Microbiological Pattern of Surgical Site Infection Following Caesarean Section at the University of Calabar Teaching Hospital

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Abstract

BACKGROUND: Surgical site infection (SSI) is among the most common problems of patients who undergo a caesarean section, despite improved infection control practices. It contributes to increased morbidity and negative impact on the mental, social and economic aspect of patients’ life.

AIM: To determine the incidence, risk factors and the bacteriological aetiology for SSI following caesarean section and their antimicrobial susceptibility patterns at UCTH.

METHODS: This was a prospective study of 600 patients who had a caesarean section over 6 months. Wound swab was collected from the patients who developed clinical evidence of SSI during this study period were recorded. Microbiology culture and antibiotic sensitivity were conducted for both aerobic and anaerobic organisms. The data obtained were analysed using the SPSS version 22 statistical program.

RESULTS: Out of the 600 participants who had a caesarean section, 51 patients had SSI, giving an incidence of 8.5%. The common isolates were S. aureus (37.3%), Klebsiella pneumonia (27.1%) and E. coli (22.0%). Independent risk factors significantly associated with post caesarean section wound infection in the logistic regression model were emergency caesarean section, prolonged rupture of membrane rupture greater than 24 hours, prolonged labour, intra-operative blood loss greater than one litre, duration of surgery greater than one hour and post-operative PCV less than 30%. Most isolates were highly resistant to cephaporphins, gentamycin and amoxicillin; moderately resistant to fluoroquinolones and highly sensitive to amikacin and imipenem.

CONCLUSION: The post-caesarean wound infection rate in our centre of 8.5% was high. Imipenem and amikacin antibiotics were very sensitive for SSIs and can be used as evidenced-based sensitive antibiotics to be commenced initially when wound infection is identified in our wards while awaiting the result of wound swab microscopy, culture and sensitivity to reduce the complications of post-caesarean wound infection in our centre.

Introduction

Surgical site infection is defined as an infection occurring within 30 days after a surgical operation (or within 1 year if an implant is left in place after the procedure) and affecting either incision or deep tissues at the operation site. These infections may be a superficial or deep incisional infection or infections involving organ or body space [1]. Postoperative SSI is among the most common problems for patients who undergo caesarean section and the third most frequently reported nosocomial infection in the hospital population [1]. Postoperative SSI following caesarean section is associated with increased morbidity, mortality, prolonged hospital stay, secondary infertility and increased economic costs for patient care [2]. The incidence of postoperative SSI varies widely between procedures, hospitals, surgeons, patients and geographical locations. It complicates 2.85% in India [3], 21% in Ethiopia [4] and 7-9.6% in Nigeria [5], [6]. Staphylococcus aureus is a commonly isolated organism in SSI, accounting for 20-30% of SSI occurring in hospital [7]. Other organisms regularly isolated from SSIs include gram-negative bacilli, Pseudomonas aeruginosa, Klebsiella, and Escherichia coli [5], [6].

There has been advance in SSI control practices which include: improved operating room ventilation, sterilisation methods, use of barriers, surgical techniques and availability of antimicrobial...
prolonged labour prior caesarean section, prolonged operating time, prolonged obstructed labour, postoperative anaemia, high body mass index, diabetes mellitus, immunosuppressive disorders and certain medications like steroids [1]. Also, the surgical infection rate is higher in our environment due to poor adherence to infection prevention and control practices in theatre. Potential sources of infection identified include unfiltered air, antiseptic solutions, transporting of patients, surgical team, overcrowding in theatre, theatre gowns, inadequately sterilised equipment, contaminated environment and grossly contaminated surfaces [8]. Complications of SSIs include prolonged wound healing, wound dehiscence, wound pain, burst abdomen, necrotising fasciitis and pelvic abscess. Others are prolonged admission, a prolonged course of antibiotics, the possibility of re-admission, secondary repair surgery, incisional hernia, disfiguring scar, and in rare condition can lead to severe sepsis and mortality [1]. Surgical site infections also hurt the physical, emotional, social and economic aspects of life.

