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Bacteriological Profile and Antimicrobial Susceptibility Pattern of Surgical Site Infections in Obstetrics and Gynecological Surgeries in a Tertiary Care Hospital

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Abstract **Original Research Article**

Introduction: Surgical site infections (SSI) remain as the most common nosocomial infections in patients undergoing surgeries, despite advances in operative techniques and post-operative care. It is ranked 3rd in the most common nosocomial infections worldwide, contributing to morbidity, prolonged hospital stay and even death of the patients. This study was conducted to evaluate the current rates of Surgical Site Infections and their etiological agents in the department of Obstetrics & Gynecology (OG) in our tertiary care hospital. ***Materials and methods*:** Patients who underwent surgeries in the department of OG in our tertiary care hospital for a period of 6 months from January 2019 to June 2019 were included in the study. 2 wound swabs were taken from the wounds with SSI, and processed for bacteriological culture and antimicrobial susceptibility testing according to standard operating protocols. ***Results:*** Out of 1988 patients, 84 were tested positive for SSI. The overall SSI rate in OG surgeries was found to be 4.2%. Gynecological surgeries had highest SSI rate of around 11%. Patients who underwent emergency Lower Segment Cesarean Section (LSCS) surgeries (3.9%) were found to have developed more SSI than elective LSCS surgeries (1.2%). The most common isolate was found to be Escherichia coli (30%), followed by Staphylococcus aureus (27.4%). The antimicrobial susceptibility pattern showed that GNB had 98% sensitivity to Imipenem and GPC had 100% sensitivity to Linezolid and Vancomycin. ***Conclusion*:** Regular surveillance activities which provide a good knowledge of common etiological agents with their antimicrobial susceptibility pattern in their hospital setup, along with other infection control practices will prevent SSI, thereby reducing the associated morbidity effectively.

Keywords: Surgical site infection, Obstetrics and Gynecology, Bacteriological profile.

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INTRODUCTION

Nosocomial infections are acquired by patients receiving healthcare, and are the most frequent complication affecting patient safety, with a global incidence of 7% in developed countries to 15% in developing countries [1]. Surgical site infection (SSI) remains as the most common nosocomial infection in patients undergoing surgeries, despite advances in operative techniques and post-operative care. It is ranked 3rd in the most common nosocomial infections worldwide, contributing to morbidity, prolonged hospital stay and even death of the patient [2, 3]. It affects up to a third of patients who undergo surgeries, with a mortality of up to 3%, thus posing as a serious public health problem, which may lead to significant morbidity and huge financial strain on health system [1, 2].

Among the Obstetrics and Gynecology (OG) surgical procedures, most common is the Lower Segment Caesarean Section (LSCS), which may be elective or emergency, followed by hysterectomy which may be done through abdominal, vaginal, or laparoscopic routes. Of them, abdominal hysterectomy and emergency caesarean sections pose high risks for surgical wound infections. One of the most common infections occurring in OG department is surgical site infection, whose incidence ranges from 2.8% to 26.6%, as against the overall SSI rate of 4.1 to 11.0 % in India [2, 3].

The Centre for Disease Control has given the definition of Surgical Site Infection (SSI) as "an infection that develops at the surgical site within 30 days of surgery" [4]. The etiological agents implicated depend upon the surgical site and source of infection, which may be endogenous such as patients' flora or exogenous such as from operating room, personnel, instruments or the environment. The most commonly isolated microbes are Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, and Klebsiella species [2]. Antimicrobial susceptibility pattern of the bacteria responsible for causing infections vary greatly.

Knowledge of the most likely organism and the prevailing susceptibility pattern will greatly help in initiating empirical treatment, thus ensuring proper management of the patients with SSI. Hence, the surveillance of SSI plays an important role in analyzing the burden of infection, infectious agents and their antimicrobial susceptibility. These data have immense contribution in regulating the proper and judicial use of therapeutic & prophylactic antimicrobial agents and adherence to strict asepsis during surgical and post-surgical procedures [5].

