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Research Article

Surgical Site Infection Following Emergency LSCS – to Find out the Incidence, Risk Factors and Commonly Associated Bacteria

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Abstract: This particular study was conducted with the aims to find out the incidence, risk factors and commonly associated bacteria in cases of surgical site infection (SSI) following emergency caesarean section. It was an observational case control study conducted at Gauhati Medical College and Hospital (GMCH), Guwahati including all the cases of SSI developing following emergency caesarean section conducted at GMCH between 1st August 2014 to 31st July 2015. Two groups were taken for the study - one with SSI and the other without SSI. During the study period, out of the 6330 cases of emergency caesarean sections, 382 cases developed SSI (incidence rate 6.03%).Factors significantly contributing to the development of SSI were anaemia, high BMI, PIH, prom, repeated per vaginal examinations, prolong labour, long duration of operation, blood transfusion. Staph. aureus was the commonest organism isolated(37.96%) followed by coagulase negative staph aureus(21.73%) and klebsiella(18.32%).Most of the risk factors for SSI are either avoidable or correctible. A proper assessment of risk factors that predispose to SSI and their modifications may help in reduction of SSI rates.
Keywords: Surgical site infection, postoperative wound infection, puerperal sepsis, caesarean section

INTRODUCTION

Wound infection is the commonest and the most troublesome disorder of wound healing. Surgical site infection (SSI) is the second most common infectious complication after urinary tract infection following a delivery by caesarean section (CS). At Gauhati Medical College, there has been no study documenting the incidence and risk factors of SSI after CS despite the large number of CS being performed and the relatively common occurrence of SSIs. Postoperative wound infection has been a problem since surgery was started as a treatment modality and is responsible for significant postoperative morbidity, prolonged hospital stay and adds to economic burden to the patient and the health-care system.

In Obstetrics, Emergency LSCS is one such procedure whose incidence has increased substantially worldwide due to emphasis on improving the maternal and perinatal outcome. With the increase in the numbers of LSCS being performed, the incidence of SSI has also increased.

Reduction in surgical site infections still remains a challenge for many health care institutions. Surveillance of surgical site infections is an important infection control activity. While most of the studies on surgical site infections in lower segment caesarean section have been conducted outside India, a few studies were conducted in India as well. As a result, not much data is available on the incidence rates of SSI following lower segment caesarean section (LSCS) in Indian hospitals. The data is also lacking in the knowledge of common pathogens causing SSI after LSCS. In spite of the availability of antibiotics, SSIs are still responsible for much morbidity and far reaching socioeconomic consequences for both patients as well as health care system. Data regarding incidence rates and the knowledge of the common pathogens causing it is essential to reduce the postoperative morbidity. There is also a need to investigate the intra operative and postoperative risk factors for surgical site infections after Emergency LSCS. Keeping all these needs in mind, the present study was conducted in the Department of Obstetrics and Gynaecology, GMCH with the following aims and objectives:

To find out-

- The incidence of SSI in patients undergoing Emergency LSCS for various indications in GMCH in one year period.
- The risk factors and

- The commonly associated bacteria.

MATERIALS AND METHODS

Place of Study

Department of Obstetrics and Gynaecology, Gauhati Medical College and Hospital (GMCH), Guwahati.

A total number of 383 patients, in the post-operative(LSCS) wards of GMCH, who developed SSI following emergency LSCS conducted at this hospital for various indications, from 1st August 2014 to 31st July 2015were taken up for the study. Swabs were taken from the skin wound sites with discharge and sent for culture and sensitivity (C/S). Detailed history-taking and physical examination of these patients were done. For every case of SSI, another case from the same ward without wound discharge was taken as a control. So, two groups were taken for the study - one with SSI and the other without SSI. Data were collected from the patients in both the groups in a proforma for analysis.

Study Design

Hospital based analytical case-control study.

Study Period

1 year (01-08-14 to 31-07-15).

Data Analysis

Data were analysed by finding out the incidence rate of SSI, p values using Fischer's exact test to determine the significance of various risk factors ($p < 0.05$ was taken as significant) and by finding out the percentage of various bacteria involved in the development of SSI following emergency LSCS.

