Original Research Article

Indian Journal of Obstetrics and Gynecology
Volume 6 Number 1, January - February 2018
DOI: http://dx.doi.org/10.21088/ijog.2321.1636.6118.11

Assessment of Risk Factors for Surgical Site Infection in Obstetric Patients and Its Impact on Postoperative Recovery

Sunanda Bharatnur*, Vandana Agarwal**

*Associate Professor
**Junior Resident,
Department of Obstetrics & Gynaecology, Kasturba Medical College & Hospital, Manipal University, Manipal 576104, India.

Corresponding Author:
Sunanda Bharatnur,
Associate Professor,
Department of Obstetrics & Gynaecology,
Kasturba Medical College & Hospital Manipal University,
Manipal 576104, India.
E-mail:
sunanda.somu@manipal.edu

Received on 23.11.2017,
Accepted on 08.12.2017

Abstract

Objective: To evaluate the preoperative and intraoperative risk factors associated with surgical site infection amongst obstetric patients and its impact on postoperative recovery. *Methods:* Aprospective, observational study was conducted among 332 patients Who underwent surgery in Obstetrics both elective and emergency over a period of two years. Among the 332 patients, 200 were operated on emergency basis and 132 on elective basis. Diagnosis of SSI was made as per CDC criteria. Various risk factors and impact of SSI on postoperative recovery were analysed. *Results:* The incidence of SSI was found to be 54 out of 332 women (16.3%). In these 54 cases, 35 (64.8%) underwent surgery on emergency basis. The most common type of SSI was superficial SSI. The risk of SSI was high in patients with exploratory laparotomies and midline incision ($p < 0.005$). Presence of medical comorbidities like anaemia (6.29), hypertension (OR 3.07) and diabetes (OR 1.03) were identified as significant risk factors. *Conclusion:* SSIs are preventable by early identification and optimization of medical comorbidities and BMI. Reduction in infection rate can lead to decrease in substantial burden of the disease, both for the patients as well as healthcare services.

Keywords: Obstetric Cases; Post-Operative Impact; Surgical Site Infection.

Introduction

The Centre for Disease Control and Prevention (CDC), defines a Surgical site infection (SSI) as an infection occurring within thirty days of a surgery, in one of the three locations: superficial at the infection site, deep at the incision site, or in other organs or spaces opened or manipulated during an operation [1,2].

SSIs are one of the most important causes of healthcare associated infections also called nosocomial infections. They are most commonly seen complications in gynaecologic and obstetric surgical procedures resulting in significant patient morbidity, prolongation of hospital stay and medical costs [3].

Obstetric surgeries pose a unique challenge in that potential pathogenic microorganisms from the skin, vagina or endocervix migrate to operative sites and can result in vaginal cuff cellulitis, pelvic cellulitis and pelvic abscess and all of these are preventable. Precautions taken in the preoperative, intraoperative and postoperative phases of care can reduce the risk of infection.

Surgical site infections have a significant impact on the quality of life of the patient. They are associated with considerable morbidity and increase in hospital stay. It also results in considerable financial burden to the patients.

Multiple patient risk factors and surgical techniques have been identified as risk factors that increase infectious sequelae during pelvic surgery. This study focuses on evaluating preoperative and intraoperative risk factors associated with surgical site infection and its impact on postoperative recovery.

Materials and Methods

Aprospective, observational study was conducted among 332 patients who underwent surgery in obstetrics both elective and emergency over a period of two years. Among the 332 patients, 200 were operated on emergency and 132 on elective basis. Diagnosis of SSI was made as per CDC criteria. Various risk factors and impact of SSI on postoperative recovery were analysed.

Statistical analysis was carried out with the application of Scientific Package for Social Sciences (SPSS version 16.0). Result was calculated in descriptive statistics like mean, frequency and percentage for numerical data. Frequencies and percentages were determined for binary and categorical variables.

Range and means were calculated for continuous variables. Overall incidence rate of SSI was calculated. Pearson Chi-square test was used to test for each risk factor's association with SSI. Odds ratios and 95% confidence intervals (CI) were calculated. Significance was assumed at a p value of less than 0.05.

