

## Treatment of breast infection

J Michael Dixon,<sup>1,2</sup> Lucy R Khan<sup>2</sup>

<sup>1</sup>Breakthrough Research Unit, Edinburgh Breast Unit, Western General Hospital, Edinburgh EH4 2XU, UK

<sup>2</sup>Edinburgh Breast Unit

Correspondence to: J M Dixon [jmd@ed.ac.uk](mailto:jmd@ed.ac.uk)

Cite this as: *BMJ* 2011;342:d396  
doi: 10.1136/bmj.d396

A cohort study of American women reported that 10% of women who breast feed have mastitis,<sup>1</sup> and a recent Cochrane review reported the incidence to be as high as 33%.<sup>2</sup> Breast abscesses are seen less often, but when they do develop delays in referral to a specialist surgeon may occur. A recent survey in the United Kingdom found that many surgical units have no clear protocols for managing patients with breast infection who are referred to hospital.<sup>3</sup> Some surgeons aspirate breast abscesses under local anaesthesia, whereas others use general anaesthesia. The management of breast infection has evolved over the past two decades, with advances in both diagnosis and treatment. A new concept is bedside ultrasound, and this plays an important part in current management.

We review management of breast infection in the primary care setting and after hospital referral. The review is based on our current practice and the best quality evidence available. Few randomised controlled trials deal with this topic, and most breast specialists have adopted their own protocols for clinical management, loosely based on published algorithms, and largely dictated by their specific patient population and their clinical practice setting. This review provides a resource for those who see breast infection infrequently. Appropriate timely referral will help avoid unnecessary morbidity for patients.

### What kinds of breast infection are there?

Infection can occur in the parenchyma of the breast or the skin overlying the breast (fig 1). Parenchymal breast infections can occur in lactating and non-lactating breasts. One cross sectional analysis of 89 patients with breast abscesses requiring surgical intervention found that 14% were lactational and 86% were non-lactational.<sup>4</sup>

### SOURCES AND SELECTION CRITERIA

We conducted a Medline search using the key words “breast infection”, “mastitis”, and “breast abscess”. This review focuses on parenchymal breast infection, with brief mention of infections of the skin overlying the breast. We do not include infection associated with implants. We selected articles that provided the best evidence available. Our experience from clinical practice is huge, and we have included many of the lessons learnt over the many years that we have managed patients with breast abscesses.

### Which micro-organisms are implicated?

An up to date retrospective case series shows that during lactation the most common organism responsible is *Staphylococcus aureus*,<sup>6</sup> including strains of methicillin resistant *S aureus* (MRSA), particularly if the infection was acquired in hospital.<sup>1-7</sup> Other organisms responsible include streptococci and *Staphylococcus epidermidis*. Organisms responsible for non-lactating breast infections include bacteria commonly associated with skin infections but also include enterococci and anaerobic bacteria such as *Bacteroides* spp and anaerobic streptococci.<sup>8</sup> Patients with recurrent breast abscesses have a higher incidence of mixed flora (20.5% in those with recurrence v 8.9% with a single episode), including anaerobic organisms (4.5% v 0%).<sup>4</sup>

### Investigating and managing breast infection in lactating women

#### Who gets it and how do they present?

Lactating breast infection is most commonly seen within the first six weeks of breast feeding, although it can develop during weaning. The infection arises initially in a localised

### SUMMARY POINTS

- Early prescription of appropriate antibiotics reduces the rate of breast abscess development
- Refer to hospital all patients whose infection does not settle rapidly after one course of appropriate antibiotics
- Use ultrasound routinely in patients referred with a suspected abscess to see whether pus is present
- Breast abscesses can usually be treated in the outpatients department by repeated aspiration or mini-incision and drainage under local anaesthesia
- Patients whose inflammatory changes do not settle after a course of antibiotics may have inflammatory breast cancer; in such cases perform imaging and image guided core biopsy if a localised suspicious abnormality is present
- Recurrent central infection is usually associated with periductal mastitis—a smoking related disease—and total duct excision is often needed