This study was conducted to find out the current rates of SSI in the department of OG in our tertiary care hospital, to find out their associated risk factors and to evaluate their bacterial etiological agents and their antimicrobial susceptibility, for early recognition of the problem and hence better management.

Materials and Methodology

It is a cross sectional study, conducted over a period of 6 months from January 2019 to June 2019, after getting approval from Institutional Ethical Committee at our tertiary care hospital. Patients who underwent both elective and emergency surgeries in the department of OG were included in the study, after obtaining written informed consent, in a consecutive manner. Patients who had underwent OG surgeries outside and presented in our tertiary care hospital with SSI and those who were not willing to give informed consent were excluded from the study.

Surgical site infections were identified based on the following CDC criteria[4], such as involvement of only skin and subcutaneous tissue, and presence of any one of the following signs like purulent discharge, pain or tenderness, localized swelling, erythema, or heat. In patients, following surgeries, surgical wound was inspected daily from 1st postoperative day till discharge of the patient and then followed up during their review visit till 30th post-operative day. Wounds were given a saline wash to remove any superficial slough. Then, 2 wound swabs were taken using sterile cotton swabs by rotating over the wound base with a little pressure to express exudates, and transported to the microbiology laboratory immediately. Further processing was done, by conventional methods, using standard operating procedures [6]. One of the swabs was used to make smear and Gram's staining for direct microscopy and the other one was used for inoculation onto culture media such as MacConkey Agar Plate, Blood Agar Plate and Nutrient Agar Plate and incubated at 37°C for 24 to 48 hours. The isolated bacterial colonies were further identified by a set of standard biochemical reactions. Then Antimicrobial sensitivity testing was done by Modified Kirby Bauer's disc diffusion method using Mueller Hinton Agar and interpretations were done according to CLSI guidelines 2019[7]. The results were documented and analyzed statistically.

Results

Table-1: Surgical Site Infection Rates in different types of surgeries [n=1988]

Type of Surgery	No. of surgeries	No. Infected	Percentage (%)
LSCS– emergency	1112	44	3.9%
LSCS – elective	579	7	1.2%
Vaginal hysterectomy	189	20	10.5%
Total abdominal hysterectomy with bilateral salphingo oopherectomy	108	13	12.0%
Total	**1988**	**84**	**4.2%**

1988 Obstetrics & Gynecology surgeries have been done during the period from January 2019 to June 2019 of which 84 patients developed surgical site infections which accounted for 4.2%. Of the different types of surgeries, least SSI rate of 1.2% was observed in Elective LSCS (Lower segment caesarean section), and highest SSI rate of 12% was observed in Total abdominal hysterectomy.

Table-2: Risk factors in Surgical site infection patients [n=84]

Risk factors	No. Infected	Percentage (%)
Age [>60 years]	28	33%
Anemia	25	30%
Diabetes milletus	11	13%
Hypertension	14	16%
No risk factors	31	37%

Among the 84 patients, showing signs and symptoms of surgical site infection, predominant risk factors were found to be elderly age (>60 years)(33%), followed by Anemia (30%) (Table 2).

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Table 3 – Bacteria isolated from Surgical Site Infections (n=84)

Name of the organisms	Number of isolates	Percentage (%)
Escherichia coli	26	30.9%
Staphylococcus aureus	23	27.4%
Klebsiella pneumoniae	12	14.3%
Pseudomonas aeruginosa	10	11.9%
Staphylococcus epidermidis	9	10.7%
Proteus mirabilis	2	2.4%
Citrobacter freundii	1	1.2%
Acinetobacter spp	1	1.2%
Total	84	100%

A total of 84 bacterial organisms were isolated from 84 patients showing signs and symptoms of surgical site infection. Gram negative bacilli (GNB) (62%) were predominant over Gram positive cocci (GPC) (38%) in our study. Escherichia coli was the most predominant organism isolated (30.9%), followed by Staphylococcus aureus (27.4%), Klebsiella pneumoniae (14.3%) and Pseudomonas aeruginosa (11.9%) (Table 3).

