infants are discussed separately. (See "Initiation of breastfeeding".)

INADEQUATE MILK INTAKE

Inadequate milk intake or the perception of inadequate milk production is the most common reason for early termination of breastfeeding. Inadequate milk intake may be due to failure of the infant to extract milk or insufficient milk production, and determining the primary problem can be challenging.

**Diagnosis of inadequate intake** — The diagnosis of inadequate milk intake is made clinically by demonstrating insufficient feeding based on a nursing history, decreased infant urine and stool output, and excess weight loss of the infant. (See "Initiation of breastfeeding", section on 'Assessment of intake'.)

- During the first week of life, mothers with term infants generally nurse when the infant exhibits hunger cues, which usually occurs 8 to 12 times in 24 hours. By four weeks after delivery, nursing usually decreases to seven to nine times per day.
- By the fifth day of life, infants with adequate intake urinate six to eight times daily and have three or more pale yellow and seedy stools daily.
• A history of normal breastfeeding frequency, urination, and stools cannot guarantee sufficient weight gain. To determine whether caloric intake is adequate, infants must be weighed at the newborn office visit and during each of their routine health assessment visits.

• Term infants generally lose weight in the first three to five days of life with an average loss of 7 percent of their birth weight. They typically will regain their birth weight by one to two weeks of life. Once the mother's breasts feel full with milk by day three to five, the infant should not continue to lose weight. If an infant has lost 10 percent of its weight or fails to regain birthweight appropriately, inadequate intake should be considered and direct observation of breastfeeding should be performed. (See "Breastfeeding the preterm infant", section on 'Test weighing' and 'Observed feeding' below.)

Management — Inadequate milk intake is most commonly related to or worsened by ineffective breastfeeding technique and usually responds to maternal education and support (see 'Optimize breastfeeding technique' below). In some cases, specific maternal and/or infant factors contribute to the problem, which may warrant specific interventions, depending on the cause (table 1). (See 'Assess and address contributing factors' below.)

Optimize breastfeeding technique — The primary intervention most often involves guidance to increase the effectiveness and frequency of breastfeeding and building maternal confidence [1].

• Breastfeeding history – The clinician should inquire about when breastfeeding was first initiated, the frequency of breastfeeding, and any challenges perceived by the mother and review her breastfeeding technique.

Poor feeding routines in the early postpartum period are the most common cause of insufficient milk intake. They include delayed initiation, infrequent feeding, maternal-infant separation, and use of supplemental formula. Very early pacifier use may lead to insufficient nursing or may be a result of it [2,3]. Insufficient nursing tends to result in inadequate milk production since frequent and adequate breast emptying is necessary for adequate breast milk volume. Many babies are sleepy and difficult to keep awake during the first several days after birth, causing insufficient milk transfer [4]. (See "Initiation of breastfeeding", section on 'Demand feeding' and "Initiation of breastfeeding", section on 'Pacifier use'.)

• Observation – Breastfeeding should be directly observed to detect improper breastfeeding technique (eg, position and latch-on). Positioning for breastfeeding is illustrated in the figures (figure 1 and figure 2 and figure 3). Proper latch-on is illustrated in the figure (figure 4) and further detailed in this video.

• Examination – If the mother reports nipple or breast pain, the breast should be examined for evidence of nipple injury or dermatitis, engorgement, or plugged ducts, all of which cause pain and may interfere with breastfeeding and/or milk transfer. The combination of nipple pain and oral
candidiasis in the infant suggests the possibility of candidal infection of the nipple. Although this is a common clinical diagnosis, there is considerable controversy about how frequently candidal infection is the cause of pain during breastfeeding. Diagnosis and management of these problems are discussed below. (See 'Nipple and breast pain' below and 'Candidal infection' below.)

Assess and address contributing factors — Additional factors that contribute to inadequate milk intake can be divided into insufficient milk production and failure of the infant to extract milk (table 1) [1].

- **Inadequate milk production** — Inadequate milk production may be due to:
  - A delay in the usual progression from colostrum production to copious milk production (lactogenesis stage II). Lactogenesis II, which is perceived by mothers as increased breast fullness or leakage, normally occurs within 72 hours postpartum. Delayed lactogenesis is more common in women with prepregnancy obesity [5], especially with insulin resistance; endocrine abnormalities; pregnancy-induced hypertension [6]; polycystic ovary syndrome [7]; and other complications associated with high androgen levels during pregnancy [8]. Delayed lactogenesis usually can be managed with breastfeeding support and increased frequency of feeding to stimulate lactogenesis and close monitoring of infant weight. (See "Initiation of breastfeeding", section on 'Lactogenesis'.)
  - Other less common causes of delayed stage II lactogenesis are retained placental fragments and pituitary insufficiency due to postpartum pituitary infarction, also known as Sheehan syndrome. (See "Overview of postpartum hemorrhage", section on 'Sheehan syndrome'.)
  - Insufficient breast development during pregnancy, which may be due to congenital insufficient glandular tissue, previous breast surgery or irradiation, insulin resistance, high androgen levels, or other endocrine abnormalities (eg, prolactinoma). The degree to which this affects milk production and ability to breastfeed varies with the cause and severity. Mothers with these issues should be encouraged to optimize breastfeeding technique and frequency. Their infants should be monitored more closely for inadequate weight gain.
  - Previous maternal breast surgery may result in poor milk production. While these mothers should be encouraged to breastfeed, their infant's intake should be monitored closely.

    - Breast reduction, regardless of the procedure, is associated with a high risk of insufficient breast milk production. All mothers who have undergone breast reduction should be monitored closely during breastfeeding. Breastfeeding is typically not feasible in women undergoing breast reduction using the free nipple technique, in which subareolar parenchyma is completely transected, since the ducts are completely disrupted and unlikely to recanalize [9,10]. Surgical techniques that maintain a column of subareolar breast tissue are associated with higher success rates [10]. (See "Overview of breast reduction", section on 'Impact on future breastfeeding'.)
    - Breast augmentation does not generally affect lactation, but a minority of women
experience lactation insufficiency, as indicated by lower rates of exclusive breastfeeding [11]. Studies conflict in their conclusions about whether this is more common among women with a periareolar incision, compared with an inframammary approach [11-14]. The mechanism is unclear, but may include the breast hypoplasia that is common among women who choose to have a breast augmentation procedure, as well as effects of the surgery itself.

- A history of breast biopsy would not be expected to decrease milk production.

- Some maternal medications interfere with the establishment of a milk supply. These include oxytocin and, possibly, selective serotonin reuptake inhibitors (SSRIs) [15]. Other medications decrease the existing milk supply. These include dopamine agonists (for example, bromocriptine), decongestants, and estrogens [16]. If a mother is taking these medications and has compromised breast milk supply, consider alternative medications if possible. The LactMed database, which is maintained by the National Library of Medicine, provides data on potential adverse effects of prescription and over-the-counter medications on breastfeeding infants and lactation and recommendations for alternative drugs. (See 'Maternal use of medications' below.)

Because estrogen-containing oral contraceptives are known to reduce milk volume, most guidelines advise avoiding their use by breastfeeding women, especially during the first 30 days postpartum [17]. This effect is dose-related, so low-dose estrogen products such as estradiol 10 micrograms/day are unlikely to appreciably diminish milk supply [18,19]. A World Health Organization guideline is more restrictive and suggests that they generally should not be used through six months postpartum [20]. Other contraceptive methods are available that have less effect on lactation [18,19]. (See "Postpartum contraception: Counseling and methods", section on 'Impact of contraception on breastfeeding'.)

- **Poor milk extraction** – Specific infant factors that may interfere with milk extraction include:

  - Oral-motor, neurologic abnormalities or anatomic abnormalities such as cleft palate. Management depends upon the abnormality and often requires special attention to latch and feeding positioning as well as support from a specialized lactation expert or speech-language pathologist. (See "Neonatal oral feeding difficulties due to sucking and swallowing disorders".)

  - Prematurity – Late preterm infants (gestational age between 34 and 37 weeks) often have feeding difficulties compared with term infants. As a result, they often need additional breastfeeding support and monitoring, often including scheduled feedings and after-feeding pumping. (See "Breastfeeding the preterm infant", section on 'Late preterm infants'.)

  - Ankyloglossia – Ankyloglossia (infant tongue-tie) is sometimes a cause of poor milk extraction. Infants with ankyloglossia and breastfeeding difficulties should be evaluated by a lactation specialist. In some cases, frenulotomy has been shown to improve breastfeeding, although the procedure may be overutilized [21]. (See "Ankyloglossia (tongue-tie) in infants and children".)
Supplementation (if medically necessary) — Supplementation of feeds with formula or donor human milk should be avoided if possible. If supplementation reduces breast emptying, it may decrease milk production and exacerbate the breastfeeding problem. However, supplementation may be necessary in some cases to provide adequate nutrition to the infant:

- During the first two weeks of life, due to delayed stage II lactogenesis or infant immaturity – Thresholds for initiating supplements and approaches for boosting milk production are discussed separately. In addition, these patients should be given expert lactation support to optimize breastfeeding technique. (See "Initiation of breastfeeding", section on 'Supplementation'.)

- Factors that hinder effective breastfeeding – These include insufficient maternal breast development or infant factors such as prematurity or oral-motor abnormalities that interfere with breast milk transfer. In these cases, the decision to initiate supplements and volume of supplementation is individualized and depends upon the infant's growth and whether the underlying problem is amenable to treatment. If supplements are given, breast milk production can be maintained by having the mother pump to empty her breasts after each nursing session and each time a supplemental feed is given. These patients benefit from referral to a lactation consultant to optimize the effectiveness of breastfeeding. (See "Breast milk expression for the preterm infant".)

- Lactation failure – Some mothers are physically unable to produce enough breast milk for their baby or have medical conditions that preclude breastfeeding. Mothers should be asked to consider which aspects of breastfeeding were most important to them and try to find alternatives. After optimizing breastfeeding support, some mothers use a supplemental feeder, ie, a tube attached near the nipple to deliver breast milk or formula. This allows most of the closeness of breastfeeding. Other mothers mourn the loss of breastfeeding but learn to enjoy the other aspects of infant care.

If the mother chooses to supplement with donor human milk, it should be obtained from an established human milk bank that follows safety regulations for optimal milk collection, pasteurization, storage, and shipping. These can be found through the Human Milk Banking Association of North America. Safety standards are also maintained by central organizations in many other countries, including the United Kingdom Association for Milk Banking, the European Milk Bank Association, and Banco de Leite Humano in Brazil. Information for other countries can be found at the International Milk Banking Initiative. Donor milk obtained over the internet and/or that is not pasteurized by an established milk bank should not be used. (See "Human milk feeding and fortification of human milk for premature infants", section on 'Source of donor milk'.)

Galactagogues (not recommended) — Galactagogues (or lactagogues) are medications or other substances believed to augment maternal milk production. The most commonly used prescription agents are dopamine receptor antagonists, primarily metoclopramide and domperidone. We do not recommend the routine use of galactagogues, because there is limited evidence to support their efficacy and because
of potential safety concerns [22]. These agents should never be used in place of an evaluation and correction of any modifiable factors such as frequency and thoroughness of breast emptying [22-24]. If galactagogues are considered in selected patients who have not responded to lactation support, they should be used with caution, and mothers need to be aware of potential side effects and the lack of data supporting their use.

Most studies suggest limited efficacy of galactagogues in increasing milk production [25-31]. In small randomized trials of metoclopramide given to mothers of term or preterm infants at a dose of 10 mg every eight hours, there was no difference in the amount of milk production between mothers who received metoclopramide compared with mothers who received placebo [25,30,31]. A systematic review concluded that domperidone may increase the volume of expressed breast milk in mothers pumping for their preterm infants, but the findings may not be generalizable, because the two included studies involved mothers greater than 14 days postpartum and who had full lactation support [32-34]. In another trial of 80 mothers who were expressing breast milk to feed their infants in the neonatal intensive care unit, 10-day courses of domperidone and metoclopramide appeared to be equally effective in increasing milk production [35]. Although 15 percent of mothers reported side effects (eg, headaches, diarrhea, and mood swings), this may be an underestimation, as a significant number of mothers withdrew from the trial (n = 15). Another trial in mothers of preterm infants under 29 weeks gestation found that domperidone appeared to increase milk volume, at least in some of the subjects, although the absolute increase in milk volume was modest [36].

The use of metoclopramide and domperidone is also limited by concerns about possible adverse effects and because the long-term effects of these medications on offspring are unknown [22,37].

- For metoclopramide, no definite adverse effects on the infant have been demonstrated. However, there are theoretical concerns about the use of this drug during lactation because of its known effects on the central nervous system [34].

- Domperidone is excreted in low concentrations in breast milk, and does not cross the blood-brain barrier. However, because of important concerns about arrhythmias due to QT prolongation, domperidone is not approved for marketing in the United States [38,39]. Moreover, the quality of product available from compounding pharmacies cannot be assured. Domperidone use is most risky in mothers with a history of arrhythmias or who are at risk for prolonged QT syndrome, are on other medications that increase the QT interval, on CYP3A4 inhibitors such as grapefruit juice or fluconazole, or who take domperidone doses over 30 mg daily [40].

Data on the use of herbal galactagogues are even more limited. Fenugreek is the most widely used herbal agent, but data are insufficient to determine its efficacy and safety [41-44]. Reported side effects include diarrhea, flatulence, allergic reactions, and hypokalemia. In addition, it is not known whether components of the herb are transferred to the infant via breast milk. As with all herbal supplements, manufacturers are not required to demonstrate efficacy, and the contents of individual products vary. Further information about fenugreek and other herbal galactagogues is available from the LactMed.
NIPPLE AND BREAST PAIN

After insufficient milk intake, nipple and breast pain are the most common causes of premature discontinuation of breastfeeding.

Etiology — Causes of nipple and breast pain include:

- Nipple injury from improper suck, latch, or trauma from breast
- Nipple vasoconstriction
- Engorgement
- Plugged ducts
- Nipple and breast infections (see 'Breast infections' below)
- Excessive milk supply
- Nipple dermatitis/psoriasis

Evaluation — Evaluation of breast pain begins with a thorough history, examination of the infant and mother's breasts, and observation of feeding.

History — The following are key elements in the history:

- The onset of breast pain, as breast pain in the first days of breastfeeding is most often caused by poor latch, whereas infectious causes of breast pain occur later.
- Description of the pain including the clinical setting. For example, pain that occurs in a mother who feels fullness of her breasts may be due to excessive milk supply. Whereas pain that occurs only with pumping may be due to trauma from the pump.
- Feeding history that includes the frequency and duration of feedings, when the milk "came in," and how well the infant latches onto the breast.
- Previous breastfeeding experience.
- History of yeast infections. (See 'Candidal infection' below.)
- Maternal breast surgeries including breast reduction, piercings and implants, or the presence of inverted nipples.
- History of nipple pain or extreme sensitivity during pregnancy.
- History of Raynaud syndrome or autoimmune disease, which may be associated with nipple vasoconstriction. (See 'Nipple vasoconstriction' below.)

Physical examination
Infant — Physical examination of the infant should focus on the head and neck:

- Torticollis commonly causes a unilateral sore nipple.
- A tight lingual or (less commonly) labial frenulum may cause sore, traumatized nipples.
- Cleft lip and/or palate, retrognathia, large adenoids with mouth-breathing, and oral defensiveness are other reasons for difficulty achieving a nontraumatic wide latch with good vacuum.
- Mucocutaneous candidiasis that involves the oral cavity (eg, thrush) or diaper area may be associated with breast pain. (See 'Candidal infection' below.)

Maternal breast examination — The mother's nipples should first be inspected for swelling, rash, vasospasm, impetiginized nipple pores, blocked pores, abrasions, ulcers, and open cracks. A thorough breast examination should also be done to identify engorgement, masses, abscesses, tenderness, or areas of erythema indicating mastitis.

Observed feeding — It is essential that an episode of breastfeeding be observed because most causes of breast pain in the lactating mother are due to incorrect breastfeeding technique. The latch and feeding technique should be directly assessed. For example, a poor latch may result in injury to the nipple and may interfere with the infant's ability to empty the breast, which may result in engorgement, plugged ducts, mastitis, and breast abscess. The observation and education can be performed by either the primary care provider or a lactation consultant, and supplemented with educational videos, such as this one demonstrating effective latch-on technique. (See "Initiation of breastfeeding", section on 'Mechanics of feeding'.)

Nipple pain — Sore nipples are one of the most common complaints by mothers in the immediate postpartum period. Pain due to nipple injury needs to be distinguished from nipple sensitivity, which normally increases during pregnancy and peaks approximately on the fourth postpartum day. Normal nipple sensitivity can be differentiated from the pain due to nipple trauma, the most common cause of nipple pain, by differences in their timing and course [45].

- Normal sensitivity typically subsides approximately 30 seconds to 1 minute after suckling begins. It also diminishes after the fourth postpartum day and completely resolves approximately seven days after delivery.
- In contrast, pain due to trauma persists at the same or an increasing level throughout the nursing episode. Severe pain or pain that extends beyond the first postpartum week is more likely to be due to nipple injury.

Normal nipple sensitivity — As noted above, most mothers experience nipple discomfort with breastfeeding initiation. This nipple sensitivity is usually limited to the first few suckles of the feed and is thought to be related to the negative pressure on the ductules that have not yet filled with milk [45]. This "latch-on pain" should not persist throughout the whole feeding and should resolve completely after the
first week or two. In addition, some mothers find the "pins and needles" sensation of let-down to be uncomfortable, but this discomfort often improves in the first weeks of breastfeeding. In any case, the pain is not severe.

If needed, the mother can use acetaminophen before the feeding. Nipple toughening procedures during pregnancy have not been shown to be beneficial in preventing nipple sensitivity as breastfeeding is initiated [46].

**Nipple injury** — Nipple pain due to trauma persists at the same or an increasing level throughout the nursing episode. Severe pain or pain that extends beyond the first postpartum week is more likely due to nipple injury.

Nipple injury usually is due to incorrect breastfeeding technique, particularly poor position or latch-on. Nipple abrasion, bruising, cracking, and/or blistering may result when an infant fails to achieve a proper latch-on. Mothers with infants with mouth abnormalities (eg, ankyloglossia or palatal anomalies [47]) are at risk for nipple pain due to trauma. Ankyloglossia, also known as "tongue-tie," occurs when the frenulum connecting the tongue to the floor of the mouth is tight and limits extension of the tongue (picture 1). (See "Ankyloglossia (tongue-tie) in infants and children", section on 'Breastfeeding problems'.

Other contributing factors for nipple trauma include harsh breast cleansing, use of potentially irritating products including breast pads, and infant biting or oromotor problems [23]. Nipple injury also is associated with plugged ducts, candidal and bacterial infections, and engorgement. (See 'Plugged ducts' below and 'Breast infections' below and 'Engorgement' below.)

**General management** — Management includes prevention of nipple injury and healing of traumatized nipples.

- **Prevention:**
  - The most effective techniques for preventing nipple trauma are proper positioning and latch of the infant.
  - Anticipatory guidance should be given prior to hospital discharge, regarding prevention of engorgement. Engorgement interferes with proper latch-on, which contributes to nipple injury. Conversely, nipple pain contributes to poor milk extraction, resulting in engorgement.
  - Avoidance of excessive moisture of the nipples and irritating cleansers. The nipples should be allowed to air dry gently after breastfeeding, and pads that prevent drying should be avoided.
  - Nipple abnormalities detected in the prenatal period should be evaluated by a lactation consultant. (See "Initiation of breastfeeding", section on 'Inverted nipples'.)
  - Abnormalities of the infant's oral cavity (eg, ankyloglossia) should be evaluated during the birth hospitalization. (See "Ankyloglossia (tongue-tie) in infants and children".)
• Care of the traumatized nipple consists of the following:

  • Assessment of infant positioning and latch-on and correction of improper technique. She should nurse first on the unaffected side. If the mother is unable to achieve appropriate latch and positioning such that nursing continues to be traumatic, she should seek lactation consultation and consider just pumping and supplementing the baby with expressed breast milk until the infant feeding problem is alleviated.

  • Traumatized nipples should be treated with moist wound-healing principles. If the nipple is cracked or abraded, an antibiotic ointment such as bacitracin or mupirocin is applied and a nonstick pad is used to cover the affected area. This will help to prevent nipple infection and prevent the abraded open areas of the nipple from sticking to the breast pad and bra.

  • If the nipples appear to be infected, a culture of the drainage should be obtained to check for bacterial infection (eg, Staphylococcus aureus). If candidal infection is expected based on significant erythema and scaling, empiric treatment for yeast can be considered. Dermoscopy can also be helpful in these situations [48]. (See 'Breast infections' below and "Office-based dermatologic diagnostic procedures", section on 'Potassium hydroxide preparation'.)

  • Cool or warm compresses, the application of expressed breast milk to the nipple, and mild analgesics such as acetaminophen or ibuprofen may be helpful.

  • There is probably no benefit to applying lanolin or other substances to the nipple. A systematic review evaluated the effectiveness of glycerine gel dressings, breast shells with lanolin, lanolin alone, or the all-purpose nipple ointment containing mupirocin, miconazole, and hydrocortisone. The review concluded that none of these interventions were clearly effective in alleviating nipple pain in lactating women, and that nipple pain decreased significantly by 7 to 10 days postpartum regardless of the intervention [49]. Despite this, lanolin is frequently recommended by health care professionals. Highly purified lanolin (Lansinoh) is purported to have enhanced safety and reduced allergic potential compared with other lanolins because residual pesticides and detergent residues are removed and the natural free alcohols are reduced [50]. Nonsterile honey may contain botulism spores and so should be avoided on the nipple. Medical grade honey should not have the risk of botulism in the infant but its efficacy has not been researched.

  • Highly concentrated vitamin E oil should not be applied to the nipples, because it is readily absorbed by the infant and may be toxic at high levels [51].

  • Infants with mechanical feeding problems may need special interventions:

    • For infants with ankyloglossia, lingual frenotomy may facilitate breastfeeding and may decrease nipple pain. This is because effective breastfeeding requires coordinated anterior and vertical motion of the tongue [52,53]. (See "Ankyloglossia (tongue-tie) in infants and children", section on 'Breastfeeding issues'.)
Biting — Some infants cause pain to their nursing mothers by biting.

Biting that occurs in the first few weeks postpartum is typically due to a tonic bite reflex that often occurs due to infant oral defensiveness, retrognathia, and tight lingual frenulum. Natal teeth can rarely present at birth. In these neonates, the incisal edge may need to be smoothed to decrease maternal discomfort, or if they are causing great discomfort or pain they may need to be removed. (See "Developmental defects of the teeth", section on 'Natal and neonatal teeth'.)

Biting may also occur due to teething after the normal teeth eruption at 3 to 12 months and may cause nipple pain and trauma. Infants usually bite more at the end of the feeding since their tongues cover the teeth during active feeding. Biting is often avoided by keeping the baby close to the breast while feeding with the mouth wide open, which prevents the baby's latch from becoming shallow onto the nipple. Once swallowing is over and the baby is nursing for comfort, taking the baby off the breast prevents biting. If these steps are not helpful, and the baby continues to bite, the mother should say "no" firmly, break the suction with her finger, and put the infant on a safe surface. Mothers should avoid expressing too much emotion over the event to discourage the infant from repeating it [46]. Most infants learn quickly not to bite. They should be offered teething rings as more suitable objects for teething.

Areolar dermatitis — Eczema and psoriasis of the nipple/areolar complex can present as a red, scaly rash. Women describe sore, itchy, and painful burning of the areola and nipples, and it is more common in women with a previous episode(s) of either of these two skin conditions. Other contributing factors include irritant dermatitis due to soaps or fragrances, solid foods in the infant's diet, or allergic reaction to topical agents such as lanolin, antifungals, or antibiotics. During an acute presentation, vesicles, crusting, and erosions are seen in the affected areas, whereas in the chronic state, the areas are generally dry, erythematous, lichenified, and scaling [55].

Management begins with avoidance of potential irritants and allergens. Medium potency topical steroids are generally effective and should be applied after feeding [55]. Ointments are more easily absorbed, but can expose the infant to mineral paraffins, which may be of concern [56,57]. Visible topical agents should be removed from the nipple/areolar area before the next feeding. Expressed breast milk applied before the feeding is often effective in their removal.