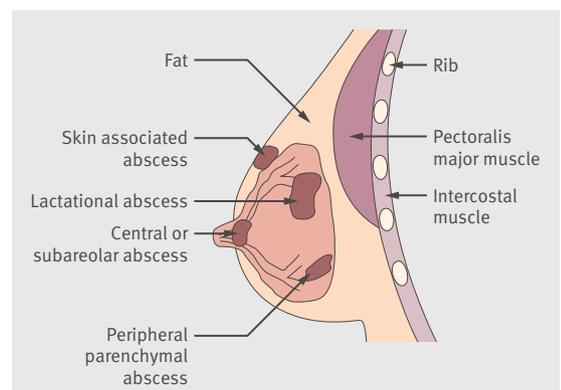


Fig 1 | Diagram showing common sites and types of breast infection<sup>5</sup>

**bmj.com** Previous articles in this series

- ▶ Pharmacological prevention of migraine (*BMJ* 2011;342:d583)
- ▶ Telehealthcare for long term conditions (*BMJ* 2011;342:d120)
- ▶ Preventing exacerbations in chronic obstructive pulmonary disease (*BMJ* 2011;342:c7207)
- ▶ Islet transplantation in type 1 diabetes (*BMJ* 2011;342:d217)
- ▶ Diagnosis and management of hereditary haemochromatosis (*BMJ* 2011;342:c7251)



**Fig 2 | Lactating abscess at presentation with visible swelling and overlying erythema**

segment of the breast and can spread to the entire quadrant and then the whole of the breast if untreated.

A review of 946 cases of lactational mastitis in the United States found that women often gave a history of difficulty with breast feeding and many had experienced engorgement, poor milk drainage, or an excoriated nipple.<sup>9</sup> Population based studies have shown that risk factors for abscess formation include maternal age over 30 years, gestational age greater than 41 weeks, and a history of mastitis.<sup>10 11</sup> The examining doctor may see erythema, localised tenderness, localised engorgement, or swelling. Some women present with fever, malaise, and occasionally rigors.

A cohort study estimated that 2-10% of breastfeeding women get mastitis but only 0.4% develop an abscess.<sup>1</sup> A prospective study of 128 women reported that 5-10% of women with mastitis developed a breast abscess, possibly because of suboptimal management of their mastitis.<sup>12</sup>

#### How to treat mastitis

Guidelines from the World Health Organization and numerous reviews of the condition recommend treating lactating women with mastitis by prescribing appropriate oral antibiotics and encouraging milk flow from the engorged segment (by continuation of breast feeding or use of a breast pump). Such measures reduce the rate of abscess formation and thereby relieve symptoms.<sup>2</sup> A Cochrane review found only one reported randomised trial of antibiotic treatment versus breast emptying alone conducted among women with lactational mastitis that showed faster clearance (mean 2.1 v 4.2 days) of symptoms in women using antibiotics.<sup>2</sup> Oral antibiotics are usually sufficient, and only rarely do patients with sepsis require hospital admission and intravenous antibiotics. Lactating infection can be treated by flucloxacillin, co-amoxiclav, or a macrolide such as erythromycin or clarithromycin (in patients who are allergic to penicillin), given for at least 10 days. Tetracycline, ciprofloxacin, and chloramphenicol should not be

used to treat lactating breast infection because these drugs can enter breast milk and harm the baby.

One report of using *Lactobacillus fermentum* and *Lactobacillus salivarius* as an alternative treatment has shown them to be as effective as antibiotics.<sup>13</sup> Further studies are needed before they can be used as an alternative to appropriate antibiotics.

There is an alarming trend towards believing that fungi are important in the aetiology of breast infection and deep breast pain associated with breast feeding, despite a lack of good quality evidence. The prescription of antifungals, such as fluconazole, is common despite the lack of good quality clinical evidence to support their use.<sup>14</sup>

A case series describes several patients with breast pain during breast feeding who did not have mastitis but Raynaud's disease of the nipple and who responded to nifedipine.<sup>15</sup> Prescription of anti-inflammatory drugs and the application of cold compresses or ice packs can help to alleviate pain. One small trial compared the effectiveness of chilled or room temperature cabbage leaves with ice packs and both produced identical symptom relief.<sup>16</sup>

We have found that it is not uncommon for patients to be referred late to hospital with established large volume abscesses (fig 2). Reasons for this include failure to refer infection that does not settle rapidly after one course of antibiotics; a lack of continuity of care in the community; use of inappropriate antibiotics; and delays as a result of using other treatment modalities, such as antifungal agents and cold compresses alone.

