ORIGINAL ARTICLE

A Study of the Incidence, Risk Factors, and Current Approaches to the Prevention and Management of Post Cesarean Section Wound Infections

Ahmed A. Hussein *, Muhammad M. Jebril, Muhammad A. Abdelmoaty

Department of Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***Post-cesarean wound infections significantly impact maternal health, prolong hospital stays, increase costs, and cause complications. Rising cesarean section (CS) rates heighten SSI risks, making understanding incidence, risk factors, microbiology, prevention, and management crucial for better outcomes.***

Aim of the work: ***To provide a comprehensive analysis of post-CS wound infections, focusing on their epidemiology, associated risk factors, microbial aetiology, current preventive strategies, and evidence-based management approaches.***

Methods: ***A narrative review of existing literature was conducted, analyzing studies on the incidence, risk factors, and clinical management of post-CS wound infections. Relevant data on microbiological profiles, antibiotic resistance patterns, and preventive measures, including surgical techniques and prophylactic antibiotic use, were reviewed.***

Results: ***The incidence of post-CS wound infections varies widely, ranging from 3% to 15%, with higher rates in low- and middle-income countries. Key risk factors include obesity, diabetes, prolonged labour, emergency CS, and inadequate perioperative infection control. The most commonly isolated pathogens are Staphylococcus aureus, Escherichia coli, and Klebsiella pneumoniae. Effective prevention includes timely antibiotic prophylaxis, optimal skin preparation, and improved surgical techniques. Management strategies involve antibiotic therapy, wound care, and, in severe cases, surgical intervention.***

Conclusion: ***Post-CS wound infections remain a major obstetric concern despite advancements in prevention and management. A multifaceted approach, including evidence-based perioperative care and antimicrobial stewardship, is crucial to reducing infection rates and improving maternal health outcomes. Further research is needed to refine prevention protocols and address emerging antibiotic resistance challenges.***

Keywords: Post caesarean section; Emergency CS; Wound infections; SSI

1. Introduction

Cesarean delivery is a crucial surgical procedure aimed at protecting both maternal and neonatal health. Over recent decades, its global prevalence has risen sharply, with an estimated 22.9 million procedures performed in 2012 alone.[1] While cesarean sections help prevent adverse outcomes, they also carry risks, including surgical site infections (SSIs).[2] SSI rates after cesarean delivery range from 3% to 15% worldwide, influenced by factors such as population characteristics, underlying risks, perioperative care, and infection assessment time frames.[3]

Over the past 30 years, significant advancements in medical practices have contributed to a notable decline in the risk of SSI following cesarean procedures.[4] Enhanced hygiene measures, the widespread use of antibiotic prophylaxis, improved sterile techniques, and other preventive strategies have played a crucial role in reducing infection rates. However, despite these improvements, the ongoing rise in cesarean delivery rates suggests that the absolute number of post-cesarean SSIs may continue to grow.[5]

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* Corresponding author at: Obstetrics and Gynecology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: ahmedabdelnaby138@gmail.com (A. A. Hussein).

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Postoperative SSI following a cesarean section can have serious consequences for maternal health. It can lead to increased maternal morbidity and, in severe cases, mortality.[6] Additionally, the presence of an infection can be distressing for a new mother, who must simultaneously recover from major surgery while caring for her newborn. The challenges associated with post-cesarean SSI extend beyond personal health concerns, as they may also result in prolonged hospital stays, increased medical expenses, and additional socioeconomic burdens on families and healthcare.[4]

Given these potential complications, preventing SSI in post-cesarean patients remains a critical aspect of obstetric care. Continued efforts to optimize infection control measures, implement evidence-based perioperative practices, and promote timely interventions are essential to minimizing the risk of infection and improving maternal outcomes. Although significant progress has been made in reducing infection rates, the growing number of cesarean deliveries worldwide underscores the ongoing need for vigilance in surgical care to ensure the best possible health outcomes for mothers and their infants.[7]

This review aims to provide a comprehensive overview of the incidence and risk factors associated with post-cesarean wound infections. We will also discuss the microbiology of these infections, current preventive measures, and evidence-based management strategies. By synthesizing the latest research, this review seeks to inform clinical practice and guide future research efforts to reduce the burden of post-cesarean wound infections.