Inclusion Criteria

All women who developed surgical site infection after an emergency LSCS conducted at GMCH, before discharge from the hospital.

Exclusion Criteria

- Patients referred to GMCH from any outside hospital postoperatively after LSCS.
- Patients who have pre-existing skin infections around the site of surgical wound
- Immuno compromised patients (AIDS, steroid etc.)
- Elective LSCS cases.

All the patients undertaken for the study were subjected to proper history taking, thorough examination- general, systemic and local, investigations and bacteriological study. All the positive and negative findings related to the study were recorded.

RESULTS

The total number of LSCS conducted at GMCH from 1-8-14 to 31-7-15 was 8,128 out of which 6,330 cases were done for emergency indications. Among these 6,330 patients 382 patients developed SSI before discharge from the hospital. Therefore the incidence of SSI is 6.03%.All SSIs in this study were found to be superficial and limited to the stitch line.

The commonest indication for emergency LSCS in this study was for foetal distress (36.39%) followed by post caesarean pregnancy (20.68 %) and prolonged labour (12.89 %).

BMI $\geq$ 25 kg/m² (p value 0.0247), anaemia (p value ‹0.0001), PIH (p value 0.0057), prom (p value ‹.0018), repeated p/v examinations $\geq$ 5(0.0001), prolong labour (p value ‹ .0025), prolong duration of operation ($\geq$40 minutes) (p value ‹0.0001), increased intra-op blood loss ($\geq$ 750 ml) (p value ‹0.0001) and blood transfusion (p value 0.0089) were found to be significant risk factors for the development of SSI following emergency LSCS.

In the present study, we did not find any increasing risk of SSI with increasing age, longitudinal versus P fennenstiel skin incision, use of silk versus nylon sutures for skin closure of, and also no relationship was found between diabetes and wound infection.

Among the organisms cultured from the various swabs taken the most frequent organisms cultured were Staphylococcus aureus (37.96 %), Coagulase negative Staph. aureus (21.73 %), Klebsiella (18.32 %), E. coli (13.87 %), Pseudomonas aeruginosa (8.12 %).

Some cases were done for more than one indication. So, adding together the number of cases on the basis of indication for LSCS (in either of the study or the control group), exceeds total number of 382.

Table-1: Categorising cases as per indications of emergency LSCS among both the study and the control groups

Indication of LSCS	Cases with SSI	Control
Foetal distress	128 (33.51 %)	122 (31.94 %)
Post caesarean	79 (20.68 %)	40 (10.47 %)
Severe Oligohydroamnios	44 (11.52 %)	75(19.63%)
Prolong labour	69 (18.06 %)	39 (10.21 %)
APH	17 (4.45 %)	12 (3.14 %)
Induction failure	25 (6.55 %)	31 (8.12 %)
Breech	25 (6.55 %)	41 (10.73 %)
Eclampsia	11 (2.88 %)	8 (2.09 %)
Obstructed labour	11 (2.88 %)	3 (0.78 %)
CPD	16 (4.19 %)	31 (8.12 %)

Table-2: Various risk factors and their significance in this study

RISK FACTORS	CASES (n = 382)	Controls (n=382)	p value
Age (years)			› 0.05
• ≤ 20	24	26	
• 21-25	201	215	
• 26-30	138	126	
• › 30	19	15	
Hb% (gm/dl)			0.0004
• ≥ 8	328	359	
• ≤ 7.9	54	23	
BMI (kg/m²)			0.0247
• ≥ 25	61	40	
• ‹ 25	321	342	
PIH			0.0057
• Yes	112	78	
• No	270	304	
DIABETES (GDM and Type II DM)	3	1	0.6240
PROM/PPROM			0.0018
Yes	98	62	
No	284	320	
No. of p/v examination			0.0001
• ‹ 5	166	267	
• ≥ 5	216	115	
Pre-op antibiotic			0.0001
• Yes	62	154	
• No	320	228	
Prolong labour			0.0025
• Yes	69	39	
• No	313	343	
Duration of operation (minutes)			0.0001
• ‹ 40	187	269	
• ≥ 40	195	113	
Intra-op blood loss (ml)			0.0001
• ‹ 750	260	312	
• ≥ 750	122	70	
Blood transfusion			0.0089
• Yes	85	56	
• No	297	326	
Type of skin incision			0.3574
• longitudinal	344	335	
• pfennenstiel	38	47	
Suture for skin closure			0.1825
• Nylon	360	367	
• Silk	22	15	

