

Methicillin-resistant *Staphylococcus aureus* infections in postpartum period

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ABSTRACT

The overall risk of methicillin-resistant *Staphylococcus aureus* (MRSA) in obstetric populations is unknown. MRSA infection incidence has increased in pregnant women and neonates even if prevention techniques of MRSA have improved. MRSA infections affect both mothers and their infants. MRSA is the most common pathogen responsible for postpartum mastitis. There are also other postpartum infections with MRSA such as cellulitis, pelvic thrombophlebitis, pneumonia, septicemia, cesarean wound infections, episiotomy infections and urinary tract infections.

The objectives of this review were to identify the most frequent risk factors for postpartum MRSA infection and to determine the frequency of antibiotic-resistant *Staphylococcus aureus* infections after delivery.

A literature review was conducted using PubMed and we used the following key words "MRSA infection in postpartum", "risk factors for postpartum MRSA infection". We are included in our review 27 articles from the last 20 years which presented rare cases of MRSA infection in postpartum and those which identified the risk factors of this infection after delivery.

Infections with MRSA appear to be more frequent among pregnant women colonized with MRSA. Early identification of MRSA, early diagnosis and appropriate treatment of infection is mandatory for a good prognosis. By now, vigilance and effective MRSA prevention strategies are considered essential to limit the spread and infection.

Keywords: methicillin-resistant *Staphylococcus aureus*, postpartum infection, risk factors

INTRODUCTION

Antimicrobial resistance is a major global health concern and *Staphylococcus aureus* (SA) is a dangerous pathogen, responsible for multiple human infections involving the skin, soft tissue, bone, joints or infections associated with indwelling medical devices [1-4]. Bacteremia with methicillin-resistant *Staphylococcus aureus* (MRSA) can cause secondary infections such as infective endocarditis, septic arthritis, and osteomyelitis and complications such as sepsis and septic shock that may be life-threatening [4].

Methicillin-resistant *Staphylococcus aureus* often colonize asymptotically skin, skin glands or

mucous tissues of healthy individuals [5]. MRSA is one of the major causes of hospital and community-acquired infection [1-2]. Studies have shown that about 20% of individuals are persistent nasal carriers of *Staphylococcus aureus* and around 30% are intermittent carriers [6]. In the hospital, contaminated medical devices may play a role as intermediate sources of MRSA infection, but ultimately these originate from patients or healthcare workers that carry MRSA [6]. This colonization represents a reservoir of the pathogen, and it significantly increases the chances of infections. In most cases, the affected individuals are infected by the *Staphylococcus aureus* with which they usually are colonized [7]. Re-

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sistance to the entire class of β -lactam antibiotics, such as methicillin and penicillin, makes MRSA infections difficult to treat and with poorer clinical outcomes [8].

Hospital-acquired MRSA infections generally arise from persistent carriers undergoing antibiotic therapy or from intermittent carriers [9].

The overall risk of MRSA in obstetric populations is unknown. The objectives of this review were to identify the most frequent risk factors for postpartum MRSA infection and to determine the frequency of antibiotic-resistant *Staphylococcus aureus* infections in pregnant and postpartum women.

METHODS

A literature review was conducted using PubMed and we used the following key words “MRSA infection in postpartum”, “risk factors for postpartum *Staphylococcus aureus* infection”. We are included in our review 27 articles from the last 20 years which presented rare cases of MRSA infection in postpartum and those which identified the risk factors of this infection after delivery. Publications were selected based on accessibility to full paper article, publication year, attempting to select recent studies. The publications used are mentioned in the References section.

RISK FACTORS FOR MRSA INFECTION IN POSTPARTUM PERIOD

Over the years, MRSA infection has increased in pregnant women and neonates, even in developed countries [10,11]. Infections with MRSA appear to be more frequent among patients colonized with MRSA in the anterior nares and other sites [9]. Moreover, the exposure to antibiotics of pregnant women is frequent and this is a known risk factor for MRSA infection [12]. MRSA infections affect both mothers and their infants. It is the most common pathogen responsible for postpartum mastitis [13]. There are also other postpartum infections with MRSA such as cellulitis, pelvic thrombophlebitis, pneumonia, septicemia, cesarean wound infections, episiotomy infections and urinary tract infections [14].

There are some studies that showed an increasing neonatal MRSA colonization and, sometimes, infection because of horizontal transmission from MRSA colonized mothers to their neonates [15].

Other studies investigated that the high volume of deliveries at the hospital, provider level and cesarean section rates may predispose to postpartum MRSA infection, but clear data were not found, and additional studies are needed [16]. Overall, postpartum MRSA is associated with worse health and economic outcomes for women and their infants [17].

However, the asymptomatic colonization with MRSA in pregnancy is considered the major risk factor for infection after delivery, including serious systemic infections. Stumpf et al. reported a serious postpartum infection (wound abscess, septicemia, septic thrombophlebitis and septic pulmonary emboli) due to MRSA in an asymptomatic carrier who had screened positive for MRSA in nares, vagina, and rectum at the time of her prior admission in labor, as part of a research study [18].