Results

The study population of 332 patients who underwent an obstetric surgery were randomly selected (Figure 1). Each patient was followed up post-operatively and assessed for surgical site infection as per CDC criteria. The incidence of SSI was found to be 54 (16.3 %).

Out of these 54 patients, 35 (64.8%) had undergone emergency surgery and 19 (35.2%) underwent elective surgery. In the remaining 278 patients who did not develop SSI, 165 (59.4 %) had undergone emergency surgery and 113 (40.6%) patientsunderwent elective surgery.

Superficial SSI was the most common (89 %). Incidence of deep and organ SSI were 5.5 % each. The various preoperative and intraoperative risk factors associated with SSI have been analysed in Figure 2.

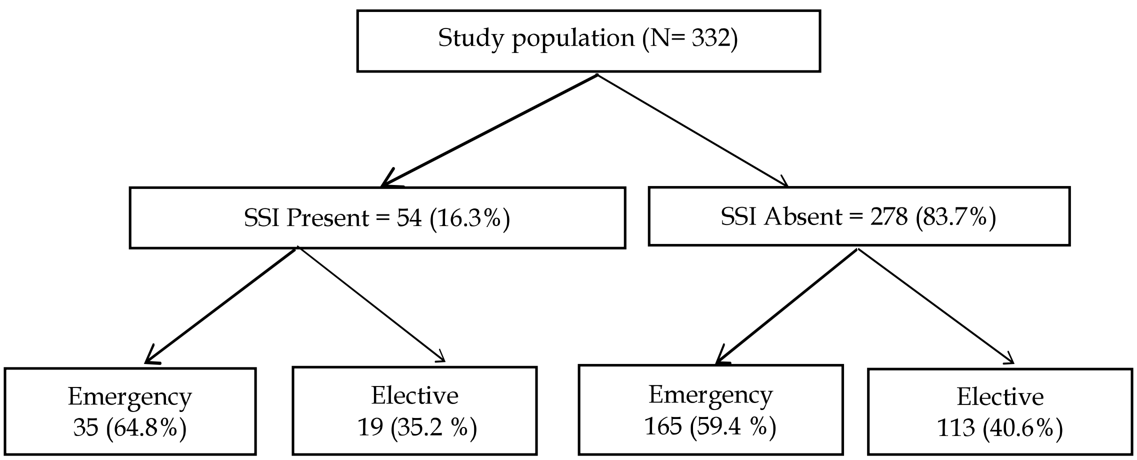

Fig. 1: Showing study population and its analysis

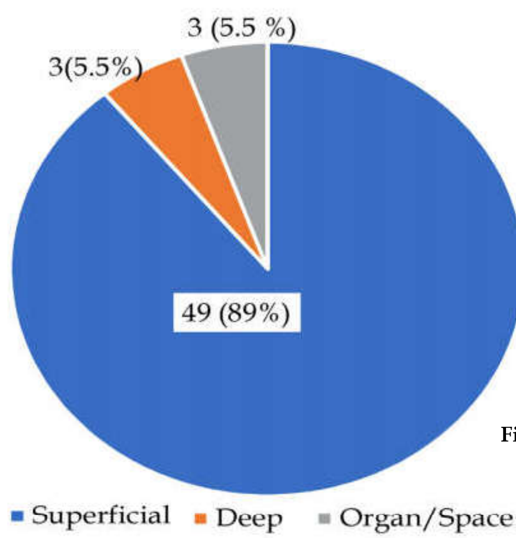

Fig. 2: Type of SSI (N = 54)

Table 1 depicts the increased risk of developing SSI in case of emergency surgeries than elective surgeries (OR 1.26, 95% CI 0.689-2.316). This is attributable to the fact that in emergency surgeries, rupture of membrane, repeated vaginal examinations, breach in sterile technique and lack of timely antibiotic prophylaxis.

The odds of developing SSI was 1.7 times more in women who had previous surgeries. This is owing to presence of adhesions, poor wound healing and impaired scar integrity due to previous surgeries.