Other conditions that may present with similar skin manifestations include:

- Herpes simplex and herpes zoster — Women with herpes simplex and herpes zoster breast lesions should not breastfeed from the affected breast until the lesions resolve, because direct contact with the lesions may transmit the herpes viruses to her infant [58]. Mothers should use careful hand hygiene and cover any lesions with which the infant might come into contact. Mothers can pump and the expressed milk that does not come into direct contact with open herpetic lesions can be given to
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Nipple vasoconstriction — Cutaneous vasospasm of the nipple due to arteriolar vasoconstriction can occur in mothers who have Raynaud phenomenon, unusual cold sensitivity, or nipple trauma (picture 2) [45,59,60]. (See "Clinical manifestations and diagnosis of Raynaud phenomenon", section on 'Clinical manifestations'.)

Engorgement — Engorgement occurs either from interstitial edema with the onset of lactation after birth, or at other times during lactation with accumulation of excess milk.

Herpes simplex is diagnosed by viral culture, serology, or skin scrapings. Herpes zoster is usually diagnosed based on clinical examination, although laboratory confirmation may be needed if the presentation is atypical. (See "Epidemiology, clinical manifestations, and diagnosis of herpes simplex virus type 1 infection", section on 'Diagnosis' and "Epidemiology, clinical manifestations, and diagnosis of herpes zoster", section on 'Approach to diagnosis'.)

• Impetigo – Eczema can predispose a mother to impetigo. A culture should be obtained in mothers with pustules and thick adherent crusting with a characteristic golden appearance of the affected area. (See "Impetigo", section on 'Diagnosis'.)

Nipple vasoconstriction — Clinical manifestations

- Mothers with nipple vasoconstriction typically experience pain, burning, and paresthesias with cold exposure, nursing, or nipple trauma; the pain may radiate into the breast as a sharp or deep aching sensation. The vasoconstriction can be reproduced with exposure of the nipple to cold air or compresses [61]. Between episodes, the mother is asymptomatic, and the nipples are normal in appearance. In patients with Raynaud phenomenon or cold sensitivity, vasoconstriction is responsible for the classic tricolor change of pallor, followed by cyanosis, and then erythema as the circulation returns.

• Diagnosis — The diagnosis is made by the history of nipple vasoconstriction occurring during cold exposure and/or breastfeeding. Because of the intensity of the pain, a diagnosis of candidiasis of the nipple is often made; however, the trigger of cold exposure for the onset of pain and changes in nipple appearance should differentiate between the two conditions [60].

• Management — In mothers with cold sensitivity, warming the entire body appears to be helpful in reducing nipple vasoconstriction, so affected mothers should breastfeed in warm conditions (if possible) and wear warm clothing or use a heating source applied over the bra. Other interventions include avoidance of vasoconstricting medications (eg, nicotine and caffeine) and warming the nipple at the onset of symptoms [59].

Case reports suggest that the administration of nifedipine, a potent vasodilating calcium channel blocker, relieved symptoms of nipple vasoconstriction [59-61]. Low levels of nifedipine are found in breast milk, but no adverse effects have been observed in nursing infants whose mothers have been treated with nifedipine [37,59].

Engorgement — Clinical manifestations

- Engorgement results in breast fullness and firmness, which is accompanied by pain and tenderness. Among mothers, the affected area varies with primarily...
areolar involvement in some mothers, more peripheral involvement in others, and in some mothers both peripheral and areolar involvement. If the areola is engorged it can impair the baby's ability to latch and worsen the engorgement [45].

Engorgement can occur at varying times postpartum:

- **Primary engorgement** occurs with the onset of copious milk production (i.e., lactogenesis stage II), usually between days three to five after delivery. It is due to interstitial edema of the breast prompted by the decrease in progesterone levels after the placenta is delivered [62].

- **Secondary engorgement** typically occurs later when there is a mismatch between milk production and extraction as the mother's milk supply exceeds the amount of milk removed by her infant. This may occur from excessive stimulation of milk production via pumping, taking medications to increase milk supply, decreased milk extraction from not feeding the baby as often (e.g., weaning), or during times of infant illness. (See 'Routine weaning' below.)

**Management** – Effective management hinges on adequate removal of the milk. For primary engorgement, it is important to ensure implementation of good feeding techniques with a satisfactory latch and optimal nursing positioning.

- If the areola is involved, manual expression of small amounts of milk before the feeding will soften the areola and facilitate latching. Hand expression is accomplished by placing the thumb and forefingers well behind the areola toward the chest wall and then compressing them together and toward the nipple in a rhythmic fashion. Using the fingers in a similar position, the mother can present the nipple in a way that is easier to latch. Mothers can also use this rhythmic compression while the infant is suckling to enhance milk transfer (Stanford video link on hand expression of breast milk).

- Some mothers may find use of a breast pump to be helpful. However, this use should be limited to immediately before a feeding to soften the breast because overuse will stimulate milk production and could increase the engorgement.

- For others, applying pressure toward the chest wall softens the edema and facilitates the latch.

Evidence for other supportive measures is limited because engorgement usually resolves over time; therefore, it is difficult to see the effect of specific interventions. In addition, studies of these measures have included only small numbers of patients and were poorly controlled. This was best illustrated in a systematic review that found possible benefits of interventions including hot/cold packs, gua sha (scraping therapy), protease complex (plant enzyme), acupuncture, cabbage leaf application, but insufficient evidence to justify widespread use [63]. Results from the two studies using acupuncture showed improved symptoms in the days following treatment, but there was no difference in outcome by six days after treatment. In the single study using cold gel packs, there appeared to be improvement in symptoms, but differences between the control and intervention
groups made it difficult to interpret the results.

Nevertheless, the following interventions are often used for pain relief associated with either primary or secondary engorgement:

- Applying warm compresses or a warm shower enhances let-down and may facilitate milk removal either by hand expression or with suckling
- After or between feedings, cold compresses may decrease the swelling and discomfort
- Analgesics such as ibuprofen and acetaminophen may decrease the discomfort
- Cool green cabbage leaves

**Plugged ducts** — Plugged milk ducts are localized areas of milk stasis within the milk ducts that cause distention of mammary tissue.

**Clinical manifestations** — The presentation of a plugged duct involves a tender and often painful palpable lump due to obstruction of a mammary duct without systemic findings [45]. In addition to a plugged mammary duct, obstruction of the nipple pore ducts (figure 5) may also occur and present as a white dot or bleb at the end of the nipple, commonly referred to as a milk blister.

Predisposing factors for plugged ducts include previous breast surgery or biopsy, poor feeding technique, wearing tight clothing including ill-fitting brassieres, abrupt decrease in feeding, engorgement, and bacterial intraductal infections [45,46]. Poor feeding technique (eg, poor latch-on and positioning) results in inadequate emptying and stasis that contribute to blockage of the milk ducts.

**Diagnosis** — The diagnosis is made clinically on typical presentation and response to management. Plugged milk ducts are distinguished by the absence of localized redness and no systemic findings from other conditions (mastitis and breast abscess) that present with a tender area of breast inflammation. These other disorders are usually accompanied by systemic findings (eg, fever >38.3°C, myalgia, chills, malaise, and flu-like symptoms).

**Management** — Management is focused on opening up the blocked milk duct and draining the area behind the blockage. The following approach is based on clinical experience and expert opinion.

- Optimize feeding technique — The most effective manner to open the blockage and drain the area of concern is by emptying of the breast with frequent feeds. The infant's positioning and latch should be assessed and, if needed, corrected (figure 4 and figure 1 and figure 2 and figure 3). The mother should be encouraged to vary the position to ensure complete drainage of the entire affected breast. Some clinicians recommend positioning the infant so the chin is near the area of concern because this positioning maximizes drainage of the affected area. Pumping or hand expression after the feeding may improve the drainage. The La Leche League website provides patient information on feeding techniques for a mother with a plugged duct.
- Mothers should be counseled not to stop breastfeeding, since this could lead to engorgement
and worsen the problem.

- Other measures that may facilitate drainage include warm compresses or showers, and manual massage [45,46]. In the shower, the mother can massage the breast from the affected area toward the nipple to try to remove the blockage. Others recommend that the massage begin beyond the mass and toward the nipple at first to clear the duct and then to progress toward the mass [64].

- Analgesics such as ibuprofen and acetaminophen may decrease the discomfort.

- Plugs can often be prevented by prevention of secondary engorgement.

The vast majority of plugged ducts resolve in 48 hours. If the plugged ducts do not resolve with the above measures within 48 hours, additional evaluation and treatment are required. An ultrasound should be considered to rule out an abscess or other breast mass.

In some mothers with a milk blister (white bleb) on the nipple, relief may be obtained by gently opening the skin covering with a sterile needle and expressing the white cheesy substance from the nipple pore [45]. However, this procedure can be painful and should be performed by an experienced clinician. Topical lecithin massaged into the nipple after each feeding has been recommended [65]. Oral lecithin supplementation has also been recommended under the theory that this may change the milk consistency, causing it to be less prone to blockage. Research on the topic is very limited. Caution should be used in obtaining lecithin supplements because they are not regulated by the US Food and Drug Administration (FDA). The effect of maternal lecithin supplements on the breastfed infant has not been studied, but seems unlikely to be of concern (see record in the LactMed database) [66].

**Galactoceles** — Galactoceles are milk retention cysts (image 1) that result from a blocked milk duct. They present as cystic, sometimes very large masses during pregnancy, lactation, and after weaning. Unless they are infected, they are usually painless. Initially, they contain milky fluid, but over time, contents become thicker, more creamy, or oily as the fluid is reabsorbed [45].

**Diagnosis** – Ultrasound is the primary diagnostic imaging modality to distinguish galactoceles from other breast masses including adenomas, fibroadenomas, papillomas, lipomas, abscesses, and fibrocystic disease [67]. In addition, although uncommon, breast malignancies can present as breast masses during lactation. (See "Diagnostic evaluation of women with suspected breast cancer", section on 'Ultrasonography'.)

On ultrasound, galactoceles appear as a well-defined lesion with thin echogenic walls [68]. The internal appearance consists of either homogeneous contents with medium-level echoes or heterogeneous contents with fluid clefts and anechoic rims, especially in galactoceles of longstanding duration. Focal echogenic areas with distal shadowing are sometimes seen [68]. On mammography, they may also appear cystic, contain an air fluid level, or appear heterogeneous.
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BREAST INFECTIONS

Lactational mastitis — Mastitis is a localized inflammation of the breast that is associated with fever, myalgias, breast pain, and redness. It can be infectious or noninfectious, although the term is usually used clinically to imply an infectious etiology. Although mastitis can occur any time during lactation, it is most common during the first six weeks postpartum. It tends to occur in the setting of breastfeeding problems that result in prolonged engorgement or poor drainage, including partial blockage of milk duct, inefficient milk removal or infrequent feedings, oversupply of milk, nipple trauma, and pressure on the breast [70].

Lactational mastitis typically presents as a firm, red, and tender area of one breast and fever. In the early stages of breast infection, the presentation can be subtle with few clinical signs, while patients with advanced infection may present with a large area of breast swelling with overlying skin changes (eg, erythema). Details on diagnosis and management of lactational mastitis are discussed separately. (See "Lactational mastitis".)

Breast abscess — Breast abscess is a localized collection of pus within the breast tissue that is often preceded by mastitis. It is an uncommon problem in breastfeeding with a reported incidence of 0.1 percent [71] that increases to 3 percent of women with antibiotic treated mastitis [72]. The presentation of breast abscess is often similar to mastitis, with breast pain and systemic symptoms, but in addition there is a fluctuant, tender, palpable mass. Breast abscesses may also occur without fever or breast redness.

Breast abscess in lactating women and its management are discussed separately. (See "Primary breast abscess".)

Candidal infection — Many women are diagnosed with a "candidal" infection when they complain of sore nipples, especially when associated with deep sharp shooting and/or burning pains in the breasts, particularly when these symptoms occur in association with infant thrush.

Limitations of evidence — Although this is a common clinical diagnosis, there is considerable controversy about whether candidal infection is associated with pain during breastfeeding. On one hand, several studies reported that Candida was more likely to be recovered from breast milk samples of symptomatic versus asymptomatic women [73-76]. On the other hand, at least one-third of the

Aspiration demonstrating the characteristic milky contents confirms the diagnosis of galactocele and excludes malignancy [69].

Management – In mothers with a diagnosis of galactocele confirmed by aspiration, repeated needle aspiration or surgical excision is only necessary if the galactocele is bothersome to the mother. Breastfeeding generally can continue during aspiration or excision. Preoperative discussion with the surgeon regarding plans to continue breastfeeding is essential. In some cases, surgery can be postponed until after the infant is weaned.
symptomatic women had no detectable candida in their breast milk, even when polymerase chain reaction was used for testing. Moreover, other studies found no such association. Instead, some of these studies found an association between symptoms and staphylococci and streptococci species [77-79].

Pending more definitive information, it is reasonable to use the common practice of clinical diagnosis and empiric management, as outlined below, since it is often effective. However, it is important to be aware of the limited evidence for an association between these symptoms and candidal infection.

**Diagnosis** — Diagnosis of a candidal infection of the breast is challenging [75,77,80]. In general, mammary candidiasis is diagnosed clinically based on the following:

- Breast pain out of proportion to physical findings
- History of infant oral or diaper candidal infection or maternal vaginal candidal infection
- Physical finding of shiny or flaky skin of the affected nipple
- If available, a positive skin scraping of nipple or areolar region demonstrating *Candida* or positive breast milk culture for *Candida*

**Management** — It is reasonable to treat the mother with nipple/breast pain for a candidal infection of the nipple/breast if other causes of pain are ruled out and the infant has definite oral candidiasis, even if there is no evidence of a nipple/areolar rash, or if the mother has evidence of a candidal infection on her nipple/breast. In such patients, we use the following approach, which is based on clinical experience and used by lactation specialists ([La Leche League: Thrush](https://www.lalecheleague.org/education/_thrush.php) and [International Breastfeeding Centre: Candida Protocol](https://www.internationalbreastfeedingcentre.org/clinical-guidelines/candida-protocol)) [45]. Selection of therapy depends on the clinical suspicion of candidal infection and other patient-specific factors, as outlined below.

- **Initial treatment of women with nipple/breast pain only** – Initial treatment consists of topical miconazole or clotrimazole applied to the nipple. These agents are preferred rather than topical nystatin since there is less resistance of *Candida* species [80]. Topical ketoconazole should be avoided due to potential hepatotoxicity for the infant [57]. Combination topical antifungal and antiinflammatory agent (Mycolog) may also be effective. Although the effects of maternal use of topical antifungal agents in breastfed infants have not been studied, it is unlikely to represent a safety problem. However, prior to each feeding, visible residual medication should be removed using oil (eg, olive oil or coconut oil) rather than soap and water, which can irritate the nipples. After feeding, the antifungal agent should be reapplied. If fissures are present, a topical antibiotic such as mupirocin or bacitracin is often added. These agents are also removed prior to and reapplied after each feeding.

  **Gentian violet** is no longer recommended in areas where other alternatives are available. It is associated with toxicity to the mucous membranes and can cause tattooing of the skin. It is also potentially carcinogenic and may cause allergic hypersensitization. (See "[Candida infections in children](https://www.uptodate.com/contents/candida-infections-in-children?source=see_link&selectedTitle=1_1&search=candida%20infections%20in%20children#rsearch)", section on 'Oropharyngeal candidiasis'.)

- Refractory symptoms or breast pain associated with other clinical evidence of maternal candidal
infection – If the mother’s symptoms fail to respond to topical treatment, oral fluconazole is an alternative. In our practice, we also use oral fluconazole as initial therapy if there is clinical evidence of candidal infection, ie, other causes of nipple pain are ruled out and if the infant has definite thrush. If practical, a breast milk culture also should be done at the time of treatment to document whether Candida is present in the breast milk. Other experts in the field only use fluconazole after confirmation of candidal infection, based on a positive breast milk culture or a potassium hydroxide (KOH) examination of skin scraping, because of the controversy about whether candidal infection is responsible for these clinical symptoms, as outlined above. (See ‘Limitations of evidence’ above and "Intertrigo", section on 'Diagnosis'.)

Dosing for lactating mothers is 400 mg the first day followed by 200 mg per day for 14 days. At this dose, the peak level in breast milk is 4.1 mg/L, which is considered to be a safe level for breastfeeding infants, as the amount of drug an infant would receive from the milk is less than the amount given to treat an infant with a Candida infection [37]. In addition, this level in the milk is insufficient to treat yeast in the infant. The dose used to treat vaginal candidiasis (a single dose of 150 mg) is too low to be effective for candidiasis of the breast or nipple.

• Infant care – Although there is a lack of supportive data, the infant is often treated for oral candidal infection with the same regimen used to treat oral mucocutaneous candidiasis. This is administered as an oral suspension of nystatin (100,000 units/mL) at a dose of 0.5 mL to each side of the mouth, given four times a day. Others in the field only administer nystatin if the infant is clinically diagnosed with oral thrush. More detailed discussions on the diagnosis and treatment of neonatal mucocutaneous candidiasis are presented separately. (See "Clinical manifestations and diagnosis of Candida infection in neonates", section on 'Oropharyngeal candidiasis (thrush)' and "Treatment of Candida infection in neonates".)

BLOODY NIPPLE DISCHARGE

Some women have bloody nipple discharge during the first days of lactation (this has been called "rusty pipe syndrome") [81]. This is more common with the first pregnancy, and it is thought to be caused by the increased vascularization of the alveoli and ducts with the onset of milk production. The color of the milk varies from pink to red or brown and generally resolves within a few days. This should be differentiated from Serratia marcescens colonization of breast milk, which can cause a bright pink discoloration, usually not in the early postpartum period [82]. (See "Nipple discharge", section on 'Bloody discharge'.)

For patients with bloody nipple discharge for more than one week, other causes of bloody milk should also be considered, including cracked nipples or subacute mastitis. These disorders should be evaluated with a thorough breast examination and breast milk culture. If no explanation is found and the discharge persists, the possibility of an intraductal papilloma (tumor derived from the lining of the breast duct) should be entertained. Evaluation for this can include mammography, breast ultrasound, and magnetic resonance imaging (MRI), usually with surgical consultation. (See "Overview of benign breast disease".
In settings when the infant spits up blood-tinged milk or has blood in the stool, an Apt test is used to confirm whether the source of bleeding is from the mother or infant. (See "Lower gastrointestinal bleeding in children: Causes and diagnostic approach", section on 'Swallowed maternal blood'.

**MILK OVERSUPPLY**

Some mothers experience milk overproduction, also known as hypergalactia or hyperlactation. Generally, the production of milk is determined by the infant's demand, but in this case, the supply exceeds demand. Milk overproduction occurs early in lactation and may worsen in affected mothers with successive pregnancies [83].

**Clinical features and evaluation** — In some cases, the rush of the milk with the mother's ejection reflex may be too forceful and the infant may have trouble feeding. Infants may choke, cough, and become irritable with feeding and may bite to clamp the nipple. Infants may either have an increased weight gain or, paradoxically, poor weight because of inadequate intake as they cannot handle the flow of milk or because the infant is not receiving hind milk with its higher caloric content. Overproduction of milk typically resolves over the first few weeks of lactation.

Mothers with milk oversupply should be evaluated for drugs that increase milk production (eg, psychiatric medications that may be dopamine antagonists or herbs like fenugreek). If the problem persists, the mother should also be evaluated for hypo- or hyperthyroidism [45].

**Management** — The management of milk oversupply and/or an overactive milk ejection reflex is based on clinical experience and consists of the following (La Leche League: Oversupply):

- **Nursing position** – Mothers should nurse with the infant in a more upright position and the mother leaning back or in the side lying position; this allows the infant to better control the flow of milk.

- **Manual reduction of flow** – Using a scissors-hold on the areola or pressing on the breast with the heel of the hand may restrict flow.

- **Feeding strategies** – Infants should be allowed to interrupt feeding as needed, and often need frequent burping. Block feedings are often successful. In these, the mother uses only one breast for a planned interval (usually three hours). The resulting milk stasis in the other breast should decrease milk production. For the subsequent three hours, the other breast is used [84].

- **Pumping** – Avoid pumping to prevent continued stimulation of milk overproduction. However, some mothers may find it necessary to hand express some milk at the beginning of a feeding.

- **Discomfort** – Cold compresses can be helpful.
• Medications – Any galactagogues, including herbal forms such as fenugreek, should be stopped. The use of pharmacologic intervention is not well studied. Low-dose oral contraceptives or pseudoephedrine may be helpful [45,83]. The LactMed database maintained by the United States National Library of Medicine considers both agents to be safe in lactating mothers, although they should be used with caution due to their diminishing effect on milk production and should be avoided for the first two weeks until milk supply is well established. Pseudoephedrine may cause irritability in the infant.

NEONATAL JAUNDICE

Breastfeeding is associated with hyperbilirubinemia as two distinct entities, breastfeeding failure jaundice and breast milk jaundice, which are discussed separately. (See "Unconjugated hyperbilirubinemia in the newborn: Pathogenesis and etiology", section on 'Lactation failure jaundice' and "Unconjugated hyperbilirubinemia in the newborn: Pathogenesis and etiology", section on 'Breast milk jaundice'.

MATERNAL USE OF MEDICATIONS

Most, but not all, therapeutic drugs are compatible with breastfeeding. Medications generally diffuse into and out of breast milk via their concentration gradient with the maternal serum. As reiterated in the 2013 American Academy of Pediatrics clinical report, the benefits of breastfeeding for both the infant and mother need to be weighed against the potential risks of drug exposure to the infant [22]. The following general considerations help to guide decisions:

• Medications that can be prescribed directly to an infant are usually safe because the doses transferred via breast milk are much lower than the therapeutic doses [85].

• The risk of medication toxicity is higher in preterm and ill infants, and is rare in infants over six months of age [22].

• Infant medication exposure can be minimized by dosing medications after nursing and before prolonged infant sleep.

• Medications that are highly protein bound, have low lipid solubility, or have large molecular weights do not appreciably enter breast milk.

• Breastfed infants are generally not affected by medications with poor oral bioavailability, such as insulin or heparin.

• Breastfeeding does not need to be interrupted when iodinated or gadolinium contrast is administered. Radiopharmaceuticals should be avoided [22].

The LactMed database, produced by the National Library of Medicine is a free, authoritative reference for...
lactation compatibility for prescription and over-the-counter drugs. This resource provides data on drug levels in human milk and infant serum, potential adverse effects on breastfeeding infants and lactation, and recommendations for alternative drugs. A free app is also available.

Detailed discussion about specific classes of drugs can be found in the following UpToDate topics:

- (See "Postpartum contraception: Counseling and methods", section on 'Impact of contraception on breastfeeding'.)
- (See "Safety of infant exposure to antidepressants and benzodiazepines through breastfeeding").
- (See "Breastfeeding infants: Safety of exposure to antipsychotics, lithium, stimulants, and medications for substance use disorders").
- (See "Infants of mothers with substance use disorder", section on 'Breastfeeding'.)
- (See "Hyperthyroidism during pregnancy: Treatment", section on 'Breastfeeding'.)

WEANING

The timing of weaning is a personal decision made by the mother in the context of her social setting. This decision is influenced by factors including subsequent pregnancies, career choices, and maternal health. Exclusive breastfeeding is recommended by the American Academy of Pediatrics (AAP) for the first six months of life. Around six months of age, iron-rich complementary foods should generally be offered to infants. The AAP recommends breastfeeding be continued for at least one year and longer as desired by the mother or child [86]. (See "Introducing solid foods and vitamin and mineral supplementation during infancy", section on 'When to initiate complementary foods'.)

Abrupt weaning — Abrupt weaning is not recommended. When abrupt weaning occurs because of unanticipated maternal-child separation or severe maternal illness, engorgement is likely and steps should be taken to diminish it. The mother may experience "milk fever" (a condition of a flu-like illness with fever chills and malaise). This is thought to be caused by maternal reabsorption of milk products [45]. Rapid weaning results in a rapid decrease in prolactin, and this may cause an increase in depressive symptoms. (See 'Engorgement' above.)

Routine weaning — Routine weaning of the infant after six months of age is most easily accomplished following the child's lead. After the child starts solid foods, the child will diminish breastfeeding, and gradually the weaning process begins. If the weaning is gradual, engorgement is not likely to occur.

Strategies for weaning include dropping a breastfeeding session every two to five days, shortening each breastfeeding session, and increasing the time between breastfeeding sessions. Midday feedings are often ideal to eliminate first since the child is often active at this time and so may not become fussy. Persons other than the mother may have more success offering other feedings [46]. During the weaning process, it is important that the mother continue to maintain closeness.

