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Original Research Article

Effectiveness of bundled interventions in reducing surgical site infections in elective caesarean sections and caesarean hysterectomies in a tertiary care centre

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ABSTRACT

Background: Surgical site infections are the most common and easily preventable infections complicating surgeries. CDC recommends certain bundle interventions for the prevention of SSIs. Hence the present study was undertaken to see the effectiveness and feasibility of the bundle interventions in the elective caesarean sections and caesarean hysterectomies.

Methods: A total of 600 patients were taken. Bundled interventions were applied in 278 caesarean sections and 26 caesarean hysterectomies. Routine care was implemented in 262 caesarean sections and 34 caesarean hysterectomies. Rate of SSI, risk factors associated and treatment outcomes were studied.

Results: 8 out of 304 cases of the bundled intervention group developed SSI, giving a rate of 2.6%. 52 cases out of 296 in the routine care group developed SSI, the SSI rate being 17.5%. Anemia and diabetes were the most common risk factors.

Conclusions: Adherence to bundled interventions can significantly and easily reduce the incidence of SSI.

Keywords: Bundled intervention, Caesarean hysterectomy, Caesarean sections, Surgical site infections

INTRODUCTION

Surgical site infections (SSIs) are infections of the incision or organ or space that occur after surgery within 30 days of surgery¹. Surgical site infections (SSIs) can lead to substantial morbidity, prolonged hospitalization, increased costs, and death in patients. The incidence of SSI is 6 to 11% in patients undergoing inpatient surgery. SSI ranks as the most-costly of all hospital acquired infections. The most widely used definition of SSI has been provided by the CDC. According to this definition, SSIs are classified by depth and tissue spaces involved. A superficial incisional SSI involves only the skin or subcutaneous tissue. A deep incisional SSI involves the fascia or muscle layers, and an organ space SSI involves any part of the body opened or manipulated during a procedure, excluding the previously mentioned layers.

Duration of SSI is an important risk factor for SSI according to the American Society of Anaesthesiologists (ASA).² SSI are both common and morbid. SSI are now the most common and costly of all hospital acquired infections, accounting for 20% of all hospital acquired infections. SSI are associated with increased length of stay and a 2 to 11-fold increase in the risk of mortality. Although most patients recover from an SSI without long term adverse sequelae, 77% of mortality in patients with an SSI can be attributed to the infection itself.³⁻⁶

'Bundled intervention' are the guidelines provided by the CDC for prevention of surgical site infection. Caesarean sections are very commonly performed surgeries in every hospital. Caesarean hysterectomies are also not uncommon. There is also an increasing trend in the number of caesarean sections in the past few years. As

per the latest data (National Family Health Survey 2015-16 (NFHS-4), the caesarean rates at population level in India seem to be 17.2%.⁷ Therefore the risk of SSI is also increasing. The present study was therefore conducted to evaluate the feasibility and effectiveness of the bundled intervention in decreasing the SSI in caesarean sections and caesarean hysterectomies performed in study hospital.

To study the effect of bundled intervention in reducing surgical site infections in caesarean sections and caesarean hysterectomies.

METHODS

This prospective interventional study was conducted in department of obstetrics and gynecology in S. S. Medical College, Rewa from February 2019 to January 2020 over a period of 12 months. 600 women were selected based on the following inclusion and exclusion criteria.

Inclusion criteria

- Women undergoing elective caesarean section for various indications like cephalopelvic disproportion, gestational diabetes mellitus, malpresentation
- Women undergoing elective caesarean hysterectomy for various indications like preop diagnosed morbidly adherent placenta, fibroid uterus.

Exclusion criteria

- Women undergoing emergency caesarean sections or caesarean hysterectomy
- Women not giving consent for the study.

All study subjects were analysed thoroughly regarding age, parity, previous obstetric history. A thorough general, physical, systemic and obstetric examination was done. A detailed history was taken regarding medical and surgical history and co-morbidities like diabetes mellitus and hypertension. A detailed drug history was also taken. Bundled interventions were divided into pre-operative, intra operative and post-operative care and implemented as follows:

Pre-operative

- Antibacterial soap bath the night before and morning of surgery
- Single shot of antibiotic ceftriaxone+ sulbactam 1.5 gm i.v. 30 minutes before surgery
- No hair removal.

Intra-operative

- Cleaning of abdomen by savlon and spirit followed by painting by povidone iodine

- Gloves were changed by surgeons and nurses after closure of peritoneum
- Rectus sheath was closed in single layer by vicryl no. 1-0
- Subcutaneous tissue was closed with interrupted sutures with chromic no. 1-0 if depth of subcutaneous tissue was >2.5 cm
- Skin was closed with nylon 1-0 with mattress sutures
- Duration of surgery was noted.

