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Assessment of Breast Bacterial Infection in Women: A Review

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Abstract

Many studies reported that the bacteria are one of the causes of infections occurs in women's breast, mastitis, and the common bacteria that cause breast infections are *S. aureus* and *S. epidemidis*. However, there is a rare/or uncommon bacteria that cause infection including *Pseudomonas* species, *Salmonella* species, *Porteus mirabilis*, *Klebsiella pneumonia*, *Streptococcus* group A/or B, *Brucella*, *E. coli* and *Mycobacterium* species.

The mastitis affects both lactation and non-lactation women. Most bacteria contain virulence factors that help to penetrate the invaded tissue and secreted enzymes that degraded skin/tissue.

In some cases, there is a possibility to increase the severity of the infection and led to cancer. We recommended the women they notice any abnormal change or feeling pain in the breast to visit a specialist to check their breast for any infection.

Keywords: Breast infection, *S. aureus*, *S. epidemidis*, other bacteria.

1. Introduction

Breast infection is common in breastfeeding women (lactating women) which occurs in approximately 20 % of breastfeeding women and may lead to the stop the breastfeeding. It is ranged from mild superficial mastitis to deep abscesses. This infection also occurs in non-breastfeeding women, however its uncommon (Abdel Hadi, Bukharie, 2005; Cullinane et al., 2015).

The majority of cases occur in the first 6 weeks of post-partum when bacteria enter milk ducts from baby's mouth through a crack in the nipple but also can occur at any time during lactation or non-lactation (AL-awady et al., 2019).

The infection affects the fatty tissue in the breast, cause swelling, lumps, and pain. Most breast infections are due to breastfeeding or clogged milk ducts, and a small percentage is associated with rare kinds of breast cancer. A chronic inflammation of the breast, affecting mainly women of reproductive age, is commonly associated with duct ectasia, and breast abscess (Ducatman, Wang, 2009) and the breast abscess occurs generally in women with infectious mastitis (Abdul-Razaq et al., 2014). Traditionally, *Staphylococcus aureus* has been considered the most common etiological agent of mastitis and is often isolated in cases of infective mastitis and breast abscesses. Many other opportunistic pathogens are known to cause mastitis including, *P. aeruginosa*, *E. coli*, *S. agalactiae* and *K. pneumoniae* (Dudhatra et al., 2010).

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2. Results and discussion

Staphylococcus aureus

Amir et al. (2006) found that women with mastitis were more likely to have *S. aureus* present in breast milk than women in the control group. In another study by Cullinane et al., (2015) who investigates the presence of *S. aureus* in women with mastitis, they found there was a positive correlation (Cullinane et al., 2015). Also, the study obtained by Kataria et al., (2013) shows that *S. aureus* is a common cause of abscess in the breast. This bacteria has many virulence factors include coagulase, collagenase, exfoliate toxin, hemolysins, hyaluronidase, leucocidins, lipase, nuclease and staphylo-kinase, which can invade and colonize host tissue and evasion of the host immune defence mechanisms (Tuchscherr et al., 2019).

Fifty percent of *S. aureus* that causes breast abscess are penicillin-sensitive and there is an increasing range of methicillin-resistant *Staphylococcus aureus* (MRSA) breast abscess which is susceptible to antimicrobials like trimethoprim/sulfamethoxazole, fluoroquinolones and clindamycin (Ramakrishnan et al., 2017).

Abdel Hadi and Bukhari (2005) collected samples from 6314 patients with breast problems and find that 179 (3.5 %) had a breast infection. Of these infected clinical conditions were found in 26 patients (60 %) in non-lactating namely granulomatous mastitis 13(50 %), duct ectasia 4(15.3 %), pregnancy 3(11.5 %), diabetes 3(11.5 %), fat-necrosis 1(3.8 %) and breast cancer 2(7.6 %).