It may be challenging for exclusively breastfed infants to accommodate to bottle feeding. Older infants
may be directly weaned to a cup. For infants being weaned to a bottle, varying the type of nipple may be helpful in those who are having difficulty adjusting to bottle feeding.

If engorgement occurs during the weaning process, mothers should try to avoid pumping any more than is necessary to relieve engorgement as this will increase milk supply.

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Breastfeeding and infant nutrition".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5<sup>th</sup> to 6<sup>th</sup> grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10<sup>th</sup> to 12<sup>th</sup> grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)


- Beyond the Basics topics (see "Patient education: Common breastfeeding problems (Beyond the Basics)" and "Patient education: Weaning from breastfeeding (Beyond the Basics)" and "Patient education: Breastfeeding guide (Beyond the Basics)" and "Patient education: Pumping breast milk (Beyond the Basics)"

SUMMARY AND RECOMMENDATIONS

The most common problems of breastfeeding in the postpartum period are inadequate milk intake by the infant, nipple and breast pain, and breast infections.

- Inadequate milk intake may be due to failure of the infant to extract milk or insufficient milk production (table 1). Management is focused upon determining the cause of inadequate milk intake
based upon a thorough history, direct observation of breastfeeding, and determination of milk volume before and after feeding. Intervention is based upon the identified specific problem and, in most cases, includes optimizing breastfeeding technique. We do not suggest the use of galactagogues to increase milk production (Grade 2C). The available data suggest that galactagogues are not more beneficial than interventions focused upon improving breastfeeding technique. (See 'Inadequate milk intake' above.)

- Conditions that typically present with nipple and breast pain include nipple injury or vasoconstriction, engorgement, plugged ducts, and breast infections. These problems are usually due in part to incorrect breastfeeding techniques (particularly, the inability of the infant to form a good latch-on and to empty the breast). (See 'Nipple and breast pain' above and 'Breast infections' above and "Initiation of breastfeeding", section on 'Latch-on'.)

- For conditions that present with breast pain, the primary intervention is to identify and correct any improper breastfeeding technique or routine to ensure that the infant is achieving a satisfactory latch-on (figure 4) and is thoroughly emptying the breast on a regular and frequent basis. (See "Initiation of breastfeeding", section on 'Mechanics of feeding'.)

- Other interventions of breast pain depend upon the specific condition as follows:
  - Pain due to nipple injury needs to be distinguished from nipple sensitivity, which peaks during the fourth postpartum day and then resolves. Women with nipple injury should be assessed (and if present, treated) for an underlying nipple condition (particularly, improper breastfeeding technique). Other interventions include the symptomatic relief with the use of mild analgesics or cool or warm compresses. (See 'Nipple pain' above.)
  - Engorgement – Interventions for symptomatic pain relief for engorgement include cool compresses, hand expression of breast milk, and use of analgesics (eg, acetaminophen or ibuprofen). However, there are no data regarding their comparative efficacy. (See 'Engorgement' above.)
  - Plugged ducts – The initial management of plugged ducts is to assess breastfeeding technique and assure that the breast is thoroughly emptied with each feed. Other interventions include hand expression of breast milk and heat application. If there is no resolution after 72 hours, further assessment (and possible intervention) is required. Unrelieved plugged ducts may result in galactoceles (image 1), which may need to be aspirated. (See 'Plugged ducts' above.)
  - Lactational mastitis – Lactational mastitis is a condition in which a woman's breast becomes painful, swollen, and red; it is most common in the first three months of breastfeeding. It tends to occur in the setting of breastfeeding problems that result in prolonged engorgement or poor drainage, including nipple trauma, inefficient milk removal, or infrequent feedings and oversupply of milk. Diagnosis and management of lactational mastitis and breast abscess are discussed separately. (See "Lactational mastitis" and "Primary breast abscess".)
• Candidal infection of the breast or nipple should be considered in mothers with pain out of proportion to the physical examination, especially if the mother has had vaginal yeast infections or the infant has thrush. There is substantial variation in practice regarding its diagnosis and management, and research is ongoing. (See 'Candidal infection' above.)

• Other breastfeeding problems include bloody nipple discharge, milk overproduction, and neonatal jaundice. (See 'Bloody nipple discharge' above and 'Milk oversupply' above and 'Candidal infection' above and 'Neonatal jaundice' above.)

• Most, but not all, therapeutic drugs are compatible with breastfeeding. The safest medications are those that are safe to administer directly to an infant and those that are not orally bioavailable. The LactMed database is a valuable free online database for medication compatibility. (See 'Maternal use of medications' above.)

• Weaning can be accomplished gradually by eliminating one breastfeeding session every two to five days. The infant can be weaned to a bottle and then a cup or directly to a cup. (See 'Weaning' above and "Introducing solid foods and vitamin and mineral supplementation during infancy", section on 'Self-feeding'.)

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## Factors that may cause or contribute to inadequate milk intake in young infants

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<tr>
<th>Condition</th>
<th>Comments/explanation/examples</th>
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| Breast surgery | - Likely to affect milk production:  
  - Breast reduction using a technique that has a high risk of insufficient milk production. As an example, if the "free nipple" technique was used for breast reduction, breastfeeding is typically not feasible.  
  - Possibly may affect milk production:  
    - Breast augmentation.  
  - Unlikely to affect milk production:  
    - Breast biopsy. | Optimize breastfeeding technique and any other contributing factors, while monitoring infant's weight gain. Use pumping to increase milk supply. If weight gain is inadequate, consider supplementation. |
| Nipple conditions | - Sore nipples may decrease milk supply because of infrequent feeds or inadequate breast emptying. | Assess cause and optimize nipple care and breastfeeding technique. Continue breastfeeding to stimulate milk production. Refer to UpToDate content on nipple pain during breastfeeding. |
| Medications associated with decreased milk production* | - Combination oral contraceptive pills with high estrogen content.  
  - Pseudoephedrine.  
  - Nicotine.  
  - Diuretics.  
  - Ethanol – Excessive use may decrease milk supply. Conversely, a small amount of beer may raise prolactin levels.  
  - Antihistamines in high doses. | Optimize breastfeeding technique; consider alternative medication if possible. Refer to UpToDate content on postpartum contraception and to the LactMed database*. |
| **Hormonal** | | |
| Maternal stress, obesity, hypertension, diabetes, and elevated androgen levels can delay full milk production (lactogenesis II).  
Insufficient breast tissue due to congenital decreased glandular development.  
Pituitary insufficiency due to postpartum pituitary infarction (Sheehan syndrome).  
Retained placenta. | Optimize breastfeeding technique while monitoring infant's weight gain closely. Assess for the cause and treat if possible. The degree to which these factors affect milk production and ability to breastfeed varies with the cause and severity. |
| **Infant** | | |
| Prematurity.  
Ankyloglossia.  
Neuromotor delay.  
Sucking and swallowing disorders.  
Malformations of the lip and palate, including cleft lip and/or palate. | Optimize breastfeeding technique; refer to a lactation consultant or other expert in swallowing disorders. For ankyloglossia, frenulotomy should be performed only after assessment by a lactation specialist. |
| **Mother and infant dyad** | Delayed breastfeeding initiation.  
Separation of mother and infant.  
Poor latch. | Room-sharing (including in the postpartum period). Optimize breastfeeding technique; refer to a lactation consultant if needed. |

* Refer to the LactMed database for information on specific medications. LactMed, produced by the National Library of Medicine, is a free, authoritative reference for lactation compatibility for prescription and over-the-counter drugs. It provides data on drug levels in human milk and infant serum, potential adverse effects on breastfeeding infants and lactation, and recommendations for alternative drugs.

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2. Thomas J, Marinelli KA, Hennessy M, Academy of Breastfeeding Medicine Protocol Committee. ABM clinical protocol #16:

Cradle position for breastfeeding

The cradle hold can be done while the mother sits in a chair. To feed from the left breast, the infant's head and body are supported by the mother's left forearm. The mother's left hand usually supports the baby's buttocks or upper thighs. Some women use a pillow to support this arm. The baby's stomach should be flat against the mother's chest, and the baby's head should be in line with the body (not turned). The mother's free hand (the right hand in this example) supports and guides the breast to the infant's wide open mouth. The thumb on the free hand may be placed on top of the areola and the breast supported with the cupped fingers. Care should be taken to position the hand away from the nipple so that the thumb and fingers do not interfere with latching.

Graphic 69936 Version 6.0
Cross-cradle position for breastfeeding

The cross-cradle hold can also be done while the mother sits in a chair. To feed from the left breast, the infant's head and body are supported by the mother's right hand and forearm. Some women use a pillow to support this arm. The baby's stomach should be flat against the mother's chest, and the baby's head should be in line with the body (not turned). The mother's free hand (the left hand in this example) supports and guides the breast to the infant's wide open mouth. The thumb on the free hand may be placed on top of the areola and the breast supported with the cupped fingers. Care should be taken to position the hand away from the nipple so that the thumb and fingers do not interfere with latching.

Graphic 71940 Version 5.0
Football position for breastfeeding

The football position allows a woman to easily see the baby at her breast. It is often preferred by women who have an abdominal incision, after a cesarean section, or by women with large breasts or a small premature baby. The baby is supported by a pillow as the mother sits, which should allow the baby’s head to be at the level of the mother’s breast. To feed from the right breast as shown above, the baby’s body and legs are under the right arm, with the head supported with the mother's right hand. The mother's free hand (the left hand in this example) supports and guides the breast to the infant’s wide open mouth.
Latch-on breastfeeding

During latch-on, the infant's mouth forms a tight seal around the nipple and most of the areola. Signs that the infant has a good latch-on include:

- The top and bottom lips are wide open
- The lower lip is turned outward against the breast
- The chin is touching the breast, and the nose is close to the breast
- The cheeks are full
- The tongue is extended over the lower dental ridge and is in contact with the breast; this can be seen if the lower lip is pulled away

Graphic 112380 Version 3.0
Ankyloglossia in a newborn

Abnormally short frenulum, inserting at the tip of the tongue in a neonate.

*Courtesy of Glenn C Isaacson, MD, FAAP.*

Graphic 60685 Version 2.0
Vasoconstriction of the nipple

Cycles from blanched white to deep red and back again at a frequency of approximately one minute.
Anatomy of the breast
Ultrasound of the breast showing a galactocele in a lactating woman. A majority of galactoceles are cystic or multicystic, as in this case, but they may also be mixed cystic/solid or, occasionally, solid\(^1,2\). Needle aspiration demonstrating the characteristic milky contents confirms the diagnosis of galactocele and excludes malignancy; it is also an effective treatment in most patients with galactoceles.

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References:

Graphic 65929 Version 3.0

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INTRODUCTION

Breast conserving therapy (BCT) refers to breast conserving surgery (BCS; ie, lumpectomy) followed by moderate-dose radiation therapy (RT) to eradicate any microscopic residual disease. It is an alternative to mastectomy for patients with early breast cancer.

Prior to the advent of BCT, all breast cancers were treated with mastectomy. Despite the fact that modern surgical techniques are less morbid than radical mastectomy, a mastectomy still requires the loss of the breast. The goals of BCT are to provide the survival equivalent of mastectomy, a cosmetically acceptable breast, and a low rate of recurrence in the treated breast.

The indications, techniques, complications, and outcomes of BCT will be reviewed here. BCT requires adjuvant radiation therapy in most patients, which is discussed in detail elsewhere. (See "Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer".)

Additional topics related to the diagnosis and management of breast cancer include:

- (See "Clinical features, diagnosis, and staging of newly diagnosed breast cancer".)
- (See "Diagnostic evaluation of women with suspected breast cancer".)
- (See "Overview of the treatment of newly diagnosed, non-metastatic breast cancer".)
- (See "Overview of sentinel lymph node biopsy in breast cancer".)
- (See "Mastectomy: Indications, types, and concurrent axillary lymph node management".)
- (See "Management of locoregional recurrence of breast cancer after breast-conserving therapy".)

PATIENT SELECTION FOR BCT
Although breast conserving therapy (BCT) provides an acceptable alternative to mastectomy for the treatment of invasive breast cancer, it is not applicable to all patients. The selection of appropriate patients is crucial to the success of BCT. Most contraindications to BCT are due to either a failure to obtain margin control with breast conserving surgery (BCS) or an inability to tolerate adjuvant radiotherapy.

**Absolute contraindications for BCT**

- A clinical diagnosis of inflammatory breast cancer (IBC) or the presence of extensive skin changes or dermal lymphatic involvement consistent with IBC. For patients with IBC, we suggest modified radical mastectomy rather than BCS, even after a complete clinical response to neoadjuvant chemotherapy. (See "Inflammatory breast cancer: Clinical features and treatment", section on 'Locoregional treatment'.)

- Multicentric disease with two or more primary tumors in separate quadrants of the breast such that they cannot be encompassed in a single excision.

- Diffuse malignant microcalcifications on mammography.

- A history of prior therapeutic radiation therapy (RT) that included a portion of the affected breast, which, when combined with the proposed treatment, would result in an excessively high total radiation dose to the chest wall. The two most common scenarios are prior mantle radiation to the chest wall for Hodgkin lymphoma and prior whole breast radiotherapy for breast cancer. Although there is ongoing research exploring the potential of 3D conformal partial breast reirradiation in selected patients who have an in-breast recurrence and prior whole breast irradiation [1], it is still investigational.

- Pregnancy is an absolute contraindication to the use of breast irradiation. Thus, breast cancer diagnosed during the first trimester should be treated with mastectomy. Breast cancer diagnosed during the second or third trimester can be managed with BCS followed by adjuvant chemotherapy, or with neoadjuvant chemotherapy followed by postpartum surgery and radiotherapy. For breast cancer diagnosed late in the third trimester, it may be possible to perform BCS in the third trimester, deferring breast irradiation until after delivery. Breast cancer during pregnancy is further discussed elsewhere. (See "Gestational breast cancer: Epidemiology and diagnosis" and "Gestational breast cancer: Treatment").

- Persistently positive resection margins despite multiple attempts at re-excision after BCS [2].

**Relative contraindications for BCT**

- **Connective tissue disease** — Some patients with a history of connective tissue disease tolerate irradiation poorly, and so the use of radiation as a component of BCT must be weighed against the possible complications [3-5].
Scleroderma and Sjögren syndrome are contraindications to radiation because of cutaneous fragility [3]. Breast cancer patients with these two connective tissue disorders should undergo mastectomy instead of BCT.

- Systemic lupus erythematosus and rheumatoid arthritis can also increase risk of radiation toxicity, but data are sparse. Thus, management of breast cancer in patients with these two conditions can be individualized [5,6].

**Tumor and breast size** — It is now widely accepted that patient eligibility for BCS is determined more by the anticipated cosmetic result, as well as the ability to achieve margin control and deliver adjuvant radiation, than by the size of the primary tumor [7]. Tumor size relative to breast size is an important consideration in selecting patients for BCS. A large tumor in a small breast is a relative contraindication, since an adequate resection would result in significant cosmetic alteration.

However, breast size in itself is not a contraindication to BCT. Women with large or pendulous breasts can undergo breast irradiation successfully as long as reproducibility of patient setup can be ensured and it is technically possible to obtain adequate dose homogeneity. Severe obesity, however, may preclude BCT because equipment at radiotherapy facilities usually has a weight limit.

Tumor size in itself is not an absolute contraindication to BCT either. Neoadjuvant treatment with chemotherapy or hormonal therapy can reduce tumor size significantly and allow for breast conservation with acceptable rates of local recurrence [8]. Whether a patient is eligible for BCT is dependent on the extent of tumor involvement after, not before, neoadjuvant treatment. (See 'Neoadjuvant therapy prior to BCT' below and "General principles of neoadjuvant management of breast cancer".)

**Not a contraindication for BCT** — The pool of candidates for BCT is expanding commensurate with advances in neoadjuvant therapy, surgical and radiation therapy techniques, and pathologic evaluation [9]. Factors that are no longer considered contraindications for BCT include:

- Age is not a contraindication for BCT. For older women, physiologic age and the presence of comorbid conditions should be the primary determinants of local therapy, rather than chronological age. Young age, which is defined as ≤40 years in the majority of studies, by itself, is not a contraindication to BCT and is a prognostic rather than predictive factor [10-19]. Furthermore, the recurrence rates after BCT are very similar to those after mastectomy in young women in contemporary series [20,21]. However, bilateral mastectomy may be preferred among relatively younger patients with hereditary breast cancer, such as BRCA1/BRCA2 mutation carriers. In those patients, bilateral mastectomy serves a risk-reducing purpose (see discussion below).

- Although IBC cannot be treated with BCT, retraction of the skin, nipple, or breast parenchyma is not necessarily a sign of locally advanced breast cancer and does not contraindicate BCT without a pathologic diagnosis of IBC. However, if a portion of skin or the nipple-areolar complex will need to be resected to achieve negative margins, the cosmetic implications of this should be factored into the decision to proceed with BCT (see discussion below).
• Histologic subtypes other than invasive ductal carcinoma (eg, invasive lobular cancer) are not associated with an increased risk of breast cancer recurrence; these women are candidates for BCT if the tumor distribution is not diffuse and it can be excised with negative margins.

Because tumors with a lobular histology often present insidiously, it may be more difficult to perform BCS in these patients [22]. However, as long as negative margins can be obtained, the local control of invasive lobular cancer is comparable to that in invasive ductal cancer. The presence of lobular carcinoma in situ (LCIS) does not affect rates of local recurrence, and classic LCIS at lumpectomy margins has no clinical significance and does not warrant a re-excision. Pleomorphic LCIS, however, behaves more like ductal carcinoma in situ and does require margin clearance. (See "Atypia and lobular carcinoma in situ: High-risk lesions of the breast" and "Pathology of breast cancer".)

• Extensive intraductal component (EIC) is defined as an invasive ductal carcinoma in which intraductal cancer (DCIS) is present in greater than 25 percent of the tumor. Both requirements must be met before EIC can be diagnosed: presence of invasive cancer and that DCIS takes up >25 percent of the total volume of the tumor. Because EIC refers to the DCIS component of an invasive cancer, it does not apply to pure DCIS.

The presence of EIC is an indicator that disease extent may be greater than clinically suspected. While EIC-positive cancers with a positive margin have a higher rate of local recurrence compared with EIC-negative cancers, EIC-positive cancers with negative resection margins do not have an increased risk of ipsilateral recurrence following BCT [23]. Thus, EIC is not a contraindication to BCT by itself, though routine assessment of the margins of resection is an important component of the histologic evaluation in women with an EIC; patients with negative margins are still acceptable candidates for BCT. (See "Breast ductal carcinoma in situ: Epidemiology, clinical manifestations, and diagnosis".)

• Lymph node positivity is a marker of worse prognosis, but positive lymph nodes are not a contraindication for BCT, as BCT and mastectomy have equivalent outcomes independent of nodal metastases. (See "Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer", section on 'Patients treated with mastectomy'.)

• Tumor location should not dictate but can influence the choice of treatment. Tumors in a superficial subareolar location may require resection of the nipple-areolar complex to achieve negative margins; oncologic outcomes will not be affected, but the cosmetic result may be. Although oncoplastic techniques improve cosmesis, the patient and her clinician need to assess whether such a resection is preferable to mastectomy.

• An inherited susceptibility to breast and other cancers has been linked to germ-line mutations in BRCA1 and BRCA2 genes in some women. Young women with a strong family history of either breast or ovarian cancer have a significant probability of harboring one of the mutations and should be offered genetic counseling about these mutations. (See "Overview of hereditary breast and
Mastectomy is mandatory for tumor control in patients with breast cancer and one or more absolute or relative contraindications for BCT, and it may provide more satisfactory outcomes in others. The specific indications and techniques of mastectomy are discussed separately. (See "Mastectomy: Indications, types, and concurrent axillary lymph node management".)

Shared decision making — In the past, BCT was underutilized in the United States [27-30] due to both surgeon and patient reasons [31-34]. To inform an optimal choice, the individual patient's needs and expectations should be accurately assessed. This requires that the patient and physician discuss the benefits and risks of mastectomy versus BCT in regards to long-term survival, the likelihood and consequence of local recurrence, and the impact on cosmetic outcome and psychosocial adjustment. (See 'Outcomes' below.)

To dispel a common misconception that mastectomy is a more "aggressive" approach to treating cancer that guarantees that they will never have to deal with cancer or additional treatment again, patients should be clearly told that [35]:

- BCT and mastectomy have equivalent survival outcomes. (See 'Survival' below.)

Although a family history of breast cancer is not a contraindication to BCT, women with hereditary breast cancer (eg, BRCA1 or BRCA2 mutation carrier) should be informed about their increased risk of a second primary cancer of as high as 2 to 5 percent per year [24], and for younger patients, bilateral mastectomy may reduce the risk of a second primary. However, those contemplating bilateral mastectomy must understand that contralateral prophylactic mastectomy (CPM) has not been shown to have a survival benefit [25]. That is because the survival rates tend to be driven by the metastatic potential of the first cancer and mastectomy does not eliminate the risk of either a chest wall recurrence or a new primary. (See "Overview of hereditary breast and ovarian cancer syndromes associated with genes other than BRCA1/2".)

The decision whether to pursue BCT in known BRCA1 or BRCA2 mutation carriers should be made following extensive discussion with an experienced surgeon and a genetics counselor.

- BCS is not contraindicated for women with dense breast tissue. In a prospective study of 1052 patients undergoing attempted BCS, patients with dense breast tissue were significantly more likely to be treated with an initial mastectomy compared with women with less dense breast tissue (74 versus 52 percent, odds ratio [OR] 1.94, 95% CI 1.44-2.62) [26]. This may reflect surgeon or patient bias rather than an inability to fulfill criteria for BCS.

In addition, magnetic resonance imaging (MRI) was performed more often in patients with dense breast tissue (65 versus 33 percent). However, breast density was not associated with positive margins for BCS or conversion to a mastectomy, and preoperative MRI did not decrease the risk of positive margins. (See 'Preoperative evaluation' below.)

Mastectomy is mandatory for tumor control in patients with breast cancer and one or more absolute or relative contraindications for BCT, and it may provide more satisfactory outcomes in others. The specific indications and techniques of mastectomy are discussed separately. (See "Mastectomy: Indications, types, and concurrent axillary lymph node management".)

BSO ovarian cancer syndromes associated with genes other than BRCA1/2" and "Genetic testing and management of individuals at risk of hereditary breast and ovarian cancer syndromes".)

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However, studies show that only 50 to 70 percent of women with early breast cancer actively participate in the surgical decision [33,36]. The use of decision aids (paper, visual, audiotape, or computerized audiovisual) can enhance patient knowledge of treatment options [37].

**PREOPERATIVE EVALUATION**

Patients diagnosed with breast cancer should undergo the following evaluation, the result of which helps determine if each individual is a better candidate for breast conserving therapy (BCT) or mastectomy [6,38]:

- A complete history and physical examination.

- Tissue biopsy with core needle sampling to provide conclusive proof of malignancy. Needle biopsy is preferred over surgical biopsy to reduce unnecessary surgery and avoid scars that may complicate the placement of the subsequent lumpectomy incision. (See "Breast biopsy".)

- Accurate histologic assessment of the primary tumor, including histologic subtype, hormone receptor status, and HER2 status. (See "Pathology of breast cancer" and "Prognostic and predictive factors in early, non-metastatic breast cancer", section on 'Tissue markers' and "HER2 and predicting response to therapy in breast cancer", section on 'Testing for HER2 expression' and "Hormone receptors in breast cancer: Clinical utility and guideline recommendations to improve test accuracy", section on 'Assays for ER and PR' and "Prognostic and predictive factors in metastatic breast cancer", section on 'Tests done on metastatic tissue'.)

- Once the diagnosis of cancer is made, multidisciplinary coordination among breast and reconstructive surgeons, radiation and medical oncologists, and radiologists and pathologists facilitates treatment planning and streamlines patient care [39]. In some cases, neoadjuvant chemotherapy is warranted to decrease the tumor size and improve the success rate of breast conservation. (See "Diagnostic evaluation of women with suspected breast cancer" and "General principles of neoadjuvant management of breast cancer" and 'Neoadjuvant therapy prior to BCT'.)
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Neoadjuvant therapy prior to BCT — The benefits of neoadjuvant chemotherapy in women with unresectable breast cancer were recognized several decades ago, although successfully downstaged patients routinely underwent mastectomy in that era. Subsequent studies confirmed that the neoadjuvant approach to chemotherapy can also increase the volume of patients who are eligible for breast conserving surgery (BCS) without increasing local recurrence rate [9]. (See "General principles of neoadjuvant management of breast cancer".)