Post-operative

- Inj. ceftriaxone+ sulbactam 1.5 gm i.v. 12 hourly for 48 hours
- Dressing on post op day 3
- Suture removal on day 7 for pfannensteil incision and day 10 for vertical incision.

In the routine care group, preoperatively antiseptic soap bathing and antibiotic administration was not done. Hair were not removed. Intraoperatively gloves were not changed after closure of peritoneum. Post-operatively Inj amikacin 500 mg i.v. 12 hourly for 48 hours was also administered.

Signs and symptoms of SSI, like redness, tenderness, fever, induration and pus discharge were noted. Pus culture was sent for culture sensitivity and the microbes were noted. Rate of SSI in relation to the type of surgery and comorbidities present were noted. Treatment required for SSI was also noted.

Statistical analysis

The data was analysed using various statistical analyses like SPSS. Various tests for calculation of standard deviation were applied and p value was calculated.

RESULTS

In the present study, total 540 caesarean sections and 60 elective caesarean hysterectomies were included based on the inclusion and exclusion criteria. Out of these, 278 caesarean sections and 26 elective caesarean hysterectomies were included in the bundled intervention group while 262 caesarean sections and 34 elective caesarean hysterectomies were included in the routine care group. In the present study, 1.9% cases in the intervention group developed superficial SSI while 10.8% cases in the routine group developed superficial SSI which is significantly high ($p < 0.001$). Only 0.2% cases in the intervention group developed deep SSI which is significantly lower than 6.7% cases in the routine group that developed deep SSI ($p < 0.001$).

In the present study, 1.08% of caesarean sections developed SSI in the intervention group which is significantly less than the 16.4% caesarean sections that developed SSI in the routine care group ($p < 0.001$). 19.4%

cases undergoing caesarean hysterectomy developed SSI in the intervention group which is proportionately lower than 26.4% of the caesarean hysterectomies that developed SSI in the routine care group. However, it was not statistically significant.

In the present study, anemia and diabetes mellitus were the most common comorbidities seen in both the groups. 121/304 (39.8%) cases had comorbidities in the intervention group while 127/296 (42.9%) cases had comorbidities in the routine care group which is not significantly different than the intervention group. However, only 5.7 and cases in the intervention group

developed SSI which is significantly lower than the 32.3% cases that developed SSI in the routine care group ($p < 0.001$).

Table 1: Division of cases.

Division of cases	Intervention group	Routine care group	Total
Caesarean sections	278	262	540
Elective caesarean hysterectomies	26	34	60

Table 2: Rate and type of SSI in different groups.

Type of SSI	Intervention group			Routine group			Total SSI	p value
	No. of SSI	Total cases	%	No. of SSI	Total cases	%		
Superficial SSI	6	304	1.9%	32	296	10.8%	38	<0.001
Deep SSI	2	304	0.6%	20	296	6.7%	22	<0.001
Organ space SSI	0	304	0%	0	296	0%	0	0

Table 3: Rate of SSI in different surgeries.

Type of surgery	Intervention group			Routine group			Total	p value
	No. of SSI	Total cases	%	No. of SSI	Total cases	%		
Caesarean sections	3	278	1.08%	43	262	16.4%	46	<0.001
Elective caesarean hysterectomies	5	26	19.2%	9	34	26.4%	14	>0.001

Table 4: Relation of comorbidities and rate of SSI.

Co morbidity	Intervention group			Routine group			Total	p value
	No. of cases with/without co morbidity	No. of cases developing SSI	%	No. of cases with/without co morbidity	No. of cases developing SSI	%		
Anaemia/ diabetes/ any other	121	7	5.7%	127	41	32.3%	48	<0.001
None	183	1	0.5%	169	11	6.5%	12	<0.001

Table 5: Methods of treatment of SSI.

Treatment	Intervention group		Routine group		Total	p value
	No.	%	No.	%		
Antibiotics (oral/i.v.)	8	100%	52	100%	60	>0.001
Daily dressing	4	50%	41	79%	46	>0.001
Resuturing	2	24%	18	34%	14	>0.001

Table 6: Rate of SSI in relation to duration of surgery.

Duration of surgery	Intervention group			Routine group			Total	p value
	No. of cases	No. of SSI	%	No. of cases	No. of SSI	%		
<120 min	96	0	0%	109	3	2.7%	3	>0.001
>120 min	208	8	3.8%	187	49	26%	57	<0.001

In the intervention group, only 0.5% cases of the comorbidity free group developed SSI, while in the routine care group, 6.5% cases of the comorbidity free group developed SSI which is statistically significant ($p < 0.001$).

In the present study, proportionately higher number of cases in the routine group required daily dressing administration and resuturing for the treatment of SSI as compared to intervention group. 100% of the cases in both the groups required antibiotic administration for 5-7 days post operatively. 24% cases in the intervention group required resuturing which is much less than the 34% cases that required resuturing in the routine group.