The pattern of culture results was different in the lactating and non-lactating from differing causative organisms, but *S. aureus* was the communal organism in patients. Other organisms as *K. pneumoniae*, Streptococcus group-B, *Peptococcus Magnus*, *E. cloacae*, Methicillin-resistant *S. aureus* and *M. tuberculosis* occurring in non-lactating only (AbdelHadi, Bukharie, 2005).

In a study conducted by AL-awady et al. (2019), they have used sau gene which is a specific gene for detection of *S. aureus* to confirm the diagnosis, found out of 100 samples only 50 samples contain this gene. In addition, specific primers (hla, hld, hlb, hlg) were used to amplify the four hemolysins virulence genes in all *S. aureus* isolates using PCR. The result demonstrated that 24 (54.5 %) of *S. aureus* have hld gene, followed by hla gene which constituted 20 (45.4 %), then hld gene 16 (36.3 %) followed by hlb gene which constituted 14 (32 %) from all *S. aureus* isolates. Oliverira et al. (2013) found that beta-hemolysins toxin is produced in large quantities in *S. aureus* strain isolated from mastitis and human skin infection. Beta-hemolysins is cytotoxic towards human keratinocytes, Polymorph nuclear leukocyte, monocyte, T-lymphocyte, inhibit interleukin 8 expressions by endothelial cell, and induce biofilm formation in *S. aureus*.

Bengualid et al. (2008), recorded that the most common pathogen in non-lactating breast abscesses was *S. aureus* (32 %) and 39 % of abscesses were caused by poly-microbial; while 7 % were an-aerobic pathogens. These cases were including 13 cases of nipple piercing infections and 4 cases were coagulase-negative staphylococci, four cases were mycobacteria, and others an-aerobes, group A streptococcus, *Gordonia terrae* and group B streptococcus.

Co.N.S species, Pseudomonas species & other bacteria

Coagulase-negative staphylococci (Co.N.S) now consider a communal pathogen that can cause mastitis in the world such as *S. epidermidis*, *S. chromogenes*, *S. simulans*, *S. xylosum*, *S. hyicus*, and *S. haemolyticus* (Sakwinska, Bosco, 2019). Because of their ability to biofilm formation and colonization on any surfaces, in addition to virulence factor of biofilm, they have the methicillin resistance genes that make the treatment of its infection so difficult (Namvar et al., 2014). *Pseudomonas* species is an opportunistic nosocomial pathogen contains many virulence factors such as LasI and LasB. These factors increase the invasiveness of pathogen and their presence is necessary for the development of infection of *P. aeruginosa* (Al-Wrafy et al., 2016). They are also responsible for biofilm formation and antibiotic resistance which leads to increase the difficulty of treatment of this infection (Moghaddam et al., 2014).

Nezar et al. (2020) reported that the highest bacteria to cause acute mastitis in non-lactating women were *S. epidermidis*. They have collected fifty-six samples from nipple discharge out of them fifty-one samples give positive culture for bacteria, out of these fifty-one isolates they found 40 isolates were *S. epidermidis* (78.43 %), 3 isolates were *P. stutzeri* (5.88 %), 3 isolates were *P. oryzihabitans* (5.88 %), one isolate was *P. aeruginosa* (1.96 %), one isolate was *K. pneumoniae* (1.96 %), 2 isolates were *S. viridans* (3.92 %), and one isolate was *Acinetobacter baumannii* (1.96 %). The result of antibiotics revealed that *S. epidermidis* show high sensitivity to imipenem then tobramycin, gentamycin, and amikacin, respectively. *Pseudomonas* species are more sensitive

to imipenem, azithromycin, ciprofloxacin, tobramycin, amikacin, tetracycline, gentamycin, and piperacillin respectively. In addition, by using PCR found 4/40, isolates of *S. epidermidis* have *icaA* gene, all isolates of the *S. epidermidis* have *icaD* gene, *sei* gene enterotoxin found in 6/40 of isolates and *mecA* gene found in 38/40 of *S. epidermidis* isolates. In *Pseudomonas* species, the virulence factors *lasR*, *gyrB* and *lasI* genes were positive for all isolates.