The risk of development of SSI was about 3.5 times higher in case of wound closure by mattress stitch than subcuticular stitch (OR 3.61, 95% CI 1.952 – 6.700). The reason being better tissue approximation in case of subcuticular stitches. Moreover, mattress suture is used in case of patients with high BMI previous surgeries/patients with increased intraoperative bleed.

There was significant association noted when surgeries involving midline incision were compared to pfannenstiel incision and laparoscopic surgeries (p value 0.05). Healing of wound in case of midline incision was poor when compared to pfannenstiel incision as the tissue approximation is better in the latter.

As shown in Table 2 the risk of development of SSI was significantly higher (p value <0.001) in case of major surgeries like Exploratory laparotomy as compared to caesarean section. Exploratory laparotomies performedin emergency surgeries like bilateral internal arterial ligation, caesarean hysterectomy, and postpartum haemorrhage.

Risk of SSI also depends on wound class. There are four wound classes: clean, clean contaminated, contaminated and dirty. The number of surgical site infections noted in this was significantly higher in clean contaminated and dirty wounds as compared to clean wound (p value 0.03).

High BMI has been identified as a significant risk factor for causing SSIs. In this study we observed that as the BMI increases, risk of acquiring SSI also increases significantly (p value 0.02).

Table 1: Association of Risk factors with SSI (N=332)

Variable		SSI Present N (%)	SSI Absent N (%)	p value	Odds Ratio	95% CI
Nature of surgery	Emergency (n=200)	35 (17.5)	165 (82.5)	0.45	1.26	0.689 - 2.316
	Elective (n= 132)	19 (14.4)	113 (85.6)			
Previous surgeries	Yes (n=107)	23 (21.5)	84 (78.5)	0.07	1.71	0.943 – 3.113
	No (n=225)	31 (13.8)	194 (86.2)			
Skin closure	Mattress (n= 135)	36 (26.7)	99 (73.3)	<0.001	3.61	1.952 – 6.700
	Subcuticular (n=197)	18 (9.1)	179 (90.9)			
Type of incision	Pfannenstiel (n= 313)	50 (16)	264 (84)	0.05		
	Midline (n=9)	4 (40)	6 (60)			
	Others (Laparoscopy) (n=10)	0 (0)	8 (100)			

Table 2: Association of Risk factors with SSI (N=332)

Variable		SSI Present N (%)	SSI Absent N (%)	p value
Type of surgery	Caesarean section (n=318)	49 (15.4)	269 (84.6)	<0.001
	Exploratory laparotomy (n=5)	5 (100)	0 (0)	
	Others (Laparoscopic salpingectomy) (n=9)	0 (0)	9 (100)	
Type of wound	Clean (n = 10)	1 (10)	9 (90)	0.03
	Clean contaminated (n = 320)	51 (15.9)	269 (84.1)	
	Dirty (n = 2)	2 (100)	0 (0)	
BMI	Underweight (<18.5) (n=1)	1 (100)	0 (0)	0.02
	Normal (18.5 – 24.5) (n=168)	22 (13.1)	146 (86.9)	
	Overweight (24.5 – 30) (n=131)	21 (16)	110 (84)	
	Obese (30 - 35) (n =27)	9 (33.3)	18 (66.7)	
	Morbidly obese (>35) (n=5)	1 (20)	4 (80)	

Table 3: Association of Risk factors with SSI (N=332)

Variable		SSI Present N (%)	SSI Absent N (%)	p value	Odds ratio	95% CI
Co-morbidities	Yes (n=125)	35 (28)	90 (72)	<0.001	3.84	2.086 – 7.099
	No (n=207)	19 (9.2)	188 (90.8)			
Anaemia (Hb < 10 g/dl)	Yes (n=31)	15 (48.4)	16 (51.6)	<0.001	6.29	2.885-13.747
	No (n=301)	39 (13)	262 (87)			
Diabetes	Yes (n=54)	9 (16.7)	45 (83.3)	0.93	1.03	0.473 – 2.267
	No (n=278)	45 (16.2)	233 (83.8)			
HTN	Yes (n=39)	13 (33.3)	26 (66.7)	0.02	3.07	1.462- 6.461
	No (n=293)	41 (14)	252 (86)			