In the present study, statistically significant difference was not found in the development of SSI when the duration of surgery was less than 120 minutes. However, when the duration of surgery was more than 120 minutes, only 3.8% cases in the intervention group developed SSI which is significantly lower than the 26% cases that developed SSI in the routine care group ($p < 0.001$).

DISCUSSION

Surgical site infection (SSI) is an important complication of obstetric surgeries and a key quality indicator of patient care. SSIs are potentially avoidable post-operative complications. Implementation of the described bundled intervention can significantly decrease the overall rate of SSI from 17.5% to 2.6%.

In the present study, total 600 cases were selected, out of which 304 cases were included in the interventional group in which the bundled interventions were applied, and 296 cases were included in the routine care group. This can be seen in Table 1.

Table 2 shows that out of 304 cases in the interventional group, only 8 cases i.e. 2.6% cases developed SSI which is significantly lower than the routine group in which 52 out of 296 total cases (17.5%) developed SSI. Similar results were obtained by Lippitt MH et al.⁸ In their study, 219 patients were selected who underwent ovarian surgeries, out of which, 91 patients were treated in the historical pre-bundle cohort and 128 treated in the post-bundle implementation group. The overall surgical site infection rate in the pre-bundle cohort was 20% (18/91). After implementation of the 5-point surgical site infection prevention bundle, the infection rate decreased significantly to 3%. This clearly shows that implementation of the simple bundle interventions proposed by CDC can significantly reduce the incidence of SSI. Similar results were obtained by Taylor JS et al, in the disinfect initiative, who found the rate of SSI 12.5% in pre bundle group and 7.4% in post bundle group.⁹

Table 3 shows the association of the rate of SSI with type of surgery. Caesarean sections are comparatively easier

and less complicated than caesarean hysterectomy. There is increased tissue handling and tissue injury in caesarean hysterectomy. This leads to more chances of development of loci of infection in caesarean hysterectomy and thus development of SSI. Similar inference has been drawn out in this study in which there is higher incidence of SSI in the caesarean hysterectomy group as compared to the caesarean section group. This difference is statistically significant in the caesarean section group in which bundled interventions were applied compared to the routine care group. Lippitt MH et al, in their study on outcomes associated with a five-point SSI prevention bundle in women undergoing surgery for ovarian cancer found 20% rate of SSI in pre bundle group, ovarian cancer surgery being complex and time-consuming surgeries.⁸

Table 4 shows the relation between presence of comorbidities and development of SSI. The presence of comorbidities hinders the process of healing of the tissues. Anemia and diabetes are the most common comorbidities found in this study in both the groups. The application of bundled interventions leads to a decrease in the development of SSI which is clearly seen in this study. In a study by Mahdi H et al, preoperative anemia was one of the major risk factors associated with development of SSI in women undergoing surgery for gynecologic cancer.¹⁰ Bakkum Gamez JN et al, in their study found significant association between hyperglycemia, anemia and smoking habits in the patient with increased risk of development of SSI.¹¹

In Table 5, the treatment modes for SSI and their outcomes are compared in the 2 groups. I.V. antibiotics were required in 100% cases of both the groups. Interventional group received inj. ceftriaxone + sulbactam I.V. while routine care group received additional inj. amikacin I.V. Since the rate of SSI was less in interventional group, less antibiotics were required in that group compared to the routine group. This clearly indicated that application of bundled interventions can lead to a decrease in the financial burden of the hospital. Less number of patients required resuturing in the interventional group, thus decreasing the hospital stay and further reduction in the financial load of the hospital. O'Donnell RL et al, in their study found that 33% of women with SSI had prolonged hospital stay.¹²

Table 6 shows the relationship between duration of surgery and rate of development of SSI which is proportionate. As the time duration of surgery increases, there is more chance for the infectious organisms to settle in the operated area and proliferate. In a study by Schiavone MB et al of 233 identified patients, 115 had undergone colon surgery prior to (PRE) and 118 after (POST) the implementation of the intervention.¹³ In patients whose operation took longer than 360 min, 30-day SSI rates were 37% (28/76) and 12% (8/67), respectively ($p \leq 0.001$). Tran CW et al, Nugent EK and Nguyen et al, in their study also found significant

association between increase in the duration of surgery and development of SSI.¹⁴⁻¹⁶

CONCLUSION

Surgical site infection is a major contributing factor to perioperative morbidity and mortality and high costs of care in surgical patients. Surgical patients initially seen with more complex comorbidities and the emergence of antimicrobial-resistant pathogens increase the cost and challenge of treating SSIs. A large proportion of SSIs are preventable by application of evidence-based strategies. This study concludes that the implementation of SSI reduction bundle can significantly reduce 30-day SSIs in the patients. The interventions are effective in patients undergoing longer and more complex operations.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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