Before the initiation of neoadjuvant therapy, all cancer-related information must be available to the treatment team. In case of a complete response to chemotherapy, a metal clip must be placed in the tumor bed to guide BCS, or else a mastectomy is performed. Since it is not possible to predict response to neoadjuvant therapy, a metal clip should be placed in the tumor bed under ultrasound guidance in all patients considering BCT before or soon after neoadjuvant treatment begins.

The standard of care is for all patients to undergo definitive breast surgery, either BCS or mastectomy, after the completion of neoadjuvant therapy, even for those who are fortunate enough to achieve a complete response. Breast imaging should be repeated after completion of neoadjuvant chemotherapy to assess the patient's response and facilitate surgical planning. A patient's candidacy for BCT is determined by the extent of tumor involvement after, not before, neoadjuvant therapy. While neoadjuvant therapy downstages the cancer and increases the likelihood of BCT in most patients, occasionally it may unmask previously obscured microcalcifications that would exclude a patient from BCT.

Bulky cancers that are hormone receptor positive and HER2 negative are less likely to respond to neoadjuvant therapy and become eligible for BCS. Thus, these tumors are generally triaged toward
primary surgery unless they are unresectable or associated with biopsy-proven nodal disease [9]. Neoadjuvant endocrine therapy is an alternative option for this patient population, but clinical response tends to be slow and incomplete [42,43].

BREAST CONSERVING SURGERY (BCS)

BCS involves excision of the primary tumor (ie, lumpectomy) and evaluation of the axillary lymph nodes (most commonly with sentinel lymph node biopsy [SLNB]) for invasive tumors.

Lumpectomy

**Incision** — The type and location of the incision is important for several reasons. Because any patient who undergoes lumpectomy may ultimately require a mastectomy, lumpectomy incisions should be planned with possible mastectomy incisions in mind. The incision should be placed close to the tumor to avoid extensive tunneling.

In the upper part of the breast, incisions should be curvilinear or transverse and follow the natural skin creases (Langer's lines). In the lower part of the breast, the choice of a curvilinear or radial incision is dependent upon the contour of the breast, the distance from the skin to the tumor, and the amount of breast tissue to be resected. At the completion of the procedure, the incision should be closed with a subcuticular suture to avoid cross-hatching of the skin.

Incisions for planned oncoplastic techniques in BCS may deviate from the above principles, which are discussed separately. (See "Oncoplastic techniques in breast-conserving surgery", section on 'Oncoplastic techniques'.)

**Tissue handling** — For deeper lesions, it is not necessary to remove skin, and preservation of the subcutaneous fat and avoidance of thin skin flaps are important in maintaining a normal post-treatment breast contour. If the tumor is superficial, it may be necessary to remove the overlying skin. Skin removal with a curvilinear incision in the inferior breast distorts the breast contour and should be avoided. Therefore, a radial incision is preferred for removing inferior lesions where skin excision is required. It is also not necessary to remove needle tracks from core needle biopsies or fine needle aspirations.

**Closure** — While the presence of a postbiopsy hematoma is not a contraindication to BCT, meticulous hemostasis during BCS is important because a large hematoma distorts the appearance of the breast and makes re-excision and follow-up evaluation more difficult. Reapproximation of the breast tissue without tissue advancement is best avoided since it can result in distortion of the breast contour, which may not be apparent with the patient supine on the operating table [6].

Cosmetic outcomes can be improved with oncoplastic techniques of closure, when:

- The lumpectomy is large in relation to the size of the breast (eg, >20 percent in breast volume or 80 grams in breast tissue weight)
The specific techniques vary with the location of the cancer in the breast and are discussed in detail elsewhere. (See "Oncoplastic techniques in breast-conserving surgery").

Margins of resection — Microscopic resection margins are the major selection factor for BCT because of their marked influence on local recurrence: women with negative excision margins have low rates of local recurrence following BCT [23,44], while positive resection margins (ie, carcinoma at the inked margin) are associated with a higher risk of local recurrence [23,44-46].

What constitutes an adequate excision margin for BCT has been hotly debated; the current consensus differs depending on whether the cancer is invasive or in situ:

Margins for invasive cancer — A multidisciplinary panel convened by the Society of Surgical Oncology and the American Society for Radiation Oncology recommended using "no ink on tumor" as the standard margin for patients with stages I and II invasive breast cancer treated with BCS followed by whole breast irradiation [47]. The recommendation was based on a meta-analysis of 33 studies, including 28,162 patients and 1506 ipsilateral breast tumor recurrences (IBTRs) [48]. At a median follow-up of 79.2 months, the median prevalence of IBTR was 5.3 percent (interquartile range 2.3 to 7.6 percent). A positive margin, defined as ink on tumor, was associated with a greater than twofold increase in IBTR (odds ratio [OR] 2.44, 95% CI 1.97-3.03). Margins wider than "no ink on tumor," however, were not associated with any lower incidence of IBTR.

These guidelines apply only to patients treated with whole breast radiation and cannot be applied to patients receiving neoadjuvant therapy, partial breast irradiation, or those not receiving radiotherapy at all. Patients who have invasive breast cancer with a ductal carcinoma in situ (DCIS) component should be treated according to the invasive cancer guidelines on optimal margin width. (See 'Margins for DCIS' below.)

These guidelines were endorsed by the American Society of Clinical Oncology with two caveats [49]:

- Prior to radiation, postexcision mammography is necessary in patients with microcalcifications to ensure adequate resection of the primary disease.

- Flexibility in application was advocated because the guidelines were mostly based on retrospective studies that have significant selection bias, the intrinsic limitations of which remain despite the use of meta-analysis [50]. In addition, although the meta-analysis found an increased risk of IBTR following excision with close margins (as defined by each individual study), as opposed to negative margins (OR 1.74, 95% CI 1.42-2.15), this risk was not emphasized in the guidelines due to the heterogenous definitions of a close margin between studies [48].

Given these concerns and limitations, while routine re-excision is not necessary for a close margin (eg,
Margins for DCIS — A multidisciplinary panel convened by the Society of Surgical Oncology, American Society for Radiation Oncology, and American Society of Clinical Oncology recommended a 2 mm margin as the standard for patients with DCIS treated with BCS followed by whole breast irradiation [53]. The recommendation was based on a meta-analysis of 20 studies, including 7883 patients with DCIS and known margin status [54]. All patients underwent BCS followed by whole breast irradiation; approximately 20 percent received endocrine therapy. After a median follow-up of 78.3 months, 865 patients developed recurrences; the median prevalence of IBTR was 8.3 percent (interquartile range 5 to 12 percent). Patients with positive margins defined as a margin <2 mm had a twofold higher risk of developing IBTR compared with those with negative margins (24 versus 12 percent), and approximately one half of the recurrences were invasive disease. The reduction in IBTR was similar in patients with a margin of 2 mm (OR 0.51, 95% CI 0.31-0.85), 3 or 5 mm (OR 0.42, 95% CI 0.18-0.97), and 10 mm (OR 0.60, 95% CI 0.33-1.08).

The consensus panel advised clinical judgment when determining whether patients with smaller negative margin width (>0 or 1 mm) require re-excision. In some studies, patients with clear but narrower than 2 mm margins did not have worse outcomes [55,56]. Patients who have DCIS with extension of cancer cells beyond the basement membrane but no focus more than 0.1 cm in the greatest dimension (ie, DCIS-M) should be treated the same way as DCIS patients when determining optimal margin width.

Techniques to reduce positive margins in BCS — Because positive margins are associated with a twofold increase in local recurrence rate [48], reoperation is frequently necessary after initial BCS to obtain negative margins. In the United States, BCS has an aggregate reoperation rate of 21.6 percent even with contemporary imaging methods [57], at a per annum cost of 228 million dollars [58]. Tools that can be used to reduce reoperation rate and improve cosmetic outcomes of BCS include localization of nonpalpable lesions, specimen orientation and radiography, intraoperative margin assessment, and post-excision cavity shaving [59], which are discussed in a separate, dedicated topic. (See "Techniques to reduce positive margins in breast-conserving surgery".)

Evaluation of the axilla — Evaluation of the axilla provides information for treatment decisions in patients undergoing BCT for invasive breast cancer, but generally not for DCIS. (See "Management of the regional lymph nodes in breast cancer".)

For patients undergoing BCS who have a clinically negative axillary examination, sentinel lymph node biopsy (SLNB) is generally the standard initial approach. Axillary lymph node dissection (ALND) is
reserved for those with clinically positive axillary nodes or who have three or more positive nodes with SLNB (completion ALND). (See "Overview of sentinel lymph node biopsy in breast cancer" and "Management of the regional lymph nodes in breast cancer", section on 'Axillary dissection'.)

The management of microscopically positive axillary nodes (with needle biopsy) and axillary nodes after neoadjuvant chemotherapy is more nuanced, which is discussed elsewhere. (See "Overview of sentinel lymph node biopsy in breast cancer", section on 'Preoperative axilla evaluation' and "General principles of neoadjuvant management of breast cancer", section on 'Management of the axilla'.)

**ADJUVANT RADIATION THERAPY**

Most women require whole breast radiation to eradicate any tumor deposits remaining following breast conserving surgery (BCS). Doing so reduces risk of locoregional recurrence and improves breast cancer-specific and overall survival. Possible exceptions (eg, older woman with estrogen receptor [ER]-positive tumor) and radiation regimens are discussed in another topic. (See "Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer".)

**COMPLICATIONS**

Complications after breast conserving therapy (BCT) include seroma formation, infection, and arm morbidity. Some of the complications are directly attributable to surgery, while others are caused by a culmination of both surgery and adjuvant radiation.

**Seroma** — It is accepted that serous fluid will accumulate in the surgical bed in virtually all patients after breast and axillary surgery; most are clinically silent [60]. A clinically significant seroma is defined as a postoperative fluid collection that requires one or more aspirations or subsequent drain placement [61]. In a retrospective review of 324 patients who underwent 561 breast or axillary surgeries, 8.4 percent developed a seroma that required intervention [61]. Seroma rates were significantly lower after breast conserving surgery than after mastectomy (6 versus 14 to 16 percent).

The presence of a seroma significantly increased the risk of a concurrent or subsequent surgical site infection (8.5 versus 4 percent in the absence of a seroma). Prolonged seroma formation may also delay wound healing.

**Breast infection** — Breast cellulitis is a unique problem in women undergoing BCT, which is different from the ipsilateral arm cellulitis observed in the past following mastectomy and axillary lymph node dissection (ALND) [62]. (See "Breast cellulitis and other skin disorders of the breast".)

BCT may also be associated with the relatively late occurrence of a postoperative breast abscess (median 5 months, range 1.5 to 8.0 months) [63]. Necrosis of marginally viable fat in the lumpectomy cavity may contribute to this problem.
Older adults — The risk of postoperative complications increases with increasing age as well as associated comorbid illnesses after both mastectomy and BCT. In a retrospective review of 3672 patients age 65 years and older with invasive or noninvasive breast cancer, patients >85 years old were more likely to develop complications compared with the overall complication rate (25.1 versus 19.4 percent, odds ratio [OR] 1.85, 95% CI 1.37-2.50) [64]. In addition, women age 65 to 69 years had a significantly lower complication rate of 15.3 percent. The most common complications included wound infection and bleeding for all ages 65 and older, including women >85 years. Mastectomy was associated with more complications than BCT (OR 1.72, 95% CI 1.42-2.09) in the older patient population.

Long-term — Long-term complications of BCT include radiation fibrosis, lymphedema, and chronic pain, which are presented elsewhere. (See "Patterns of relapse and long-term complications of therapy in breast cancer survivors", section on 'Long-term adverse effects of primary therapy' and "Overview of breast reconstruction").

OUTCOMES

Survival — Between 1961 and 1989, multiple international randomized clinical trials were performed to directly compare breast conserving therapy (BCT) with mastectomy [65-73]. These trials consistently demonstrated similar overall and breast disease-specific survival (DSS) between the two approaches [74-76]. Since then, BCT has been considered at least equivalent to mastectomy in survival outcomes. Since 2013, a growing number of studies, both in the United States and internationally, have associated BCT with better survival than mastectomy [77], regardless of age [78,79], stage [80,81], tumor characteristics, and cancer phenotypes [82]. As examples:

- One cohort study of over 110,000 Californian women with stage I or II breast cancer associated BCT with better overall survival (OS) than mastectomy without radiation (adjusted hazard ratio [HR] 0.81, 95% CI 0.80-0.83) [83]. The DSS benefit was more pronounced among women age ≥50 with hormone receptor-positive disease (HR 0.86, 95% CI 0.82-0.91) but was seen in all subgroups analyzed regardless of age, hormone receptor status, and cancer phenotypes.

- In a population-based study from the Netherlands that included over 170,000 patients, BCT conferred a survival advantage over mastectomy (HR 0.87, 95% CI 0.81-0.93) following correction for stage, age, and adjuvant therapies [84].

However, all of these were observational studies, which could be confounded by selection bias. Thus, BCT is still considered "at least" equivalent, rather than superior to, mastectomy in survival outcomes. Both approaches are acceptable options that should be selected based upon multidisciplinary physician input and patient preference. (See 'Patient selection for BCT' above.)

The biologic plausibility of a more limited procedure (BCS) being superior to a more radical surgery (mastectomy) can potentially be explained by the impact of adjuvant radiotherapy (RT) [85] and the fact
that mastectomy may not remove all breast tissue (thus leaving behind microscopic cancer foci) [86].

Indeed, we know that the success of BCT is contingent upon moderate-dose RT in eliminating subclinical foci of disease in the ipsilateral breast. Adjuvant RT has been shown to substantially reduce the risk of in-breast recurrences [66]. (See "Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer".)

**Local recurrence** — Local control is important to overall survival because local failure is a risk factor for distant metastasis [87]. Rough estimates indicate that one patient may die from breast cancer for every four local recurrences [86].

A higher locoregional recurrence rate for BCT was reported in some of the early trials comparing BCT with mastectomy [88]. In randomized studies using variable surgical and radiation techniques, long-term recurrence rates in the treated breast following BCT range from 5 to 22 percent, compared to 4 to 14 percent with mastectomy [66-70,72,73]. In those days, the risk of local recurrence after BCT was estimated to be around 1 percent per year, or 10 percent at 10 years. However, the higher local recurrence rate did not appear to negatively impact survival [89].

Since then, better imaging, more attention to margins, and more effective and longer durations of systemic therapy have reduced local recurrence rate after BCT to just 2 percent at 10 years [90]. Thus, the local recurrence rate after contemporary treatment with BCT is no longer considered higher than that after mastectomy [91].

The local recurrence rate following BCT increases with young age, positive surgical margins, node positivity, estrogen receptor negativity, and absence of radiation therapy [19]. It is important to realize that these factors are not contraindications to BCT, but their presence may influence the choice of treatment. (See 'Not a contraindication for BCT' above.)

**Cosmetic outcome** — In addition to local recurrence, another major goal of BCT is the preservation of a cosmetically acceptable breast. With modern treatment techniques, an acceptable cosmetic outcome can be achieved in almost all patients without compromising local tumor control.

Many surgical factors will play a role in the ultimate cosmetic appearance of the breast. These include the size and placement of the incision, management of the lumpectomy cavity, and the extent of axillary dissection if necessary. The surgeon has control over several of these issues, and careful attention to detail will improve the aesthetic results [92]. (See 'Breast conserving surgery (BCS)' above.)

The amount of resected breast tissue is the major determinant of appearance following BCS. Oncoplastic surgical techniques allow resection of a breast cancer with wide surgical margins while preserving the shape and appearance of the breast. Patients with either a large tumor relative to their breast size or a central tumor are candidates for oncoplastic resections. Long-term outcomes of oncoplastic surgery are comparable or superior to standard breast conservation surgery. (See "Oncoplastic techniques in breast-conserving surgery".)
Adjuvant radiotherapy can also influence cosmetic outcomes by causing skin fibrosis. The primary approach to prevention of radiation-induced fibrosis is through the use of appropriate radiation therapy doses and techniques that minimize the radiation exposure for normal tissue. For patients with established radiation-induced fibrosis, treatment is primarily symptomatic and includes a combination of pentoxifylline and tocopherol (vitamin E). (See "Clinical manifestations, prevention, and treatment of radiation-induced fibrosis".)

Although treatment-related changes in the breast stabilize at approximately three years, other factors that affect the untreated breast, such as change in size because of weight gain or the normal ptosis seen with aging, continue to affect breast symmetry. Such less-than-ideal cosmetic results can be remedied by reconstruction of the ipsilateral or contralateral breast. (See "Overview of breast reconstruction".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Choosing treatment for early-stage breast cancer (The Basics)"

- Beyond the Basics topics (see "Patient education: Breast cancer guide to diagnosis and treatment (Beyond the Basics)" and "Patient education: Surgical procedures for breast cancer — Mastectomy and breast conserving therapy (Beyond the Basics)"

SUMMARY AND RECOMMENDATIONS

- Breast conserving therapy (BCT) allows women with early invasive breast cancer to preserve their breast without sacrificing oncologic outcome. Successful BCT requires complete surgical removal of the tumor (with negative surgical margins) followed by moderate-dose radiation therapy to eradicate any residual disease. (See 'Introduction' above.)

- Patient selection is crucial to the success of BCT. BCT should be offered unless it is not possible to
obtain margin control with breast conserving surgery (BCS), also known as lumpectomy or partial mastectomy (eg, inflammatory breast cancer, multicentric disease, diffuse malignant microcalcification, or persistent positive margins despite multiple re-excisions), or there is a contraindication to adjuvant radiation therapy (eg, pregnancy, prior breast irradiation, scleroderma, or Sjögren syndrome). Cosmetic concerns do not dictate but can influence procedure choice (eg, large tumor in a small breast, breast asymmetry, or postradiation fibrosis). (See 'Patient selection for BCT' above.)

• Neoadjuvant chemotherapy has been shown to increase eligibility for BCT. Before the initiation of neoadjuvant therapy, a clip should be placed in the tumor bed to guide BCS. After completion of neoadjuvant chemotherapy, breast imaging should be repeated to determine a patient’s candidacy for BCT. All patients should undergo definitive breast surgery, either BCS or mastectomy, including those who are fortunate enough to achieve a complete response. (See 'Neoadjuvant therapy prior to BCT' above and "Neoadjuvant management of newly diagnosed hormone-positive breast cancer".)

• BCS involves excision of the primary tumor (ie, lumpectomy) to negative margins and evaluation of the axillary lymph nodes (most commonly with sentinel lymph node biopsy). (See 'Breast conserving surgery (BCS)' above.)

• For patients with stages I or II invasive breast cancer treated with breast conserving surgery followed by whole breast irradiation, we recommend "no ink on tumor" as the standard margin (Grade 1B). However, we use an individualized approach to patients who have a close margin (eg, <1 mm) with regard to re-excision. (See 'Margins for invasive cancer' above.)

• For patients with ductal carcinoma in situ (DCIS) treated with breast conserving surgery followed by whole breast irradiation, negative margins are also required. We suggest a ≥2 mm rather than a narrower negative margin (Grade 2C) because a ≥2 mm margin may confer additional benefit for local recurrence over a narrower margin. However, we use an individualized approach to patients who have a close but negative margin (eg, >0 or 1 mm) with regard to re-excision. (See 'Margins for DCIS' above.)

• Most women require whole breast irradiation to eradicate any tumor deposits remaining following breast BCS. Doing so reduces risk of locoregional recurrence and improves breast cancer-specific and overall survival. There are exceptions (eg, older woman with estrogen receptor-positive tumor), which are discussed in another topic. (See "Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer".)

• Earlier randomized trials established that BCT and mastectomy have equivalent survival outcomes. Later observational studies suggested that BCT may have a slight survival advantage over mastectomy, but those studies are observational and may have inherent selection bias. Thus, it is now widely accepted that BCT is "at least" equal to mastectomy in terms of survival outcomes. (See 'Survival' above.)
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- While earlier trials reported a higher local recurrence rate after BCT than after mastectomy, it did not translate into worse survival. Since then, refinement in BCT techniques has reduced local recurrence rate to just 2 percent at 10 years, comparable to that of mastectomy. (See 'Local recurrence' above.)

- Another major goal of BCT is the preservation of a cosmetically acceptable breast. Surgery and radiation can both influence cosmetic outcomes. Attention to surgical techniques, oncoplastic techniques, and breast reconstruction can all contribute to optimal cosmesis after BCT. (See 'Cosmetic outcome' above and "Oncoplastic techniques in breast-conserving surgery" and "Overview of breast reconstruction".)

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Mastectomy: Indications, types, and concurrent axillary lymph node management

INTRODUCTION

A mastectomy, defined as the complete removal of the breast tissue, is a surgical option for patients diagnosed with breast cancer as well as a prophylaxis to reduce the risk of breast cancer in high-risk women.

This topic will address the types and indications for a mastectomy, management of the axilla for patients undergoing a mastectomy, and the techniques and complications of mastectomy. Breast conservation therapy for breast cancer and the surgical management of regional lymph nodes in breast cancer patients are reviewed separately. (See "Breast conserving therapy" and "Management of the regional lymph nodes in breast cancer".)

SURGICAL ANATOMY

The surgeon must understand the complex anatomy of the chest wall and axilla in order to ensure removal of all breast tissue with preservation of maximum muscular function and sensation (figure 1 and figure 2 and figure 3). Axillary anatomy and the techniques of sentinel node biopsy and axillary dissection are discussed elsewhere. (See "Sentinel lymph node biopsy in breast cancer: Techniques" and "Technique of axillary lymph node dissection".)

SELECTION CRITERIA FOR MASTECTOMY

Mastectomy is indicated for patients who are not candidates for breast-conserving therapy, patients who prefer mastectomy [1], and for prophylactic purposes to reduce the risk of breast cancer.

Breast conservation is contraindicated or unsuccessful — The criteria that preclude breast
conservation are presented here briefly and addressed in detail elsewhere. (See "Breast conserving therapy", section on 'Patient selection for BCT'.)

- Multicentric disease with two or more primary tumors in separate quadrants of the breast. In situations where there are two tumors, but both can be excised within a single specimen with a satisfactory cosmetic outcome, breast-conserving therapy can be considered.

- Diffuse malignant microcalcifications on mammography. (See "Diagnostic evaluation of women with suspected breast cancer", section on 'Mammographic features of breast cancer'.)

- A history of prior therapeutic radiation that included a portion of the affected breast, which, when combined with the proposed treatment, would result in an excessively high total radiation dose to the chest wall. This includes patients who had prior breast radiation as well as those who received chest wall radiation for other reasons, such as mantle radiation for Hodgkin's lymphoma. (See "Second malignancies after treatment of classic Hodgkin lymphoma", section on 'Breast cancer'.)

- Pregnancy is an absolute contraindication to the use of breast irradiation; however, it may be possible to perform breast-conserving surgery in the third trimester, deferring breast irradiation until after delivery. (See "Gestational breast cancer: Epidemiology and diagnosis".)

- Persistently positive resection margins after reasonable attempts at reexcision.

- Large tumor size in relation to breast size, although neoadjuvant systemic treatment may downstage large tumors and improve the chances for successful breast-conserving surgery. (See "General principles of neoadjuvant management of breast cancer", section on 'Patient selection'.)

Patient choice — Some patients may choose to have a mastectomy rather than breast-conserving therapy for various reasons, including a desire to avoid the need for postoperative radiation, further screening, or biopsies. Patients should be presented with the advantages and disadvantages of the two approaches when both breast-conserving surgery and mastectomy are clinically and oncologically acceptable. This should include discussion of cosmetic concerns because breast-conserving surgery may result in unacceptable cosmetic results if the patient has a small amount of breast tissue.

Prophylaxis — For patients with hereditary breast and ovarian syndrome and patients with mutations of the breast cancer type 1 and 2 susceptibility genes (BRCA1 and BRCA2), a prophylactic mastectomy reduces the risk of developing breast cancer by more than 90 percent [2,3]. Skin-sparing mastectomy with or without preservation of the nipple-areolar complex and immediate reconstruction provides superior cosmetic results for these patients without oncologic compromise. (See "Cancer risks and management of BRCA1/2 carriers without cancer", section on 'Risk-reducing surgery'.)