Table-4: Antimicrobial susceptibility pattern for Gram Negative Bacilli

Name of the isolate	Ampicillin (10µg)		Gentamicin (10µg)		Amikacin (30µg)		Ciprofloxacin (5µg)		Cefotaxime/ Ceftazidime (30µg)		Cefotaxime-Clavulanate/ Ceftazidime-Clavulanate (30µg/10µg)		Cefoperazone-sulbactam/ Piperacillin-tazobactam (100 µg/10µg)		Imipenem/ Meropenem (10µg)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Escherichia coli [n=26]	8	31%	9	35%	20	77%	11	42%	15	58%	25	96%	25	96%	26	100%
Klebsiella pneumoniae [n=12]	2	16%	4	34%	9	75%	5	42%	8	67%	11	96%	11	96%	11	96%
Citrobacter freundii [n=1]	0	-	0	-	1	100%	0	-	1	100%	1	100%	1	100%	1	100%
Proteus mirabilis [n=2]	0	-	0	0	2	100%	1	50%	1	50%	1	50%	1	50%	2	100%
Pseudomonas aeruginosa [n=10]	3	30%	3	30%	8	80%	5	50%	6	60%	8	80%	8	80%	9	90%
Acinetobacter spp [n=1]	0	-	0	-	0	-	0	-	1	100%	1	100%	1	100%	1	100%

Most predominant isolate, Escherichia coli shows Imipenem (100%) and Cefotaxime- clavulanate (96%) as the most sensitive antimicrobial agents, followed by Amikacin (77%) (Table4).

Table-5: Antimicrobial susceptibility pattern – Gram Positive Cocci

Name of the isolate	Penicillin (10 units)		Cefoxitin (30µg)		Ciprofloxacin (5µg)		Cotrimoxazole (1.25µg / 23.75 µg)		Erythromycin (15µg)		Clindamycin (2µg)		Amikacin (10µg)		Linezolid (30µg)		Vancomycin (mic e-strip)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Staphylococcus aureus [n=23]	12	52%	18	78%	12	50%	8	35%	10	43%	15	65%	16	70%	23	100%	23	100%
Staphylococcus epidermidis [n=9]	3	33%	7	77%	4	44%	4	44%	5	56%	7	77%	7	78%	3	100%	9	100%

Staphylococcus aureus, the second predominant isolate, shows 100% sensitivity to Vancomycin and Linezolid, followed by Amikacin (70%). (Table 5)

DISCUSSION

The problem of SSI persists despite practice of new and advanced aseptic techniques. SSI is one of the stressful and traumatic events in postoperative period. The probability of developing SSI depends on various factors which include patient's general condition, pre and postoperative management, hospital environment, and also the nature of bacteria colonizing the surgical wound. Hence, surveillance is mandatory to evaluate the above factors so as to ensure proper management.

In the present study, overall SSI rate was found to be 4.2%, which well correlates with the range of 3.0 % to 8.3% SSI rates documented in other studies [5, 9-13] (Table 1). SSI rate of emergency LSCS (3.9%) was found to be more, than elective LSCS (1.2%). This is in concordance with studies done by Harish babu *et al*. [10], Subramani J *et al*. [11] & Asha Rani *et al*. [12], which shows 3.04%, 8.6% & 21.5% SSI rate in emergency LSCS and 0.87%, 4.8% & 9.09% in Elective LSCS, respectively. This may be because of the lesser time available for preoperative preparation and management of the patient. The SSI rates of gynecological surgeries were 12% and 10.5% for total abdominal hysterectomy and vaginal hysterectomy respectively, which correlates with a study done by Bhuvaneswari SP *et al*. [14]. SSI rate of gynecological surgeries was found to be almost 4 times that of Caesarean sections which is also comparable to Subramani J *et al*. [11] & Harish babu *et al*. [10]. The relatively increased SSI rate in gynecological surgeries may be attributed to the presence of risk factors such as patients belonging to elderly age group and presence of co morbidities such as anemia, and diabetes (Table 2). The common risk factors in the patients with SSI were found to be elderly age, anemia, diabetes, and hypertension, of which elderly age (33%) and anemia (30%), were predominantly found among the patients (Table 2), as proven in multiple other studies[5, 10, 14-16]. Pre-operative assessment and proper management of these risk factors, such as correction of anemia, maintenance of good glycemic control and blood pressure, may bring down the incidence of SSI.