#### Investigating a suspected breast abscess

Ultrasound will establish the presence of pus and should be performed in any patient whose infection does not settle with one course of antibiotics, whether a breast abscess is suspected or not (fig 3). Even when clinical examination shows obvious signs of an abscess, ultrasound is useful because it may identify more than one collection of pus that might otherwise be missed.

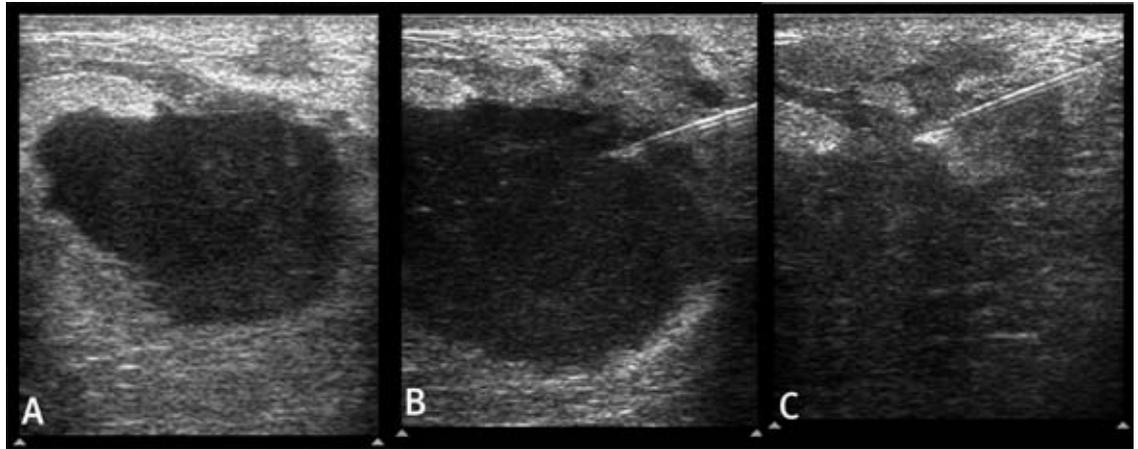
#### Draining an abscess

In our specialist practice we have developed and evaluated the following approach to the management of breast abscesses. We base our approach to draining the abscess on the appearance of the skin overlying the abscess (fig 4).

If the overlying skin is normal, we recommend aspiration of the abscess under ultrasound guidance using adequate local anaesthesia. A 21 gauge needle is introduced through the skin some distance away from the abscess and 1% lidocaine with 1:200 000 adrenaline is infiltrated into the skin and into the breast tissue under ultrasound image guidance. When reaching the abscess cavity (fig 3B), if the pus is thin enough it can be aspirated with the same needle. Once the pus has been aspirated the syringe is changed and the abscess cavity is irrigated with as much as 50 mL of 1% lidocaine and adrenaline. On ultrasound imaging the abscess cavity should be seen to expand and collapse as fluid is injected and aspirated to dryness (fig 3C).

If the pus is very thick and cannot be aspirated through a 21 gauge needle, then having waited for local anaesthetic to be effective, a larger gauge needle may be advanced through the skin and breast tissue into the cavity. The

**Fig 3 |** (A) Ultrasound of lactating breast abscess. (B) Lactating breast abscess; the needle is visible on the upper right immediately before aspiration. (C) Lactating breast abscess after aspiration; no more fluid is visible in the abscess, which has now collapsed



pus is diluted with local anaesthetic and adrenaline, after which this is aspirated. We find that using a combination of lidocaine and adrenaline in solution reduces pain and minimises bleeding and subsequent bruising. Irrigation is continued until all the pus is aspirated and the fluid used to irrigate comes back clear. The net effect of this procedure is to control pain by a combination of providing local anaesthesia and reducing the pressure within the abscess cavity by aspirating all the pus. We send a sample of pus to the microbiology department for culture and continue appropriate oral antibiotics and analgesia until the abscess resolves.

We review the patient every two to three days and repeat aspiration under ultrasound guidance if fluid is present in the abscess cavity. We continue with this approach until no further fluid is visible in the abscess cavity or the fluid aspirated does not contain pus. Few abscesses require more than two to three aspirations, although very large collections may require more. Characteristically, the fluid aspirated changes from pus to serous fluid and then to milk over a few days. Most abscesses in lactating breasts can be managed successfully in this manner.