A contralateral mastectomy may be an option, such as for patients who have been diagnosed with unilateral breast cancer and carry a deleterious BRCA1 or BRCA2 mutation [4]. (See "Contralateral prophylactic mastectomy".)
TYPES OF MASTECTOMY

Mastectomy is the complete surgical resection of the breast tissue. In most cases, mastectomy also includes removal of the nipple-areolar complex, some overlying skin, and the pectoral fascia. Types of mastectomy include radical mastectomy, modified radical mastectomy, simple mastectomy, skin-sparing mastectomy, and nipple-areolar sparing mastectomy. The differences between the types of mastectomy are explained below.

Radical mastectomy — A radical mastectomy (Halsted mastectomy) consists of en bloc removal of the breast, the overlying skin, the pectoralis major and minor muscles, and the entire axillary contents (level I, II, and III nodes). This extensive resection was originally proposed to provide a better chance of disease control than lumpectomy alone and was the standard of care for treating breast cancer for many years [5]. However, despite improved local control, the curative potential of this operation remained limited. In a series that followed 1438 women who had undergone radical mastectomy over 30 years, only 13 percent were free of disease, and 57 percent had died of breast cancer [6]. Attempts to further expand the field of resection by including the internal mammary nodes [7], known as an "extended radical mastectomy," failed to improve survival [8]. Radical mastectomy is rarely used today.

Modified radical mastectomy — A modified radical mastectomy (MRM) is complete removal of the breast and the underlying fascia of the pectoralis major muscle along with the removal of the level I and II axillary lymph nodes. Several randomized trials documented equivalent survival rates with MRM as compared with radical mastectomy, with less morbidity [9-12]. The equivalent survival outcome of the two procedures was further confirmed in an analysis of 3236 women enrolled in four randomized trials [13,14]. Modified radical mastectomy is utilized in patients requiring or desiring mastectomy who have biopsy-proven axillary metastases.

Simple mastectomy — A total or simple mastectomy is removal of the entire breast, with preservation of the pectoral muscles and the axillary contents. The difference between MRM and a simple mastectomy is that the former includes axillary dissection (level I and level II axillary dissection being the standard procedure). With the emergence of sentinel node biopsy, simple mastectomy is performed more frequently than in the past. (See "Overview of sentinel lymph node biopsy in breast cancer" and "Sentinel lymph node biopsy in breast cancer: Techniques".)

Skin-sparing mastectomy — The "skin-sparing" mastectomy (SSM) is a surgical technique in which the majority of the natural breast skin envelope is not resected; in contrast, a conventional mastectomy incision removes a larger portion of the overlying skin [15,16]. The breast parenchyma is excised, usually through a circular incision around the nipple-areolar complex, with a lateral extension if needed to access the axilla (figure 4). In some cases, the existing biopsy scar and/or the skin overlying the tumor is also excised. A reconstructive procedure is typically performed in the same setting as an SSM. Preservation of the skin of the breast and the inframammary fold provides the reconstructed breast with a more natural shape and contour. The superior cosmetic result has resulted in the increasing popularity of this...
approach in both the United States and Europe [17-24]. (See "Options for flap-based breast reconstruction", section on 'Background' and "Overview of breast reconstruction", section on 'Choice of reconstruction'.)

This procedure is an oncologically safe and acceptable option for the surgical management of patients with noninvasive breast cancer (DCIS) and stage I, II, or III breast cancer [25,26]. It is also an acceptable option for high-risk women who prefer a mastectomy as prophylaxis against breast cancer development [27]. (See "Cancer risks and management of BRCA1/2 carriers without cancer", section on 'Risk-reducing surgery'.)

Retrospective and prospective studies found that the local recurrence rates following an SSM range from 0 to 7 percent, comparable to a standard mastectomy, provided the dissection between the breast and the skin is meticulously performed [16,20,21,25,26,28-31]. In a meta-analysis of retrospective studies (median follow-up 37 to 101 months), no significant difference in local recurrence was identified between patients with an SSM and immediate reconstruction (n = 1104) and those undergoing a conventional mastectomy without reconstruction (n = 2635) [26].

SSM is contraindicated for women with inflammatory breast cancer (IBC) because of cancer cell invasion of the dermal lymphatics [32]. (See "Inflammatory breast cancer: Clinical features and treatment", section on 'Surgery'.)

Nipple-areolar sparing mastectomy — A nipple-areolar sparing mastectomy (NSM) preserves the dermis and epidermis of the nipple but removes the major ducts from within the nipple lumen [33]. This approach is an option for carefully selected patients, particularly those who are having surgery for prophylactic purposes and are having immediate reconstruction [17,34-40].

Criteria — NSM for the treatment of breast cancer is becoming more widely accepted with time. Because this technique results in large flaps, it is primarily utilized for women with small- to moderate-sized breasts with minimal ptosis. It is very appropriate for patients undergoing mastectomy for prophylaxis; however, it can be used in selected patients undergoing therapeutic mastectomy. Most retrospective studies of NSM have limited its use to women with small peripherally located tumors, without multicentricity [41,42]. Some studies have suggested it may be reasonable in highly selected patients with larger tumors or tumors closer to the nipple-areolar complex (NAC) [43]. NSM is contraindicated in patients with inflammatory breast cancer, clinical involvement of the NAC, nipple retraction, Paget disease, bloody nipple discharge, or multicentricity [44].

For select patients who wish to preserve the NAC, magnetic resonance imaging (MRI) was not superior to a clinical breast examination in detecting cancer in or near the NAC. In a retrospective review of 71 patients undergoing 77 mastectomy procedures, 18 of the procedures (23 percent) had cancer involving or within 1 cm of the NAC, confirmed histopathologically [45]. The preoperative history and physical examination detected 61 percent, and MRI detected 56 percent of patients with confirmed NAC involvement.
Retroareolar margin assessment — An intraoperative biopsy of the retroareolar margin must be histologically negative for malignancy. A precise measurement of a negative margin has not been defined. However, these biopsies of the areola and nipple are not completely reliable in predicting occult involvement in patients with a breast cancer.

These retrospective reviews illustrate the risk of a positive margin following an NSM [46,47]:

- A retrospective review of 438 NSM specimens found that 22 (5 percent) had positive subareolar duct margins [47]. The risk of a positive nipple-areolar margin in patients with breast cancer was 10 percent (21 of 220 specimens) compared with a risk of 0.5 percent in NSM specimens performed for prophylaxis.

- A retrospective review of 325 consecutive patients undergoing an NSM with a normal-appearing nipple found that patients undergoing a therapeutic mastectomy (n = 208) were significantly more likely to have a positive nipple margin compared with patients undergoing a prophylactic procedure (14 versus 0 percent) [46]. For patients with breast cancer, central tumor location and N2/N3 lymph node status were significantly associated with a positive nipple margin. Factors not associated with a positive nipple margin included age, tumor grade, tumor size, histology, lymphovascular invasion, HER2/neu status, or estrogen receptor status.

Postoperative results — NSM is a safe and effective procedure for treating select patients with breast cancer or as a prophylactic procedure to reduce the risk of breast cancer development and is associated with few postoperative complications. NAC necrosis is a major risk with this procedure. In a retrospective review of 138 NSM procedures, the total NAC necrosis or skin desquamation rate was 18 percent [43]. The risk of NAC necrosis in smokers was comparable to nonsmokers (7/34 patients [21 percent] versus 18/104 patients [17 percent]). Overall, 72 percent of all patients had no complications. Additional postoperative complications include wound infection, skin loss, and implant loss [48].

Recurrence rates — There are no randomized trials of NSM, and long-term follow-up in clinical series is limited [33,43,48-50]. A 2015 meta-analysis of 20 studies, which included 5594 patients, showed that at <3-year, 3- to 5-year, and >5-year follow-up, NSM resulted in overall survival (OS) of 97.2, 97.0, and 86.8 percent; disease-free survival (DFS) of 93.1, 92.3, and 76.1 percent; local recurrence (LR) of 5.4, 1.4, and 11.4 percent; and nipple-areolar recurrence of 2.1, 1.0, and 3.4 percent, respectively [51]. These OS, DFS, and LR rates are comparable to those of modified radical mastectomy or skin sparing mastectomy.

BRCA carriers — In a retrospective study, a total of 548 risk-reducing NSMs in 346 BRCA carriers were performed at nine institutions [52]. With a median and mean follow-up of 34 and 56 months, respectively, no ipsilateral breast cancers occurred after prophylactic NSM. Using risk models for BRCA1/2 mutation carriers, approximately 22 new primary breast cancers were expected without prophylactic NSM.

Other studies with short or intermediate follow-up (three to four years) reached the same conclusions.
CHOICE OF MASTECTOMY

The choice of mastectomy depends on the clinical scenario [44].

- Radical mastectomy, which includes the pectoralis major and pectoralis minor muscles, and the level III nodes, is no longer used.

- For patients who are not having immediate reconstruction, a modified radical or simple mastectomy is performed. The difference between a modified radical and a simple mastectomy is that the former includes axillary dissection and should be limited to patients with biopsy-proven axillary metastases. Clinically node-negative patients should undergo simple mastectomy and sentinel lymph node biopsy.

- For patients having a therapeutic mastectomy with immediate reconstruction, a skin-sparing mastectomy preserves the skin of the breast and the inframammary fold, resulting in a superior cosmetic result.

- For patients having a therapeutic mastectomy with immediate reconstruction, a nipple-areolar sparing mastectomy can be considered in select patients, specifically women with small-to-moderate breast size with minimal ptosis, tumors <2 cm with a tumor to nipple-areolar complex (NAC) distance >2 cm. Nipple-sparing mastectomy is contraindicated in patients with inflammatory breast cancer, clinical involvement of the NAC, nipple retraction, Paget disease, bloody nipple discharge, or multicentricity.

- For patients having mastectomy for prophylactic purposes, a skin-sparing or nipple-sparing mastectomy will provide the best cosmetic result.

EVALUATION AND MANAGEMENT OF THE AXILLA

The initial evaluation of the axilla for patients undergoing a mastectomy for invasive breast cancer includes a clinical examination and ultrasound assessment for metastatic disease to the axillary lymph nodes (ALNs). For patients with an enlarged or suspicious axillary node found on the clinical examination or by ultrasound, a fine needle aspiration is performed. For all other operative patients, a sentinel lymph node dissection (SLND) is performed at the time of the mastectomy or as a separate procedure prior to the mastectomy. (See "Management of the regional lymph nodes in breast cancer", section on 'Assessment of the axilla', and "Overview of sentinel lymph node biopsy in breast cancer".)

For patients with a clinically positive ALN (including ultrasound-identified suspicious nodes), the standard of care is a complete axillary dissection, performed at the time of the mastectomy. (See "Management of the regional lymph nodes in breast cancer", section on 'Axillary dissection'.)
The management of the axilla for patients undergoing an SLN dissection (i.e., clinically negative disease) and a mastectomy is evolving, based on data extrapolated from several prospective randomized studies:

- The American College of Surgeons Oncology Group (ACOSOG) Z0011 trial, limited to patients undergoing breast conservation therapy, demonstrated no significant difference in overall survival or locoregional recurrences between women with positive SLNs undergoing a completion ALND versus no ALND [54]. (See "Overview of sentinel lymph node biopsy in breast cancer".)

- The International Breast Cancer Study Group (IBCSG) 23-01 trial was similar to Z0011. However, it was limited to patients with micrometastatic (≤2-mm) disease within the sentinel node and did include mastectomy patients (although this represented only 9 percent of patients) [55]. Regional recurrence was <1 percent for the ALND arm and 1 percent for the no ALND arm, with no differences in disease-free survival (DFS), cumulative incidence, or overall survival.

- The results of the European Organization for Research and Treatment of Cancer (EORTC) AMAROS trial, which included >1400 patients with cT1-T2 breast cancer and a positive SLN (micrometastatic or macrometastatic), found no difference in five-year overall or disease-free survival for patients randomized to ALND versus axillary radiation [56]. Patients treated with ALND were more likely to develop lymphedema. Mastectomy patients were a small fraction of the total population studied.

Based on these results, our recommendation is for no completion ALND for patients with node-negative disease or micrometastatic disease (≤2-mm disease). However, we recommend a completion ALND for patients with macroscopically positive SLN (>2-mm disease) who will not be treated with radiation therapy.

The management of the axillary SLN-negative and SLN-positive clinical settings include:

- For patients with a negative SLN, no further axillary dissection is necessary [57,58].

- For patients with a positive SLN and planned administration of radiation to the chest wall and axilla, a completion axillary dissection is not required. This approach is parallel to axillary management for SLN-positive patients undergoing breast conservation therapy (partial mastectomy and radiation therapy). (See "Overview of sentinel lymph node biopsy in breast cancer" and "Management of the regional lymph nodes in breast cancer".)

- For patients with a positive SLN with no planned radiation and/or planned immediate reconstruction, the management of the axilla is evolving, although most surgeons typically would perform a completion ALND at the time of the mastectomy.

- For patients who are considering immediate reconstruction, particularly implant-based reconstruction, it is often helpful to perform the SLN biopsy prior to the mastectomy. SLN-negative patients can proceed with mastectomy and immediate reconstruction. SLN-positive patients can then decide whether to have a modified radical mastectomy with immediate reconstruction and forego
PREOPERATIVE PREPARATION

Mark the site and side — The patient should be examined in the perioperative holding area and the correct breast to be removed should be identified, confirmed with the patient, and marked with a water-soluble pen.

Antibiotics — A preoperative antibiotic that covers skin flora, such as cefazolin, should be administered within one hour before the incision is made (table 1) [59-64]. A meta-analysis of the randomized controlled trials of preoperative antibiotics versus placebo in patients undergoing breast surgery found that the use of preoperative antibiotics was associated with a significant reduction in infection (relative risk 0.60; 95% CI 0.45-0.81) [65]. (See "Antimicrobial prophylaxis for prevention of surgical site infection in adults".)

Deep venous thrombosis prophylaxis — For patients undergoing general anesthesia, primary prophylaxis for prevention of deep venous thrombosis (DVT) should be employed (table 2). We suggest sequential compression devices rather than systemic prophylaxis because the rate of DVT after breast surgery is low and systemic prophylaxis is associated with a high risk of wound hematoma. In one study of 3898 patients undergoing surgery for breast cancer with DVT prophylaxis using compression stockings and early ambulation alone, the DVT rate was 0.16 percent [66]. In a series of 425 breast cancer patients, 19 percent of the 310 patients in the heparin group developed a hematoma after surgery as compared with 7 percent of the 102 patients in the compression stocking group [67]. Patients at a high risk of DVT, including those with a history of thrombosis or coagulation disorder, should receive subcutaneous heparin. (See "Prevention of venous thromboembolic disease in adult nonorthopedic surgical patients".)

ANESTHETICS

Mastectomy is usually performed under general anesthesia. Single-injection paravertebral block at the T4 level is an alternative or adjunct to general anesthesia for breast surgery [68-73]. As an example, one randomized trial found significantly shortened recovery times, improved postoperative pain scores with diminished requirements for analgesics, and decreased incidence of vomiting in women undergoing breast surgery with a paravertebral block (T4 paravertebral injection [0.3 mL/kg, 0.5% bupivacaine]) compared with those who underwent general anesthesia [70]. A meta-analysis of 11 studies of paravertebral block in breast surgery demonstrated significant decreases in postoperative pain, analgesic consumption, and postoperative nausea and vomiting as compared with general anesthesia [73]. Preoperative paravertebral blocks are an alternative that may also reduce the incidence of chronic pain following breast surgery [74-76]. The use of paravertebral block is discussed in detail elsewhere. (See...
SURGICAL TECHNIQUE

Positioning — The patient is positioned supine with her arms extended on padded arm boards at ≤90 degrees abduction from the chest wall. Arm positioning with >90 degrees of abduction increases the potential for stretching the brachial plexus and should be avoided. It is important to position the arm while the patient is awake to make sure the arm is not abducted beyond what is comfortable for the patient, especially if there are preexisting problems with shoulder mobility. The ipsilateral arm can be included in the prepped field, which allows the arm to be mobilized during the procedure.

Axillary staging — If the patient is having a sentinel node biopsy or axillary dissection for staging of the axilla, this can be performed before the mastectomy through a separate axillary incision, or through the mastectomy incision after the breast has been removed, depending on whether adequate access to the axilla with appropriate visibility can be obtained through the mastectomy incision [77]. A study of 44 patients showed that the sentinel node biopsy could be removed via the breast incision in 98 percent of cases [78]. However, if a skin-sparing or nipple-sparing mastectomy is planned, access to the axilla may need to be obtained via a separate incision. (See "Sentinel lymph node biopsy in breast cancer: Techniques" and "Technique of axillary lymph node dissection".)

Incision — The choice of incision will depend upon tumor location, tumor size, and whether immediate reconstruction is planned. In most cases, if immediate reconstruction is planned, a skin-sparing mastectomy is preferred because it preserves the skin envelope and provides the best cosmetic result.

- For a skin-sparing mastectomy, the incision is usually circular and encompasses the nipple-areolar complex (figure 4). Sentinel node biopsy is usually performed through a separate axillary incision. (See "Overview of sentinel lymph node biopsy in breast cancer".)

- For a simple or modified radical mastectomy without immediate reconstruction, the most common incision is a transverse or oblique elliptical incision including the tumor mass, with lateral extension towards the axilla (figure 5). However, the incision planning depends on the tumor location and should be adjusted accordingly (figure 6 and figure 7 and figure 8 and figure 9). The incision should not be extended across the anterior axillary line to avoid scar contractures that could decrease the range of shoulder movement. The axillary lymph nodes are accessed through the mastectomy incision. (See "Technique of axillary lymph node dissection".)

- The surgical approach for nipple-sparing mastectomy can be periareolar or transareolar with lateral extension, or via a mammary crease incision. The nipple tissue is sent to pathology as a separate specimen, and the nipple must be removed if any carcinoma is identified [33]. Resection of the nipple tissue may lead to partial or complete necrosis of the nipple and/or areola in up to 20 percent of cases and may necessitate subsequent surgical removal.
Skin flaps — Skin flaps are raised superiorly to the clavicle, inferiorly to the superior aspect of the rectus sheath, medially to the sternal border, and laterally to the latissimus dorsi muscle edge (figure 10). Flap thickness should vary with patient body habitus but generally is approximately 7 to 8 mm thick. The flaps are raised in the plane deep to the subcutaneous fat and superficial to the breast parenchyma, using scissors, scalpel, or electrocautery (figure 11 and figure 12) [79-84].

An alternative method for creating skin flaps is the tumescent technique [85], which allows for potentially less blood loss when the dissection is performed sharply with a knife or electrocautery. The subcutaneous tissue is infiltrated with 1 liter of lactated Ringer's solution mixed with 30 mL of 1% lidocaine hydrochloride and dilute epinephrine (1:1000); the breast tissue is then sharply dissected from the subcutaneous tissue. While some studies report on an increased rate of complications with this technique [86-88], the rate of complications directly related to tumescence is not statistically significant when compared with skin flaps created sharply with a knife or electrocautery without tumescent fluid (9.8 versus 7.0 percent) when the procedure is performed by skilled surgeons in the practice of the technique [89].

Dissection from the chest wall — The breast tissue is dissected off the muscle, using cautery to decrease bleeding from the muscle (figure 13). The pectoralis fascia is routinely removed with the breast tissue. A trial of 247 breast cancer patients undergoing mastectomy randomized patients between removal (n = 122) versus preservation (n = 125) of the pectoral fascia and reported a trend toward increased risk for chest wall recurrence when the fascia was preserved [90]. There were 18 chest wall recurrences in the pectoral fascia preservation group versus 10 in the pectoral fascia removal group (hazard ratio 1.8, 95% CI 0.8-4.0).

It is important to remove the breast tissue that lies at the superior-lateral border where the pectoralis major muscle inserts into the humerus. When the lateral border of the breast is reached, the pectoralis muscle is gently retracted medially to expose the axillary content, and axillary dissection can be performed if indicated [91]. (See "Technique of axillary lymph node dissection".)

Drains — Closed suction drains are placed through separate stab wounds inferior to the main incision and sewn in place (figure 14). The drains are left in place until the drainage of serous fluid has decreased to approximately 25 to 30 mL per 24-hour period [92]. If the drains are removed too soon, a seroma can occur, which will require management with aspiration [93-96].

Closure — The incisions are usually closed in two layers, using absorbable sutures.

Avoiding dog-ear deformity — The obese or large-breasted patient will often have redundant tissue, which can result in an unsightly and uncomfortable "dog-ear" deformity at the axillary end of the incision. A "Y"-shaped incision can be used to excise excess skin and avoid this deformity [97]. Instead of suturing the full length of the wound, the medial one-half to two-thirds of the wound is first sutured using a subcuticular suturing technique (figure 14 and figure 15). The lateral tip of the incision is then approximated to the midline of the closure, excess skin is removed, and the final wound will be "Y"- or "fish-tail"-shaped with two "arms" facing toward the lateral side of the wound. In a study of 117 women
who underwent mastectomy with a “Y”-shaped incision, the cosmetic outcome was improved and <1 percent developed skin flap necrosis [98]. Alternatively, two additional oblique incisions can be added to the traditional transverse elliptical incision at the lateral part of the mastectomy incision site. The resulting lateral triangular flap is advanced medially during the closure of the wound, and the redundant skin in the superior and inferior areas is excised.

For patients planning on delayed reconstruction, these incisions can complicate that reconstruction, and therefore it may be better to temporarily accept a dog-ear deformity until reconstruction, where it will be corrected. For patients who were considering delayed reconstruction but ultimately opt not to, any residual dog-ear deformity can be excised.

COMPLICATIONS

Complications after mastectomy include seroma, wound infection, skin flap necrosis, chest wall pain, phantom breast syndrome, and arm morbidity. These are discussed below.

Seroma — Seroma formation, a collection of serous fluid under the skin flaps, is commonly seen after breast and axillary surgery [99-101]. Untreated seroma formation results in delayed wound healing, wound infection, wound dehiscence, flap necrosis, delayed recovery, and poor cosmetic outcome [102]. The pathophysiology of seroma formation is poorly understood, but seroma formation is increased with obesity, extensive surgery, and the use of electrocautery for skin flap dissection [103-106]. Seromas are more likely to occur after mastectomy than with breast conservation [107,108].

Drains are effective for seroma prevention in most cases because they obliterate the dead space between the skin flap and the pectoralis muscle [109] (see ‘Drains’ above). Another method of reducing the dead space is by suturing the skin flaps to the underlying muscle, although this may compromise the cosmetic outcome [101,109]. Other techniques, such as sealants and sclerotherapy, tetracycline, fibrin glues, patches, and the use of external compression dressings, are not useful [110-115].

Vigorous postoperative shoulder exercises can increase seroma formation. While patients are encouraged to use their arms normally postoperatively for activities of daily living such as brushing their hair or brushing their teeth, formal exercises should be postponed until the drains are removed and any seroma is resolved. A meta-analysis of six randomized trials showed that delaying formal exercises significantly decreased seroma formation (odds ratio 0.4; 95% CI 0.2-0.5) [92].

Wound infection — The rates of postoperative wound infection after breast surgery are low because these are clean procedures [116-128]. As an example, the wound infection rate after breast surgery was 2.9 percent in a study of 1400 patients [129]. Obesity, smoking, older age, and diabetes mellitus have been identified to be associated with an increased risk of infection after breast surgery [130]. Smoking, in particular, increases the risk of wound infection fourfold after breast surgery [117]. (See "Risk factors for impaired wound healing and wound complications".)
A meta-analysis of 2587 surgical breast procedures found a wound infection rate of 3.8 percent [119]. Most are staphylococcal infections, caused by skin flora.

Most postoperative cellulitis can be treated with oral antibiotics, but nonresponsive or extensive infection requires intravenous antibiotics. A small number of postoperative infections will develop into an abscess requiring drainage by reopening the original surgical incision.

**Skin flap necrosis** — The rate of skin flap necrosis from modified radical mastectomy (MRM) or simple mastectomy is estimated at 10 to 18 percent [131,132]. Full-thickness skin flap necrosis requires surgical debridement and may require skin grafting, and result in delays in adjuvant treatment and diminished cosmetic outcome [86]. Prior radiation treatment, obesity, older age, and a smoking history can increase the rates of flap necrosis. Technical methods of decreasing the risk of skin flap necrosis include minimizing the use of electric cautery method in dissection, maintaining appropriate skin flap thickness, and avoiding tension on closure of the incision.

