Research Highlight

Breast Implant Infections: Clinical Microbiology, Early Diagnosis, and Antibiotic Treatment

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In the United States, more than 95,000 breast reconstructions were performed in 2013. Of these, tissue expander- and/or implant-based surgical procedures accounted for nearly 79%[1]. Meanwhile, plastic surgery in developing countries, particularly breast esthetic and reconstructive surgery, is drawing more attention. A literature review indicates that up to 2.9% of women receiving esthetic breast augmentation have postsurgical infection[2], and the rate of surgical site infection with postmastectomy breast reconstruction is usually higher, ranging from 1% to 53%, particularly with expander implants and in developing countries[3]. The most common surgical site infections (SSIs) account for 73% of healthcare-associated infections (HAIs)[4]. SSIs not only increase the length of hospital stay but also increase costs between $10,443 and $25,546 per infection[5]. Postsurgical implant infections, together with concerns such as infections related to artificial joints and heart valves, result in a new disease burden. To assess the threat caused by infections implants to patient safety, we assessed the associated clinical pathology and effects of early diagnosis and antibiotic treatment.

Clinical Pathology

Although increased body mass index, diabetes, smoking, chemotherapy, larger breast size, and other factors are thought to be individual risk factors related to postsurgical breast implant infection, the real determinant of the SSI rate is the surgical technique. Overall, SSI seems to be more frequent in patients who have immediate reconstruction than in those who have delayed and multistep reconstruction, which may be due to contamination of the surgical bed. Axillary node dissection is related to a 6.29-fold increase in the chance of implant infection. In the United States, up to 56% of breast reconstruction surgeries that involve tissue expanders and/or implants use the acellular dermal matrix (ADM), which increases the risk of infection, as confirmed by Liu et al.[6]. Infection rates in breast reconstruction with ADM can exceed 31%. In 2012, Leyngold et al.[7] reported on 195 women who had breast reconstruction surgery and an infection rate of 5%; inpatient procedures were the only significant risk factor. A case report of 470 patients[6] showed an immediate postreconstruction implant removal rate of 4.2% because of infection related to ADM-coated implants; the removal rate for noncoated implants was 2.4%. There is debate about whether drain placement increases SSI; however, it does seem to increase the regressive infection rate. Peled et al.[8] reported that adjuvant chemotherapy was associated with a 44% infection rate following mastectomy and immediate reconstruction in comparison with a 23% infection rate with neoadjuvant chemotherapy and a 25% infection rate without chemotherapy. Patients with breast implantation frequently experience local complications in the following 5 years; however, there are significantly fewer complications in patients who receive cosmetic implants than in those who receive implants following mastectomy for cancer or for cancer prophylaxis[9].

The most common postoperative acute infections usually occur between the first and sixth weeks after surgery; the average time of onset is 10 to 12 days after surgery. Gram-positive microorganisms of endogenous breast flora are mainly involved. Coagulase-negative *staphylococci* are most frequently observed; others include *Staphylococcus aureus*, methicillin-resistant *S. aureus* (MRSA), *Streptococcus pyogenes*, *Propionibacterium acnes*, diphtheroids*, lactobacilli,* and *Bacillus* species[10]. Gram-negative bacteria have been reported in only 6% of infections. In general, clinical presentation includes breast erythema, edema, pain, fever, and the presence of leukocytosis.

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More seriously, SSI can cause toxic shock syndrome (TSS) via toxin-producing strains of *S. aureus* and *S. pyogenes*[11]. Late infections, which occur within 8 to 26 weeks (average 4 to 13 weeks), involve gram-positive and gram-negative microbes; however, coagulase-negative *staphylococci* and *P. acnes* are the most common infectious bacteria. Delayed wound healing, rather than breast pain along with slightly warm and stretched skin, is often the primary indicator of infection. Bacteremia occurs in 30% of normal hosts but in up to 80% of immunocompromised patients. Late infections may be due to *Pasteurella multocida*, *Brucella*[12], *Listeria*, *Clostridium perfringens*, *Granulicatella adiacens*, *Enterococcus avium*, *Bacteroides fragilis*, *Pseudomonas aeruginosa,* and others. In addition, fungal infections by *Trichosporon* spp., *Aspergillus flavus*, *A. niger*, and *Candida albicans*[13] have been described. However, some rare infectious pathogens are noteworthy, including some that are commonly present in soil as well as municipal and hospital water systems. For example, atypical *mycobacteria* [rapid-growing *Mycobacterium* (RGM) is the most frequently isolated microorganism] account for 60% to 80% of postsurgical wound infections[14]. Other rare causative bacteria include *S. marcescens, R. equi*, *Gordonia sputi*, and others.