This review aims to provide a comprehensive analysis of post-cesarean wound infections by exploring their incidence, associated risk factors, and microbial aetiology. Additionally, it evaluates current preventive strategies and evidence-based management approaches to guide clinical practice and improve maternal health outcomes.

Epidemiology of Post-Cesarean Wound Infections

The incidence of post-cesarean surgical site infections (SSIs) varies across regions and healthcare settings, with global rates ranging from 3% to 15%. Higher infection rates are reported in low- and middle-income countries (LMICs), such as 19% in Kenya, 16.2% in Nigeria, and 24.3% in Pakistan, compared to lower rates in China (3.34%) and Israel (3.7%).[3]

These disparities stem from differences in healthcare infrastructure, infection prevention measures, and patient demographics. In LMICs, limited access to sterile environments, inadequate antibiotic prophylaxis, and resource constraints contribute to higher SSI rates.[3] In contrast, countries with advanced healthcare systems enforce stricter infection control protocols, leading to lower infection rates.[8]

Understanding these differences is vital for improving maternal health outcomes. Strengthening surgical hygiene, antibiotic stewardship, and healthcare accessibility in high-risk regions can help reduce SSIs. While high-income countries have seen declining SSI rates, rising cesarean deliveries in LMICs necessitate targeted interventions for safer childbirth practices. [1]

Microbiology of Post-Cesarean Wound Infections

Post-cesarean wound infections are typically polymicrobial, involving both aerobic and anaerobic bacteria. The most frequently identified pathogens include Staphylococcus aureus, coagulase-negative staphylococci, Enterococcus species, and Gram-negative bacilli such as Escherichia coli. These infections often arise from a combination of the patient's skin and vaginal flora, along with microorganisms present in the hospital environment.[9]

Among the various pathogens, Staphylococcus aureus is the most commonly isolated bacterium in surgical site infections (SSIs), responsible for approximately 15%–20% of cases. A growing concern in healthcare settings is the prevalence of methicillin-resistant Staphylococcus aureus (MRSA), which complicates treatment and increases the risk of poor outcomes. In addition to S. aureus, Gram-negative bacteria such as E. coli and Klebsiella species are frequently implicated, particularly in cases of endometritis and deep SSIs.[8]

The polymicrobial nature of these infections highlights the necessity of broad-spectrum antibiotic therapy for both prevention and treatment. However, the rising incidence of antibiotic-resistant organisms presents a significant challenge in managing post-cesarean SSIs. This growing threat emphasizes the need for enhanced antimicrobial stewardship, improved infection control practices, and the development of novel therapeutic strategies to reduce the burden of surgical infections and improve maternal health outcomes.

Risk Factors for Post-Cesarean Wound Infections

Several risk factors have been identified for post-cesarean wound infections, including patient-related, surgical, and healthcare-related factors. Understanding these risk factors is essential for identifying high-risk patients and implementing targeted preventive measures.

Patient-Related Risk Factors:

Obesity is a major patient-related risk factor for post-cesarean surgical site infections (SSIs). Women with a BMI over 30 kg/m² face an increased risk, which rises further with a BMI above 35 kg/m². Obesity impairs wound healing due to excess subcutaneous tissue, poor circulation, and reduced oxygenation, increasing the likelihood of wound dehiscence, seroma formation, and infection.[10]

Other patient-related factors also contribute to SSIs. Diabetes, whether pregestational or gestational, weakens immune function and disrupts glycemic control, impairing leukocyte activity and delaying wound healing. Hyperglycemia further promotes bacterial colonization, elevating infection risks.[8]

Smoking during pregnancy also heightens SSI risk by reducing tissue oxygenation, impairing collagen synthesis, and weakening immune responses, leading to delayed healing and increased complications. Additionally, immunocompromised conditions further compromise infection control and wound recovery.[10]

To reduce SSI risk, optimizing maternal health through weight management, blood sugar control, smoking cessation, and enhanced perioperative care is essential for improving surgical outcomes and maternal health.