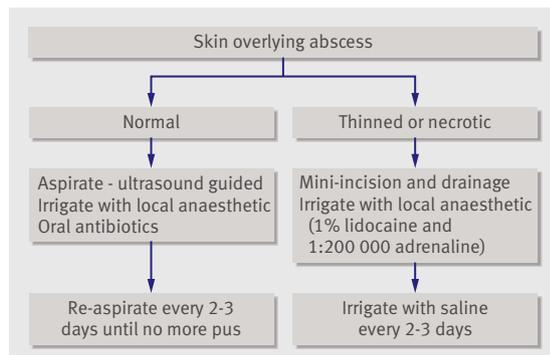
If the skin overlying the abscess is compromised and is thin and shiny or necrotic we perform mini-incision and drainage (fig 5). Local anaesthetic is infiltrated into the skin overlying the abscess and left for a minimum of seven to eight minutes, and then a small stab incision with a number 15 blade is made into the abscess over the point of maximum fluctuation. If the point of maximum fluctuation is not clear, ultrasound can help to define the best site for incision. We excise any necrotic skin. Once the con-

tents of the abscess cavity are drained, we irrigate the cavity thoroughly with local anaesthetic solution and repeat every two to three days until there is no evident leakage from the abscess, the wound closes, and no further pus is draining. Most patients whose abscess needs to be incised and drained can have the procedure performed under local anaesthesia in the outpatient clinic. Large incisions are not necessary to drain breast abscesses, and the cosmetic results of the small incisions needed are usually excellent. The placement of drains and insertion of packing have no role in the modern day management of breast abscesses.

If infection fails to regress with appropriate management, carry out further imaging combined with needle core biopsy of any suspicious abnormality to exclude an inflammatory cancer.

**Breast feeding after breast infection**

Although women are encouraged to continue breast feeding after treatment of mastitis or an abscess, it may be difficult to do so from the affected side. If the infant cannot relieve



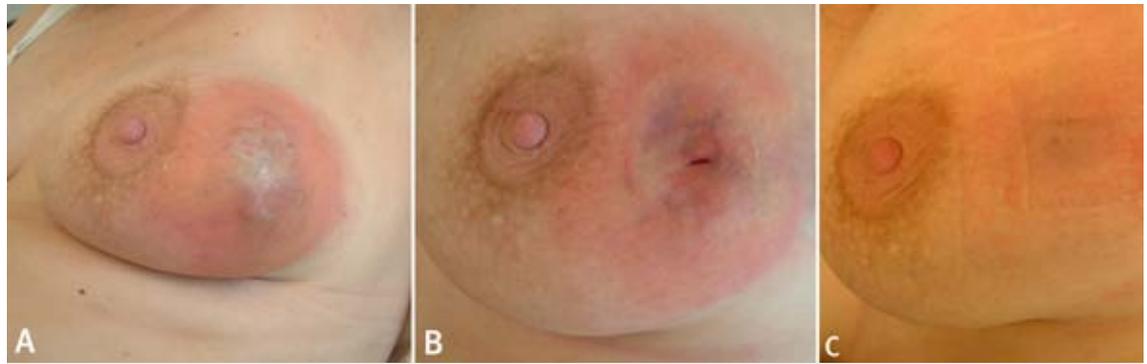
**Fig 4 |** Breast abscess protocol

**A PATIENT'S PERSPECTIVE**

My problems with breast feeding started as soon as my baby was born with pain from sore, cracked, and bleeding nipples. During the first four weeks the pain increased until I developed extreme shooting pains, which would make my body writhe and jump in bed. I was unable to sleep and dreaded each feed. Then a hard lump developed in my breast. I thought it was a blocked duct and was advised to continue feeding. I sought out as much help and advice as possible from midwives, general practitioners, health visitors, breastfeeding councillors, and breastfeeding groups. The lump continued to grow until I could cup it in my hand. I was advised to try fluconazole but was not given antibiotics. In the end, I had to ask the fourth general practitioner I saw to make an emergency referral to the breast unit.