The use of tumescence solution (ie, 1% lidocaine with epinephrine) injected into the subcutaneous tissue is associated with a high risk of flap necrosis [86,87]. The tumescent mastectomy technique was associated with a fourfold increase in the risk of skin flap necrosis in a series of 100 mastectomies performed using the tumescent technique as compared with 280 mastectomies performed without tumescence [86].

**Pain** — Burning, aching, and tight constriction of the axilla, upper arm, and chest wall with superimposed lancinations and scar sensitivity are characteristic of postmastectomy pain. In the past, less than 10 percent of patients undergoing mastectomy developed chronic pain [133]; subsequent surveys have reported chronic pain, paresthesias, and phantom sensations in up to one-half of cases [134]. This trend may be related to the radiation and chemotherapy, which are often needed in addition to surgery. Although the available data are scant, at least one long-term follow-up study suggests that approximately one-half of cases resolve over time, while the remainder persist long-term [135].

Factors that contribute to the development of postmastectomy pain include axillary dissection [136] and breast reconstruction with implants after mastectomy [137]. Submuscular implant placement can cause injury to the long thoracic, thoracodorsal, lateral-pectoral, and medial-pectoral nerves. Capsule formation around the implant also may entrap the long thoracic and the two pectoral nerves.

Evaluation of chest and arm pain after mastectomy should focus upon the nature of the pain and its location, and a neurologic examination to define the areas of sensory loss and hypersensitivity. Pain that is not typical of postmastectomy pain syndrome should prompt evaluation for infection, tumor recurrence, or other causes of chest pain, such as cardiac, pulmonary, or esophageal disease. Progressively worsening pain should prompt suspicion for recurrent disease.

**Phantom breast syndrome** — Patients may describe a change in chest wall sensation after mastectomy, sometimes described as "phantom breast syndrome" [138]. The sensation of residual breast tissue can persist for years after surgery [139]. The most common complaint is pain, but itching, nipple
sensation, erotic sensations, and premenstrual-type breast soreness are also described.

Although the cause is unknown, psychologic factors related to mastectomy have been implicated. Patient education before mastectomy, outlining the possible changes in chest wall sensation and the possibility of phantom breast syndrome, may help to relieve patient anxiety if symptoms develop and may even reduce the frequency of this syndrome.

**Arm morbidity** — Arm morbidity is common after mastectomy and can include arm swelling, arm pain, arm numbness, arm stiffness, shoulder stiffness, shoulder pain, or nerve injury. Postmastectomy radiation also contributes to arm morbidity and shoulder dysfunction. Complications of axillary surgery are discussed separately. (See "Technique of axillary lymph node dissection", section on 'Complications'.)

After breast cancer surgery, patients should be provided with rehabilitation services as needed and informed about methods to improve shoulder function and reduce the risk of lymphedema. Prevention and treatment of arm edema are discussed separately. (See "Clinical features and diagnosis of peripheral lymphedema" and "Clinical staging and conservative management of peripheral lymphedema").

**Brachial plexopathy** — Patients can develop brachial plexopathy from a stretch injury caused by malpositioning in the operating room. This can be avoided by careful positioning and the use of padded armboards. (See 'Positioning' above.)

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**POSTMASTECTOMY RADIATION THERAPY**

Postmastectomy radiation is indicated for patients at high risk for local recurrence, T4 tumors, positive margins, and positive axillary lymph nodes. If postmastectomy radiation is likely, this may affect the choice of mastectomy type, the choice of the reconstructive approach, and optimal timing of the breast reconstruction (immediate versus delayed). Thus, preoperative coordination of care assures the best outcome, and sentinel lymph node (SLN) biopsy prior to mastectomy can be useful. Postmastectomy radiation is discussed in detail elsewhere. (See "Overview of breast reconstruction", section on 'Integrating radiation therapy and breast reconstruction' and "Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer", section on 'Patients treated with mastectomy'.)

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**BREAST RECONSTRUCTION**

Most women undergoing mastectomy are candidates for immediate or delayed breast reconstruction. (See "Overview of breast reconstruction").

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**SUMMARY AND RECOMMENDATIONS**
A mastectomy is indicated for patients who are not candidates for breast-conserving therapy, patients who prefer mastectomy, and for prophylactic purposes. (See 'Selection criteria for mastectomy' above.)

The choice of mastectomy depends on the clinical scenario (see 'Choice of mastectomy' above):

- Radical mastectomy is rarely used unless the tumor invades the pectoral muscle.
- For patients who are not having immediate reconstruction, a modified radical or simple mastectomy is performed. The difference between a modified radical and a simple mastectomy is that the former includes axillary dissection. With the emergence of sentinel node biopsy, simple mastectomy is performed more commonly.
- For patients having immediate reconstruction, a skin-sparing mastectomy preserves the skin of the breast and the inframammary fold, which provides a superior cosmetic result.
- For patients having mastectomy for prophylactic purposes, a skin-sparing or nipple-sparing mastectomy will provide the best cosmetic result.
- For patients undergoing a mastectomy and sentinel lymph node (SLN) procedure (clinically negative findings), we recommend not performing a completion axillary node dissection if the sentinel lymph node is negative (Grade 1B). (See 'Evaluation and management of the axilla' above and "Overview of sentinel lymph node biopsy in breast cancer", section on 'Pathologic analysis of nodal metastases'.)
- We recommend not performing a completion axillary lymph node dissection if the sentinel lymph node contains only micrometastatic disease (≤2-mm disease) (Grade 1B). (See 'Evaluation and management of the axilla' above.)
- For patients with clinically positive lymph nodes undergoing a mastectomy or macroscopically positive SLNs (>2-mm disease) who will not be treated with radiation therapy, we perform a completion axillary node dissection. (See 'Evaluation and management of the axilla' above.)
- Complications after mastectomy include seroma, wound infection, skin flap necrosis, chest wall pain, phantom breast syndrome, and arm morbidity. (See 'Complications' above.)

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areola complex and autologous reconstruction is an oncologically safe procedure. Ann Surg 2003; 238:120.


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64. Braxton CC, Gerstenberger PA, Cox GG. Improving antibiotic stewardship: order set implementation to improve prophylactic antimicrobial prescribing in the outpatient surgical setting. J Ambul Care Manage 2010; 33:131.


to prevent lymphoedema after surgery for breast cancer: randomised, single blinded, clinical trial.
Topographic anatomic depiction of levels I, II, and III of the axillary contents with relation to the neurovascular bundle, pectoralis minor, latissimus dorsi, posterior axillary space, and chest wall. Level I comprises three principal axillary nodal groups: the external mammary group, the subscapular group, and the axillary vein (lateral) group. Level II, the central nodal group, is centrally placed immediately beneath the pectoralis minor muscle. The subclavicular (apical) group is designated level III nodes and is superomedial to the pectoralis minor muscle.


Graphic 54961 Version 8.0
Superficial anatomy of the axilla

Superficial dissection of the pectoral region of the female. On the left side, observe the breast (skin removed) extending from the 2nd through the 6th ribs. Observe also the axillary tail extending into the axilla. The nonlactating breast consists primarily of fat. On the right side, observe the deep pectoral fascia covering the pectoralis major. Observe that the mammary gland lies in the subcutaneous connective tissue, or superficial fascia, between the skin and deep fascia.


Graphic S8037 Version 2.0
Structures of the axilla. Most of the anterior wall of the axilla and the axillary fat pad have been removed, revealing the axilla's medial and posterior walls and neurovascular contents. Of the structures forming the anterior wall, only portions of the pectoralis major (attaching ends, a central part overlying the pectoralis minor, and a cube of muscle reflected superior to the clavicle) and the pectoralis minor remain. All the clavipectoral fascia has been removed, as has the axillary sheath surrounding the neurovascular bundle. Observe the axillary artery emerging from the cervicoaxillary canal inferior to the clavicle and subclavius muscle and then passing a finger's breadth inferior to the coracoid process of the scapula. As the axillary artery passes through the axilla, it is surrounded by the brachial plexus of nerves. The major nerves arising from the lateral and medial cords (anterior divisions) of the plexus have been elevated by an applicator stick.


Graphic 69782 Version 2.0
Incisions for skin sparing mastectomy

A variety of skin-sparing incisions have been described. Three incision types more frequently used include the (A) periareolar, (B) tennis racket, and (C) teardrop. Tennis racket or teardrop incisions are used to obtain better access to the axilla, especially if the patient has a small breast.


Graphic 71134 Version 7.0
### Timing of prophylactic antibiotic administration and subsequent rates of SSIs

<table>
<thead>
<tr>
<th>Time of administration*</th>
<th>Percent with SSI</th>
<th>Odds ratio ‡</th>
<th>95 percent CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>3.8</td>
<td>4.3</td>
<td>1.8-10.4</td>
</tr>
<tr>
<td>Preoperative</td>
<td>0.6</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Perioperative</td>
<td>1.4</td>
<td>2.1</td>
<td>0.6-7.4</td>
</tr>
<tr>
<td>Postoperative</td>
<td>3.3</td>
<td>5.8</td>
<td>2.4-13.8</td>
</tr>
</tbody>
</table>

SSI: surgical site infection.
* "Early" denotes 2 to 24 hours before incision, "preoperative" 0 to 2 hours before incision, "perioperative" within 3 hours after incision, and "postoperative" more than 3 hours after incision.
‡ Odds ratio determined by logistic-regression analysis.

**Hospital Quality Alliance/Centers for Medicare & Medicaid Services (CMS) Surgical Care Improvement quality measures for perioperative VTE prevention**

<table>
<thead>
<tr>
<th>Surgery type</th>
<th>Recommended prophylaxis optionsΔ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial neurosurgery</td>
<td>Any of the following:</td>
</tr>
<tr>
<td></td>
<td>• Intermittent pneumatic compression devices (IPC) with or without graduated compression stockings (GCS)</td>
</tr>
<tr>
<td></td>
<td>• Low-dose unfractionated heparin (LDUH)</td>
</tr>
<tr>
<td></td>
<td>• Low molecular weight heparin (LMWH)</td>
</tr>
<tr>
<td></td>
<td>• LDUH or LMWH combined with IPC or GCS</td>
</tr>
<tr>
<td>General surgery</td>
<td>Any of the following:</td>
</tr>
<tr>
<td></td>
<td>• Low-dose unfractionated heparin (LDUH)</td>
</tr>
<tr>
<td></td>
<td>• Low molecular weight heparin (LMWH)</td>
</tr>
<tr>
<td></td>
<td>• Factor Xa Inhibitor (fondaparinux)</td>
</tr>
<tr>
<td></td>
<td>• LDUH or LMWH or Factor Xa Inhibitor combined with intermittent pneumatic compression devices (IPC) or graduated compression stockings (GCS)</td>
</tr>
<tr>
<td>General surgery with contraindications to pharmacological prophylaxis</td>
<td>Any of the following:</td>
</tr>
<tr>
<td></td>
<td>• Graduated compression stockings (GCS)</td>
</tr>
<tr>
<td></td>
<td>• Intermittent pneumatic compression devices (IPC)</td>
</tr>
<tr>
<td>Gynecologic surgery</td>
<td>Any of the following:</td>
</tr>
<tr>
<td></td>
<td>• Low-dose unfractionated heparin (LDUH)</td>
</tr>
<tr>
<td></td>
<td>• Low molecular weight heparin (LMWH)</td>
</tr>
<tr>
<td></td>
<td>• Factor Xa Inhibitor (fondaparinux)</td>
</tr>
<tr>
<td></td>
<td>• Intermittent pneumatic compression devices (IPC)</td>
</tr>
<tr>
<td></td>
<td>• LDUH or LMWH or Factor Xa Inhibitor combined with IPC or graduated compression stockings (GCS)</td>
</tr>
<tr>
<td>Urologic surgery</td>
<td>Any of the following:</td>
</tr>
<tr>
<td></td>
<td>• Low-dose unfractionated heparin (LDUH)</td>
</tr>
<tr>
<td></td>
<td>• Low molecular weight heparin (LMWH)</td>
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<td></td>
<td>• Factor Xa Inhibitor (fondaparinux)</td>
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<tr>
<td></td>
<td>• Intermittent pneumatic compression devices (IPC)</td>
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<tr>
<td></td>
<td>• Graduated compression stockings (GCS)</td>
</tr>
<tr>
<td></td>
<td>• LDUH or LMWH or Factor Xa Inhibitor combined with IPC or GCS</td>
</tr>
<tr>
<td>Elective total hip replacement</td>
<td>Any of the following started within 24 hours of surgery:</td>
</tr>
<tr>
<td></td>
<td>• Low molecular weight heparin (LMWH)</td>
</tr>
<tr>
<td></td>
<td>• Factor Xa Inhibitor (fondaparinux)</td>
</tr>
<tr>
<td></td>
<td>• Warfarin</td>
</tr>
</tbody>
</table>

**Excluded populations:**

- Patients less than 18 years of age
- Patients who have a length of stay >120 days
- Burn patients
- Patients with procedures performed entirely by laparoscope
- Patients enrolled in clinical trials
- Patients who are on warfarin prior to admission
- Patients whose ICD-9-CM principal procedure occurred prior to the date of admission
- Patients whose total surgery time is less than or equal to 60 minutes
- Patients who stayed less than or equal to three calendar days postoperatively
- Patients with contraindications to both mechanical and pharmacological prophylaxis

Δ Patients who receive neuraxial anesthesia or have a documented contraindication to pharmacological prophylaxis may pass the performance measure if either appropriate pharmacological or mechanical prophylaxis is ordered.
Current guidelines recommend postoperative low molecular weight heparin for intracranial neurosurgery.
Incisions for mastectomy

(A) A practical incision based on that of Stewart is planned by choosing two points, in line with the nipple, to either side of the breast, with the lateral site along the posterior axillary fold, under the hairline.

(B) The breast skin is pulled down orthogonal to that imaginary line and a straight line drawn between the points.

(C) The breast is pushed up orthogonal to the imaginary line between the two points and a lower straight line drawn between the points below the nipple.

(D) With the breast relaxed, an ellipse has formed, which will close relatively flat against the chest.

Mastectomy incisions for central breast tumors

Design of the classic Stewart elliptical incision for central and subareolar primary lesions of the breast. The medial extent of the incision ends at the margin of the sternum. The lateral extent of the skin incision should overlie the anterior margin of the latissimus dorsi. The design of the skin incision should incorporate the primary neoplasm en bloc with margins that are 1 to 2 cm from the cranial and caudal edges of the tumor.


Graphic 66661 Version 7.0
Mastectomy incisions for tumors of the inner quadrants of the breast

Design of the obliquely placed modified Stewart incision for cancer of the inner quadrant of the breast. The medial extent of the incision often must incorporate skin to the midsternum to allow a 1 to 2 cm margin in all directions from the edge of the tumor. Lateral extent of the incision ends at the anterior margin of the latissimus.


Graphic 81050 Version 8.0
Mastectomy incisions for tumors of the lower outer quadrant of the breast

Incisions for cancer of the lower outer quadrants of the breast. The surgeon should design incisions that achieve margins of 1 to 2 cm from the tumor with cephalad margins that allow access for dissection of the axilla. The medial extent is the margin of the sternum. Laterally, the inferior extent of the incision is the latissimus.


Graphic 69254 Version 7.0
Mastectomy incisions for tumors of the upper outer quadrant of the breast

Design of the classic Orr oblique incision for carcinoma of the upper outer quadrants of the breast. The skin incision is placed 1 to 2 cm from the margin of the tumor in an oblique plane that is directed cephalad toward the ipsilateral axilla. This incision is a variant of the original Greenough, Kocher, and Rodman techniques for flap development.


Graphic 61564 Version 7.0
Limits of the dissection for mastectomy

(Inset) Limits of the modified radical mastectomy are delineated laterally by the anterior margin of the latissimus dorsi muscle, medially by the sternal border, superiorly by the subclavius muscle, and inferiorly by the caudal extension of the breast approximately 3 to 4 cm inferior to the inframammary fold. Skin flaps for the modified radical technique are planned with relation to the quadrant in which the primary neoplasm is located. Adequate margins are ensured by developing skin edges 3 to 5 cm from the tumor margin. Skin incisions are made perpendicular to the subcutaneous plane. Flap thickness should vary with patient body habitus but ideally should be 7 to 8 mm thick. Flap tension should be perpendicular to the chest wall with flap elevation deep to the cutaneous vasculature, which is accentuated by flap retraction.

Mastectomy skin flap development

Development of the skin flaps proceeds with retraction of the skin at a right angle to the table. With traction on the breast tissue, pressing down or pulling away from the skin flap, the tissue plane is more readily identifiable. The plane between the adipose of the skin and that of the breast is usually found 2 to 4 mm below the dermis. The adipose of the skin is the thinnest near the areola and slowly becomes thicker toward the chest wall. Adair breast tenaculae are depicted here in the retraction, but other methods are utilized as well.


Graphic 50156 Version 7.0
Skin sparing mastectomy flap development

Development of the skin flaps with a skin-sparing incision is similar to that of the larger incision, just in a smaller field. Tension is placed on the breast tissue by pulling down on the breast tissue toward the chest wall or by pulling the breast tissue away from the skin. The skin is initially retracted away from the chest wall, with skin rakes or hooks as the plane is developed. As the dissection progresses, one can switch to hand retraction, occasional rolling the flap forward or backward for access. One could also utilize a lighted retractor in the context of space restraint.


Graphic 61995 Version 7.0
Mobilization of the breast off the chest wall for mastectomy

Mobilization of the breast off the chest wall can be aided by placement of Allis clamps along the superior border of the breast, including the investing "fascia" of the muscle (perimysium). The tissue is pulled up or inferiorly with gentle traction. The dissection is performed utilizing electrocautery or sharp dissection, traveling in parallel to the chest wall muscle fibers. Since the pectoralis major muscle fibers splay, the angle of dissection shifts as one progresses within the dissection.


Graphic 52804 Version 7.0
Mastectomy closure and drain placement

(A) The incision with a simple closure of the ellipse.

(B) With a Y-plasty modification in the context of those larger individuals who have developed a ridge of tissue extending to the lateral thorax or back secondary to the weight of the breast over time. This closure results in reducing the excess tissue laterally, beyond the breast, which may stick out after closure. Closure of the skin-sparing incisions is not depicted, as it is generally used in the context of collaboration with a plastic surgeon who will reconstruct before closure.

Prevention of dog ear deformity

The obese or large breasted patient will often have redundant tissue, which can result in an unsightly and uncomfortable "dog-ear" deformity at the axillary end of the incision. A "Y" shaped incision can be used to excise excess skin and avoid this deformity. Instead of suturing the full length of the wound, the medial one-half to two-thirds of the wound is first sutured using a subcuticular suturing technique. The lateral tip of the incision is then approximated to the midline of the closure, excess skin is removed, and the final wound will be "Y" or "fish-tail" shaped with two "arms" facing towards the lateral side of the wound.

Contributor Disclosures

Ava Kwong, MBBS, BSc, FRCS, FCSHK, FHKAM  Nothing to disclose  Michael S Sabel, MD  Nothing to disclose  Anees B Chagpar, MD, MSc, MA, MPH, MBA, FACS, FRCS(C)  Consultant/Advisory Boards: Protean BioDiagnostics [Breast cancer].  Wenliang Chen, MD, PhD  Nothing to disclose

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy
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Conflict of interest policy
Overview of breast reconstruction

Author: Maurice Nahabedian, MD
Section Editors: Anees B Chagpar, MD, MSc, MA, MPH, MBA, FACS, FRCS(C), Charles E Butler, MD, FACS
Deputy Editor: Kathryn A Collins, MD, PhD, FACS

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: Feb 2020. | This topic last updated: Jul 09, 2019.

INTRODUCTION

Breast reconstruction is an option for patients following a unilateral or bilateral mastectomy, or after breast conservation therapy that has had a less-than-ideal cosmetic result. Breast reconstruction provides psychological, social, emotional, and functional improvements, including improved psychological health, self-esteem [1], sexuality, and body image [2,3]. Patients who choose breast reconstruction are presented with complex decisions, including the type and timing of reconstruction.

An overview of breast reconstruction following mastectomy for breast cancer is reviewed. Techniques for breast reconstruction using autologous tissue and prosthetic implants, and complications of breast reconstruction, are reviewed in detail separately. (See "Implant-based breast reconstruction and augmentation" and "Options for flap-based breast reconstruction" and "Complications of reconstructive and aesthetic breast surgery".)

UNDERUTILIZATION OF BREAST RECONSTRUCTION

Outcomes research on quality-of-life improvements and psychosocial benefits associated with breast reconstruction served as the driving force for the 1998 Women's Health and Cancer Rights Act, which mandated health care payer coverage for breast and nipple reconstruction, contralateral procedures to achieve symmetry, and treatment for the sequelae of mastectomy [4]. This was followed in 2001 by additional legislation imposing penalties on noncompliant insurers. Despite such legislation in the United States, breast reconstruction still remains an underutilized option. The underlying reasons seem to be multifactorial and related to socioeconomic factors, including access to care, insurance coverage, education, and race/ethnicity, as well as geographic location, age, and personal choice [5-9].

Although the overall rate of breast reconstruction is increasing in the United States, the number of women who undergo reconstruction after mastectomy remains low [10]. Approximately 40 percent of all patients undergoing a mastectomy in the United States undergo breast reconstruction. A survey of
attending general surgeons from a population-based sample of 1844 women diagnosed with breast cancer in 2002 showed that only 24 percent of surgeons referred more than 75 percent of their mastectomy patients to plastic surgeons prior to surgery [11]. A survey of patients diagnosed with breast cancer reported that the desire to avoid additional surgery was the most common reason given for not pursuing reconstruction [6]. In a survey of 84 women treated with mastectomy, participants were able to correctly respond to only 38 percent of questions about reconstruction options [12].

Immediate breast reconstruction is increasing by approximately 5 percent per year [13] and is often recommended when it is oncologically safe and in patients who are good candidates. Immediate breast reconstruction can be performed with prosthetic implants or autologous tissues. Immediate restoration of the breast is often associated with improved body image and self-esteem.

Implant-based reconstruction has been increasing at a rate of 11 percent per year, while the rate of autologous reconstruction has remained unchanged. Additional studies have demonstrated that unilateral mastectomy rates are decreasing by 2 percent per year, whereas contralateral and bilateral prophylactic mastectomies are increasing at the rate of 15 and 12 percent per year, respectively [14]. The reasons for these changes are multifactorial and include risk reduction and improved aesthetic outcomes.

With the advent of genetic testing, many women are choosing to undergo prophylactic mastectomy, either of the contralateral breast or bilaterally. Some surgeons feel that aesthetic outcomes are typically improved following bilateral mastectomy and reconstruction because of the ability to achieve better symmetry. A symmetry procedure can be performed on the reconstructed breast or on the natural breast [15]. On the contralateral breast, symmetry is usually achieved by performing a reduction mammoplasty or mastopexy; however, in some cases an implant is needed. On the reconstructed breast, symmetry procedures may include soft tissue contouring, autologous fat grafting, implant repositioning, and in the case of autologous reconstruction, placement of a small implant. Plastic surgeons are able to optimize aesthetic outcomes because of our wide range of reconstructive options that include improved prosthetic devices and the use of patients' own body tissues with minimal morbidity. (See 'Adjunctive procedures' below.)

**TECHNIQUES FOR BREAST RECONSTRUCTION**

Breast reconstruction following a mastectomy can be performed using a breast expander/implant, or using autologous tissues, or a combination of expander/implant and autologous reconstruction (eg, latissimus dorsi musculocutaneous flap with an implant). When using a combination of autologous flaps and implants, a simultaneous approach compared with a staged approach is associated with an increased rate of complications (32 versus 18 percent) [16].

**Implant-based reconstruction** — Implant-based (ie, prosthetic) reconstruction can be performed in one or two stages. With one-stage reconstruction, a permanent implant is inserted at the time of mastectomy. With two-stage reconstruction, a tissue expander is placed following the mastectomy and gradually filled...
to the desired volume. A permanent implant is used to replace the tissue expander at a later date. Prosthetic devices can be placed under (subpectoral) or above (prepectoral) the pectoralis major muscle. Studies have demonstrated several advantages to prepectoral placement of implants and tissue expanders; however, proper patient selection is important for prepectoral prosthetic breast reconstruction [17-21]. (See "Implant-based breast reconstruction and augmentation".)