Early Diagnosis

Early identification and diagnosis are necessary to address breast implant infections. The most common pathogens are those detected on the breast skin, which often helps direct empirical therapy. Thus, bacterial cultures remain the gold standard for identifying antibiotic resistance via aspirated periprosthetic fluids or biopsy samples, particularly in late and rare infections. In addition, the high rate of resistance to multiple drugs emphasizes on the importance of cultures and antibiogram. However, the clinical presentation of patients does not always provide a clear clue to subsequent treatment; patients may present with fever, leukocytosis associated with edema and swelling, and others. Surgeons should note these signs that imply the possibility of infection. Furthermore, clinicians should pay attention to atypical *mycobacterial* infections, which are becoming more prevalent in developing countries. It is difficult to identify rare infections via culture; genomic sequencing is often necessary. Usually, rare bacterial identification of the strain is possible by 16S rRNA sequencing. According to the primer, we may obtain a 1-k to 2-kbp sequence. This sequence can then be compared with different GenBank accession numbers. The comparison results are helpful for identification, particularly of important and nonspecific clinical pathogens. Because most infections are caused by endogenous skin flora such as coagulase-negative *staphylococci* and *S. aureus*, empiric therapy with vancomycin (strictly limited in uncontrolled infection), extended-spectrum penicillins, and cephalosporins is recommended before culture and antibiogram. The high number of infections are caused by beta-lactam-resistant pathogens, including methicillin-resistant *S. aureus* and coagulase-negative *staphylococci*. If routine culture results are negative, therapy must be performed for two weeks to eliminate possible pathogens. At the same time, an atypical *mycobacterial* culture must be performed.

Antibiotic Treatment

According to the U.S. Centers for Disease Control and Prevention (CDC) guidelines for SSIs, the average SSI rate is 14.4% without preoperative antibiotic prophylaxis and 5.8% with preoperative antibiotic prophylaxis[15]. At present, based on *in vitro* susceptibilities, the preferred antimicrobials include imipenem, vancomycin, linezolid, fluoroquinolones, erythromycin, rifampin, and aminoglycosides. For susceptibility variability, clindamycin, tetracyclines, chloramphenicol, trimethoprim-sulfamethoxazole, and cephalosporins cannot be considered as first-line antimicrobials. In practice, a single dose of intravenous (IV) first- or second-generation cephalosporins before anesthetic procedures is often administered. If the surgical time exceeds 3 h, an intraoperative dose of antibiotic may be required. However, postoperative antibiotics should not be administered for longer than 24 h. The current literature lacks consensus on the necessary duration of postoperative antibiotic prophylaxis, including for ADM breast reconstruction. In addition, prolonged antibiotics are associated with systemic side effects as well as bacterial resistance and *C. difficile* infection (CDI). In addition to empirical therapy for addressing uncommon pathogens, after prosthesis removal, systemic antibiotics should generally be administered for 10 to 14 d, and reimplantation is often performed 3 to 6 months later.

In general, the most common pathogens related to breast implant infections arise from the breast skin. However, in this study, we highlight increasing

rare pathogenic infections. Resolving such infections includes strict aseptic protocol, prophylactic preoperative antibiotics, implant removal, and other surgical procedures such as debridement and drainage. Without sufficient evidence, prolonged antibiotic therapy is not recommended. Of course, regulatory plastics healthcare choice is the most important for patients.

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