By the time I was seen, several weeks after the lump developed, I was desperate for somebody to do something. I was becoming depressed with the pain and at the thought of having to give up breast feeding, but I knew I could not continue on in agony. My 7×7 cm breast abscess had to be aspirated six times over two weeks and I took antibiotics for 10 days. It was extremely important to me that I was seen by the same person each time I attended. I have been able to continue breast feeding and my breast has now recovered completely.

**Fig 5 |** (A) Lactating breast abscess with thin overlying skin best treated by mini-incision and drainage under local anaesthesia. (B) Lactating breast abscess immediately after mini-incision and drainage. (C) One week after mini-incision and drainage



**Fig 6 |** Extensive lactating breast infection with multiple abscesses. Patient had sepsis and was fatigued, and she decided to stop breast feeding



breast fullness during nursing, the woman may use hand expression or a breast pump to encourage and maintain milk flow until breast feeding can resume. Although most women are able to continue breast feeding even if they have excoriation of the nipple and pain, a few experience continuous and disabling pain (fig 6). If after discussion a woman chooses to stop breast feeding so that the breast infection can be controlled and the breast can heal, lactation can be suppressed using cabergoline.

**Investigating and managing breast infection in non-lactating women**

**Who is at risk?**

People at highest risk of developing an infection of breast tissue when not lactating are those who smoke and those with diabetes. A recent retrospective analysis found that patients with non-lactating skin associated abscesses who have diabetes or who smoke (or both) are likely to have recurrent episodes of breast infection.<sup>17</sup> Infections are categorised as central or subareolar infections and peripheral infections—each has different causes and treatments. Infections that occur in the skin of the breast are usually

secondary to an underlying lesion such as a sebaceous cyst or hidradenitis suppurativa.

**Types of infection**

*Central or subareolar infection*

This is usually secondary to periductal mastitis, a condition in which the subareolar ducts are damaged and become infected, often by anaerobic bacteria.<sup>8</sup> Patients may present initially with subareolar inflammation (with or without an associated mass) or with an established abscess (fig 7A). Associated features include nipple retraction and a discharge from the nipple. Periductal mastitis predominantly affects young women, the average age being 32 years, and smoking is a major causative factor, with 90% of patients being smokers. Periductal mastitis can also occur in men.<sup>18 19</sup> Substances in cigarette smoke—such as lipid peroxidase, nicotine, and cotinine—concentrate in the breast and are found at much higher concentrations in subareolar ducts than in plasma. Either the toxic substances in cigarette smoke damage the ducts directly or local hypoxia causes subareolar duct damage and subsequent inflammation and infection.<sup>18</sup> Patients with periductal mastitis can have bilateral disease, and some women present with bilateral fistulas and nipple changes on both sides. Smokers who have nipple piercing can develop persistent and troublesome infection. Breast abscesses can affect men as well as women.

*Peripheral non-lactating infection*

This is less common than central infection. Peripheral infection has been associated with diabetes, rheumatoid arthritis, steroid treatment, trauma, and granulomatous lobular mastitis but often there is no underlying cause. Occasionally, comedo ductal carcinoma in situ can become infected and present with inflammation or as an abscess; we therefore recommend that patients over 35 years with peripheral infection and no obvious cause undergo bilateral mammography once the infection has resolved.

