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Recent Trends in LSCS Surgical Site Infections and Therapeutic Strategies

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Abstract: ***Introduction**: In obstetrics there has been a sharp rise in lower segment caesarean section (LSCS) over last 30 years in view of improving maternal and perinatal outcome. With this, there has been a definitive increase of postpartum infections. So, it's necessary to identify the recent trends in resistance shown by MDR bugs and therapeutic strategies to overcome that and to make relevant health recommendations aimed at preventing, controlling, or managing caesarean section wound infections. **Materials and Methods**: A prospective study was conducted among 88 patients with LSCS wound infections during the period of February 2023 to November 2023. Samples were processed, bacteria responsible for infection were isolated. Further gram - positive organisms screened for inducible clindamycin resistance, vancomycin resistance and Gram - negative organisms for ESBL and MBL resistance as per CLSI guidelines. **Results**: Out of 88 samples analysed, 80 (90%) yielded growth. Organisms isolated were Staphylococcus aureus (63.8%), Escherichia coli (17.5%), Acinetobacter species (8.8%), Klebsiella species (5%), Enterococcus species (2.5%) and Enterobacter species (2.5%). Among 10 MDR E. coli isolates 30% were ESBL and 10% were MBL producers. In Acinetobacter species isolates 57% were ESBL producers and 28% were MBL producers and was more sensitive to aminoglycosides. **Conclusion**: This study explores recent trends in antimicrobial resistance patterns and therapeutic strategies for managing LSCS surgical site infections. Conducted on 88 patients over 10 months, the research identifies key microbial agents responsible for infections, focusing on Gram positive and multidrug - resistant Gram - negative organisms. Findings emphasize the rising prevalence of methicillin - resistant staphylococcus aureus and extended spectrum beta - lactamase producing pathogens. The study underscores the importance of targeted therapeutic approaches and stringent infection control measures to mitigate antimicrobial resistance and improve maternal outcomes.***

Keywords: LSCS surgical site infections, antimicrobial resistance, Staphylococcus aureus, multidrug - resistant pathogens, infection control

1. Introduction

Caesarean delivery is the most prevalent surgical procedure aimed at safeguarding the lives of mothers and fetuses, experiencing a significant surge in frequency over recent decades. ([1] Furthermore, obstetrics has witnessed a notable increase in the incidence of lower segment caesarean sections (LSCS) over the past 30 years, driven by advancements in maternal and perinatal outcomes. [2] However, C - sections present a twentyfold elevated risk of infection compared to vaginal deliveries. ([3] As the rate of caesarean births continues to rise, the incidence of postpartum infections among women is anticipated to grow correspondingly.

Regarding LSCS wound infection, any breach in the integrity of skin and mucous membranes is a risk factor in acquisition of infection by either endogenous or exogenous organisms. Surgery itself is a risk factor for acquisition of infection including nosocomial infections. ([4] Along with this, factors contribute to surgical site infections (SSIs), includes pre - existing comorbidities, age, operation duration, anaemia, the frequency of manual vaginal examinations, and inadequate antibiotic prophylaxis. Additional risk factors Specific to Caesarean sections, encompass insufficient prenatal care, multiple pregnancies, a history of prior C - sections, chorioamnionitis, pre - labour rupture of fetal membranes, labour dystocia, emergency or prolonged deliveries, and obstetrical procedures conducted in teaching hospitals. [5] Together, these elements significantly elevate the risk of SSIs, underscoring the need for comprehensive management strategies in surgical settings.