List of Bacteria Isolated From the Wound Sites

Among the organisms cultured from the various swabs taken the most frequent organisms cultured were Staphylococcus aureus (37.96 %), Coagulase negative staph. aureus (21.73 %), Klebsiella (18.32 %), E. coli (13.87 %), pseudomonas aeruginosa (8.12 %).

Table-3: Showing the different types bacteria isolated from the SSI cases

Name of the bacteria	Total number	Percentage (%)
Staph. aureus	145	37.96 %
Coagulase negative Staph aureus	83	21.73 %
Klebsiella	70	18.32 %
E. coli	53	13.87 %
Pseudomonas aeruginosa	31	8.12 %

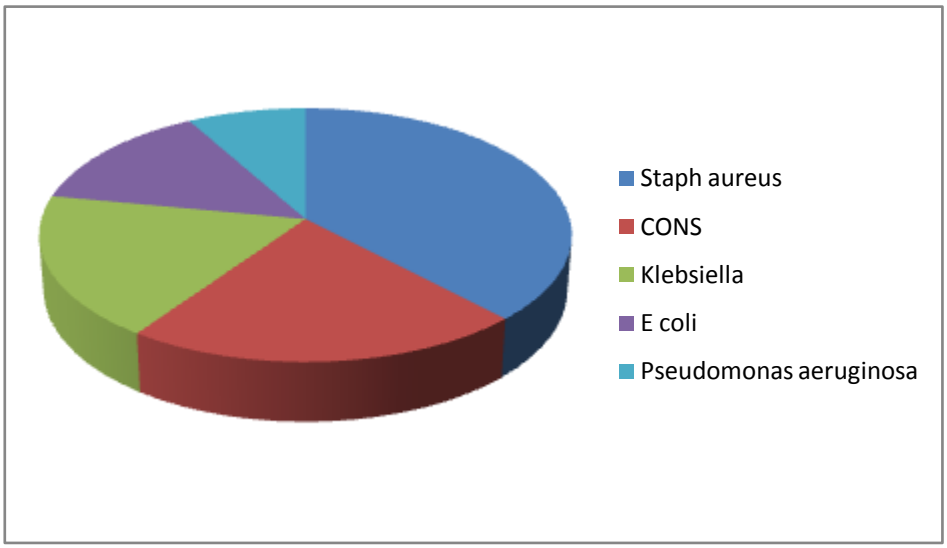

Fig-1: Showing various types of bacteria isolated from the SSI cases.

DISCUSSION

Despite the advances in the operative techniques and a better understanding of the pathogenesis of the wound infections, post operative wound infections continue to be a major source of morbidity for the patients undergoing LSCS. In India, the incidence of postoperative infections in various hospitals varies from 10 to 25% [1-3]. In our study the incidence was 6.05%. The actual incidence may be even higher as the study conducted by Couto R C *et al.* [4] concluded that most of SSI following caesarean section was detected only after patient's discharge from the hospital.

The relatively lower rate of SSI in this study compared to the other studies conducted in India may be attributed to the fact that only those patients who developed SSI during their stay in the hospital were included in the study and patients could not be followed up after being discharged from the hospital, as they usually attend local hospitals for any complaints such as wound discharge.

Ageing has been reported to increase the likelihood of post-operative wound infection owing to the decreased immune-competence with increasing age. William *et al.* [5], Olson and Lee [6] reported higher incidence of wound infection in older age group. In another study by Scott *et al.* [7] similar results were found. In the present study, we did not find any increasing risk of SSI with increasing age. This may be because of the fact that, most of the patients in this study are from the rural areas where early marriage is common and also, lesser number of patients are above the age of 30 years to be considered elderly.

The commonest indication for emergency LSCS in this study was for foetal distress (36.39 %) followed by post caesarean pregnancy (20.68 %) and prolonged labour (12.89 %). It confirms favourably to various studies worldwide [8-10].