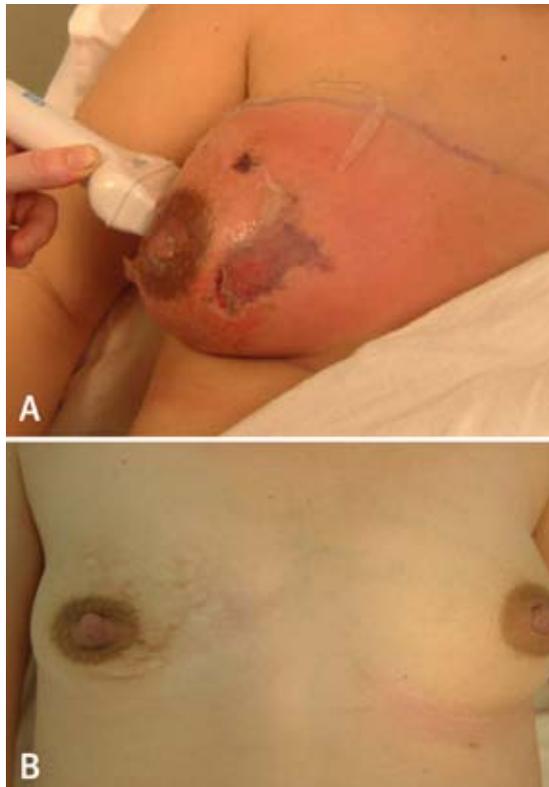
*Granulomatous lobular mastitis*

One cause of peripheral infection is granulomatous lobular mastitis, a condition of unknown aetiology. It can present as a peripheral inflammatory mass that masquerades as cancer or as an area of infection with or without overlying skin ulceration. Although this condition mostly affects young parous women, who develop multiple and recurrent abscesses, it is seen in nulliparous women as well. It has been suggested that *Corynebacterium* spp play



**Fig 7 |** (A) Periareolar abscess with thin overlying skin. (B) Abscess during mini-incision and drainage

**Fig 8 | (A)** Abscess where referral was greatly delayed. **(B)** Same patient one year later showing major asymmetry as a result of tissue loss



a part in this condition,<sup>20</sup> but antibiotics effective against these organisms rarely lead to resolution of disease and thus they are unlikely to have a major aetiological role.

*Skin associated infection*

Sebaceous cysts are common over the skin of the breast and these can become infected to form local abscesses. Cellulitis of the breast with or without abscess formation is common in patients who are overweight, have large breasts, or have had breast surgery or radiotherapy. It

occurs in the lower half of the breast and also under the breast where sweat accumulates and intertrigo develops. Intertrigo may be a recurrent problem in women with large ptotic breasts. *Staphylococcus aureus* is the usual causative organism. Although antifungal creams are commonly prescribed, there is no evidence that fungi play an aetiological role in this condition.<sup>21</sup> Hidradenitis suppurativa commonly affects the axilla and groin and can also affect the skin of the lower half of the breast, resulting in recurrent episodes of infection and abscess formation.

**Which antibiotic is best?**

We recommend treating non-lactating and skin associated breast infections with amoxicillin and clavulanic acid or, if the patient is allergic to penicillin, a combination of erythromycin and metronidazole.

**Managing abscesses**

Non-lactating abscesses are managed in a similar way to lactating breast abscesses by aspiration or mini-incision and drainage (fig 7B) combined with appropriate oral antibiotics. Recurrence is common after resolution of central or subareolar non-lactating abscesses because the underlying pathology in the central ducts often persists. Patients with recurrent disease require definitive surgery in the form of total duct excision to remove the diseased ducts and stop the cycle of recurrent infection.

Recurrent episodes of periductal mastitis and infection can result in a mammary duct fistula. In such cases, excision of the fistula combined with total duct excision or laying open the fistula is usually effective. To reduce the risk of recurrence, all the ducts must be excised right up to the back of the nipple, leaving only nipple skin.<sup>22</sup> It is sometimes necessary to remove the nipple areolar complex in cases with recurrent infection. All patients who smoke should be advised of the risks of continued smoking and its association with recurrent breast infection and fistula formation.

Granulomatous lobular mastitis eventually resolves without active intervention so management is focused on treating abscesses appropriately.<sup>23</sup> Steroids have been used,<sup>24</sup> but we do not recommend them for this condition.

**Managing skin related infections**

For abscesses related to sebaceous cysts, incision under local anaesthesia with irrigation of the cavity and evacuation of the sebaceous material is usually effective. After resolution of the abscess, the sebaceous cyst is usually sufficiently scarred that it does not require formal excision. If the sebaceous cyst persists, then consider excision of the cyst under local anaesthetic once all infection has resolved.

Abscesses related to hidradenitis are treated by mini-incision and drainage combined with appropriate antibiotics. Options for recurrent infection include treatment with retinoids in mild cases. Surgical excision of the affected area or skin grafting results in long term control in 20-50% of women.<sup>25</sup> Consider referring patients with severe hidradenitis to a dermatologist or plastic surgeon.