Baqer and Mahdi (2019) identify seventy-four Co.N.S isolates, 56 mastitis & 18 healthy women. The most frequent bacterial isolates in lactating women, mastitis and healthy were *S. epidermidis*. The highest resistance percentages were found to ampicillin, erythromycin, trimethoprim/sulphamethoxazole, methicillin, carbenicillin, gentamicin, cefotaxime, temocillin, ceftazidim, cefepime, ciprofloxacin, ampicillin/sulbactam, ceftazidim, nalidixic acid and tobramycin, respectively. A study by Aldeen and Méshekoor (2017), recorded that *Staphylococcus epidermidis* was the most common species in breast infection followed by *Staphylococcus haemolyticus* and *Staphylococcus hominis*. They noticed that most of the Co.N.S isolates were resistant to penicillin G, Cefoxitin, oxacillin. All isolates appeared to have the *mecA* gene. In another study by Delgado et al. (2009), they reported the presence of staphylococci in twenty-seven of the thirty samples provided by women with locational mastitis. They collected a total of 270 isolates obtained from the Baird Parker agar plates, 10 from each lactating-woman, 200 isolates were identified as *S. epidermidis*, 35 isolates were *S. aureus*, 16 isolates were *S. pasteurii*, 11 isolates were *S. warneri* and 8 isolates were *S. hominis*. In a study conducted by Shnawa and Al-Bermani (2007) reported from sixty women with lactating mastitis and twenty normal lactating women as control milk samples 16 samples (26.6 %) were *S. aureus* isolates, *P. aeruginosa* 13 samples (21 %), *K. pneumonia* 10 samples (16 %), *S. epidermidis* 9 samples (15 %), *E. coli* 2 samples (3.3 %), *S. viridans* 1 sample (1.6 %). A Study by Al-Haddad et al. (2018) showed that *Salmonella* species, *P. aeruginosa*, *E. coli*, *P. mirabilis*, *K. pneumonia*, *Kocuria kristinae* and *Citrobacter* species are most causes of infection. Recently Chen et al. (2018) revealed that *Salmonella* species, *E. coli* and few by *P. mirabilis* result in different infections and no cases reported with re-current breast abscesses caused by *Kocuria kristinae*. Different bilateral breast abscess was caused by multiple organisms in immune-competent non-lactating women. Brucellar breast abscess is a rare entity, however, Erdem et al. (2006) and Ibis et al. (2009) were isolated *Brucella* species from breast abscess in old women. Another uncommon pathogen to cause mastitis is *Actinomyces europaeus*, which were isolated by Silva et al. (2011) from primary breast abscess in a post-menopausal woman.

Mycobacterium tuberculosis (TB)

In a study by Jairajpuri et al. (2018) reported that breast TB associated with both pulmonary and extrapulmonary manifestations which important to diagnose the disease as malignancy or present as an inflammatory lump/or abscess. Malhotra et al. (2015) were reported primary tubercular abscess in young non-lactating women represented by painful lump and non-specific symptoms. They use ultra-sound for breast, fine needle aspiration, cytology and Ziehl-Neelson staining confirmed on culture to diagnose tuberculosis. TB is a major public health problem in a developing country, for example in India accounting for 1/4 of the global incident TB cases annually.

Mycobacterium fortuitum

Mycobacterium fortuitum infection has been estimated to be between four and six cases per 1 million people. Abbass et al. (2014) recorded that *M. fortuitum* & *Nocardia* species form breast abscess after nipple piercing, however, this infection appears to be uncommon. At the time of writing this review, there were no-standard recommendations to controller treatment of breast abscess. The treatment of this condition is similar to the treatment of *M. fortuitum* implant infection. Betal and MacNeill (2011) recommended removal of the piercing as an initial measure, no standard duration of therapy has been described, treatment might last six months or more, and they used imipenem, doxycycline, sulfonamides, linezolid, fluoroquinolones, clarithromycin and ceftazidim, as first-line antibiotic therapy for *M. fortuitum* infection. Similarly, Bengualid et al. (2008) recorded two cases of infection by *M. fortuitum*.