The common organisms causing infection after caesarean section in our department and their sensitivity patterns are unknown because no such study has been done in our centre on caesarean sections. Also, there is a paucity of study on the extent to which anaerobes are involved in the aetiology of SSIs in Nigeria. This gap makes the choice of empirical therapy more difficult to the clinicians. Therefore a better understanding of the spectrum of pathogens causing SSI as well as their susceptibility pattern in our department is important for prompt management of patients and provides evidenced-based sensitive antibiotics to be commenced initially when wound infection is identified in our wards while awaiting the result of wound swab microscopy, culture and sensitivity in 48-72 hours. Having such data would help to establish guidelines for the prevention and management of SSIs and contribute to the planning of surveillance and control of this group of infections.

Methods

This prospective study was carried out in the maternity unit of the Department of Obstetrics and Gynaecology of UCTH, Calabar, Cross River State, Nigeria. Caesarean section accounted for 37% and 38.2% in 2015 and 2016 respectively.

The study population comprised of patients that had a caesarean section and then followed-up to document those that developed post-caesarean section surgical site infections. The exclusion criteria were women with wound infections occurring after 30 days of surgery, caesarean sections done outside our hospital admitted following wound infection and refusal to give consent.

Post-operative surgical site infection was as defined according to CDC criteria [1]. Timing and classification of SSI were used. SSI was classified as superficial, deep incisional or organ/space infection [1]. It includes purulent drainage with or without laboratory confirmation from the superficial or deep incision, organism isolated from an aseptically obtained culture of fluid or tissue from the superficial or deep incision or organ/space and sign or symptoms of infection such as pain, tenderness and localised swelling, or heat. It also includes purulent drainage from the drain that is placed into the organ/space.

The study lasted for 6 months, and all eligible patients that had caesarean sections over the study period that consented to participate in the study were included. Structured questionnaires were used to extract data from the patients undergoing caesarean sections. The information includes demographic data, existing chronic disease (such as diabetes mellitus, hypertension), past medical history, current drug use such as steroid and smoking. Physical examination was done to determine the weight, height and body mass index (BMI). The indication for the caesarean section was documented, and the patients were followed up to document the surgical complications, duration of the operation and post-operative PCV. For those patients that developed SSI, physical examination was done to determine the diagnosis and type of the surgical site infection. Wound swabs for microbiologic culture were taken from the infection site using sterile swabs sticks before the wound is cleaned with an antiseptic solution without contaminating with skin commensals and sent to the hospital laboratory immediately for microscopic, culture and sensitivity.

The data were analysed using SPSS version 22. Statistical comparison was made using Chi-square (χ²) test at 95% confidence and level of significance less than 0.05.

Results

During this period, there were a total of 1,584 deliveries. Of this, 953 were vaginal deliveries, and
631 were caesarean sections giving the prevalence of caesarean section of 39.8%.

Figure 1 shows that 51 patients out of 600 participants (8.5%) had surgical site infection following caesarean section.

Table 1 shows the demographic characteristics of women with SSI following caesarean section. Majority of the patients with post-caesarean wound infection were teenagers (16.7%), single women (35%), Artisans (15.9%), had primary education (18.2%) and unbooked (13.3%). Surgical site infection following caesarean section was significantly higher among unbooked pregnancy (13.3%) than booked pregnancy (7.4%) (p = 0.042).

Table 2 shows the risk factors for post-caesarean wound infection. SSI was significantly higher among emergency caesarean section (11.0%) than the elective caesarean section (3.6%) (p = 0.001). SSI was significantly higher among patients with prolonged rupture of membranes (> 24 hours) (p = 0.000) and prolonged labour (> 12 hours) (p = 0.000). Other factors associated with increased risk of post-caesarean wound infection were intra-operative blood loss greater than one litre (p = 0.020), blood transfusion (p = 0.029), history of previous surgery (p = 0.024), duration of surgery (> 1 hour) (p = 0.001) and post-operative PCV less than 30% (p = 0.000).
Table 2: Risk factors for post-caesarean section wound infection