Among the isolated bacteria, GNB (62%) were found to be predominant over GPC (38%) (Table 3). Predominance of Gram negative bacilli in etiology may be due to their constant presence in hospital environment and tendency to spread easily through health care personnel, medical equipments and surfaces of the hospital environment. Also they are found to be resistant to commonly used disinfectants, making them difficult to eradicate, thus causing infection [18]. The most common bacterial species isolated was Escherichia coli (30%) (Table 3), which correlates with Bhadauria *et al*. [5] & Natesan B *et al*. [19] and Kochhal N *et al*. [21] . This was followed by Staphylococcus aureus which accounts to 27.4%. This is against the findings of Subramani J *et al.* [11], and Harish babu *et al*. [10], which had Staphylococcus aureus (38.3%, 31.03% respectively) as predominant isolate, followed by Escherichia coli (21.27%, 24.13% respectively). Staphylococcus aureus which forms the second most common cause (27.4%) in our study is only few numbers less than the most predominant isolate Escherichia coli, the difference in number being negligible. Staphylococcus aureus is one of the important pathogens of SSI, as it is the common skin flora which may have an endogenous source such as patient's own skin or exogenous source, on surfaces of the hospital environment [20].

The antimicrobial susceptibility pattern of GNB (Table 4) were found to be showing high sensitivity to Imipenem, followed by Cefotaxime-Clavulanate and Amikacin which is in concordance with a study by Harish babu *et al*. [10]. In the same way, the antimicrobial susceptibility of Staphylococcus aureus (Table 5) isolates also matches with that of the study conducted by Harish babu *et al*. [10] showing high sensitivity to Vancomycin, Linezolid and Amikacin. All our GPC isolates were found to be 100% sensitive to Vancomycin. But this is not in agreement with Bhadauria *et al.* [5] which showed good sensitivity to amoxicillin-clavulanate and related antimicrobial agents but low sensitivity to Amikacin.

The bacterial isolates producing extended spectrum beta-lactamase (ESBL) was found to be around 41.25% in the current study, which is less compared to multiple other studies such as Amudha B *et al*. [17], Ananthi *et al*. [18], Natesan B *et al.* [19], & Bhadauria *et al*. [5] which show 50% to 80% prevalence of ESBL. Prevalence of Methicillin Resistant Staphylococcus aureus [MRSA] is found to be around 22.5%, which is also relatively low, and correlates well with studies by Bhattacharya *et al.* (25.4%) [22] and Krishna S *et al*. (28.6%) [23]. Other studies such as Natesan *et al*. [19], Bhadauria *et al*. [5], and Amudha B *et al*. [17] showed a comparatively higher prevalence of MRSA as 37.5%, 50%, and 67% respectively.

There found to be relatively low SSI rates and also relatively low antimicrobial resistance in the bacteria isolated in our study which may be because most of our study population underwent clean surgeries. Also, it implies that the geographical distribution of bacterial strains here show lesser multidrug resistance patterns. However, practice of rational antibiotic usage is still essential to contain the spread of multi drug resistant organisms in the hospital environment. Further studies covering larger population with broader surgical categories is imperative to delineate the various factors contributing to surgical site infections in our hospital.

Conclusion

The current study had shown that, emergency surgeries are more prone to develop SSI than elective surgeries. Proper identification of associated risk factors and their effective management will contribute in reducing SSI rate. Regular surveillance activities which provide a good knowledge of common etiological agents with their antimicrobial susceptibility pattern in the hospital setup, along with other infection control practices, especially, periodic review of antibiotic policy so as to implement appropriate empirical therapy and surgical antimicrobial prophylaxis will also prevent SSI, thereby reducing the associated morbidity effectively.

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