Salmonella Species

Murugesan et al. (2016) isolate *S. typhi* in non-lactating women in ages between 23 and 45 years in immune-competent. The sensitivity test revealed that *S. typhi* sensitive to amikacin, ampicillin-sulbactam, ceftazidim, cefepime, piperacillin and imipenem. In a recently published study by Al-Benwan et al. (2010), *S. enterica* serotype Poona was isolated from abscess of the breast with

erythema-nodosum. The pathogenesis of abscess formation in *S. typhi* infection is unknown. Bilateral breast abscesses due to *S. typhi* is a rare condition (Singh et al., 2009). Rizzo et al. (2009) and Singh et al. (2011) isolated *S. enterica* serotype Typhi and *S. typhi* from non-lactating women with breast abscess, respectively. Brncic et al. (2012) isolated *S. enterica* serotype Enteritidis from old women with breast abscess and the infection was treated with a combination of surgical and antibiotic treatment. Likewise, Baran et al. (2016) isolated *S. enterica* serotype Typhimurium from breast abscess.

Age of patients with breast abscess

A breast abscess is an infection with pus cells which commonly affects women with age ranging from 18-50 years. It has been classified as a lactation & non-lactation infection (Dixon, 1994). Shnawa and Al-Bermani (2007) recorded that the domination mastitis age in lactating women was 15-45 years old. A study by Nezar et al. (2020) reported that the high incidence of infection in non-lactating women was among ages range (21-50) years and less incidence was in age under 21 and above 50 years, however, the incidence of infection is high in age 40-45 year. In another study by Al-Sarraf (2010), he recorded that the majority of breast disease was among ages of 21-50 years. The mean age of carcinoma was 41.5 years. In his study which including 53 patients had bacterial mastitis of these patients, 50 were lactating women, 13 (17.1 %) patients have carcinoma of the breast, 6 (7.9 %) patients with fibro-adenosis 2 (2.6 %) patients have fibro-adenoma, one patient has hydatid cyst in breast and one (1.3 %) patients with galactocele. Similarly, the study by Chen Chen et al. (2018) reported that 75 % of women were at the 2nd and 8th postpartum weeks at the time of diagnosis, 80.5 % patients were primi-parae while 19.5 % were multi-parae, 86.1 % of women have a history of milk stasis of the affected breast within three days before symptoms onset, 22.2 % of women have inverted nipples, while 11.1 % have damaged nipples with a mean duration of symptoms is 9.4 ± 6.2 days. 91.7 % of women recorded symptoms such as redness and swelling of the affected breast, 19.5 % of women ran a sustained fever at 24 hours and $\geq 38.5^{\circ}\text{C}$.

3. Conclusion

We concluded from previous studies that bacteria have an important role in mastitis, and of them, *Staphylococcus aureus* and *Staphylococcus epidermidis* are the most common bacteria that cause infection. Additionally, mastitis infections occur in breastfeeding and non-breastfeeding women. Other bacteria that cause infection but rare/or uncommon are *Pseudomonas* spp, *Salmonella* spp, *Porteus mirabilis*, *Klebsiella pneumonia*, *Streptococcus* group A/or B, *Brucella*, *E. coli* and *Mycobacterium* species. The mastitis infections occur in breastfeeding and non-breastfeeding women. Education on optimal placing and attachment are leading to a decrease in nipple injury and incidence of mastitis among women. Also, the combination of medical and surgical management is helps in some cases when supported by a microbiological culture and sensitivity report.

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