Over time, while the pathogens responsible for surgical site infections (SSIs) have largely remained consistent, there have been significant shifts in their antimicrobial susceptibility patterns. A significant concern is the development of various mechanisms by these organisms to evade standard therapeutic approaches, which can lead to suboptimal wound healing and extended hospital stays for patients. Understanding the latest trends in etiological agents and their resistance profiles and various drug resistance mechanism adopted is crucial. Also thorough understanding of the pharmacodynamics and pharmacokinetics of available drugs will serve as a powerful weapon against the resistance mechanisms employed by pathogens. This knowledge will facilitate the formulation of targeted health recommendations aimed at preventing, controlling, and effectively managing infections related to Caesarean sections. The purpose of this study is to identify the recent trends in antimicrobial resistance patterns and therapeutic strategies to mitigate LSCS surgical site infections. This study highlights the critical need for monitoring antimicrobial resistance trends and adopting tailored therapeutic approaches to address the growing burden of LSCS surgical site infections.

2. Materials and Methods

A prospective study was conducted among 88 patients with LSCS wound infections during the period of February 2023 to November 2023. The SSI case was defined as a patient within 30 days of the surgical procedure with any of the following observed or reported symptoms:

a) A purulent (pus) discharge in, or coming from, the wound (including evidence of an abscess)
b) Any reopening of the surgical wound
c) Evidence of fever with painful, spreading erythema surrounding the surgical site

Samples were collected from patients who underwent both elective and emergency lower segment Caesarean sections within the Obstetrics and Gynecology department. To minimize contamination during sample collection, sterile cotton swabs were utilized. These samples were promptly transported to the laboratory for analysis. A direct smear was prepared and subjected to Gram staining for preliminary diagnosis. In the laboratory, the swabs were inoculated onto Blood Agar and MacConkey Agar plates, cultured at 37°C for 24 to 48 hours. Following the incubation period, isolates were identified based on their cultural characteristics, morphological traits, and biochemical reactions. Furthermore, the antibiotic susceptibility of these isolates was assessed using the Modified Kirby - Bauer disc diffusion method, adhering to the standards established by the Clinical Laboratory Standards Institute (CLSI). This thorough methodology facilitated precise identification and susceptibility profiling of the microbial isolates obtained from the patients.

Screening Methods

All Staphylococcus aureus isolates were evaluated for mecA - mediated oxacillin resistance using cefoxitin (30 µg) as a surrogate marker. Additionally, all staphylococcal isolates were assessed for inducible clindamycin resistance employing the disk diffusion method, with erythromycin (15 µg) and clindamycin (2 µg) positioned 15–26 mm apart. The presence of a D - zone, characterized by a flattening of the inhibition zone adjacent to the erythromycin disk, indicated that the isolate exhibited inducible resistance to clindamycin. Extended - spectrum beta - lactamase (ESBL) producing organisms were identified using ceftazidime and ceftazidime - clavulanic acid discs on Mueller - Hinton agar plates. The detection method relied on noting a difference of at least 3 mm in the zone of inhibition between the two discs. This discrepancy signifies the presence of ESBL enzymes capable of hydrolyzing ceftazidime, enabling the bacteria to evade its effects. For the detection of metallo - beta - lactamase (MBL) producing organisms, Imipenem and Imipenem with EDTA discs were utilized. In this case, a difference of 5 mm in the zone of inhibition was examined. The presence of a significant increase in the zone size when EDTA is added suggests that the organism produces MBL enzymes, which can break down carbapenems like Imipenem. This method is crucial for accurately identifying these resistant bacterial strains, which pose a significant challenge in clinical settings

Table 1: Frequency of Distribution (Total N=80)

Organisms	Number	Percentage
Staphylococcus aureus	51	63.80%
Enterococcus species	2	2.50%
Escherichia coli	14	17.50%
Klebsiella species	4	5%
Enterobacter species	2	2.50%
Acinetobacter species	7	8.80%

3. Results

Out of 88 samples analysed, 80 (90%) samples were culture positive. Among the isolated organisms Staphylococcus aureus being the most prevalent, accounting for 63.8% of the total isolates. Following this, Escherichia coli comprised 17.5% of the isolates, highlighting its significance as a common pathogen. Acinetobacter species were found in 8.8% of the samples, while Klebsiella species represented 5%. Additionally, Enterococcus species and Enterobacter species each made up 2.5% of the isolates. (TABLE - 1)