Table 4: Organisms isolated on Wound swab culture (N=13)

Organisms isolated	N=13 (%)
Klebsiella	4 (31%)
E. coli	3 (21)
Enterococcus faecium	2 (16)
Staphylococcus	1 (8)
Pseudomonas	1 (8)
MRSA	1 (8)
Enterobacter	1 (8)

Table 5: Comparative analysis (N=332)

Characteristic	SSI Present (N=54)		SSI Absent (N=278)	
	Median	Quartile	Median	Quartile
Postoperative stay	6	(5,8)	10	(8,14)
Total hospital stay	8	(6,11)	12	(10,17)
BMI	24.2	(22.6,27.5)	26.5	(23.1, 28.6)
Hb (g/dl)	11.6	(10.9,12.4)	10.9	(9.5,11.9)

Table 3 shows a strong association between presence of medical comorbidities and SSI. Patients with comorbidities had nearly 4 times higher risk of developing SSI. (OR 3.84, p value< 0.001). There was increased risk of developing SSI in diabetic thannon-diabetic women (OR 1.03, 95% CI 0.473 – 2.267). This may be due to deranged sugar levels leading to tissue hypoxia causing poor wound healing.

It is noted in this study that presence of hypertension and anaemia lead to increased risk of developing SSI. There was a three-fold rise in the risk noted (OR 3.07) in hypertensive women. Hypertension causes vasculopathy resulting in impaired wound healing. A six-fold rise in development of SSI was noted in women with anaemia.

Table 4 shows wound swab culture showed growth of organisms in 13 out of the 54 patients with SSI i.e. 24%. Klebsiella was the most common microbe grown (31%), followed by E. coli (21%), Enterococcus faecium (16%) and the rest being staphylococcus, Pseudomonas, MRSA and Enterobacter.

Majority of the SSIs (80%) were cured with primary antibiotics. 11 out of the 54 patients with SSI required secondary antibiotics, most common of which was Piperacilin-Tazobactum.

Resuturing of the surgical wound had to be done in 12 out of the 54 patients i.e. 22% of them. Readmission was required in 1 of 54 patients i.e. 2% of patients with SSI for further wound care.

Table 5 depicts that the median postoperative stay was longer in women with SSI (10 days Vs 6 days) as also the total hospital stay (12 days Vs 8 days). The median BMI was observed to be higher in women with SSI (26.5 Vs 24.1). Obesity is a proven risk factor for development of surgical site infection. The median hemoglobin was lower in patients with SSI (10.9 g/dl Vs 11.6 g/dl), reconfirming the fact that anemic patients are more prone to developing postoperative infections.

Discussion

Surgical site infection is a common health care associated infection (HAI) and one of the most frequent causes of postoperative morbidity. In low and middle-income countries, 11% of patients who undergo surgery are infected with SSI [1,4]. Although the rates of SSI are low in United States of America (USA) and European countries, it is second frequent type of HAI [1]. SSIs are the second most common complication after urinary tract infections in caesarean delivery with reported rates between 3 to 15% in USA. [5, 6, 7] and a cumulative rate of 2.9% in European Centre for Disease Control data from 20 networks in 15 European Union countries [8].

The overall incidence of SSI in India varies from 4 to 30%.However, the incidence of SSI in the obstetric population varies from 2.8% to 26.6% [9,10,11]. A study conducted by Varsha et al[12] reported an overall incidence of 6%, Jyoti Sonawane et al[13] reported it as 10%. Vidyadhar B et al [14] reported an incidence of 2.8% among gynaecology patients.

This variation in incidence rate is attributable to the fact that SSIs are multifactorial and vary from hospital to hospital depending on the patient load, type of referral hospital and the patient population.

A study from Estonia reported a SSI rate of 6.2% among 305 patients that underwent caesarean section [15]. A cohort of women with caesarean from Thai-Myanmar border showed a SSI rate of 5.9% (293 SSIs in 4,988 cases) [16]. In our study, a total of 332 patients were studied. The incidence of SSI was noted to be 16.3%.

