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SURGICAL SITE INFECTIONS AFTER OPERATIVE DELIVERY AT THE TERTIARY CARE HOSPITAL IN RAJASTHAN, THEIR MICROBIOLOGICAL PROFILE, ANTIBIOTIC SENSITIVITY AND CLINICAL RISK FACTORS

Microbiology

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ABSTRACT

Introduction: Surgical site infections (SSI) are common problem in developing country like India. There are so many factors are responsible for SSI like low immunity, prolonged labour, production of hematoma presence of gestational diabetes Anaemia, multiparaty, heavy blood loss during delivery. **Methods:** It is a case-control study undertaken for a period of one year in a tertiary care hospital of Rajasthan state, India. The study population included patients suffering from SSIs in the various unit of obstetrics ward of our hospital. **Result:** in our study we found a lot of factor affecting prevalence of SSIs like anaemia, premature rupture of membrane, prolonged labour, multiparity and obesity. Common organism are Escherichia coli, staphylococcus and pseudomonas. Most of the organism are susceptible with carbapenems vancomycin and amikacin. **Conclusion:** Even though the total number of Cesarean delivery has increasing consistently, wound infection should be has remained less constant. This may be achieved by high compliance among the infection control practices by health care workers in the hospital.

KEYWORDS

SSI Surgical Site Infections, PROM Premature Rupture Of Membrane, Operative Delivery, Hematoma

INTRODUCTION

The Surgical Site Infections (SSI) are defined by the Disease Control and Prevention (CDC) criteria as infections which occurs within 30 days after a surgical procedure and is further divided into superficial incisional primary and secondary SSIs, deep incisional primary and secondary SSIs and organ/space SSIs if involving structures deeper than muscle and fascia space. [1]

Wound infections in obstetrics and gynecology are not unusual problems in developing country likely India. Stiches abscess after incision or after episiotomy are major burden on health system. Prevention of these type of infection should be a priority for health care system. SSIs present with signs of sepsis present concurrently (warmth, erythema, induration, tenderness, pain, raised local temperature) were included. [2]

The burden of surgical site infections (SSI) are from 0.5–15% in world. Liu et al [2] There are so many risk factors for SSI in obstetric and gyenocology like low immunity, more perioperative bacterial load at the site of surgery, diminished integrity of the host's defenses.[3]

Presence of chorioamnionitis, history of a previous Caesarean delivery, use of certain medications like steroids, the lack of pre-incision antimicrobial care, lengthy labor and surgery, obesity, smoking, malnutrition, and diabetes mellitus, some local factor like wound hematoma, seroma and dehiscence. (Wound hematoma and seroma are collections of blood and serum, respectively.) [4]

Hematoma or seroma, described in 2-5% of women after CD can cause wound dehiscence and act as a nidus for development of wound infection wound dehiscence is separation of incision and complicates 2-7% after CD [5].

There are some preventing measures which can minimize the prevalence such as proper use of antisepsis, all the preoperative preparation, a reduction in the duration of surgery and blood loss, the use of absorbable sutures and avoiding cross infection. [4,6]

As SSI are common postoperative complication in developing countries like India, it is necessary to implement SSI surveillance during and after surgeries so as to obtain a standardized rate of SSI .[7]

The delivery of high-quality infection control services with early interventions to reduce surgical wound infections is a major aspect of patient safety measures. Therefore, the aim of this study was to determine the incidence of SSI in patients undergoing obstetrics and gynaecology surgery tertiary care hospital in Rajasthan (India) and to identify risk factors, common bacterial pathogens and antibiotic sensitivity.

Methods

It is a case-control study for a period of one year (January 2019 to December 2020) conducted in a tertiary care hospital of Rajasthan state, India.

Inclusion criteria

The study population included patients suffering from SSIs in the various unit of obstetrics ward of our hospital. All women who underwent operative delivery were eligible for the study. All women who have sign and symptom of wound infection with serous or seropurulent discharge and with signs of sepsis present concurrently (warmth, erythema, induration, tenderness, pain, raised local temperature) were included.. Surgical site infection (SSI) was determined by the criteria adapted from the Centers for Disease Control and Prevention (CDC) [1]

For control group we selected cases randomly during the same period, who had operative delivery and were routinely discharged on their fifth postoperative day without any symptoms of wound infections. According to the study protocol all subjects participating in the study were followed until 30days after the operative procedure.

Follow-up took place in the Outpatient Department. Culture-based microbiological methods were used to identify causal agents in postoperative wounds. Material was taken using two sterile swabs and then forwarded to the Department of Microbiology. All patients with wound infections underwent swab cultures and all cases of suspected SSI had swabs taken prior to the commencement of antibiotics.