Flap-based reconstruction — Flap-based (ie, autologous) breast reconstruction can take two forms. One type uses remote tissues from different parts of the body such as the abdomen (figure 1 and figure 2 and figure 3), posterior chest (figure 4), medial thighs (figure 5), or buttock (figure 6). Flaps can be moved to the breast as a free tissue transfer where the artery and vein supplying the flap is attached to an artery and vein (microsurgery) at the mastectomy site (free flap) or on a vascular pedicle (pedicle flap) where attaching the blood vessels is not necessary. (See "Options for flap-based breast reconstruction".)

The most common flaps for breast reconstruction are the deep inferior epigastric artery perforator (DIEP) flap and the free transverse rectus abdominis musculocutaneous (TRAM) flap. These are based from the abdominal area. Other flaps include the gluteal musculocutaneous and perforator flaps (SGAP and IGAP) as well as the thigh-based flaps such as the transverse gracilis (TUG) and profunda artery perforator (PAP) flaps. The latissimus dorsi flap uses skin, fat, and muscle from the back, whereas the thoracodorsal artery perforator flap (TDAP) uses skin and fat only. These flaps can be performed immediately following the mastectomy or on a delayed basis. Some of these smaller-volume flaps such as the latissimus dorsi flap are often combined with an implant, when needed, to achieve optimal volume and contour symmetry. The latissimus dorsi flaps are also commonly used for salvage procedures following failed implant reconstruction.

Another type of autologous reconstruction uses breast tissue adjacent a partial mastectomy defect to fill the tumor resection related breast defect. This is also known as oncoplastic surgery. Oncoplastic surgery is used to prevent or minimize the occurrence of a contour abnormality or significant asymmetry [22,23]. Oncoplastic resection increases the margin of excision, decreases reexcision rates, and decreases the need for completion mastectomy [24]. Techniques for oncoplastic surgery, which include either volume displacement or volume replacement procedures, are reviewed separately. (See "Oncoplastic techniques in breast-conserving surgery".)

- Volume displacement procedures involve rearrangement of the adjacent tissue, mastopexy, or reduction mammoplasty [23]. These are usually considered in women with moderate-to-large breasts. A partial mastectomy is performed first and typically involves resection of a specimen that weighs between 100 and 200 grams. Following that, a common approach is to perform a reduction mammoplasty; the contralateral breast is reduced at the same time. (See "Overview of breast reduction".)

- Volume replacement procedures involve advancement or rotation of local pedicle flaps or free tissue transfer to obliterate the defect following breast resection [23]. These techniques are usually recommended for women with small-to-moderate breasts who do not have enough breast tissue to
Adjunctive procedures — Following implant-based or flap-based breast reconstruction, adjunctive secondary procedures are often necessary to improve symmetry, reconstruct the nipple, or correct contour abnormalities [15,26]. In the United States, these are usually covered by insurance.

Obtaining symmetry — Once reconstruction of the affected breast has begun, the challenge of creating symmetry with the contralateral breast is undertaken [27]. Mastopexy, breast reduction, breast augmentation, or a combination of procedures can be used to improve symmetry and aesthetics (picture 1). As an example, in a woman with very large breasts who undergoes a mastectomy with reconstruction, a contralateral breast reduction will decrease the size discrepancy, resulting in improved patient comfort and increased symmetry. Contralateral breast surgery can be performed at the time of the initial reconstruction or at a second stage [28,29]. (See "Implant-based breast reconstruction and augmentation" and "Overview of breast reduction".)

Nipple reconstruction — Following completion of the breast reconstruction, women are given the option of nipple-areolar reconstruction. This is typically performed during the second stage of breast reconstruction but can also be performed in an office setting. The goal of nipple and areolar reconstruction is to achieve symmetry of position of the nipple-areolar complex in the contralateral breast with comparable appearance and color [30,31]. There are multiple techniques by which a nipple and areola can be created. Surgical methods involve local tissue rearrangement procedures or skin grafts, while others use donor sites that are closed primarily. Nipple projection varies among the different techniques, but adequate results can be achieved with most. Although nipple projection may be adequate immediately following the procedure, flattening of the reconstructed nipple over time may limit its efficacy. Symmetry of position on the breast mound is the most important goal of nipple reconstruction as even small discrepancies are obvious. Once the projecting papilla has been created, the appearance of the entire nipple-areolar complex can be enhanced by the use of tattooing (picture 2). An alternative to surgical reconstruction of a nipple is a three-dimensional tattoo. Most of these three-dimensional tattoos are performed in a nonmedical facility since many large centers do not have dedicated practitioners in their clinics. The tattooing of a surgically created nipple not only includes tattooing of the nipple but also creation of a new areola with pigmentation. The results with nipple tattooing have been excellent, and patient satisfaction has been high.

Handling contour abnormalities — Approximately 20 to 40 percent of women undergoing breast-conserving surgery will develop a contour abnormality [32-37]. The adverse change in contour can be particularly challenging to correct if the patient also received radiation therapy to the breast. The initial assessment includes a thorough evaluation of the skin and parenchymal quality, as well as an assessment of the degree of postradiation skin damage. The cutaneous and glandular elements often become fibrotic and scarred after radiation treatments. The most common contemporary reconstructive procedure performed to restore a breast contour is fat grafting (autologous fat transfer). Prospective studies have shown that fat grafting is an effective approach to correct these deformities [37]. Other surgical approaches include mastopexy and reduction mammoplasty. While these procedures can

safely and aesthetically perform a reduction mammoplasty [25].
effectively restore the breast contour for patients after breast-conserving surgery, complications, including delayed healing, infection, and fat necrosis, are more common for women who have also been treated with radiation therapy [38]. In a study comparing secondary procedures following breast-conserving surgery, ipsilateral breast reduction/mastopexy was performed in 41 percent, augmentation or implant exchange was performed in 18 percent, myocutaneous flaps were performed in 17 percent, local procedures such as fat grafting were performed in 14 percent, and contralateral reduction mammaplasty was performed in 10 percent [39]. (See "Options for flap-based breast reconstruction".)

### CLINICAL EVALUATION

Optimal management of women who have undergone mastectomy for breast cancer requires a collaborative effort between oncologic and reconstructive surgeons, radiologists, and pathologists, as well as medical and radiation oncologists [40,41]. This multimodality approach allows providers to coordinate cancer and reconstructive procedures with the need for radiation therapy and chemotherapy. (See "Clinical features, diagnosis, and staging of newly diagnosed breast cancer".)

A productive, caring relationship is crucial to patient satisfaction with the reconstructive process and must be established early [42]. The patient with newly diagnosed breast cancer may have feelings of grief and anger as well as unrealistic expectations that may be directed toward her health care team. If possible, the patient's family should be included in the consultation.

At the initial consultation, educational literature, including preoperative and postoperative photographs of patients who have undergone reconstruction, is helpful for the patient to aid the decision-making process. Peer-reviewed internet sites (eg, National Cancer Institute, American Cancer Society) are a useful resource for information on breast reconstruction [43]. The opportunity to speak with other women who have undergone breast reconstruction may also be worthwhile.

#### History

A thorough medical history should focus on the following factors:

- Stage of disease
- Treatment plan (including likelihood for postmastectomy radiotherapy)
- Past surgical history
- Comorbidities
- Volume and shape of the contralateral breast
- Body habitus
- Smoking history
- Potential donor sites for autologous reconstruction
- Patient expectations

A past medical history of radiation therapy or current disease extent for which radiation therapy is mandated may impact the patient's reconstructive options. (See 'Integrating radiation therapy and breast reconstruction' below.)
Comorbidities such as obesity, insulin-dependent diabetes mellitus, chronic obstructive pulmonary disease, smoking, thrombophilia, and connective tissue disease may also influence reconstructive options [44,45]. When poorly controlled, these comorbidities may increase the risk for complications such as impaired wound healing, reduced tissue perfusion, and infection. (See "Complications of reconstructive and aesthetic breast surgery".)

Likewise, past surgical histories that include open cholecystectomy, abdominoplasty, or coronary artery bypass grafting (with use of internal mammary vessels) may limit reconstructive choices because of their adverse effects on the blood supply to autologous tissues at potential donor sites.

**Physical examination** — The physical examination is a critical component in order to adequately set patient expectations following reconstructive breast surgery. (See 'Patient counseling' below.)

The physical examination of the breasts includes an evaluation for volume, ptosis, asymmetry, and scars, and the axilla is examined for palpably abnormal lymph nodes. If radiation therapy has been administered previously, the quality of the breast and chest wall soft tissues must be assessed. The abdomen, back, and buttocks are evaluated as possible donor sites, taking note of scars, overall fat content, skin laxity, and abdominal wall strength. Potential asymmetry between the native contralateral breast and the newly reconstructed breast must be addressed. The contralateral breast may require a reconstructive procedure, such as mastopexy, reduction, or even augmentation (breast implant placement), in order to obtain symmetry. The patient's personal distribution of excess skin and fat is also considered because it dictates whether a given reconstructive choice can provide enough tissue volume to recreate a breast. Finally, the patient's wishes regarding scar location, tissue sacrifice, postoperative recovery, and aesthetic outcome are also important in guiding the reconstructive surgeon. (See 'Adjunctive procedures' above.)

**Patient counseling** — The counseling consultation for breast reconstruction is comprehensive and involves a major time commitment from both the surgeon and patient. The complexities can be difficult to comprehend during a time when many patients with newly diagnosed breast cancer have stress and anxiety. Psychologic support should be offered to all women diagnosed with breast cancer, regardless of type of surgical procedure (breast conserving or mastectomy) or reconstruction being undertaken.

During this time, a rapport is established between the reconstructive team and the patient. Following the initial history and physical examination, patient-specific recommendations are made for breast reconstruction that may include prosthetic reconstruction, autologous reconstruction, and/or oncoplastic reconstruction.

An in-depth discussion regarding appropriate timing for reconstruction is essential to optimize outcomes and minimize the potential for postoperative complications [46]. Although patient satisfaction with postmastectomy reconstruction remains high in obese patients, these patients should be counseled preoperatively regarding their higher complication rates [47,48]. (See "Complications of reconstructive and aesthetic breast surgery", section on 'Obesity'.)
Following the surgeon's initial discussion with the patient regarding the options for breast reconstruction, it is generally considered good practice to have a nurse or midlevel provider review the information discussed and assist in answering any additional questions. This approach can be less intimidating for many patients and is often very effective in alleviating the patient's fears and anxiety. It also can be useful to show patients drawings, videos, and preoperative and postoperative photographs of the results of the specific reconstructive procedures. One important aspect of the initial consultation for the surgeon is to understand what the patient's expectations are and whether or not they are realistic, and to address them with the patient. This is arguably one of the most important components of the initial consultation.

Tobacco users are at a significantly greater risk for developing surgical complications, particularly related to autologous (natural) tissue reconstructions [49,50]. For these reasons, avoidance of tobacco products and nicotine products, including electronic cigarettes, is recommended for at least four weeks prior to surgery and two weeks following prosthetic or autologous breast reconstruction [51-53]. Former smokers do not appear to be at increased risk of morbidity provided they are in otherwise good physical health. (See "Complications of reconstructive and aesthetic breast surgery", section on 'Smoking'.)

**CHOICE OF RECONSTRUCTION**

For women undergoing mastectomy, breast reconstruction offers significant quality-of-life benefits and is a vital option to enhance breast cancer recovery. With the variety of reconstructive techniques available, choosing the "right" option can sometimes be a daunting task, even for highly educated consumers.

The selection of a reconstructive procedure depends on a variety of clinical factors, but patient preference plays a major role in determining the procedure that is ultimately performed. Considerations include body habitus and prior surgical procedures. Age alone should not discourage breast reconstruction. Older women who undergo breast reconstruction following mastectomy have similar outcomes and may have better breast-related quality-of-life outcomes compared with those who do not [54,55].

**Based on clinical factors** — Most women will be considered a reasonable candidate for either implant-based or flap-based breast reconstruction. Some women are clearly a better candidate for one approach over another, based upon individual body habitus, previous breast-related surgery or radiation, or personal choice. The ideal patient characteristics for flap-based breast reconstruction include:

- Ample tissue at the desired donor site (eg, at the abdomen, posterior thorax, gluteal region, or thigh). The most commonly considered donor site is the abdomen. The benefits of using abdominal tissue are the ability to form and shape the tissues to recreate the breast, as well as contouring the abdomen for an abdominoplasty-type effect. The other donor sites listed are usually secondary sites and associated with a lesser amount of tissue, and these are sometimes used in conjunction with an implant. For patients who desire autologous reconstruction but who have a paucity of donor site tissue, stacked flaps can be considered, where two flaps are used to create one breast [56,57].
• Personal history of previous radiation to the breast. Because of the local tissue effects of radiation therapy, autologous tissue options are preferred over implant-based techniques in previously irradiated patients. It is recommended to wait 6 to 12 months following radiation to perform a microvascular anastomosis, when considering microvascular reconstruction using the abdominal, gluteal, or thigh donor sites [58].

• Multiple scars on the breast — The scarred breast may pose challenges when considering mastectomy and reconstruction. Poorly placed biopsy scars may compromise prosthetic reconstruction because of the risk of skin necrosis. When planning a breast biopsy, it is important to place scars along aesthetic units that include the periareolar region and radially when along the periphery of the breast [59,60]. With autologous reconstruction, the scarred skin can be excised and replaced with skin from the donor flap.

• Bilateral mastectomies and any of the above characteristics.

The ideal patient characteristics for implant-based reconstruction include:

• Body mass index (BMI) <30 kg/m² — Although less desirable, some patients with a BMI in excess of 30 kg/m² may still be candidates for prosthetic reconstruction. This will depend on assessment of tissue perfusion, general health, and absence of tobacco use. Patients with a BMI exceeding 40 kg/m² are not good candidates for immediate breast reconstruction, in general.

• Patients with active lifestyles who desire a shorter recovery time.

Based on outcomes — Outcomes data on surgical complications, physical function, quality of life, and patient satisfaction provide the surgeon and patient with useful information when choosing the most appropriate reconstructive technique and timing. The following sections emphasize data on postreconstruction outcomes that are relevant to psychosocial issues, patient satisfaction, and physical functioning.

Patient satisfaction — Clinicians and researchers evaluate health care not just by assessing objective outcomes (complication rates and length of hospitalization, for example) but also from the consumer's point of view in terms of patient satisfaction.

It is well established that breast reconstruction is associated with high levels of patient satisfaction [61-64]. The type of reconstructive procedure appears to affect postoperative patient satisfaction. This was illustrated in the Michigan Breast Reconstruction Outcomes Study project, which measured patient satisfaction with regard to aesthetic result (softness, symmetry) and general satisfaction with the process and outcome of care [64,65]. At one year following surgery, women with pedicled transverse rectus abdominis musculocutaneous (TRAM) flaps, free TRAM flaps, and expander/implants had similar levels of general satisfaction [65], but autologous tissue reconstructions (TRAM procedures) were associated with greater aesthetic satisfaction than expander/implant techniques. At year 2, these procedural differences had diminished, but patients continued to be more aesthetically satisfied with autologous
tissue compared with expander/implant reconstructions [64]. At postoperative year 2, the percentages of patients aesthetically satisfied in the expander/implant, pedicled TRAM, and free TRAM groups were 43, 69, and 70 percent, respectively. With regard to general satisfaction, the percentages of patients who were satisfied with their procedure were 64, 79, and 78 percent, respectively.

While more extensive reconstructive procedures are associated with increased surgical risk and longer recovery times, the choice of reconstruction has had a limited impact on most measures at one and two years of observation [65,66]. One randomized trial of 75 women treated with delayed reconstruction (ie, lateral thoracodorsal flap, the latissimus dorsi flap, or the pedicled TRAM flap) found a high level of satisfaction in the majority of women regarding the cosmetic result of each procedure [4]. All three reconstructive procedures were associated with improvements in patient-defined problem areas of life, quality of life, and social functioning at six months and one year after reconstruction. The latissimus dorsi and TRAM flap cohorts scored higher on quality-of-life questionnaires in terms of breast symmetry and reduced problems in social situations compared with patients undergoing the thoracodorsal flap. In a later review of 459 patients, women who underwent deep inferior epigastric artery perforator (DIEP) flap had higher satisfaction scores with breast and overall outcomes compared with those who had a latissimus dorsi flap, lateral thoracodorsal flap, or expanders with secondary implant [67].

Even after controlling for possible confounding factors, such as preoperative physical function and timing of surgery, patients with TRAM flaps (both free and pedicle) had higher levels of aesthetic satisfaction at year 2 as compared with expander/implant patients (odds ratio [OR] 2.8, p <0.01). There were no significant differences in aesthetic satisfaction between women with free and pedicle TRAM flaps, a finding that has been noted by other investigators [68,69].

Overall satisfaction and patient aesthetic satisfaction are not significantly different in patients who undergo implant/expander reconstruction following radiation compared with patients who did not receive radiation therapy [70]. However, radiation therapy may have more of a negative effect on health-related quality of life and satisfaction with implant breast reconstruction. Based upon a multicenter cross-sectional BREAST-Q survey of women with implant reconstruction (n = 633), women undergoing radiation therapy (n = 219) were less likely to be satisfied with the results compared with women without radiation treatments (66.8 versus 71.4 percent) [71]. In addition, women undergoing radiation treatment also scored lower for psychosocial well-being (66.7 versus 70.9 percent), sexual well-being (47.0 versus 52.3 percent), and physical well-being (71.8 versus 75.1 percent). The impact of the diagnosis or clinical setting that required the addition of radiation therapy, rather than the results of the radiation treatments on the reconstructed breast, needs to be further evaluated.

However, in a separate study, radiation therapy did not affect patient satisfaction scores but was associated with an increased rate of breast implant removal [72]. A cohort study comparing outcomes among 40 women who had reconstruction with an implant in the setting of radiation therapy with 40 others who were not irradiated showed that capsular contraction rates among the women who did and did not receive radiation therapy were 33 and 0 percent, respectively [73]. Nineteen of the 40 irradiated breasts ultimately needed the addition of, or replacement by, autologous tissue to salvage the
Not all studies associate poor cosmetic/aesthetic outcomes with women who undergo immediate implant reconstruction followed by radiation therapy [75-78]. A cohort study that included 725 women (754 reconstructed breasts) undergoing breast cancer reconstruction with implants found that the five-year implant failure rate was 10.4 percent for nonradiated implants (n = 386), 28.2 percent for implants placed after prior radiation (n = 64), and 25.2 percent for implants placed prior to radiation (n = 304) [78]. The majority of women with none (86.2 percent), previous (68.6 percent), and postoperative (77.7 percent) radiation would encourage implant reconstruction for other women. Newer strategies for implant placement (ie, prepectoral placement) have demonstrated that radiation-related complications may be reduced when compared with subpectoral placement [79]. The reasons for this are that the effects of radiation on the pectoralis major muscle are more deleterious and will cause foreshortening of the muscle that will in turn result in radiation-related device malposition.

**Physical functioning** — The variability in the degree of muscle that is sacrificed, denervated, or injured in creating abdominal wall flaps for breast reconstruction makes the comparison of abdominal wall function after abdominal flap reconstruction challenging. Several studies have evaluated abdominal function using basic physical functioning tests such as getting out of bed and the ability to perform sit-ups, although more sensitive testing of muscle function, such as isokinetic dynamometry, which measures the maximum strength a muscle can reach, may be necessary for accurate comparison [80-82].

Many patients are concerned about potential abdominal wall morbidity with TRAM procedures. Physical functioning following free or pedicled TRAM flap reconstructive surgery depends upon whether the reconstruction was unilateral or bilateral, whether the motor innervation to the rectus abdominis muscles was sacrificed or preserved, and the degree of postoperative fibrosis occurring within the remaining muscle. In general, for most women who require unilateral reconstruction, breast reconstruction with a pedicle TRAM flap will not make a significant impact on the activities of daily living. However, for women who need bilateral reconstruction, perforator or muscle-sparing flaps may confer an advantage in physical function. In a review of 20 studies of abdominal wall function following breast reconstruction, bilateral reconstruction was associated with the greatest difficulty in performing some daily activities [83]. However, unilateral reconstruction did not affect the performance of activities of daily living.

Functional outcomes studies have shown mixed results, with between 6 and 23 percent of patients demonstrating deficits in trunk function (eg, torque and range of motion) following TRAM reconstruction [84,85]. However, these are largely single-center studies without long-term follow-up. Physical function outcomes data are especially important as more technically complex procedures, such as perforator flaps, are being increasingly performed to limit the surgical "insult" to the abdominal wall. In the Michigan Breast Reconstruction Outcomes Study, data on trunk peak torque and range of motion were collected preoperatively and at postoperative years 1 and 2 in the expander/implant, free TRAM, and pedicled TRAM groups [86]. At two years postoperatively, procedure type, timing, and laterality (unilateral versus bilateral) did not significantly affect the range of motion for trunk flexion or extension. Peak torque for
trunk flexion at year 2 was significantly lower (by 11 to 18 percent) in patients with TRAM flaps compared with those undergoing expander/implant reconstructions. However, no significant difference in flexion peak torque was found between patients who had free and pedicle TRAM reconstructions. These data are consistent with other contemporary breast reconstruction functional outcomes studies [87-89].

The available outcomes data on perforator flaps are limited to retrospective reviews [90-93]. One study evaluated the ability of patients to do sit-ups at three and six months following perforator flap reconstruction [92]. At three months, 95 percent of women were able to return to their preoperative sit-up activity; this was 100 percent by six months postoperatively. Another retrospective series evaluated abdominal wall function in 18 patients with DIEP flaps compared with free TRAM reconstructions [93]. The TRAM group appeared to have significantly lower trunk flexion torque compared with the DIEP group.

**Psychosocial function and quality of life** — It is challenging to accurately compare the psychosocial impact of the various surgical procedures as some women who are candidates for breast-conserving surgery opt for mastectomy, and some who are candidates for reconstruction opt for none. A breast cancer diagnosis affects psychologic function, regardless of the surgical procedure (ie, mastectomy, mastectomy with reconstruction, or breast-conserving surgery) [94]. In addition, some women are not candidates for either breast conservation or immediate reconstruction because of advanced stage of disease or comorbid illnesses.

A few studies have attempted to measure the impact of the type of reconstruction on psychosocial function and quality of life. A prospective study of 90 women found that psychologic distress was evident regardless of reconstruction (performed or not) or timing of reconstruction (delayed or immediate) at one year after the procedure [95]. Nevertheless, quality of life at one year following reconstruction after mastectomy was equivalent to age-matched controls of women never diagnosed with breast cancer [55].

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**TIMING OF BREAST RECONSTRUCTION**

Breast reconstruction can be carried out at the time of the mastectomy (immediate) or during a subsequent operation (delayed). Immediate reconstruction may be considered in most patients who are undergoing mastectomy. This includes patients having prophylactic mastectomy as well as mastectomy for invasive or in situ carcinoma. Delayed reconstruction is considered in patients with inflammatory breast cancer or in patients at increased risk for adverse outcomes due to comorbidities as well as patient or surgeon preference. Staged-immediate reconstruction is sometimes considered in patients with suboptimal perfusion of the mastectomy skin flaps as a method of reducing the incidence of delayed healing and reconstructive failure. Patients in this category are usually able to resume reconstruction two to four weeks later once the healing is complete [96].

**Immediate** — Opinion within the surgical community regarding immediate breast reconstruction has evolved over time [97,98]. Delayed procedures had been favored because it was assumed that the time...
between mastectomy and reconstruction provided women with the opportunity to "psychologically adjust" to the loss of a breast, therefore allowing for a greater appreciation for their reconstruction. This assumption was found to be faulty when several studies revealed that women undergoing immediate reconstruction experienced significant psychosocial benefits. It is our belief that immediate reconstruction provides at least some "buffer" from the psychological and body image disturbances associated with a breast cancer diagnosis and mastectomy. In a study from Toronto, Canada, immediate breast reconstruction appeared to protect breast cancer patients from a period of psychosocial distress, poor body image, and diminished sexual well-being compared with women waiting for delayed breast reconstruction [99].

Immediate reconstruction may be considered for most patients who are undergoing mastectomy. Contraindications to immediate reconstruction include inflammatory breast cancer and those patients with multiple medical conditions that are poorly controlled. The types of immediate reconstruction that can be performed include prosthetic, autologous, and oncoplastic. The indications for the various options are highly variable and depend upon body habitus, likelihood of postoperative radiation, prior breast radiation, patient desire, and surgeon recommendation.