Worldwide the rate of vaginal birth after caesarean (VBAC) is decreasing and this may contribute to the high number of LSCS being performed in post cs patients.

Preoperative anaemia is an important predictor of infection and has been proved by several other studies [11-13]. Anaemia diminishes resistance to infection and

is frequently associated with puerperal sepsis. In our study also, anaemia was found to be significantly associated with SSI (P ‹0.0004).

Body mass index of more than 25 has been shown to affect the outcome of surgery [14,15,11]. The local changes such as increase in adipose tissue, a need for larger incision, decrease circulation to fat tissue, operations taking more time and thus increasing the chances of contamination, an increase in local tissue trauma related to retraction contribute to an increased incidence of SSI in these patients [16,17]. In the present study an increased BMI was seen to influence the outcome of surgery in terms of an increased rate of infection.

Hypertensive disorders of pregnancy have been found to be independent risk factors for the development of SSI following LSCS by various studies [18,19]. This study also shows similar results. The exact cause for this is not known but may be due to frequent association of other risk factors of SSI with PIH. Eclamptic women undergoing caesarean section require general anaesthesia which itself is considered to be an independent risk factor for development of SSI [20,21].

The number of cases with diabetes was found to be too less in both the study and the control groups to draw any inference. Most of the patients in this study come from the rural areas, belonging mostly to the lower middle class of the society, in which the prevalence of diabetes is less as compared to the higher class of the society.

Premature rupture of membranes was a significant risk factor in this study, as was reported by several other authors [18, 22-25]. PROM is associated with the largest bacterial inoculum and liquor gets infected and infection supervenes [26].

Patients with multiple per vaginal examinations (more than 5) were found to be more predisposed to SSI as shown by other studies [13,19]. Multiple per vaginal examinations make easy entrance of the organisms colonizing the cervix and vagina into the amniotic fluid during labour, which gets contaminated. During LSCS these contaminated amniotic fluid comes in contact with the wound site and predispose to the risk of development of SSI.

Several studies have shown that cases of prolonged/obstructed labour are associated with higher incidence of SSI [27,28]. Prolonged and obstructed labour, were among the majority of cases that were referred to our unit from outside hospitals especially from rural areas (PHC/CHC/ Sub-centre) perhaps after some non-aseptic manipulations; it also aids ascent of microbial pathogens from the lower genital tract to the upper genital tract. Prolong labour was found to be a significant risk factor for SSI in this study as well.

In absence of preoperative antibiotic, there is a significant increase in the incidence of SSI [25, 29-31]. In our study, only 16.23 % of patients in the infection group received pre-operative injectable antibiotics, as compared to 40.31 % of patients in the non-infection control group. This absence of preoperative antibiotic in the majority of cases in the infection group was found to be a statistically significant factor for SSI.

This study did not show any significant difference in the rate of SSI between the longitudinal skin incision group and the Pfennenstiel incision group. This may be due to the fact that most surgeons doing an LSCS for emergency indications preferred a longitudinal incision over pfennenstiel's incision (344 versus 38 in the study group and 335 versus 47 in the control group) due to its ease and comparatively less time required to access the uterus and deliver the baby.

Shapiro *et al.* reported that with each hour of surgery the infection rate almost doubles [46].The finding relates to the pharmacokinetics of the antibiotic prophylaxis and to the greater bacterial wound contamination that occurs in lengthy clean-contaminated surgeries. In the present study, 51.05%of patients in the study group with prolonged duration of surgery exceeding 40 minutes got infected which was found to be statistically significant. Lilani et al. reported a rate of 38.46% for surgeries that lasted more than 2 hours [45]. Johnson *et al.* Classified duration of LSCS into ≤ 30 minutes and 31–60 minutes and found an increased rate of SSI in the latter group[27]. Similar findings have been reported by several other studies [32, 25,33].

Several studies have reported an increased SSI rate in patients who had increased amount loss during LSCS [27,34]. Ward VP *et al.* [34] found that increased intraoperative blood loss was a significant risk factor for the development of SSI following LSCS. Another study by Jido T and Garba I [27] found a similar result (p ‹0.001).