SSI rate varies from 2.9% to 30% according to various studies, most of which are superficial SSI. Even in our study majority of SSI were superficial (89%), Incidence of deep and organ SSI was 5.5% each.

A study conducted by Shrestha et al [11] where 648 women were studied, incidence of SSI was observed to be 12.6% which is close to the present study. According to a study conducted by Ashish Pathak et al [17], 1173 patients were studied and the overall incidence of SSI was 7.84%. Majority of SSIs become apparent within 30 days of an operative procedure and most often between the 5th to 10th postoperative days. In this study, the median postoperative day when SSI became apparent was postoperative day five.

A number of studies have shown that diabetes is strongly associated with an increased risk of SSI [19, 20, 21]. Studies report a two to three fold increase in risk of developing an SSI in patients with diabetes. This is related to altered cellular immune function as a result of hyperglycaemia and advanced glucose end products which result in impaired healing.

Thirteen studies considered diabetes as a risk factor in a multivariable analysis; 85% found a significant association with SSI, with odds ratios from 1.5-24.3. In the present study, a strong correlation was noted between diabetes and risk of development of SSI (OR 1.03). Optimal glycaemic control is of paramount importance for proper wound healing.

High BMI has been identified as a significant risk factor for causing SSIs. Adipose tissue is poorly vascularised and the consequent effect on oxygenation of tissues and immune response is thought to increase the risk of SSI. In addition, operations on patients who are obese can be more complex and prolonged. The effect of obesity on SSI has been investigated and studies report ORs between 2 and 7 for SSI in patients with BMI of 35 kg/m^2 or more [19]. We noted a high BMI as a strong risk factor for SSI (p value 0.02).

According to Shah DK et al [22], women with BMIs 40 or higher had five times the odds of wound infection (8.9% compared with 1.4%, OR 5.34, CI 3.85-7.41). Wound class is an independent predictor of SSI (ORs for clean-contaminated, contaminated and dirty wound classes were 1.04, 1.7 and 1.5, respectively, $P < 0.0001$) according to study conducted by Neumayer et al. [20] in this study, similar observation was made. As the wound class increased, risk of SSI increased (p value 0.03).

In present study, higher incidence of SSI was noted in emergency surgeries as compared to elective procedures (OR 1.26). According to a study by Karthika et al [23] incidence of SSI was higher in emergency surgeries (19.6% Vs 3.06%) with significant p value. It was concordant with higher SSI rate among the emergency case 16.01% followed by elective cases 3.67% reported by Amirta et al [9]. Similar finding was reported according to a study by Shrestha et al [11]. This finding is attributable to the fact that in emergency cases rupture of membrane and multiple vaginal examinations are frequent. There is also increased risk of bacterial contamination, breach in sterile technique and lack of timely antibiotic prophylaxis.

Conclusion

Surgical site infections are preventable by early identification and optimization of the medical comorbidities which are identified in our as diabetes, anaemia and hypertension.Appropriate antibiotic-prophylaxis, low BMI and good surgical technique will add further to reduce the risk of SSI among obstetric patients. SSI cannot be eliminated, however reduction in the infection rate leads to decrease in substantial burden of the disease, both for the patients and healthcare services in terms of the morbidity, mortality and decreased cost of hospitalization.