Both culture-positive and -negative cases were included in the study. Where the culture was positive, an antibiotic sensitivity tests of the organism was carried out using standard microbiology techniques. The wound swabs of the culture-negative cases yielded no organism growth of any kind after 48 hours of incubation.[7]

The cases and controls were reviewed in detail with respect to preexisting risk factors contributing to infections, like obesity, prolonged labor, premature rupture of the membranes (PROM), use of tobacco, body mass index more than 35, previous cesarean delivery, presence of hematoma or seroma, emergency delivery and any other comorbid medical conditions like anemia, diabetes and hypertension.

The organisms isolated from the incision sites were investigated and antibiotic sensitivity was measured.[8]

Exclusion criteria

All the patients who declined informed consent, were operated in private hospitals and then subsequently hospitalized and those who received antibiotics preoperatively. Patients who had suture abscesses, wounds with cellulitis and no drainage.

In Microbiology laboratory first Gram stained preparations were made from one swab for provisional diagnosis. The other swab was inoculated on 5% sheep blood agar (BA) and Mac Conkey agar (MA)

plates and in liquid media thioglycholate and incubated at 37°C for 48 hours before being reported as sterile. Growth on culture plates was identified by its colony characters and the battery of standard biochemical tests [7,8]. Antimicrobial sensitivity testing (AST) was carried out by modified Kirby Bauer disc diffusion method on Muller Hinton agar and results were interpreted in accordance with Clinical Laboratory Standards Institute guidelines [9]. Methicillin resistance was detected by taking cefoxitin disk (30µg). For AST control strains were used, *Staphylococcus aureus* - ATCC 25923, *Escherichia coli* - ATCC 25922 and *Pseudomonas aeruginosa* - ATCC 27853. All dehydrated media, reagents and antibiotic disks were procured from Hi Media Laboratories Pvt. Ltd., Mumbai, India.[10]

Statistical data analysis was performed using SPS Statistics 20 version 10. Descriptive statistics with percentages, mean, standard deviation, frequencies were used for patient, surgical and procedure related factors.. P-value less than 0.05% was considered statistically significant.

Result

In duration of one year 196 patients were screened for SSI and randomly 200 patient studied as control. Out of 196 only 105 sample show growth in aerobic culture media so we put antibiotic sensitivity test for them. In gram stain there were 8 sample who could not grow in aerobic media. 77% were gram negative bacilli and 23 were gram positive cocci. 23 sample show poly microbial growth and.

The mean age of the patients was 21.3 ± 5.5 years, with a range from 15 to 49 years. More than half, patients (64.6%) were from urban areas and (35.4%) were from rural areas. The average length of stay was 5.2 ± 2 days. The leading procedure was C-section for the first time in 85.9% of cases, while repeated C-section for the second or more times was found in 6.6% of the study subjects., Preoperative antibiotic prophylaxis was identified in 214 patients (65.8%) (Table 1).

In present study there are some pre-existing factor that are A comparison of the case and control groups for pre-existing risk factors can be seen in Table 2.

The data showed that those women who already had more than three children were more likely to have a wound infection compared to those women who were delivering for the first time or had only one child.

However, the association between wound infections and parity was not significant. Women with diabetes were more likely to develop wound infections and the association between diabetes and wound infections was significant. A two-fold increase was noted in the rate of PROM among the case group compared to the rate among controls. The association between PROM and wound infections was highly significant (P <0.001). The risk of wound infections among those women who were anaemic was higher compared to those without anemia and the association with wound infections was significant.

Calculating the odds ratio showed that those women who had hypertension and pre-eclampsia were three times more likely to develop a wound infection compared to women without these conditions. There was a significant association between hypertension, preeclampsia and wound infections (P = 0.007). Likewise, women who were morbidly obese, with a body mass index (BMI) of >35, were more likely to develop a wound infection compared to non-obese women and the association was significant (P = 0.0180