The advantages of immediate reconstruction include:

- The surgical process is streamlined since removal of the breast cancer and reconstruction are done in one operative setting. As a result, the overall cost of the reconstructive process is decreased [100].
- There are increasing data that support the view that immediate breast reconstruction provides substantial psychosocial benefits over delayed reconstruction and preserves normal perceptions of body image in women undergoing mastectomy [65,101-107].
- With all immediate reconstruction, the preoperative markings are performed for either skin-sparing or nipple-sparing mastectomy [108-110]. (See "Mastectomy: Indications, types, and concurrent axillary lymph node management".)

The disadvantages of immediate reconstruction include:

- Immediate reconstruction prolongs operative time, adding one hour or more for prosthetic reconstruction and several hours for autologous reconstruction. Although this is not harmful for most patients, those with multiple comorbidities may be at increased risk for adverse events.
- Necrosis of the mastectomy skin flaps can adversely affect the aesthetic result of the reconstruction. (See "Mastectomy: Indications, types, and concurrent axillary lymph node management", section on 'Skin flap necrosis'.)
- Large tumor size, direct skin involvement, or documented lymph node involvement will often necessitate postoperative radiation therapy, which can adversely affect the reconstruction [111]. (See 'Integrating radiation therapy and breast reconstruction' below.)
• Postoperative radiation therapy can compromise the quality of the reconstruction. Implants can become firm (capsular contracture) and autologous flaps can shrink or atrophy. Most surgeons prefer to radiate implants because the implant can be replaced with a flap if necessary, whereas a radiated flap is less able to be replaced.

Relative contraindications to immediate reconstruction:

• Advanced disease (stage III or higher) (see "Tumor, Node, Metastasis (TNM) staging classification for breast cancer")

• Need for postmastectomy radiation therapy (see 'Integrating radiation therapy and breast reconstruction' below)

• Significant medical comorbidities such as active smoking, obesity, or cardiopulmonary disease

**Immediate autologous reconstruction** — Immediate autologous reconstruction can be performed using flaps from all donor sites that include the abdomen, back, buttock, and thigh. When no radiation therapy is planned postoperatively, immediate autologous breast reconstruction can be safely performed in patients who are otherwise good candidates. However, when postoperative radiation therapy is planned, whether to perform immediate autologous reconstruction is based on the surgeon's experience along with a detailed discussion with the patient regarding potential risks.

• Some surgeons believe that if radiation therapy is planned postoperatively, then immediate autologous reconstruction should not be performed to avoid radiating the flap because of the untoward effects of the radiation on the flap such as shrinkage, induration, and distortion [112,113].

• Others believe that the effects of radiation are minimal on well-vascularized autologous flaps and that immediate reconstruction can be safely performed [114,115].

**Immediate implant-based reconstruction** — Immediate implant-based reconstruction is a common choice following mastectomy. This can be performed using the two-stage technique that includes placement of a tissue expander followed by a permanent implant, or alternatively, using the one-stage technique (ie, direct-to-implant reconstruction) in which a permanent implant is placed immediately following the mastectomy. Most women following mastectomy will choose implant-based reconstruction because the operation requires less time, the recovery period is shorter, and the aesthetic results usually lead to high patient satisfaction. This is especially true in the setting of nipple-sparing mastectomy. Direct-to-implant reconstruction is increasing in popularity and incidence because it usually can be performed in a single setting; however, it is important to ensure that the mastectomy skin flaps have adequate blood supply. Otherwise, the incidence of adverse events may be increased [116,117].

Implant-based reconstruction is performed using a variety of specific techniques; however, the use of acellular dermal matrix (ADM) in addition to the implant(s) has been a major advancement. ADM is cadaveric skin that is used to provide tissue support following the mastectomy. Although ADM is not specifically approved by the US Food and Drug Administration for breast reconstruction, the benefits of...
ADM in this setting have been established in a variety of publications. The use of ADM has facilitated both the two-stage and the one-stage techniques by compartmentalizing the implant to minimize migration, reducing the incidence of capsular contracture, and improving surgical outcomes [118]. ADM can be used when implants are placed under the pectoralis major muscle (dual plane technique) and above the pectoralis major muscle (prepectoral technique) [119,120]. (See "Skin substitutes", section on 'Acellular dermal matrix'.)

Implant-based reconstruction also does not usually interfere with radiation therapy. In the setting of postmastectomy radiation, more surgeons prefer an implant because although radiation can cause soft tissue fibrosis, capsular contracture, and reconstructive failure, secondary procedures are relatively more easily performed [121]. However, it should be noted that the soft tissue consequences of radiation are permanent. For less severe cases, revisions can include capsulectomy or autologous fat grafting. In severe cases, many patients may opt to have their implants removed and replaced with a flap.

Delayed — Delayed reconstruction is indicated when there is impaired perfusion of the skin flaps after mastectomy, and sometimes when postmastectomy radiation will be needed [96,122]. Other considerations for delayed reconstruction include those patients with comorbidities and social habits (eg, obesity, poorly controlled diabetes mellitus, tobacco usage) that place them at high risk for complications. Women with inflammatory breast cancer are usually advised to delay reconstruction because of their higher risk of local recurrence and need for postoperative radiation therapy. In addition, the presence of dermal lymphatic invasion often mandates taking skin, so immediate reconstruction is less appropriate.

The longer the period of delay, the more fibrotic and contracted the mastectomy skin will become. If the period of delay is short (<1 month), the skin will still have its elasticity and can be manipulated for prosthetic or autologous reconstruction. However, if the period of delay is long (>2 months) or following radiation, the skin will lose some of its elasticity and will be more difficult to manipulate.

The advantages of delayed reconstruction include:

- Assurance of clear margins prior to definitive reconstruction
- Minimization of the effect of poorly perfused mastectomy skin flaps on the quality of the reconstruction
- Allows completion of all adjuvant treatment

The disadvantages of delayed reconstruction include:

- Need for subsequent surgery
- Limited reconstructive options following radiation therapy (see 'Integrating radiation therapy and breast reconstruction' below)
- Lesser aesthetic quality compared with immediate reconstruction
Delayed autologous reconstruction — Delayed autologous reconstruction is commonly performed following pre-or postmastectomy radiation therapy. (See 'Integrating radiation therapy and breast reconstruction' below.)

In the setting of prior radiation and delayed reconstruction, autologous tissue is preferred because the soft tissue fibrosis following radiation usually precludes effective tissue expansion or placement of implants. However, for patients who have not received prior radiation, either implant-based or autologous reconstruction can be considered. Ultimately, the decision between autologous and implant-based reconstruction will depend on the quality of the skin and fat over the mastectomy site.

With autologous reconstruction, the radiated soft tissues can be excised and replaced with well-vascularized autologous tissue. Donor sites for delayed reconstruction are similar to those of immediate reconstruction. Some patients undergoing immediate reconstruction with a prosthetic device with subsequent postoperative radiation therapy may have the radiation changes that can be severe and associated with capsular contracture and pain. In this setting, delayed autologous reconstruction can be considered to remove the radiated device and replace it with a flap. Patient outcomes following delayed autologous reconstruction have been favorable [123].

Delayed implant reconstruction — Delayed implant reconstruction is considered in patients who have had mastectomy without reconstruction or who have had prior failure with an autologous flap. Patients having delayed reconstruction are usually reconstructed with tissue expanders to stretch the skin followed by removal of the tissue expander and placement of a permanent implant. Permanent implants can be silicone or saline filled, round or anatomic shaped, and placed above or below the pectoralis major muscle.

Delayed reconstruction with breast implants is facilitated in patients who have not had prior radiation therapy to the breast or chest wall; however, prior radiation therapy is not a contraindication to delayed implant reconstruction. In a review comparing immediate versus delayed tissue expander reconstruction in the setting of radiation therapy, delayed tissue expander reconstruction had a lower rate of mastectomy flap necrosis and complications compared with immediate tissue expander reconstruction [124]. Postmastectomy radiation significantly increased operative complications and explantation, resulting in a decrease in overall, two-stage success rate in patients having immediate reconstruction. (See 'Integrating radiation therapy and breast reconstruction' below.)

INTEGRATING RADIATION THERAPY AND BREAST RECONSTRUCTION

Women who require postmastectomy radiation therapy present a unique reconstructive challenge. Radiation therapy leads to fibrosis, which compromises the quality of the skin and underlying tissue, results in a higher incidence of complications from the reconstructive procedure, and may produce a less aesthetically pleasing result [125,126]. For women who will need postmastectomy radiation, National Comprehensive Cancer Network (NCCN) guidelines advise women undergoing implant reconstruction to
undergo initial reconstruction with an expander, and for women undergoing autologous reconstruction to delay surgery after completion of radiation therapy to avoid fibrosis and compromised cosmesis [127]. However, no significant differences in complication rates were seen in a study comparing postmastectomy radiation after tissue expander placement with postmastectomy radiation after exchange for a permanent implant [128].

**Timing of reconstruction** — The best method of integrating radiation therapy into any method of reconstruction is controversial [129]. The need for postmastectomy radiation therapy often cannot be determined definitively until the final pathologic evaluation is complete (typically three to five days following mastectomy). A number of approaches have been suggested to circumvent this problem and permit suitable patients who have a low likelihood of needing postmastectomy radiation therapy to undergo immediate reconstruction, if they desire it.

One approach is to perform a sentinel lymph node (SLN) biopsy prior to mastectomy [130,131]. If the SLNs are tumor free, then the likelihood that postmastectomy radiation therapy will be needed is low (but not zero) in patients who have tumors <5 cm, and immediate reconstruction can be considered. (See 'Immediate' above.)

An alternative approach is the "staged-immediate" reconstruction approach [132]. The first stage consists of a skin-sparing mastectomy with subpectoral or prepectoral insertion of a filled tissue expander to preserve the shape and dimensions of the breast envelope. After a review of the permanent histologic sections, patients who do not need postmastectomy radiation therapy then undergo a "staged-immediate" reconstruction within two weeks of mastectomy. Those who require radiation therapy will sometimes be advised to have the tissue expander deflated on the chest wall to optimize treatment delivery; however, this is not universally performed. In either case, radiation is delivered to the soft tissues surrounding the prosthetic device [111]. Early results with this approach have been promising, but radiation therapy-related tissue expander complications may still require interruption of postmastectomy radiation therapy, with the associated risk of compromising oncologic outcomes. Some have suggested a prepectoral placement of prosthetic devices in the setting of known future radiation therapy [17,79]. Early outcomes demonstrated less likelihood of superior displacement of prepectoral tissue expanders following radiation therapy compared with subpectoral tissue expanders. However, in a later study that compared postmastectomy radiation in the setting of prepectoral and partial subpectoral tissue expander placement, there was no significant difference in complication rates between the two reconstructive cohorts, including rates of explantation (15.4 versus 19.3 percent) [133]. More research on breast reconstruction in irradiated patients is needed to determine optimal management in this setting. (See 'Delayed' above.)

Oncoplastic reconstruction can be performed immediately following resection or be delayed (staged). The reconstructive process is completed before the onset of radiation therapy that is typically required following partial mastectomy. Most surgeons agree that the aesthetic results are superior if performed immediately. It is often very difficult to have significant improvements if you do oncoplastic reconstruction in a delayed fashion, particularly if patients have already received radiotherapy. The risks of immediate
oncoplastic surgery include a positive tumor margin on final pathologic evaluation that often requires a reexcision or, in some cases, a mastectomy. The options for oncoplastic reconstruction include volume displacement and volume replacement procedures. (See "Oncoplastic techniques in breast-conserving surgery".)

**Radiation-related complications** — Radiation-related complication rates are highest among women undergoing expander/implant reconstruction, regardless of when radiation therapy is given relative to surgery [134,135]. The end results of the complex tissue changes induced by radiation include scar formation at the implant/tissue interface, capsular contracture, and impaired skin healing. Other complications associated with implant reconstruction include implant rupture or extrusion and implant malpositioning.

In cases of autologous reconstruction, radiation may result in flap shrinkage and fibrosis. Although autologous tissue reconstructions may be better able to withstand radiation-induced tissue damage [75,136-140], they are still subject to radiation-related fat necrosis, fibrosis, atrophy, and flap contracture. Delayed autologous flap reconstruction usually provides improved cosmetic results with the fewest complications (picture 3) [141]. However, this concept has been challenged in several studies that contend that patient-reported outcomes are no different when comparing radiation therapy before or after flap reconstruction [142].

The incidence of late complications (fat necrosis, flap volume loss, flap contracture) is significantly higher in immediate reconstructions that have undergone radiation therapy [109,112,143,144]. In a retrospective study of 113 women who underwent postmastectomy radiotherapy and breast reconstruction, the complication rate was 32 percent for patients who had radiation first and 44 percent for patients who had breast reconstruction first [74]. Early complications were seen more frequently in patients having radiation first while late complications were more common in patients who had breast reconstruction first. In another study comparing outcomes of 32 patients who underwent immediate transverse rectus abdominis musculocutaneous (TRAM) flap reconstruction followed by radiation therapy compared with 70 women who underwent radiation therapy and subsequent delayed flap reconstruction, the incidence of late complications was significantly higher in the immediate compared with the delayed reconstruction group (88 versus 9 percent) [143]. Nine patients (28 percent) in the immediate reconstruction group required an additional flap to correct contour deformities resulting from flap shrinkage and contracture.

Transferring nonirradiated tissue to the mastectomy site may avoid some of the radiation-associated wound healing complications. Tissues severely damaged by radiation therapy can be resected and discarded at the time of the reconstruction, and the skin "paddle" of the designed flap can be tailored to replace the missing breast surface skin. In general, prior radiation therapy increases the amount of tissue required for breast reconstruction, and this may limit flap selection. In some patients, volume and skin requirements may exceed those of a single flap; therefore, the use of stacked flaps or two flaps for one breast may be considered. The use of stacked (ie, combined) flaps provides a solution to increase the amount of skin available for autologous reconstruction.
POSTOPERATIVE CARE AND FOLLOW-UP

The postoperative care of a patient following prosthetic, autologous, and oncoplastic reconstruction is important. Early ambulation is recommended to reduce the risk of deep vein thrombosis (DVT) and to improve pulmonary function. It is common for patients to experience incisional pain and muscle spasm, which can be alleviated with narcotics and muscle-relaxing medications. Many institutions and surgeons are now utilizing ERAS (enhanced recovery after surgery) to reduce the risk of narcotic use and to further reduce pain and increase comfort [145]. Postoperative oral antibiotics may be prescribed based on need, although many surgeons have reduced antibiotic administration based on the Surgical Care Improvement Project (SCIP) guidelines [146]. Patients are instructed to refrain from strenuous activity for four to six weeks to allow for optimal wound healing and to reduce the risk of a seroma or contour abnormality at the donor site.

• Following prosthetic reconstruction, a drain is typically placed in the prosthetic space and will remain for several days. Most patients are allowed to shower on postoperative day 2 or 3. When a tissue expander is placed, patients typically are expanded in the office or clinic at one- to two-week intervals until complete.

• Following autologous reconstruction, most patients are typically admitted for three to four days in the hospital. Surgical drains may be placed in the reconstructed breast and the donor site. The duration of drainage is variable. Abdominal and gluteal drains are usually removed in one week, whereas latissimus dorsi drains are removed at two to three weeks because of the risk for seroma. Patients are instructed to shower on postoperative day 3 and to follow up with the surgeon a few days following discharge from the hospital.

Surveillance of the reconstructed breast — Following mastectomy, there remains a risk for locoregional recurrence and, less often, a second primary breast cancer, regardless of whether the breast was reconstructed or not.

The vast majority of locoregional recurrences are palpable; thus, physical examination remains the cornerstone of detection of recurrent breast cancer after reconstruction. Patient counseling should emphasize the importance of breast self-examination [147]. In a retrospective review of 390 patients who underwent immediate transverse rectus abdominis musculocutaneous (TRAM) flap reconstruction following mastectomy for cancer, 18 (4.6 percent) locoregional recurrences occurred at a mean interval of 35 months following the mastectomy [148]. All recurrences (nine subcutaneous, nine nodal) were detected by physical examination. Recurrent cancers can occur either just below the skin in the subcutaneous tissue or just over the pectoralis muscle. Given that most surgeons remove the pectoralis fascia with the mastectomy specimen, recurrence on the chest wall is less common than subcutaneous tissue recurrence [149]. To clarify any physical findings, imaging (eg, magnetic resonance imaging [MRI], ultrasound, mammography) can be used as an adjunct [150]. If there is a high index of suspicion for a chest wall recurrence in the setting of reconstruction, a breast MRI may be helpful; however, a biopsy is
required to make the diagnosis. If a skin lesion is present, a punch biopsy can be performed. Detection rates of locoregional recurrence using imaging and outcomes are not significantly affected by the reconstruction [150,151].

Guidelines from expert groups for the follow-up of breast cancer patients recommend annual mammography, but these recommendations generally do not apply to women who have undergone mastectomy with or without breast reconstruction, regardless of whether the reconstruction was autologous or implant based [127,152]. It is generally accepted that routine mammography following autologous breast reconstruction is not necessary [151,153]. The bulk of the reconstructed breast is composed of abdominal adipose tissue, which is not at risk, but even after the most aggressive mastectomy, some small amount of normal residual breast tissue remains, which may be at risk for developing a subsequent new primary breast cancer. While mammography is technically feasible following autologous myocutaneous flap reconstruction, particularly following TRAM or perforator flap reconstruction, fat necrosis can appear radiographically as calcifications in reconstructed breast tissue, leading to unnecessary biopsy procedures. Studies illustrating the use of mammography following autologous breast reconstruction are given below. Additional studies will be needed to determine the usefulness of mammographic surveillance following mastectomy and reconstruction for breast cancer.

- In a retrospective review of 615 patients who had autologous reconstruction for cancer, 27 patients (5 percent) demonstrated a locoregional recurrence [154]. Mammography was performed in 397 patients, resulting in 25 biopsies in 25 patients, of which 2 were malignant (8 percent). Routine clinical examination was performed in 537 patients, resulting in 77 biopsies in 66 patients, of which 30 were malignant (39 percent). Locoregional recurrence was detected on clinical exam in 24 of 27 patients (88.9 percent), whereas mammography detected two recurrences that were palpable on follow-up examination.

- In a retrospective review of 515 women who underwent mastectomy with autologous reconstruction for cancer (78.5 percent) or prophylaxis (21.5 percent), locoregional recurrence occurred in 21 women (4.1 percent) with a median time between reconstruction and first recurrence of 4.4 years (range 0.8 to 16.2 years) [151]. After prophylactic mastectomy, there were no breast cancers within the flap, skin, or chest wall; the two malignant ipsilateral events included one lymphoma and one contralateral nodal metastasis. Among 24 malignancies in the 21 women, 15 (62 percent) were symptomatic (visible or palpable) and 9 (39 percent) were occult. For women undergoing routine mammography, the cancer detection rate per flap reconstruction was 1.5 per 1000 mammograms, which was comparable to that of an age-matched woman.

**SOCIETY GUIDELINE LINKS**

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Breast surgery".)
SUMMARY AND RECOMMENDATIONS

- There are three general types of reconstructive procedures: prosthetic devices (e.g., tissue expanders, saline implants, silicone implants), oncoplastic reconstruction using volume displacement or replacement techniques, and autologous tissue reconstruction, which involves the transfer of a flap of tissue from a donor site to the anterior chest wall. The choice of the reconstructive option depends upon a variety of factors, including body habitus, associated comorbidity (e.g., obesity, history of diabetes, smoking), the size and configuration of the contralateral breast, prior surgical procedures, the quality of the chest wall skin, and patient choice. (See 'Clinical evaluation' above.)

- Breast reconstruction is often performed immediately after mastectomy. The advantages of immediate reconstruction include streamlined care, reduced cost, superior cosmetic results, and psychosocial benefits. Immediate reconstruction may be considered for most patients undergoing mastectomy (with the exception of inflammatory breast cancer). (See 'Timing of breast reconstruction' above.)

- For women who are likely to need postmastectomy radiation therapy, the majority of plastic surgeons prefer to place an implant or tissue expander. If autologous reconstruction is ultimately desired, this can be performed 6 to 12 months later. Most surgeons prefer not to radiate a flap reconstruction due to the long-term effects of the radiation on the flap. In patients who have had prior radiation therapy and now need reconstruction, most surgeons will use autologous reconstruction because of the decreased incidence of complications and the increased likelihood of long-term success. (See 'Integrating radiation therapy and breast reconstruction' above.)

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The most commonly used perforator flap for breast reconstruction is the deep inferior epigastric perforator (DIEP) flap. The DIEP flap uses the lower abdominal island of skin and fat and spares the rectus abdominis muscle. Although the underlying muscle must be split to dissect out the perforating vessels, the muscle itself is not included in the transfer. The deep inferior epigastric artery and vein, which provide the vascular supply for the free flap, are anastomosed to local recipient vessels, using either the internal mammary or thoracodorsal arteries and veins.
One of the most commonly used autogenous tissue reconstructions is the TRAM (transverse rectus abdominis myocutaneous) flap. The drawing depicts reconstruction performed in a delayed fashion, which is sometimes necessary to allow chest wall radiation. However, the procedure can also be performed at the time of mastectomy to provide immediate reconstruction. Either the contralateral or ipsilateral rectus abdominis muscle can be utilized. Incision placement and size will vary based on the patient’s body habitus. There are many ways to perform nipple reconstruction; one method is pictured here. The nipple is reconstructed after the flap heals and is then tattooed to the appropriate color so that there is symmetry with the contralateral breast.
Free TRAM flap reconstruction after skin sparing mastectomy

The free TRAM (transverse rectus abdominis myocutaneous) flap completely detaches and directly transfers the lower abdominal tissue to the mastectomy site. The deep inferior epigastric artery and vein, which provide the vascular supply for the free flap, are anastomosed to local recipient vessels, using either the internal mammary or thoracodorsal arteries and veins. This can be performed to provide immediate or delayed breast reconstruction. In this drawing, a skin sparing mastectomy is depicted. This drawing depicts the blood supply anastomosis to the thoracodorsal vessels; however, the internal mammary site is also used commonly for the site of anastomosis.

Graphic 64061 Version 5.0
Latissimus flap breast reconstruction

The latissimus dorsi (LD) flap is a reliable option for autologous tissue reconstruction. The flap is tunneled through the axilla, leaving its vascular pedicle, the thoracodorsal artery and vein, intact. Because the LD is not a bulky flap, it usually is used in combination with a saline or silicone implant to provide sufficient breast volume and projection.
The transverse upper gracilis (TUG) flap is based on the proximal gracilis muscle and its vascular pedicle, the ascending branch of the medial circumflex femoral artery. This flap utilizes tissue from the posterior upper thigh/lower buttock and provides another choice for women with insufficient lower abdominal fat for breast reconstruction.
For patients who do not have sufficient lower abdominal fat for reconstructive flaps, but who prefer the use of autologous tissue, a more viable donor site may be the buttock area. For this free flap, perforating vessels from either the superior gluteal artery (SGAP flap) or the inferior gluteal artery (IGAP flap) can be used as the vascular supply for the transferred tissue. For the SGAP flap, upper buttock tissue is used, resulting in a donor site scar that is concealable under most swimwear. If an IGAP flap is performed, the donor site scar lies within the lower buttock crease.

Graphic 75614 Version 1.0
Contralateral reduction mammoplasty for symmetry

Following right mastectomy, the patient had an immediate right breast reconstruction with an expander followed by an anatomic saline implant. Reduction mammoplasty of the contralateral side was performed to restore symmetry. Left panel: preoperative appearance; right panel: postoperative appearance.

Courtesy of Jorge de la Pedraja, MD.

Graphic 62910 Version 2.0
Reconstruction of the nipple-areolar complex

Nipple-areolar complex reconstruction is carried out with a combination of local tissue rearrangement and tattooing.

Courtesy of Jorge de la Pedraja, MD.

Graphic 54178 Version 2.0

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Kathryn A Collins, MD, PhD, FACS  Nothing to disclose
Delayed TRAM reconstruction

Following mastectomy, transverse rectus abdominis muscle (TRAM) reconstruction was delayed until after chemotherapy and radiation therapy and performed with a single-pedicle right TRAM flap. Left panel: preoperative appearance; right panel: postoperative appearance.

Courtesy of Jorge de la Pedraja, MD.

Graphic 55849 Version 3.0

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