THE WAY OF MANIFESTATION OF THE MRSA INFECTION AFTER DELIVERY

The most frequent way of manifestation of the MRSA infection was postpartum breast abscesses. Other postpartum infections with MRSA such as cesarean wound infections, episiotomy infections, endometritis and urinary tract infections may appear. There were also reported serious and potentially life-threatening infection such as septic thrombophlebitis, septic pulmonary emboli and septicemia.

Toxic shock syndrome in postpartum period due to MRSA may be, frequently, caused by endometritis or mastitis. A case of postpartum MRSA-toxic shock syndrome was reported from a perineal laceration [19]. Ovarian vein thrombophlebitis and deep septic pelvic thrombophlebitis have been described as rare forms of MRSA-infection after delivery [20]. An isolated native pulmonary valve infection endocarditis complicated by a pelvic abscess, clavicular osteomyelitis and polyarticular septic arthritis, was presented as a rare occurrence after vaginal delivery in a patient with intravenous drug use [21].

Cases of osteomyelitis involving femoral head [22], pubic symphysis [23,24], and tibia [25] or the sacroiliac joint destruction (sacroiliitis) [26-28] were also described as rare MRSA infection in postpartum.

DISCUSSION

MRSA infections can be divided into hospital-associated infections and community-associated infections. The most important risk factor considered that influence the MRSA infection is colonization with MRSA. Frequently, *Staphylococcus aureus* (SA), including MRSA colonizes the anterior nares [9], but it may also be present in the throat, axilla, rectum, groin area, perineum, or vagina and most often it colonizes more than one site [8].

The vagina is colonized by SA in 4-22% of pregnant women and the prevalence of MRSA rectovaginal colonization has been reported to range 0.5-10% [29,30]. There are reports that vaginal carriage during pregnancy represents a major risk factor for MRSA infections in pregnant and postpartum wom-

en as well as for the transmission of MRSA to the newborn [30].

Deng et al utilized *in vitro* and *in vivo* models of MRSA vaginal colonization to identify determinants of persistence within the female reproductive tract and demonstrated that both hospital-associated and community-associated MRSA isolates can colonize the murine vaginal tract. These results revealed that fibrinogen binding and the host nutritional limitation are important determinants of MRSA vaginal colonization [30].

Top et al. conducted a retrospective cohort study and demonstrated that rectovaginal colonization with SA was associated with an increased risk of infections in women but not in their infants and the frequency of MRSA infections was low. For these reasons the routine MRSA screening of pregnant women may not be indicated [29].

Hospitalization is another important risk factor for methicillin resistant *Staphylococcus aureus* infection [31-36]. Hospital associated MRSA infections usually are associated with invasive procedures or devices, such as surgeries or intravenous catheterization [31,35-36]. It is considered, also, that a high patient volume and a high rate of cesarean section have been correlated with both general nosocomial infections and MRSA infection in early postpartum period and colonization of the hospital departments [16,31-34,37]. Possible way of transmission may be via health care workers hands touching people with unclean hands or contaminated medical devices [31-36]. Moreover, in a hospital with a high volume of deliveries and an exposure to more patients, the transmission has more opportunity to be via carrier patients to other patients, possible by hands, clothing or touching unclean surfaces [16,35-37].

On the other hand, Janakiraman et al. found that individual providers with a low volume of deliveries have a higher incidence of maternal complications (including infections) compared with providers with a high volume [37]. High volume of work is associated with better experience and better results. More studies should be conducted for a reliable conclusion.

Another risk of MRSA infection at women undergoing cesarean sections is associated with the prophylactic antibiotics, which may increase the number of drug resistant organisms [38-40].

Prevention of MRSA infection is the solution of this health concern. Over the years, guidelines have been established and most hospitals have an expert team who perform surveillance and monitor for outbreaks of MRSA. All MRSA cases need to be reported when they are discovered, and preventive measures are mandatory to be applied to limit the spread. An effectively prevention of MRSA infection and transmission includes active surveillance, isolation precautions, increased hand hygiene compliance, environmental cleaning, and decontamination [41]. There are controversies regarding universal screening and decolonization. In UK methicillin-resistant *Staphylococcus aureus* screening of 'high risk' cases and women undergoing elective cesarean sections is taken into consideration [42]. The recent data from the USA do not support precesarean section universal screening for SA and decolonization of carriers to be beneficial for mothers or babies because it is unlikely to be cost-effective under the known epidemiological conditions [43-46].

CONCLUSIONS

Infections with MRSA appear to be more frequent among patients colonized with MRSA. Even if identification and prevention techniques of MRSA have improved, these infections remain a major healthcare problem in obstetrics, associated with poor clinical outcomes and a worse economic effect. Early identification of MRSA, early diagnosis and appropriate treatment of infection is mandatory for a good prognosis. By now, vigilance and effective MRSA prevention strategies are considered essential to limit the spread and infection.

Universal screening for MRSA before cesarean section and decolonization of carriers are not cost-effective and are not recommended.

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