| VARIABLES | Total (%) | PRESENT (%) | ABSENT (%) | P VALUE |
|-----------|-----------|-------------|------------|---------|
| BMI < 30  | 314       | 294 (93.9)  | 20 (6.1)   | 0.001   |
| BMI ≥ 30  | 209       | 186 (89.3)  | 23 (10.7)  |         |
| Type of surgery | | | | |
| Elective    | 190       | 182 (95.8)  | 8 (4.2)    | 0.001   |
| Emergency   | 41        | 36 (87.8)   | 5 (12.2)   |         |
| Indications for C/S | | | | |
| Preeclampsia/Eclampsia | 69 | 59 (85.6) | 10 (14.4) | 0.001 |
| ≥2 previous C/S | 66 | 63 (95.5) | 3 (4.5)   |         |
| Prolonged Obstructed Labour | 58 | 55 (94.8) | 3 (5.2)   |         |
| CPD         | 32        | 28 (87.5)   | 4 (12.5)   |         |
| Abnormal Labour | 323  | 305 (94.4) | 18 (5.6)  |         |

*Others include abnormally lies, fetal distress, placenta previa, failed induction, breech presentation, severe oligohydramnios, bad obstetric history, cord prolapse; CPD: Packed cell volume; BMI: Body mass index; CPD: Cephalopelvic disproportion.

Table 3: Multivariate analysis of Risk factors for Post- Caesarean Section Wound Infection

| VARIABLES | MEAN | SD | 95% CI | P VALUE |
|-----------|------|----|--------|---------|
| BMI       | 2.017 | 0.810 | 0.346 | 0.013   |
| Duration of labour | 2.460 | 0.834 | 0.340 | 0.013   |
| History of previous surgery | 2.013 | 0.820 | 0.330 | 0.013   |
| Type of Incision | 2.013 | 0.820 | 0.330 | 0.013   |
| Estimated Blood Loss | 2.013 | 0.820 | 0.330 | 0.013   |
| HIV | 2.013 | 0.820 | 0.330 | 0.013   |

CI - Confidence interval

Table 6 shows the antimicrobial sensitivity pattern of gram-positive and gram-negative isolates. Some of the S. aureus isolates, the majority are highly sensitive to amikacin (72.7%) and imipenem (72.7%). Some had low to moderate sensitivity to several antibiotics including ceftriaxone (13.6%), cefoxitin (13.6%), levofloxacin (31.8%) and erythromycin (40.9%). S. aureus isolates showed high resistance to multiple antimicrobial agents tested; most of the S. aureus are highly resistant to amoxicillin/clavulanate (100%) and meropenem (100%). Sixty-eight per cent were resistant to fluoroquinolones, and 59.1% were resistant to macrolides (erythromycin and clindamycin).

All E. coli isolates were sensitive to imipenem (100%). E. coli had moderate sensitivity to amikacin (76.9%), levofloxacin (53.9%) and cefoxitin (53.9%), while 23.1% were sensitive to ceftriaxone, cefoxime and ceftizime. E. coli is highly resistant to amoxicillin/clavulanate (100%) and meropenem (100%).

Table 5: Antimicrobial Susceptibility Profile of S. aureus Isolates from Surgical Wound Infections