The primary management of recurrent infections and intertrigo affecting the lower half of the skin of the breast

**ADDITIONAL EDUCATIONAL RESOURCES**

**Resources for healthcare professionals**

- Dixon JM. Benign breast disease. In: Burnand KG, Young AE, Lucas J, eds. A new Airds companion to surgical studies. Elsevier, 2005:506-17
- Beers MH, Berkow R, eds. Breast disease. The Merck manual of diagnosis and therapy. 17th ed. Merck Research Laboratories, 1999
- Dixon JM. Breast infection. In: ABC of breast diseases. Blackwell Publishing, 2006:19-23

**Resources for patients**

- NHS Choices ([www.nhs.uk/Conditions/Breast-abscess](http://www.nhs.uk/Conditions/Breast-abscess))—Information on breast abscesses including causes, symptoms, diagnosis, risks, and treatment; has links to other useful resources
- Patient UK ([www.patient.co.uk/health/Mastitis-\(Breast-Infection\).htm](http://www.patient.co.uk/health/Mastitis-(Breast-Infection).htm))—Information on symptoms and treatment; allows patients to discuss their experiences

**TIPS FOR NON-SPECIALISTS**

- Prescribe appropriate antibiotics early to minimise subsequent abscess development
- In lactating infections, promote milk drainage by encouraging women to continue breast feeding
- Refer the patient urgently to a specialist breast surgeon if infection does not settle rapidly after one course of appropriate antibiotics
- Consider breast cancer in patients with an inflammatory lesion that persists despite appropriate management

should aim to keep the area as clean and dry as possible. In our experience, it is important for patients to wash at least twice a day and avoid all creams (including antifungals) and talcum powder. Cotton bras or a cotton T shirt or vest worn inside the bra may help keep the area clean and dry.

### Conclusion

The management of breast infection has changed and doctors in primary and secondary care should be aware of current protocols and management pathways. Breast infection is common and most cases resolve with antibiotics. Urgently refer any patient whose infection does not settle rapidly after one course of appropriate antibiotics to minimise the associated morbidity. Delay in referral or instituting inappropriate antibiotic treatment can have serious consequences, with loss of large volumes of breast tissue and substantial asymmetry (fig 8). Such a result has potential medicolegal consequences in modern medicine.

**Contributors:** LRK wrote the first draft. JMD helped finalise the manuscript and provided images.

**Competing interests:** All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

**Provenance and peer review:** Commissioned; externally peer reviewed.

**Patient consent obtained.**

- 1 ACOG. Committee opinion no 361: Breastfeeding: maternal and infant aspects. *Obstet Gynaecol* 2007;109:479-80.
- 2 Jahanfar S, Ng CJ, Teng CL. Antibiotics for mastitis in breastfeeding women. *Cochrane Database Syst Rev* 2009;1:CD005458.
- 3 Thrush S, Dixon JM. Treatment of loculated lactational breast abscess with a vacuum biopsy system. *Br J Surg* 2006;93:251.
- 4 Bharat A, Gao F, Aft RL, Gillanders WE, Eberlein TJ, Margenthaler JA. Predictors of primary breast abscesses and recurrence. *World J Surg* 2009;33:2582-6.
- 5 Moazzez A, Kelso RL, Towfigh S, Sohn H, Beme TV, Mason RJ. Breast abscess bacteriologic features in the era of community-acquired methicillin-resistant *Staphylococcus aureus* epidemics. *Arch Surg* 2007;142:881-4.