Excessive intraoperative blood loss and perioperative transfusion could induce immunosuppression in postoperative patients by reducing the natural killer cell and cytotoxic T-cell populations [35,36]. In the present study 32.11 % of patients in the infection group had blood loss of ≥ 750 ml compared to 18.32 % in the non infection group, which was found to be a statistically significant factor in the development of SSI. Increased blood loss decreases body's ability to tackle infections and hence predispose to it.

The relationship between blood products and SSIs has been a matter of debate for more than two decades. Several studies have supported the association between the use of blood products and the development of postoperative surgical site infections. Allogeneic blood products have immune modulatory effects that may increase the risk of nosocomial infections [37,38]. The study by Vamvakas *et al.* [37] found that perioperative blood loss is significant risk factor for the development of post-operative wound infection [39]. Similar result came out of the study conducted by M Raghavan *et al.* [40]. It is also possible that the transfusion of blood products acts as a marker for individuals with a greater number of comorbidities and other SSI risk factors, which independently places them at an inherently greater risk for infection. Our study also showed similar results.

Sutures available today are classified as permanent or absorbable, natural or synthetic, and multi-filament or monofilament. Multi-filament or braided sutures (silk) are easy to handle and have favourable knot-tying qualities. However, bacteria can enter the braided interstices and escape phagocytosis, potentially leading to suture infection, granulomas and sinuses. By contrast, monofilament sutures cause significantly fewer tissue reactions and glide easily through tissue.[41]

But this study did not show any significant association between the use of silk sutures in the closure of skin and development of SSI. This may be due to very less number of cases with use of silk for skin closure as compared to nylon in both the study and the control group to draw any statistical significance.

Common causative organisms leading to post-LSCS SSI include Gram-negative bacteria, anaerobes, and *Staphylococcus aureus* [42]. In our study, the most frequently isolated organism was *Staphylococcus species* (37.96 %) followed by Coagulase negative Staph aureus (21.73%) and *Klebsiellaspp* (18.32%). This is similar to NNIS service survey (1997–2001) that reported *Staphylococcus aureus* (47%) including MRSA and *Staphylococcus epidermidis* (CONS) as the most common organism causing SSI [43]. In another study by S P Lilani *et al.* [45], Staph. aureus was found as being the most common organism isolated from the SSI sites followed by Pseudomonas aeruginosa and Klebsiella. Many other studies have reported similar findings of predominance of *Staphylococcus aureus* in wound infections [2,33,44,45].

CONCLUSION

Post-operative abdominal wound infection represents a substantial burden of disease both for the patients and the healthcare services in terms of the morbidity, mortality and economic costs. Although surgical wound infections cannot be completely eliminated, a reduction in the infection rate to a minimal level may have significant benefits. This may be achieved by meticulous surgical techniques, minimizing the duration of operation, proper sterilization, hygienic operation theatres and ward environments. Control of obesity, treatment of infective foci and diseases like diabetes, PIH may help in controlling the morbidity of the surgical wound infections. Emphasis should be given to bring more number of patients to antenatal clinics, so that correctible conditions such as anaemia and bacterial vaginosis (primary cause of prom) can be diagnosed and treated. To conclude a proper assessment of the risk factors that predispose to SSI and their modification may help in reduction of SSI rates.

