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Original Research Article

Incision length: an emerging risk factors for surgical-site infection following cesarean section

Tripti Nagaria[1], Avinashi Kujur[1]*, Neha Thakur[2]

[1]Department of Obstetrics and Gynecology, Pt.J.N.M.Medical College, Raipur, Chhattisgarh, India
[2]Department of Obstetrics and Gynecology, Government Medical College, Rajnandgaon, Chhattisgarh, India

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***Correspondence:**
Dr. Avinashi Kujur,
E-mail: avinashikujur@gmail.com

ABSTRACT

Background: Since late nineteenth century, the caesarean section first done there is a tremendous improvement in the surgical and anaesthetic skills. It has emerged as a safe mode of delivery but now, in the present era there is a continuous rising trend of caserean section. Objective of present study is to evaluate the effect of some specific gestational factors and other known variables associated with poor wound healing in women who delivered by cesarean section.
Methods: A total of 1215 women delivered by cesarean section at Pt. JNM Medical college, Raipur, Chhattisgarh, India from May 2014 to April 2015 were included in this study. The BMI was measured at gestational age when she got operated, grade of surgeons was noted. Subcutaneous tissue depth was intra-operatively measured from the fascia to the skin surface, while the incision length was measured after skin closure.
Results: Out of 1215 women operated 251 cases developed SSI with incidence of 20.5%. Incision length (OR 2.40, 95% CI 2.11-2.73; p<0.0001), Body mass index (BMI) at term (OR 2.9, 95% CI 1.82-4.44; <0.0001), previous caesarean section scar (OR 0.72, 95% CI 0.54-0.96; p=0.02), Grade of surgeon (OR 5.5, 95% CI 3.3-9.3; p<0.0001), subcutaneous tissue thickness (OR 1.88, 95% CI 1.60-2.23, p<0.0001) were found to be correlated with wound complications. The receiver operating characteristics curve analysis suggested a cut-off of 28.7 for the BMI at term with AUC 0.8 (0.79-0.84, p<0.0001) and 147 mm for the wound length with an AUC 0.8 (95% CI 0.78-0.82; p <0.0001). The multivariate logistic regression model, applied to these variables showed an independent correlation of incision length with SSI incision length >14.7; OR 2.40, 95% CI 2.11-2.73, p<0.0001.
Conclusions: Incision length by itself was found to be an independent risk factor for development of surgical site infection.

Keywords: BMI, Incision length, Surgeon skill, Surgical site infection

INTRODUCTION

Since late nineteenth century, the caesarean section first done there is a tremendous improvement in the surgical and anaesthetic skills. It has emerged as a safe mode of delivery but now, in the present era there is a continuous rising trend of caserean section.[1] Apart from the minimal inherent risk of any surgical procedure, the surgical site infection is the significant cause of post surgical morbidity and can be described as an indicator for surgical quality; particularly in developing countries.

According to CDC's National Nosocomial Infection Survillence system 38% of all nosocomial infections in surgical patients are SSI. They constitute third most common nosocomial infection.[2] The rates of SSI after caesarean deliveries range from the incidence varies from 0.5 to 15% depending on the type of operation,

underlying patient status associated co morbidities and surveillance methods used to identify infections, studies in India have consistently shown higher rates ranging from 23-28%.[3,4]

The CDC definition describes three levels of surgical site infection, superficial incisional affecting the skin and subcutaneous tissue, deep incisional, which affects the facial and muscle layers and organ or space infection which involves any part in the body other than the incision that is opened or manipulated during the surgical procedure.[5]

Knowledge regarding risk factors for SSI is mandatory; to develop prevention strategies and further reducing risk of infection. A number of risk factor predispose a woman to suffer from wound complication i.e. obesity, medical disorders, gestational anaemia, inter current infection, surgical asepsis, use of peri operative antibiotics, skills of surgeons and operative techniques.

METHODS

Present study was carried out in Department of Obstetrics and Gynaecology of Pt. Jawaharlal Nehru Medical College, Raipur from May 2014 to April 2015.