Surgical and Obstetric Risk Factors

The risk of post-cesarean surgical site infections (SSIs) is influenced by the type and timing of the procedure. Emergency cesarean sections carry a higher infection risk than elective ones due to inadequate surgical preparation, prolonged labour, and increased bacterial exposure. When labour exceeds 12 hours, the likelihood of infection rises significantly. Additionally, factors such as excessive tissue handling, intraoperative complications, and blood loss further contribute to the risk.[10]

Surgical factors also play a crucial role. Longer incisions (over 16.6 cm) and prolonged procedures (beyond 38 minutes) are associated with higher SSI rates due to greater tissue trauma and prolonged exposure to contaminants. Operative vaginal delivery techniques, such as forceps or vacuum assistance, can introduce additional trauma, increasing infection risk.[10]

To reduce SSIs, optimizing surgical techniques, maintaining aseptic conditions, minimizing operative time, and managing labour effectively are essential. Understanding these risks enables targeted interventions, improving maternal health outcomes.[10]

Healthcare-Related Risk Factors

Healthcare-related factors significantly influence the risk of post-cesarean surgical site infections (SSIs). Key aspects include antibiotic prophylaxis, surgical techniques, and infection control measures.[11]

Timely antibiotic administration is crucial, with studies showing that giving prophylactic antibiotics within 60 minutes before incision is more effective than administering them after cord clamping. This approach ensures adequate tissue drug levels, preventing bacterial colonization. First-generation cephalosporins, like cefazolin, are preferred due to their broad-spectrum efficacy.[11]

Surgical techniques also impact infection risk. Suture closure of the skin is associated with lower SSI rates compared to staple closure, particularly in obese women, as it promotes better wound healing. While subcutaneous drains have been used to prevent fluid accumulation in women with thicker tissue, they have not shown significant benefits in reducing infections.[12]

Maintaining a sterile operative field, minimizing surgical time, and following strict infection control protocols further reduce SSIs. Optimizing these practices enhances maternal recovery and safety after cesarean delivery.[12]

Prevention of Post-Cesarean Wound Infections

Preventing post-cesarean wound infections requires a multifaceted approach that addresses both patient-related and healthcare-related risk factors. Evidence-based interventions, such as prophylactic antibiotics, optimal surgical techniques, and enhanced infection control measures, are essential for reducing the incidence of these infections.

Prophylactic Antibiotics

The use of prophylactic antibiotics is one of the most effective measures for reducing post-cesarean surgical site infections (SSIs). First-generation cephalosporins, such as cefazolin, are the preferred agents for prophylaxis due to their broad-spectrum activity against common pathogens.[14] The recommended dosage is 1 g administered within 60 minutes before the skin incision to ensure optimal tissue penetration and effectiveness. However, for women with a body mass index (BMI) greater than 30 kg/m² or a weight exceeding 100 kg, a higher dose of 2 g is recommended to account for altered drug distribution and maintain adequate antimicrobial coverage. [11]

Recent research has investigated the potential benefits of supplementing standard antibiotic prophylaxis with azithromycin. A randomized controlled trial conducted by Tita et al. demonstrated that adding a single 500 mg intravenous dose of azithromycin to routine prophylaxis significantly reduced the incidence of endometritis and wound infections in women

undergoing non-elective cesarean sections.[15] These findings suggest that azithromycin may enhance infection prevention, particularly in high-risk cases. However, further studies are necessary to confirm these results and assess the long-term safety and efficacy of azithromycin use in cesarean deliveries. Continued research will help refine antibiotic protocols and improve maternal outcomes following cesarean sections.