- 6 Schoenfeld EM, McKay MP. Mastitis and methicillin-resistant *Staphylococcus aureus* (MRSA): the calm before the storm? *J Emerg Med* 2010;38:e31-4.
- 7 Bundred NJ, Dixon JM, Lumsden AB, Radford D, Hood J, Miles RS, et al. Are the lesions of duct ectasia sterile? *Br J Surg* 1985;72:844-5.
- 8 Foxman B, D'Arcy H, Gillespie B, Bobo JK, Schwartz K. Lactation mastitis: occurrence and medical management among 946 breastfeeding women in the United States. *Am J Epidemiol* 2002;155:103-14.
- 9 Berens PD. Prenatal, intrapartum, and postpartum support of the lactating mother. *Pediatr Clin North Am* 2001;48:365-75.
- 10 Kvist LJ, Rydhstroem H. Factors related to breast abscess after delivery: a population-based study. *BJOG* 2005;112:1070-4.
- 11 Dener C, Inan A. Breast abscesses in lactating women. *World J Surg* 2003;27:130-3.
- 12 Arroyo R, Martin V, Maldonado A, Jimenez E, Fernandez L, Rodriguez JM. Treatment of infectious mastitis during lactation: antibiotics versus oral administration of lactobacilli isolated from breast milk. *Clin Infect Dis* 2010;50:1551-8.
- 13 Carmichael AR, Dixon JM. Is lactation mastitis and shooting breast pain experienced by women during lactation caused by *Candida albicans*? *Breast* 2002;11:88-90.
- 14 Anderson JE, Held N, Wright K. Raynaud's phenomenon of the nipple: a treatable cause of painful breastfeeding. *Pediatrics* 2004;113:360-4.
- 15 Roberts KL. A comparison of chilled cabbage leaves and chilled gelpaks in reducing breast engorgement. *J Hum Lact* 1995;11:17-20.
- 16 Rizzo M, Peng L, Frisch A, Jurado M, Umpierrez G. Breast abscesses in nonlactating women with diabetes: clinical features and outcome. *Am J Med Sci* 2009;338:123-6.
- 17 Dixon JM. Periductal mastitis and duct ectasia: an update. *Breast* 1998;7:128.
- 18 Bundred NJ, Dover MS, Aluwihare N, Faragher EB, Morrison JM. Smoking and periductal mastitis. *BMJ* 1993;307:772-3.
- 19 Paviour S, Musad S, Roberts S, Taylor G, Taylor S, Shore K, et al. *Corynebacterium* species isolated from patients with mastitis. *Clin Infect Dis* 2002;35:1434-40.
- 20 Janniger CK, Schwartz RA, Szepietowski JC, Reich A. Intertrigo and common secondary skin infections. *Am Fam Physician* 2005;72:833-8.
- 21 Dixon JM, Kohlhardt SR, Dillon P. Total duct excision. *Breast* 1998;7:216.
- 22 Galea MH, Robertson JF, Ellis IO, Elston CW, Blamey RW. Granulomatous lobular mastitis. *Aust N Z J Surg* 1989;59:547-50.
- 23 Wilson JP, Massoll N, Marshall J, Foss RM, Copeland EM, Grobmyer SR. Idiopathic granulomatous mastitis: in search of a therapeutic paradigm. *Am Surg* 2007;73:798-802.
- 24 Mansel RE, Webster DJT, Sweetland HM. Miscellaneous conditions. In: Mansel RE, Webster DJT, Sweetland HM, eds. *Benign disorders and diseases of the breast: current concepts and clinical management*. 3rd ed. Saunders, Elsevier, 2009:273-96.
- 25 Hughes LE, Mansel RE, Webster DJT. Miscellaneous conditions. In: Hughes LE, Mansel RE, Webster DJT, eds. *Benign disorders and diseases of the breast: current concepts and clinical management*. Edward Arnold, 2000:230.

**ANSWERS TO ENDGAMES, p 505.** For long answers go to the Education channel on [bmj.com](http://bmj.com)

### STATISTICAL QUESTION

#### Meta-analyses VII

Statements *a* and *c* are true, whereas *b* is false.

### ON EXAMINATION QUIZ

#### Vaccination

Answer C is true.

### PICTURE QUIZ Pigmentation and confusion

- 1 This patient has Addison's disease that had been progressing over the course of more than two years. She finally presented with an Addisonian crisis, which was most likely precipitated by a viral infection.
- 2 Figure 1 shows the development of generalised skin hyperpigmentation, a specific sign that should alert the clinician to Addison's disease as a likely diagnosis, and figure 2 shows the patient's level of pigmentation before the disease developed. The figure shown here shows an area of hyperpigmentation of the gingival mucosa.
- 3 To confirm diagnosis, measurement of 9 am cortisol concentration and adrenocorticotrophic hormone concentration, as well as a short Synacthen test (that is, an adrenocorticotrophic hormone stimulation test), should be performed.
- 4 Management of Addisonian crisis requires prompt fluid resuscitation and rapid hydrocortisone administration. Lifelong hydrocortisone and fludrocortisone replacement is necessary after resolution of the acute crisis.
- 5 Autoimmune hypothyroidism, pernicious anaemia, premature gonadal failure, vitiligo, alopecia, and type 1 diabetes mellitus are associated with Addison's disease. Autoimmune polyendocrine syndromes (synonymous with autoimmune polyglandular syndromes) should be considered if certain distinctive associated autoimmune conditions and a pattern of familial inheritance coexist.