The study was prospective observational study. A total of 1215 women undergoing caesarean section at our department were included, outside operated caesarean section and referred cases attending our hospital as SSI were excluded.

Data was collected from patients by using Performa. Written informed consent was obtained and data regarding age, BMI at term, parity, gestational age, previous scar, obstetric complications, presence of UTI, type of fetal presentation, type of anaesthesia, grade of surgeon, incision length, subcutaneous tissue thickness was collected. Direct wound observation was done from postoperative fourth day and was kept under observation till day of discharge.

A wound was defined complicated when there was at least one of the following sign: classical sign of infection (redness, duration, tenderness, fever, discharge), abscess, hematoma, wound dehiscence >1cm. All the suspected cases of SSI were investigated and treated irrespective of day of operation until complete recovery. However, patient who developed infection after discharge were not included in the study due to incompleteness of follow up.

Statistical analysis

Continuous data were reported as mean and standard deviation while categorical data were reported as percentages. Correlation between the analyzed variables and the onset of wound complications were calculated by applying logistic regression analysis and the corresponding odds ratio (OR) and 95% confidence interval are reported. All the statistically significant variables in the univariate analysis were included in a multivariate logistic regression model. The ROC (receiver operating characteristics) curve, applied to the continuous variables, and was used to get a area under curve (AUC), while in order to evaluate the cut off levels-suggested by ROC curve. A p value of <0.05 was considered significant.

RESULTS

Out of the 1215 women who underwent LSCS during the study period, 251 (20.5%) women developed surgical site infection. The demographic characteristics of study population were as reported in Table 1.

Table 1: Demographic characteristics of the sample (n=1215).

Demographic characteristics	
Maternal age in years	25±4.3
Nulliparous	43.2%
BMI	28.1±5.7
Gestational age in weeks	37.04±1.5
Previous CS	45.2%
Presence of obstetric complications	35.6%
Presence of UTI	11.8%
Type of anesthesia (spinal)	86.4%
Fetal presentation (cephalic)	88.3%
Hemoglobin in gm/dl	8.73±2.07
Referral	47.2%

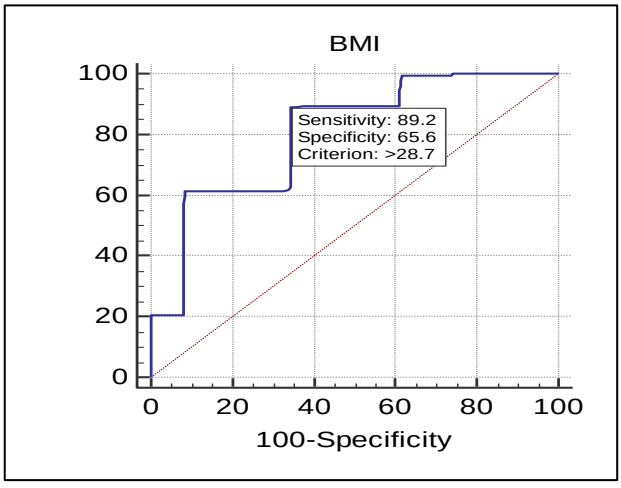

Figure 1: Receiver operating characteristics curve analysis applied for incision length. Dashed lines croSSIng the cut-off point (28.7kg/m2) indicates sensitivity (89.2%) and specificity (65.6%).

On analysis of various risk factors for wound complication, length of incision (OR 2.40, 95% CI 2.11-2.73; p<0.0001), BMI at term (OR 2.9, 95% CI 1.82-4.44; <0.0001), Grade of surgeon (OR 5.5, 95% CI 3.3-9.3; p<0.0001), previous caesarean section scar (OR 0.72, 95% CI 0.54-0.96; p=0.02), subcutaneous tissue thickness

(OR1.88, 95% CI 1.60-2.23, p<0.0001) were found to be significantly correlated with wound complications (Table 2).