Surgical Techniques

Optimal surgical techniques are critical for reducing the risk of post-cesarean wound infections. The choice of skin incision, method of skin closure, and management of subcutaneous tissue all play a role in preventing SSIs. A transverse skin incision, such as the Pfannenstiel incision, is preferred in most cases due to its association with improved wound healing and patient satisfaction. Suture closure of the skin has been shown to reduce the risk of wound infections compared to staple closure, particularly in obese women.[12]

The management of subcutaneous tissue is also important, particularly in women with a subcutaneous tissue thickness of>2 cm. Suture closure of the subcutaneous tissue has been associated with a lower risk of wound complications, including hematoma and seroma, in these patients.[16] However, the use of subcutaneous drains has not been shown to reduce the risk of SSIs and is therefore not recommended.[13]

Infection Control Measures

Enhanced infection control strategies, including preoperative skin preparation and vaginal cleansing, are essential for reducing post-cesarean surgical site infections (SSIs). Chlorhexidine-alcohol has been shown to be more effective than povidone-iodine for skin antisepsis due to its superior antimicrobial activity and prolonged bacterial suppression, making it the preferred choice.[12]

Vaginal cleansing with povidone-iodine is particularly beneficial for women with ruptured membranes, as it reduces bacterial contamination and lowers the risk of endometritis, a common postpartum infection.[17]

Proper hair removal techniques also contribute to infection prevention. Clipping hair instead of shaving minimizes skin abrasions that can serve as bacterial entry points, reducing SSI risk.[18]

Surgical bundles, which integrate evidence-based practices such as timely antibiotic administration, optimal surgical techniques, and strict infection control, have proven effective in reducing SSIs.[10]

By implementing these strategies, healthcare providers can improve maternal outcomes, enhance patient safety, and minimize post-cesarean complications.

Management of Post-Cesarean Wound Infections

The management of post-cesarean wound infections requires a combination of antibiotics, surgical intervention, and wound care. Early recognition and prompt treatment are essential for preventing complications and improving outcomes.

Antibiotic Therapy

Prompt initiation of empiric antibiotic therapy is essential in suspected post-cesarean wound infections to prevent complications and aid recovery. Antibiotic selection should target likely pathogens and consider local resistance patterns for optimal treatment.[19]

For superficial infections like cellulitis, oral antibiotics such as clindamycin, trimethoprim-sulfamethoxazole, or tetracycline are effective in preventing infection progression.[20]

Severe infections, including deep surgical site infections (SSIs) or endometritis, require intravenous antibiotics. A combination of clindamycin and gentamicin provides broad-spectrum coverage against both Gram-positive and Gram-negative bacteria.[19]

Timely and appropriate antibiotic therapy improves outcomes and reduces complications in post-cesarean infections.[20]

Surgical Intervention

Surgical intervention may be required for wound complications like hematomas, seromas, and necrotizing fasciitis. While small hematomas and seromas often resolve without treatment, larger fluid collections may need drainage to prevent infection and support healing. Prompt evacuation helps reduce discomfort, lower infection risk, and speed up recovery.[21]

Necrotizing fasciitis, a rare but severe complication, demands immediate surgical debridement to prevent tissue damage and systemic complications. Alongside surgery, broad-spectrum antibiotics are crucial to control infection and prevent sepsis.[21]

Early wound monitoring and timely intervention are essential to reducing infection risks, improving recovery, and enhancing patient outcomes after cesarean delivery. [22]

Wound Care

Proper wound care is essential for healing and preventing complications after surgery. Infected wounds should be left open to heal by secondary intention, allowing natural drainage and reducing abscess risk. This approach also facilitates the removal of necrotic tissue.[23]

Regular dressing changes help keep the wound clean, prevent bacterial overgrowth, and promote healthy granulation tissue formation. Once the infection resolves and granulation is

well-established, delayed closure may be considered to accelerate healing and improve cosmetic outcomes.[24]

Effective wound management through cleaning, dressing, and monitoring for infection is crucial for optimal recovery and minimizing complications.

4. Conclusion

Post-cesarean wound infections remain a significant maternal health concern, particularly in low-resource settings. Key risk factors, including obesity, diabetes, and prolonged labour, emphasize the need for targeted preventive measures. Effective strategies such as prophylactic antibiotics, optimized surgical techniques, and strict infection control can reduce infection rates. Future research should focus on refining preventive protocols and addressing emerging antibiotic resistance to improve patient outcomes.

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