| ORGANISM CULTURED | Total (%) | AMPC | TETR | CLI | AMS | SXT | GEN | AMX | ERY | CLI | MER |
|--------------------|-----------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| **GRAM +ve** | | | | | | | | | | | |
| Staph aureus | 22 | 3 (13.6) | 4 (18.2) | 3 (13.6) | 3 (13.6) | 16 (72.7) | 7 (31.8) | 7 (31.8) | 16 (72.7) | 0 (0.0) | 9 (40.9) | 9 (40.9) | 0 (0.0) | 3 (13.6) | 3 (13.6) |
| *E. coli* | 13 | 3 (23.1) | 3 (23.1) | 3 (23.1) | 7 (53.9) | 10 (76.9) | 7 (53.9) | 7 (53.9) | 13 (100) | 0 (0.0) | 0 (0.0) | 23 (171) | 7 (53.9) | 0 (0.0) | 3 (13.6) | 3 (13.6) |
| **GRAM -ve** | | | | | | | | | | | |
| *K. oxytoca* | 3 | 1 (0.0) | 0 (0.0) | 0 (0.0) | 1 (100) | 1 (100) | 0 (0.0) | 1 (100) | 0 (0.0) | 0 (0.0) | 1 (100) | 0 (0.0) | 1 (100) | 0 (0.0) | 1 (100) | 0 (0.0) |
| *K. pneumoniae* | 16 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 12 (75.0) | 12 (75.0) | 0 (0.0) | 8 (50.0) | 0 (0.0) |
| *Pseudomonas* | 3 | 1 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (66.7) | 2 (66.7) | 0 (0.0) | 3 (100) | 1 (100) |
| **Bacteroides** | 2 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (100) | 1 (100) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (100) | 1 (100) | 0 (0.0) |

*Others include abnormally lies, fetal distress, placenta previa, failed induction, breech presentation, severe oligohydramnios, bad obstetric history, cord prolapse; PCV: Packed cell volume; BMI: Body mass index; CPD: Cephalopelvic disproportion.

Table 4: Susceptibility profile of bacterial isolates from Surgical Wound Infections

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Pseudomonas aeruginosa isolates were highly sensitive to imipenem (100%) and 66.7% sensitive to amikacin, levofloxacin, ciprofloxacin and imipenem. All pseudomonas (100%) were resistant to Ceftriaxone, cefuroxime cefazidime, gentamicin, amoxicillin/clavulanic acid, cefpime and meropenem.

Discussion

The study gives an insight into the causative pathogens of post-operative wound infections in this hospital and their sensitivity profiles. The incidence of post-caesarean wound infection in this study was 8.5%, which is comparable to 7.0% reported in Abakiliki, Nigeria and 9.1% reported in Kano, Nigeria [5], [6]. However, it is lower than 10% reported in Lagos and 12.5% in Nnewi, Nigeria [9], [10]. The possible reason for variation in these studies could be attributed to differences in the populations investigated; diversity of indications for caesarean sections performed in different centres, as well as risk factors for surgical site infection prevalent in the facility. In the present study, the majority of the isolates were obtained from patients who were already on antimicrobial prophylaxis routinely given to women after caesarean section in our centre, and this could have reduced the pathogens identified. Post caesarean wound infection in this study may not be the true representative of what currently obtains in most of our secondary facilities where most of the caesarean sections occur and where it is likely to be higher due to lack of or poor adherence to surgical protocol and post-operative management.

Booking status was a significant determinant of SSI in this study, commoner among unbooked women than booked women and is similar to the findings from previous studies [5], [9]. The reason may be that some unbooked patient is likely to labour in churches and traditional birth attendance places, and present in labour with complications like prolonged rupture of membranes, chorioamnionitis and obstructed labour. Most unbooked women are poor and more likely to be malnourished.

There was an inverse association between educational status and surgical site infection, with least educated women showing the highest prevalence of SSI. This may be due to the positive influence of education and public enlightenment/awareness on utilization of health facility for antenatal care, hospital delivery and low parity common among more educated women than less educated women.

The predominant organism isolated was Staphylococcus aureus, as it had the highest prevalence with 37.3%. Staphylococcus aureus is one of the predominant causes of SSI and has been documented in many studies in keeping with this finding [5], [6], [11]. Other isolated bacteria were Klebsiella pneumoniae (27.1%), E. coli (22.0%), Pseudomonas aeruginosa (5.1%), Klebsiella oxytoca (5.1%) and Bacteroides (3.4%). In the present study, the only (3.4%) anaerobic organisms cultured were Bacteroides. The probable reasons for the low culture of the anaerobic organism in this study could be wide prevalent use of metronidazole as a prophylactic antibiotic in our centre for the postoperative patient, which kills anaerobes. It was observed that the two patients that had cultures positive for Bacteroides in this study were unbooked women who presented in obstructed labour and did not commence prophylactic antibiotics due to financial constraints.