The majority of SSI cases yielded growth of *Escherichia coli* (28.2%) followed by *Staphylococcus aureus* (19%) [Table 3]. Polymicrobial infections were found in 23 (15.8%) samples. The common organisms that grown together were: *Klebsiella* with Escherichia coli or Escherichia coli with *S. aureus or Escherichia coli with proteus.* A few cultures yielded the growth of organisms such as, *Acinetobacter sp* and methicillin-resistant *S. aureus* (MRSA). There were 51 cases where the culture did not yield any organisms. This was probably due to causative agent is anaerobic or fastidious organism. The Imipenem and amikacin constituted the most sensitive antibiotic and was used whenever indicated by the culture sensitivity [Table 4]. Third generation Cephalosporin is frequently used in our hospital as it is the second most sensitive antibiotic of choice and also the most convenient one. Quinolone, like ciprofloxacin or ofloxacin is the least used drug class in the antenatal and postpartum period, followed by combination of amoxicillin and clavulanate, which was not used at all due to the risk of neonatal side-effects, particularly for preterm cases. Some cases were sensitive to the antipseudomonal penicillin group of drugs, for instance tazobactam and piperacillin. Antibiotics like meropenem and imipenem were used for the *Enterobacteriaceae* which were highly resistant to cephalosporin (*E. coli*, *Klebsiella* and *Enterobacter*).

DISCUSSION

In developing countries increasing number of SSIs is a traumatic experience. Smyth et al reported that SSI to be the third most common type of nosocomial infection, accounting for 14–16%. [6.7]

And cesarean surgery has a 5–20 times higher risk of postpartum infection as compared to vaginal deliveries, mainly with regards to wound infections, endometritis, pelvic peritonitis or pelvic abscesses.[8]

Wound infections are still regarded as the most common nosocomial infections in patients undergoing surgery. The most common pathogens were Escherichia coli and *S. aureus*, followed by *Pseudomonas aeruginosa, and klebsiella sp.* In gram positive organism *Staphylococcus* is the most common cause of nosocomial infections and is often the cause of postsurgical wound infections.

According to khan et al the Gram-positive *cocci* are often found living on the skin and in the nose to avoid any infections from *Staphylococcus* bacteria, it is important to implement regular hand-hygiene and ensure that wounds are kept covered with clean, dry bandages until they are fully healed. [7]

In present study rate of SSI in our hospital is 13% which is slightly higher side . The probable reason for this difference may be our hospital is overcrowded, most of patient are from rural area with poor follow up in antenatal check up, less time was available for preoperative preparation in the emergency surgeries. In the present study, three difficult case was reported where the SSI was so severe that it had progressed to necrotizing fasciitis. A similar case of wound infection progressing to necrotizing fasciitis was reported by another study which was successfully treated with wound debridement and antibiotic[11]

In our study 4% cases had hematoma. An independent risk factor for SSI it suggests lapses in complete hemostasis during the wound closure. Hematoma provides a medium for bacterial growth. The meticulous closure of all potential spaces in wound with good hemostatic techniques would reduce the frequency of hematomas. Postoperative wound hematoma was the strongest independent risk factor for SSI in a study conducted at in the USA, where SSI were identified in 5.0% of women undergoing low transverse CS.[12]

Obesity is a major and rapidly growing health problem even in country like India. The incidence of infections in patients who are obese with a BMI of 35 or more is higher than that of the general population. This is due to the poor penetration of antibiotics into the skin because of the avascularity of adipose tissue. Moreover, obesity places greater mechanical stress on the wound and thus delays healing. In our study 6 % patient are more than 35 kg/m^2 as compared to our control group it is higher.

Another study Wloch *et al*. observed that being overweight with a BMI >35 was a major risk factor for infection compared with cases who had a BMI 18.5–25 (OR 3.7, 95% confidence interval [CI] 2.6–5.2).[13]

In our study other comorbidity like anaemia is also an important predisposing cause for wound infection.in present study 9.6% patient had anemia in study group as compare to control group.

Women should be encouraged to eat healthily, have a well-balanced diet and take adequate exercise to avoid the risks of SSI associated with obesity.

The rate of SSIs were more in patients with gestational diabetes, either controlled by diet or insulin, was significantly higher (9.6%) p value is significant.

In other studies, the number of wound infections was noted higher in diabetic patients. Uncontrolled blood glucose levels increase the infection rate and impairs wound healing as it enables the leukocytes to control the harmful proliferation of bacteria. [14,15]

Prolonged labour, after a full trial of vaginal delivery, was observed in 3.5% cases of wound infections in the current study and similar findings were reported by other study [14]

Frequent vaginal examinations may be a contributory factor for the increased infection rate in such cases. Most infections in the female genital area or the gastrointestinal tract can contaminate the normally sterile amniotic fluid.

An associated risk factor, PROM, increases the risk of chorioamnionitis as the protective effect of the intact fetal membranes is lost. The culture reports in such cases showed polymicrobial growth of both Gram positive and Gram-negative organisms. the length of time between the rupture of the membranes and surgical intervention influences the CS wound infection rate as once the membranes have ruptured, the amniotic fluid is no longer sterile and may act as a transport medium, allowing bacteria to come into contact with any uterine and/or skin incisions.