References

1. World Health Organization. Global guidelines on the prevention of surgical site infection. 2016.
2. National Nosocomial Infections Surveillance (NNIS) System. NNIS report, data summary from October 1986-April 1996. A report from the NNIS System. Am J Infect Control. 1996;24(5):380-8.
3. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control 2008;36: 313–4.
4. Rosenthal VD, Richtmann R, et al, Surgical site infections, International Nosocomial Infection Control Consortium (INICC) report, data summary of 30 countries, Infect Control Hosp Epidemiol. 2013; 34(6):597-604.
5. Mahdi H, Goodrich S, Lockhart D, DeBernardo R, Moslemi-Kebria M. Predictors of surgical site infection in women undergoing hysterectomy for benign gynaecologic disease: a multicentre analysis using the national surgical quality improvement program data. J Minim Invasive Gynecol. 2014; 21(5):901–9.
6. Krieger Y, Walfisch A, Sheiner E. Surgical site infection following caesarean deliveries: trends and risk factors. J Matern Fetal Neonatal Med. 2017;30(1): 8–12.
7. Shree R, Park SY, Beigi RH, Dunn SL, Krans EE. Surgical site infection following caesarean delivery: patient, provider, and procedure-specific risk factors. Am J Perinatol. 2016;33(2):157–164.
8. European Centre for Disease Prevention and Control. Surveillance of surgical site infections in European hospitals – HAISSI protocol. Version 1.02. Stockholm: ECDC; 2012.
9. Amrita R, Chella et al Clinical study of post-operative wound infections in obstetrics and gynaecological surgeries in a tertiary care set up. International Journal of Reproduction, Contraception, Obstetrics and Gynaecology. 2016;2(4):631-638.
10. Dr Nandita Pal, Dr Rajyasri Guhathakurta (Mukherjee). Surgical site infection in surgery ward at a tertiary care hospital: the infection rate and the bacteriological profile. IOSR Journal of Pharmacy. 2012;2(5):1-5.
11. Shrestha S, Shrestha R, Shrestha B, Dongol A. Incidence and Risk Factors of Surgical Site Infection Following Caesarean Section at Dhulikhel Hospital. Kathmandu Univ Med J. 2014; 46(2):113-6.
12. Varsha Shahane, Saikat Bhawal, Upendra Lele. Surgical site infections: A one year prospective study in a tertiary care centre. International Journal of Health Sciences, Qassim University. 2012;6(1):7984.
13. Jyoti Sonawane, Narayan Kamath, Rita Swaminathan, Kaushal Dosani. Bacterial Profile of Surgical Site Infections and Their Antibiograms in a Tertiary Care Hospital in Navi Mumbai. Bombay Hospital Journal. 2010;52:3.
14. Vidyadhar B. Bangal, Sai K Borawake, Kunaal K. Shinde and Satyajit P. Gavhane. Study of Surgical Site infections following gynaecological surgery at tertiary care teaching hospital in Rural India IJBR. 2014;5 (2):113-116.
15. Mitt P, Lang K, Peri A, Maimets M. Surgical-site infections following caesarean section in an Estonian university hospital: post discharge surveillance and analysis of risk factors. Infect Control Hosp Epidemiol. 2005;26(5):449–454.
16. Assawapalanggool S, Kasatpibal N et al Risk factors for caesarean surgical site infections at a Thai-Myanmar border hospital. Am J Infect Control. 2016; 44(9):990.
17. Ashish Pathak, Kalpana, Manmat B, Swami, Pulak Roy, Megha Sharma et al Incidence and risk factors for surgical site infections in obstetric and gynaecological surgeries from a teaching hospital in rural India. Antimicrob Resist Infect Control. 2017;6:66.
18. Miroslav Gregor, Pavla Paterova, Vladimir Buchta et al. Healthcare-associated infections in gynaecology and obstetrics at a university hospital in the Czech Republic. International Journal of Obstetrics and gynaecology. 2014;126(3):240–243.
19. Cruse PJ, Foord R. The epidemiology of wound infection. A 10-year prospective study of 62,939 wounds. Surg Clin North Am. 1980;60(1):27–40.
20. Neumayer L, Hosokawa P, Itani K, et al. Multivariable predictors of postoperative surgical site infection after general and vascular surgery: results from the patient safety in surgery study. J Am Col Surg. 2007;204 (6):1178–87.
21. Black JD, de Haydu C, Fan L, Sheth SS. Surgical site infections in gynaecology. Obstet Gynecol Surv. 2014; 69(8):501–10.
22. Shah DK, Vitonis AF et al, Association of body mass index and morbidity after abdominal, vaginal and laparoscopic hysterectomy. Obstet Gynecol. 2015; 125(3):589-98.
23. Karthika Priya.S, Somasundar.V et al, Surgical Site Infection and Incidence of MRSA Using Phenotypic and Genotypic Methods from Tertiary Care Hospital, IOSR Journal of Dental and Medical. 2016;15(7): 111-115.