ROC curve analysis for BMI at term and incision length gave an AUC 0.8 (0.78-0.82; p <0.0001) of BMI at term, and 0.8 (0.79-0.84, p<0.0001) of incision length (Figure1 and 2). Moreover, ROC curve suggested a cut-off of 28.7 for BMI at term and 14.7 for incision length. Logistic regression analysis was applied to the calculated cut-offs at term, OR 1.11 (1.05-1.18; p=0.0002) and for incision length, OR 2.89 (2.53-3.30; p<0.0001). The multivariate logistic regression analysis was applied to these variables which showed an independent correlation between these variables and surgical site infection (at term BMI>28.7; OR 1.25, 95% CI 1.21-1.29, p<0.0001; wound length>14.7; OR 2.40, 95% CI 2.11-2.73, p<0.0001).

Table 2: Analysis of risk factor for surgical site infection.

Variable		OR	CI 95%	P
BMI at term	Normal vs mild obese	3.2	1.9-5.1	<0.0001
	Normal vs moderate obese	5.15	3.2-8.1	<0.0001
	Normal vs severe obese	8.1	4.8-13.7	<0.0001
	Normal vs undernourished	0.4	0.38-107.5	0.195
Grade of operating surgeon	Senior resident vs Consultant	4.4	2.6-7.6	<0.0001
	Junior resident vs Consultant	5.8	3.1-10.8	<0.0001
	Junior resident vs Senior resident	1.41	0.9-2.08	0.083
Previous scar	Previous scar vs no scar	0.72	0.54-0.96	0.02
Incision length		2.40	2.11-2.73	<0.0001[R]
Subcutaneous scar thickness		1.88	1.60-2.23	<0.0001[R]

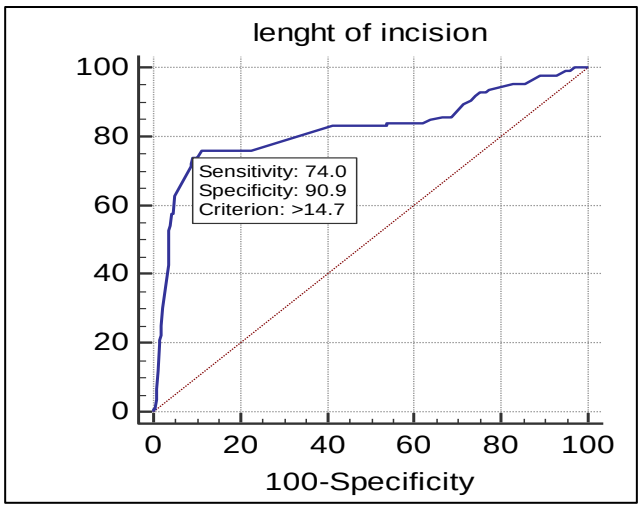

Figure 1: Receiver operating characteristics curve analysis applied for incision lenght. Dashed lines croSSIng the cut-off point (14.7cm) indicates sensitivity (74%) and specificity (90.9%).

DISCUSSION

Surgical site wound infection is the most important associated morbidity with any kind of the surgery apart from the inherent risk of the surgery and the anesthesia. Cesarean section is one of the most common surgery practiced in present era in obstetric population. A rising trend in the caesarean section rate is observed all over the world in past 30 years. In 1980, the CS rate in England was 9%, this increased to 13% in 1992 (Treffers PE et al), 21% in 2000 (RCOG), 23% in 2004 (Stats Q et al) and 24.8% in 2009 (Department of Health).[1] It has resulted in improvement in perinatal outcome but at the same time there is an increase in the postoperative morbidity particularly surgical site wound infection.

WHO has reported a SSI rate of 0.5 to 15 % depending upon type of operation and underlying patient status.[6] In present study, we observed incidence of SSI to be 20.5% (251 out of 1215) which is very high as compared to that observed by others. However, comparable to the incidence reported in our country i.e. 24.2% (Table no 3), which is in line to present study. The risk for developing SSI after caesarean section is multi factorial. In the present study, a number of the variables had been studied which were likely to influence the rate of SSI and the results were captivating in respect to detection of new risk factor not taken in consideration previously.