CONCLUSION

Even though the total number of Cesarean delivery has increasing consistently, wound infection should be has remained less constant. This may be achieved by high compliance among the infection control practices by health care workers in the hospital. All the health care workers should be adhered to hospital infection control rules and policies. These include compliance of WHO's 5 moment of hand hygiene, the use of alcohol rubs, avoiding cross infection by restricting visitors and routine education among health workers regarding infection control measures.

Its required a collaboration with a microbiologist and wound-care practitioners, and patient education on personal hygiene to help control wound infections.

There is no conflict of interest in this study.

Table 1 risk factor for SSI

	Risk factor	In study group 196		In control group 200		P value
1	Sub cutaneous hematoma/ seroma	8	4%	4	2%	> 0.05, not significant
2	Tobacco use	9	4.5%	11	5.5%	> 0.05, not significant
3	Anemia	19	9.6%	14	7%	< 0.05, significant
4	BMI >35 kg/m2	12	6%	9	4.5%	> 0.05, not significant
5	PROM	17	8.6%	13	6.5%	< 0.05, significant
6	More than 3 children	10	5%	6	3%	> 0.05, not significant
7	Prolonged labor	7	3.5%	6	3%	> 0.05, not significant
8	Heavy Blood loss	8	4%	5	2.5%	> 0.05, not significant
9	Gestational diabetes	19	9.6%	7	3.5%	< 0.05, significant
10	Previous cesarean	13	6.6%	6	3%	> 0.05, not significant
11	Emergency delivery	15	7.6%	11	6.5%	> 0.05, not significant

Table 2 Distribution of microorganisms isolated from aerobic cultures

Organism	Total 145	
Staphylococci aureus	28	19%
Escherichia coli	41	28%
Enterococci	5	3.4%
Pseudomonas sp	17	12%
Coagulase Negative Staphylococci	1	%
Streptococci group B	1	0.8%
Enterobacter cloacae	3	2.6%
Enterobacter aerogenes	4	3.5%
Citrobacter sp	9	8%
Klebsiella pneumoniae	18	13.3%
Proteus mirabilis	4	3.5%
Proteus vulgaris	2	1.7%
Morganella Morganii	3	2.67%
Acinetobacter sp	9	5.3%
Poly microbial	23	15.8%

Table 3 Antibiotic sensitivity patterns of gram-positive microorganisms

	S aureus n=28	CONS n=1	Enterococci n=5	Streptococci n=1
Ampicillin	11	Nil	Nil	100
Augmentin	33.3	100	100	100
Azithromycin	22	Nil	66	100
Ceftriaxone	55	100	66	66
Cefoxitin	66	-	-	66
Cefotaxime	66	100	66	66
Cefuroxime	55	Nil	-	66
Gentamycin	83	100	66	100
Teicoplanin	55	-	100	100
Chloremphenicol	66	-	-	
Vancomycin	100	100	100	100
Linezolid	100	100	100	100
Tigecycline	66	Nil	-	--
piperacillin+ tazobactam	83	-	66	100
Meropenem	83	100	100	100
Cefeperazone + salbactam	83	100	66	

Table 4 Antibiotic sensitivity patterns of gram-Negative microorganisms

	E coli n=41	Pseudomonas n=17	Klebsiella n= 18	Enterobacter n=7	Proteus n=6	Citrobacter n=9	Acinetobacter n=9	Morganella sp n=3
Ampicillin	14	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Amikacin	85	82	93.3	85.7	100	77.7	66.6	100
Gentamycin	60	64	73.3	57.5	66.6	66.6	66.6	33
Ceftriaxone	60	47	60	57	33.3	77.7	83	33
Ceftazidime	56	-	60	57	66.6	66.6	83	33
Cefepime	43	-	53.3	42.8	66.6	55.5	-	-
Cefuroxime	43	-	Nil	57	66	55.5	66	-
Cefixime	60	-	53.3	-	66	55	-	67
Cefeperazone	70	47	46.6	57	66.6	66.6	83	-
Piperacillin	14	47	Nil	-	Nil	Nil	-	-
Doxycycline	60		73.3	85.7	-		83	-
Imipenem	100	100	100	100	100	100	100	100
Tigecycline	43	82	46.6	100	-	100	83	33
Cotrimoxazol	60	-	46.6	-	-	-	33	Nil
Ofloxacin	65	-	66.6	55.5	100	77.7	66	100

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