The incidence of post-caesarean wound infection among those who had an emergency caesarean section was 11.0% compared to only 3.2% of elective caesarean. This was similar to a study in Nnewi where caesarean wound infection rate was seen in 20% of emergency cases and 5% in the elective group [10]. A similar result was reported by other researchers [5]. The role of prolonged rupture of the membrane as a predisposing factor for the development of wound infection was confirmed in this study. Normally in pregnancy, cervical mucus plug, foetal membranes and amniotic fluid all serve as barriers to infection. However, when foetal membranes are ruptured, this protective effect is gradually lost with time. Bacteria are now able to transverse the cervical canal into the amniotic cavity leading to chorioamnionitis and its sequel [12]. Prolonged labour was noted to be an independent risk factor for wound infection in this study. Women with prolonged labour have a higher risk of developing a post-caesarean wound infection. This was similar to other studies [11], [13]. This could be attributed to the fact that most patients that had prolonged labour were unbooked and were of low socioeconomic class. It may also be because most patients that had prolonged labour were likely to labour in a dirty environment and were usually referred to the Teaching Hospital as potential septic cases.

In the present study estimated blood loss of more than one litre had higher odds of developing a post-caesarean wound infection. Postoperative anaemia (hematocrit < 30%) have a significant association with post-caesarean wound infection. The possible relationship between post-operative anaemia and wound infection might be explained by the fact that iron deficiency anaemia results in impaired transport of haemoglobin and thus oxygen to the surgical site. It also causes tissue enzyme and cellular dysfunction. Reduced oxygen delivery can also result in impaired wound healing.

In this study, S. aureus isolates were highly sensitive to amikacin and imipenem, and highly
resistant to cephalosporins, amoxicillin/clavulanate, gentamicin and meropenem, and moderately resistant to fluoroquinolones. High resistance patterns have been reported [14]. These findings are in contrast with a previous study in Ibadan, southwest Nigeria, which reported that S. aureus isolates were highly sensitive to cephalosporins and amoxicillin [15]. Another study done in Ife, Nigeria, observed that S. aureus isolates are highly sensitive to fluoroquinolones and cephalosporins [16]. The high resistant to a first-line antimicrobial agent like amoxicillin, gentamicin, cephalosporins observed in this study may be as a result of injudicious use of these drugs in our environment.

The gram-negative isolates were highly sensitive to imipenem and amikacin; highly resistant to cephalosporins, gentamicin and amoxicillin/clavulanate, and moderately resistant to fluoroquinolones. However, a study in southwest Nigeria observed that gram-negative isolates were highly sensitive to cephalosporins and fluoroquinolones [15]. This disparity in resistant pattern to first-line antimicrobial agent observed in this study may be due to injudicious use of these drugs in our environment. This may be a reflection of the pattern of antibiotic use and abuse in the study setting, especially with the common non-prescription use of beta-lactam antibiotics for treatment of many clinical syndromes which encourages resistance. High sensitivity to imipenem and amikacin may be due to the limited exposure of these drugs to the prescription antibiotics, which are relatively more expensive.

In conclusion, the post-caesarean wound infection rate of 8.5% in our hospital was high. Staphylococcus aureus, Klebsiella pneumonia and Escherichia coli were the commonest isolates from post-caesarean wound infection. Advocacy should be stepped up for universal sensitization and education on the need for antenatal booking during pregnancy and hospital delivery to reduce the rate of prolonged rupture of membranes,chorioamnionitis, prolonged labour and obstructed labour. Imipenem and amikacin should be used as the first line antibiotics for empirical treatment of post-caesarean wound infection in our centre while awaiting the result of wound swab microscopy culture and sensitivity.