Table 2: Distribution of Staphylococcus Aureus (Total N=51, Out of 80)

Organism	Number	Percentage
MRSA	28	54.90%
MRCONS	12	23.50%
MSSA	8	15.70%
CONS	3	5.90%

Among the Staphylococcus aureus isolates, the distribution is as follows: Methicillin - resistant Staphylococcus aureus (MRSA) accounts for 54%, Methicillin - resistant coagulase - negative staphylococci (MRCONS) makes up 23.5%, Methicillin - sensitive Staphylococcus aureus (MSSA) represents 15.7%, and coagulase - negative staphylococci (CONS) comprises 5.9%. (TABLE - 2). The isolated organisms included Staphylococcus aureus (63.8%), Escherichia coli (17.5%), Acinetobacter species (8.8%), Klebsiella species (5%), and both Enterococcus and Enterobacter species, each representing 2.5%. The distribution of Staphylococcus aureus isolates was as follows: MRSA comprised 54%, MRCONS made up 23.5%, MSSA represented 15.7%, and CONS accounted for 5.9%. (TABLE - 2). Al - so very few isolates showed inducible clindamycin resistance.

All isolates of the Staphylococcus aureus and enterococcus species isolates were sensitive to Linezolid and vancomycin (TABLE 3)

Table 3: Antimicrobial Susceptibility Test Results of Staphylococcus Aureus (n= 51) (63.8%)

Sensitive to	Cotrimoxazole (22)	Vancomycin (51)	Clindamycin (27)	Erythromycin (7)	Cefoxitin (11)	Doxycycline (37)	Linezolid (51)
Staphylococcus aureus	43.10%	100%	52.90%	13.70%	21.60%	72.50%	100%

It was observed that the isolates of Escherichia coli (14 isolates), Klebsiella species (4 isolates remained sensitive to carbapenems and aminoglycosides. (TABLE - 4).

Table 4: Antimicrobial Susceptibility Test Results

Sensitive to	Ampicillin	Ciprofloxacin	Gentamycin	Piptaz	Cotrimoxazole	cefipime	Imipenam
E. coli (n=14)	7.10%	21.40%	92.90%	43%	42.90%	14.30%	71.40%
Klebsiella spp (n=4)	0%	25%	100%	0%	50%	0%	100%
Enterobacter Spp (n=2)	0%	0%	0%	50%	50%	50%	100%

Among the 14 E. coli isolates, 10 were classified as multidrug - resistant (MDR), with 3 identified as extended - spectrum beta - lactamase (ESBL) producers (30%) and 1 as a metallo - beta - lactamase (MBL) producer (10%). In comparison, the majority of Acinetobacter spp. isolates exhibited resistance to cephalosporins, fluoroquinolones, and beta - lactam/beta - lactamase inhibitors, while they remained sensitive to carbapenems and aminoglycosides. (TABLE - 5). Additionally among the 7 Acinetobacter species isolates, 4 were identified as extended - spectrum beta - lactamase (ESBL) producers (57%), and 2 were classified as metallo - beta - lactamase (MBL) producers (28%).

Table 5: Antimicrobial Susceptibility Test Results of Acinetobacter SPP

ANTIBIOTICS	Acinetobacter (n=7)	
	Number (sensitive)	Percentage
Ciprofloxacin	1	14.30%
Gentamycin	3	**42.90%**
Ceftazidime	0	0%
Cefipime	2	28.60%
Cotrimoxazole	1	14.30%
Piperacillin Tazobactam	1	14.30%
Imipenam	3	**42.90%**

4. Discussion

Surgical site infection is the most common nosocomial infection following surgery. In our study involving 88 patients who developed surgical site infections following lower segment caesarean section (LSCS), 80 (90%) were found to be culture positive. Staphylococcus aureus is widely recognized as a leading cause of surgical site infections globally, with prevalence rates ranging from 4.6% to 54.4%. ([9] Notably, our findings also revealed that Staphylococcus aureus constituted 63.5% of the isolates which is in correspondence with Ranjana Desai et al ([10], Sengupta et al and Nwachuk wu et al. Infection with S. aureus is most likely associated with endogenous source as it is a member of the skin and nasal flora and also with contamination from environment, surgical instruments, surgical techniques or from hands of health care workers.