REFERRENCES

1. Agarwal SL; Study of postoperative infections, Indian Journalof Surgery, 1972; 34: 314–320.
2. Rao S, Harsha M; Postoperative wound infections. Journal of the Indian Medical Association, 1975; 64: 490–93.
3. Kowli SS, Nayak MH, Mehta AP, Bhalerao RA; Hospital Infection, Indian Journal of Surgery, 1985; 48: 475–486.
4. Couto RC, Pedrosa TM, Nogueira JM, Gomes DL, Neto MF, Rezende NA; Post-discharge surveillance and infection rates in obstetric patients. Int J Gynaecol Obstet; 1998; 61(3): 227-31.
5. William JA, Oates GD, Brown PP, Burden DW; Abdominal wound infections and plastic wound guards. Brit. J. Surg, 1972; 59(2):142-146.
6. Olson MM, Lee J T Jr; continuous, 10 year wound infection surveillance. Results, advantages and unanswered questions. Arch. Surg, 1990;125:794-803
7. Scott JD, Forrest A, Feuerstein S, Fitzpatrick P, Schentag JJ; Factors associated with postoperative infection. Infection Control HospEpidemiol, 2001; 22:347-51.
8. F. Gary Cunningham, Kenneth J, Leveno, Steven L. Bloom, Catherine Y Spong, *et al;* Sheffield-caesarean delivery and peripartum hysterectomy. William'sObstetrics, 24thEdition, Page 588
9. Barber EL, Lundsberg LS, Belanger K, Pettker CM, Funai EF, illuzi JL; Indication Contributing To The Increasing Cesarean Delivery Rate. Obstetgynecol, 2011; 118(1): 29-38.
10. Torloni MR, Betran AP, Souza JP, Widmer M, Allen T, et al.; Classification for caesarean section: A systemic Review. PLoS ONE, 2011;6(1): e 14566.
11. Waisbren E, Rosen H, Eriksson E, Bader AM, Lipsitz SR, Rogers Jr SO; Percent body fat and prediction of surgicalsite infection. Journal of the American College of Surgeons, 2010; 210(4):381–389.

12. Walter P, Zwahlen M, Busen A et al; The association ofpreoperati veanemia and perioperative allogeneic blood transfusionwith the risk of surgical site infection. Transfusion, 2009; 49(9):1964–1970.
13. Zhou M, Chen L; Study of high-risk factors of surgical siteinfection after cesarean section. Di Jun Yi Da XueXueBao, 2005; 25(8):075–1078.
14. Schneid-Kofman N, Sheiner E, Levy A, Holcberg G; Risk factors for wound infection following caesarean deliveries. International Journal of Gynecology and Obstetrics, 2005; 90(1):10–15.
15. Cant¨urk Z, etinarslan BC, Tarkun I; Nosocomial infections and obesity in surgical patients. Obesity Research, 2003; 11(6):769–775.
16. Choban PS, Heckler R, Binge J, Flancbaum L; Increased incidence of nosocomial infections in obese surgical patients. American Surgeon, 1995; 61(11):1001–1005.
17. Nystrom PO, Jonstam A, Hojer H, Ling L; Incisional infection after colorectal surgery in obese patients. Acta Chirurgica Scandinavica, 1987;153(3):225–227.
18. TúlioCícero Franco Farreta, Jessica Dalléb, Vinícius da Silva Monteiroc, Cezar Vinícius Würdig Riched, Vicente SperbAntonellob; Risk factors for surgical site infection following cesarean section in a Brazilian Women's Hospital: a case–control study. The Brazilian Journal of Infectious Diseases , 2015;19(2):113–117
19. Filbert J Mpogoro,Stephen E Mshana, Mariam M Mirambo, Benson R Kidenya,Balthazar Gumodoka, Can Imirzalioglu; Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania Antimicrob Resist Infect Control. 2014; 3: 25.
20. Young JD, Reilly J; Caesarean section surgical site infection surveillance. Journal of Hospital Infection, 2006; 64(1);30–35.
21. H¨ager RME, Daltveit AK, Hofoss D; Complications of cesarean deliveries: rates and risk factors. American Journal of Obstetrics and Gynecology, 2004; 190(2):428–434.
22. Hansa Dhar, Ibrahim Al-Busaidi, Bhawna Rathi, Eman A. Nimre, Vibha Sachdeva, Ilham Hamdi; A Study of Post-Caesarean Section Wound Infections in a Regional Referral Hospital, Oman Sultan Qaboos Univ Med J, 2014; 14(2): e211–e217.
23. Schneid-Kofman N, Sheiner E, Levy A, Holcberg G; Risk factors for wound infection following caesarean deliveries. International Journal of Gynecology and Obstetrics, 2005; 90(1):10–15.
24. Moir-Bussy BR, Hutton RM, Thompson JR; Wound infection after caesarean section. Journal of Hospital Infection, 1984; 5(4):359–370.
25. Killian CA, Graffunder EM, Vinciguerra TJ, Venezia RA; Risk factors for surgical-site infections following cesarean section. Infection Control and Hospital Epidemiology, 2001; 22(10): 613–617.
26. Dutta DC; Medical and surgical illness complicating pregnancy. Textbook of Obstetrics, H. Konar, Ed., pp. 262–305, Central, 6th edition, 2004.
27. Jido T, Garba I; Surgical-site Infection Following Cesarean Section in Kano, Nigeria. Ann Med Health Sci Res. 2012; 2(1):33-6.
28. Amenu D, Belachew T, Araya1 F; Surgical Site Infection Rate and Risk Factors Among Obstetric Cases of Jimma University Specialized Hospital, Southwest Ethiopia**,** Ethiop J Health Sci, 201; 21(2): 91–100.
29. Smaill FM, Gyte GM; Antibiotic prophylaxis versus no prophylaxis for preventing infection after cesarean section. Cochrane Database Syst Rev, 2010; 20;(1):CD007482.
30. Weinberg M, Fuentes JM, Rinz AI; Reducing infection among women undergoing caesarean section in Columbia. Archives of Internal Medicine, 2001; 161(19):2357–2365.
31. Shetty J, Rajshekhar S, Kamath A; Short termantibioticprophylaxis for emergency caesarean section: is there a difference?. Internet Journal of Gynecologyand Obstetrics, 2009; 11(1).
32. Anvikar R, Deshmukh AB, Damle AS; A one year prospective study of 3280 surgical wounds. Indian Journal of Medical Microbiology, 1999; 17:129–132.
33. Olson MM, Lee Jr. JT; Continuous, 10-year wound infection surveillance. Results, advantages, and unanswered questions. Archives of Surgery, 1990; 125(6):794–803.
34. Ward VP, Charlett A, Fagan J, Crawshaw SC; Enhanced surgical site infection surveillance following caesarean section: experience of a multicentre collaborative post-discharge system. J Hosp Infect. 2008;70(2):166-73.
35. Gascon P, Zoumbos NC, Young NS; Immunologic abnormalities in patients receiving multiple blood transfusions, Ann. Intern. Med, 1984; 100 (2):173-177.
36. Kaplan J, Sarnaik S, Gitlin J, Lusher J; Diminished helper/suppressor lymphocyte ratios and natural killer activity in recipients of repeated blood transfusions, Blood, 1984; 64 (1):308-310.
37. Vamvakas EC, Carven JH; Transfusion of whitecell-containing allogeneic blood components and postoperative wound infection: effect of confounding factors. Transfusion Medicine, 1998; 8(1):29–36.
38. Raghavan M, Marik PE; Anemia, allogenic blood transfusion,and immunomodulation in the critically ill. Chest, 2005;127(1):295–307.