References

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centres for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control. 1999;27:97-132. https://doi.org/10.1016/S0196-6553(99)70088-X
2. Weigelt JA, Lipsky BA, Tabak YP, Derby KG, Kim M, Gupta V. Surgical site infections: Causative pathogens and associated outcomes. Am J Infect Control. 2010;38:112-20. https://doi.org/10.1016/j.ajic.2009.06.010 PMid:1989474
3. Vidyadhara BB, Sai KB, Kunaal KS, Satyajit PG. Surgical infections following gynaecological surgery at a tertiary care teaching hospital in Rural India. UBR. 2014; 5(2):113-116. https://doi.org/10.7439/ibr.v5i2.527
4. Kotisso B, Aseffa A. Surgical wound infection in a teaching hospital in Ethiopia. East Afr Med J. 1998; 75:402-5.
5. Agboeze J, Onoh RC, Umehara OLU, Ezeonu PO, Ukaeabu C, Onyebuchi AK, et al. Microbiological pattern of post caesarean wound infection at Federal Teaching Hospital, Abakaliki. Afr J Health Sci. 2013; 12(2):99-102. https://doi.org/10.4103/2384-5589.134905
6. Jido T, Garba I. Surgical site infection following caesarean section in Kano, Nigeria. Ann Med Health Sci Res. 2012; 2(1):33-6. https://doi.org/10.4103/2141-9248.96934 PMid:23209988
7. Anderson DJ, Kaye KS. Staphylococcus surgical site infections. Infect Dis Clin North Am. 2009; 23:53-72. https://doi.org/10.1016/j.idc.2008.10.004 PMid:19135916
8. Okon KO, OsundI S, Dibal J, Ngbale T, Bello M, Akuhwa RT, et al. Bacterial contamination of operating theatre and other specialized care unit in a tertiary hospital in Northeastern Nigeria. Afr J Microbiol Res. 2012; 6:3092-6.
9. Ezechi OC, Edet A, Akinlade H, Gab-Okafor CV, Herbertson E. Incidence and risk factors for caesarean wound infection in Lagos Nigeria. BMC Res Notes. 2009; 2:186. https://doi.org/10.1186/1756-0500-2-186 PMid:19772612
10. Onyegbule OA, Akujobi CN, Ezebialu IU, Nduka AC, Anahalu IC, Okolie VE, et al. Determinants of Post-Caesarean Wound Infection in Nnewi, Nigeria. BJMRR. 2015; 5(6):767-774. https://doi.org/10.9734/BJMRR/2015/10297
11. Akinkunmi EO, Adesunkanmi AR, Lamikanra A. Pattern of pathogens from surgical wound infections in a Nigeria hospital and their antimicrobial susceptibility profiles. Afr Health Sci. 2014; 14(4):802-9. https://doi.org/10.4314/ahs.v14i4.5 PMid:25834486 PMCid:PMC4370057
12. Arabshahi KS, Koohpayezade J. Investigation of risk factors for surgical wound infection among Tehran. Int Wound J. 2006; 3:59-62. https://doi.org/10.1111/j.1742-4801.2006.00176.x PMid:16650211
13. Ward VP, Charlett A, Fagan J, Crawshaw RT, et al. Microbiology of postoperative wound infections in a tertiary care teaching hospital in South Africa. Afr J Infect Dis Clin North Am. 2009; 23:53-72. https://doi.org/10.1016/j.idc.2008.10.004 PMid:19135916
14. Adegoke AA, Tom M, Okoh AI, Jacob S. Studies on multiple antibiotic resistant bacteria isolated from surgical site infection. Scientific Research and Essays. 2010; 5:3876-81.
15. Olufumuiola BM, Olugbenga AO, Adeyankinnu AF. Bacteria agents of surgical site infection in south-west Nigeria. Am J Biomed Sci. 2013; 5(4):217-225. https://doi.org/10.5099/aj13040217
16. Akinkunmi EO, Adesunkanmi AR, Lamikanra A. Pattern of pathogens from surgical wound infections in a Nigeria hospital and their antimicrobial susceptibility profiles. Afr Health Sci. 2014; 14(4):802-9. https://doi.org/10.4314/ahs.v14i4.5 PMid:25834486 PMCid:PMC4370057

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