The primary drug resistance mechanisms encountered when dealing with Staphylococcus aureus are methicillin resistance and inducible clindamycin resistance. In hospitals with a high prevalence of MRSA, administering vancomycin for preoperative surgical prophylaxis may be advisable. Additionally, erythromycin can induce resistance to clindamycin in vivo. Although clindamycin demonstrates in vitro sensitivity, the potential for therapeutic failure must always be taken into account.

According to our study, the antibiogram of Gram - negative isolates revealed significant resistance to Penicillins, cephalosporins, fluoroquinolones, and beta - lactam/beta - lactamase inhibitors. Additionally, there was moderate susceptibility observed towards aminoglycosides and carbapenems. These findings stand in contrast to results reported in other studies such as ch Arunakumari et al and Swetalina dash et al. This suggests a concerning trend in antimicrobial resistance patterns among Gram - negative bacteria that may be influenced by factors such as local antibiotic prescribing practices, patient demographics, and the emergence of resistant strains in our specific setting. The varying pattern of resistance underscores the growing challenge of managing infections caused by these Gram - negative bacteria.

When dealing with antibiogram of Gram - negative isolates important concern is emergence of MDR strains and evolving bacterial resistance mechanisms with different Beta lactamases enzymes. First and fore - most one is Extended spectrum beta lactamases (ESBL). These are group of enzymes which are capable hydrolysing beta lactam group of drugs such as penicillins, 1st, 2nd, 3rd and 4th generation cephalosporins as well as Aztreonam except carbapenems and cephamycins such as cefoxitin and cefotetan and the resistance can be overcome by addition of a Beta lactamase inhibitor (BLI). Another Notorious group of enzymes are Amp - c Beta lactamases which is associated with SPICE Organisms (Serratia marcescens, Pseudomonas aeruginosa, indole positive Proteae includes Providencia and Morganella, Citrobacter freundii, Enterobacter cloacae, Klebsiella aerogenes). This group of enzymes are resistant to penicillins, 1st, 2nd and 3rd generation cephalosporins, cephamycins but not to 4th generation cephalosporins such as cefipime and cefipirome and carbapenams. But metallobeta lactamases (MBL) which is a part of carbapenamases can only be inhibited by Aztreonam and EDTA. [15]

Once the choice of antibiotic is made next important point of consideration is to know about PK - PD of drugs which is either Time dependent kill or Concentration dependent kill. Almost all possible antibiotic choices in SSIs such as BL/BL - BLI, cephalosporins, Carbapenems, clindamycin, oxazolidinone (Linezolid) falls into Time dependent kill category with very poor post antibiotic effect. So the effect will become subpar once the concetration falls below MIC. These drugs are effective only when bugs are exposed for a long duration of time. So extended infusion of not less than 3 hrs is is adviced rather than conventional 30 min bolus dosing. [15]

Additionally, potential contamination during surgical procedures could further exacerbate the incidence of infections, as Gram - negative bacteria can easily be introduced into sterile environments. Together, these factors underscore the complexity of managing infections caused by Gram - negative organisms and highlight the urgent need for stringent infection control measures. Also highlights the critical need for continuous monitoring of resistance trends and the implementation of targeted antimicrobial stewardship strategies.

5. Conclusion

This study identifies the growing antimicrobial resistance trends in LSCS surgical site infections and highlights the necessity of early empirical therapy, tailored antibiograms, and interdisciplinary collaboration between surgeons and microbiologists. Implementing targeted infection control measures and continuous resistance monitoring is crucial for reducing maternal morbidity.

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