39. Smaill F, Hoffmeyer GJ; Antibiotic prophylaxis for caesarean section. Cochrane database systemic reviews. Cochrane Database Syst Rev. 2002;(3):CD000933
40. Hopkins L, Smaill F; Antibiotic prophylaxis regimens and drugs for caesarean section. Cochrane database systemic reviews. Cochrane Database Syst Rev, 2000; (2):CD001136.
41. Parell GJ, Becker GD; Comparison of absorbable with nonabsorbable sutures in closure of facial skin wounds. Arch Facial Plast Surg, 2003; 5:488–90.
42. Cunningham FG, Van Dorsten JP, Eds.; Operative Obstetrics, McGrawHill, NewYork, NY,USA, 2 edition, 2002.
43. Surveillance of surgical site infection in England hospitals1997–2001.NationalNosocomial Infection Surveillance Service. PHLS publication, 2001.
44. Dhar H, Al-Busaidi I, Rathi B, Nimre EA, Sachdeva V, Hamdi I; A study of post-caesarean section wound infections in a regional referral hospital, oman. Sultan Qaboos Univ Med J. 2014;14(2):e211-7.
45. Lilani SP, Jangale N, Chowdhary A, Daver GB; Surgical site infection in clean and clean-contaminated cases. Indian Journal of Medical Microbiology2005; 23(4):249–252.
46. Shapiro M, Munoz A, Tager IB; Risk factors for infection at the operative site after abdominal or vaginal hysterectomy. New England Journal of Medicine, 1982; 307(27):1661–1666.