In current study variables found to influence SSI and associated with poor wound healing were; BMI, incision length, grade of operating surgeon, previous scar, subcutaneous tissue thickness.

Interestingly, analysis of incision length never done before, found to be an important risk factor. The ROC curve generated for incision length described area under curve 0.8 (0.79-0.84, p<0.0001) giving a cut off of 14.7, indicating a sensitivity of 74% and specificity of 90.9% This can be probably explained by extensive exposure to air borne and local contamination, prolong tissue handling, decreased local immunity, oxygen tension,

surgical technique, with way to approximate wound. Greater length of incision leads to greater vascular disruption with negative impact on wound healing process.[7] The surgeon's operating skills play a important role in wound infections. In present study, remarkable difference was seen in wound outcome when consultant and senior resident were compared,30 vs 221 (<0.001), the rationale behind this may be because our hospital is a referral tertiary center and 3/4th of the LSCS were done in the emergency hours (888/1215) when most of the Obstetric work is taken care of by the resident staff. Antiseptic technique in emergency hours may also be a limiting factor.

The next factor, BMI is an independent risk factor for developing the SSI (Table 4).[8-12] The ROC curve generated in this study suggested a BMI at term cut-off point of 28.7 and AUC 0.8 (0.78-0.82; p <0.0001) indicating a sensitivity of 89.2%, specificity of 65.6%. The pathogenic mechanisms for predisposition of SSI in obese cesarean patients have been suggested to be tissue hypoperfusion (subcutaneous adipose tissue), a high ratio of tissue mass: capillaries in adipose tissue, larger wound surface areas and decreased oxygen tension in adipose tissues which may be together categorized as a poor balance between tissue oxygen demand and oxygen supply predisposing SSI through greater risk of ischemia/necrosis and suboptimal neutrophil oxidative killing.[12]

As obesity leads to subcutaneous tissue deposition the thickness of the subcutaneous fat is directly proportional to the BMI. Vermillion et al concluded that subcutaneous tissue thickness is the only significant risk factor associated with wound infection after ceasarean section.[13]

In present study, mean subcutaneous tissue thickness was 2.63±0.84 (OR 1.88, 95% CI 1.60-2.23, p<0.0001),other various studies have also confirmed a higher rate of SSI at a subcutaneous fat thickness of more than 2cm.[14,15] The healing process in obese pregnant patients can be impaired by a greater production of proinflammatory mediators such as TNF-α, IL-6 and C-reactive protein, by the thick adipose tissue , the same factors are also predispose these obese cases for the development of Preeclampsia and GDM.[16] This also shows the impact of the weight gain during pregnancy on wound healing. As it is one of the few risk factor which could not be avoided during labor; education for preconceptual weight loss and prophylactic antibiotic is recommended.[17]

In study, previous scared patients which were 550 out of which 98 (40%) developed surgical site infection, and was significantly associated, probably scarred tissue lead to fibrosis and lack proper oxygen and blood supply and it also lack proper tissue approximation in next C-section. Since previous cesarean delivery is most common and important indication for repeat caesarean section. The root solution for reduction of SSI in post caesarean deliveries is to reduce the caesarean section rate by increasing the rate of vaginal delivery whenever possible if, caesarean is not indicated.[18] With the doubling caesarean section rate it has now became mandatory to improve our obstetrical services by understanding the pathophysiology of these risk factors in women. Development of surgical site infection after cesarean delivery is a morbid event and results in inconsequential patient discomfort, inconvenience. and degrading, prolong hospital stay, additional surgery, putting a psychological, economical and social burden on individual and community care.

CONCLUSION

BMI, Gestational age, previous scar, subcutaneous thickness is independent risk factor for SSI, they all together by influencing the length of incision, thereby contributing significantly towards SSI. Incision length is itself an independent risk factor for development of surgical site infection

Therefore, giving careful and appropriate incision length, monitoring gestational BMI, bringing professionalism in surgeon skills and encouraging an attempt for vaginal delivery before taking decision for caesarean section.

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