British Journal of Medicine & Medical Research
5(6): 767-774, 2015, Article no.BJMMR.2015.080
ISSN: 2231-0614

SCIENCEDOMAIN *international*
www.sciencedomain.org

Determinants of Post-Caesarean Wound Infection in Nnewi, Nigeria

Onyema A. Onyegbule[1], Comfort N. Akujobi[2], Ifeanyichukwu U. Ezebialu[3], Arinze C. Nduka[2], Ikenna C. Anahalu[2], V. E. Okolie[1], Innocent I. Mbachu[1] and Livinus O. Okor[1]

[1]Department of Obstetrics and Gynaecology, Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi, Nigeria.
[2]Department of Medical Microbiology, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.
[3]Department of Obstetrics and Gynaecology, Faculty of Clinical Sciences, College of Medicine, Anambra State University, Awka, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors OAO and IUE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors CNA, ACN and IA performed the microbiological analyses, authors VEO, IIM and LOO managed the analyses and the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2015/10297
Editor(s):
(1) Chryssoula Staikou, Medical School, National and Kapodistrian University of Athens, Greece and 1st Department of Anaesthesia, Aretaieio Hospital, Athens, Greece.
Reviewers:
(1) Dogukan Yildirim, Department of Obstetrics and Gynecology, Kanuni Sultan Suleyman Training and Research Hospital, Istanbul, Turkey.
(2) Anonymous, University of Athens, Greece.
(3) Zaheera Saadia, Gynaecology, College of Medicine, Qassim University, Saudi Arabia.
(4) Xing Lin Feng, School of Public Health, Peking University, China.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=696&id=12&aid=6413

Original Research Article

Received 22nd March 2014
Accepted 26th July 2014
Published 8th October 2014

ABSTRACT

Background: Delivery by caesarean section has been reported as the single most important risk factor for maternal wound infection. Wound infection is not only a leading cause of prolonged hospital stay but a major cause of widespread aversion to caesarean delivery in developing countries. Despite all these, the determinants of post-caesarean wound infection in Nnewi have remained largely uninvestigated.
Objective: This study was to determine the factors that predispose to post- caesarean wound

**Corresponding author: Email: onyemath@gmail.com;*

infection at a tertiary institution in a developing country.
Design: This was a cross sectional study.
Place and Duration of Study: Labour ward, Theatre and Post natal ward of NAUTH Nnewi between April to November 2012.
Methodology: All women who had caesarean section, met the inclusion criteria and gave consent were included in the study. They were divided into two groups (Group A and Group B) each comprising 60 women. Group A comprised women who had emergency caesarean section, while those in group B had elective caesarean section. The outcome of their post-caesarean wound was assessed. Statistical analysis (Logistic regression) of identified risk factors in patients who developed wound infection was performed at a 95% confidence interval.
Results: The incidence of post caesarean wound infection was 12.5%. While the infection rate was twelve (20.0%) among women who had emergency caesarean section, it was 3 (5.0%) among those who had elective caesarean section. The identified independent risk factors for wound infections were the duration of membrane rupture more than 24 hours (OR=0.11: 95% CI 0.03-0.47: P =0.003), labour duration more than 12 hours (OR =0.07: 95% CI 0.01-0.32: P =0.001) and the use of subumbilical, midline incision (OR=0.21: 95% CI 0.05-0.91).
Conclusion: The post caesarean wound infection rate in NAUTH was high. Efforts should be geared towards the prevention of prolonged labour by health education, early intervention and use of partograph. Timely intervention for prolonged rupture of membranes would drastically reduce the incidence of wound infection in our area.

Keywords: Determinants; caesarean section; wound infection; Nnewi.

1. INTRODUCTION

Lower segment caesarean section is a common mode of delivery now and surgical site infection is the second commonest infectious complications in these patients [1].

Notwithstanding the application of standard aseptic techniques during vaginal and caesarean birth, post pregnancy infection remains a significant cause of maternal morbidity and mortality [2]. Infection is estimated to be the second highest cause of underreported maternal death in the United States [2].

Caesarean section is a commonly performed surgical operation in women and its prevalence is rising each year [3-6]. Though it has become increasingly a safe and common surgical operation, it is still associated with significant morbidity and mortality [7]. Globally, surgical site infection rates have been reported to range from 2.5% to 41.9% [8]. In addition, obstetric infections result in increased health costs related to prolonged hospital stay, re-admission and the use of oral and parenteral antibiotics [9]. The rate of post caesarean wound infection varies across localities and countries. An incidence of 2-7% was reported in United States [10], incidence of 3.2% was recorded by Barbul et al. [11] in France while an incidence of 9.1% was reported by Jido et al in Kano [12]. Morhason-Bello et al. [13] reported an incidence of 16.2% in Ibadan. Earlier studies conducted by Fasubaa and colleagues in South West of Nigeria showed that post caesarean wound infection was not only the leading cause of prolonged hospital stay but also a major cause of widespread aversion to caesarean section in the region [14].

Developing infection at the surgical site depends on the interaction between different risk factors which include patient's characteristics, pre-operative condition, intra-operative circumstance and post-operative wound care [15]. Some medical conditions which are associated with increased risk of wound infection include diabetes mellitus, sickle cell anaemia, obesity and anaemia [5,16]. Other risk factors include patients on prolonged corticosteroid therapy, low socioeconomic status, immunosuppressant and abdominal wall haematoma [16]. The preoperative conditions which could predispose to post caesarean wound infection include prolonged rupture of membranes, multiple vaginal examinations during labour, amnionitis, previous meconium passage and internal foetal monitoring during labour, prolonged pre-operative hospital stay, pubic hair removal [5]. Intra-operative factors include hazardous surgical techniques such as extensive dissection with devascularization of tissues, rigorous handling of tissues and inappropriate use of suture material [17]. The duration of surgery especially when more than one hour has been proposed as a risk factor for surgical site infection [17]. Post-operative care of the incision site before and

after discharge from the hospital may also contribute to post caesarean wound infection [17].

Owing to the fact that post operative wound infection has several risk factors each with its own unique time of onset and different causative bacteria, it becomes pertinent that the obstetrician should have the knowledge of these risk factors. The objective of this study was to determine the risk factors associated with post caesarean wound infection.

2. MATERIALS AND METHODS

This observational study was carried out between Ist April 2012 to 30th November 2012 at Nnamdi Azikiwe University Teaching Hospital Nnewi. Sample size determination was done using the formula [18]:

$n = (Z\alpha+Z\beta)^2 \times \{(P1 \times (1-P1) + P2(1-P2)\} / (P1-P2)$ [2]

n = the sample size required in each group
P1 = Prevalence of wound infection post emergency caesarean section
P2 = Prevalence of wound infection post elective caesarean section

From a study done in South West Nigeria [13]

P1 = 16.2% (0.162) and P2 = 0% (0)
P1-P2 = size of difference of clinical importance, here it was (16.2%-0%) =16.2% or 0.162.
Zα = Standard normal deviate corresponding to level of significance at 95% = 1.96
Zβ = Standard normal deviate corresponding to power of 90% =1.2816

Substituting in the formula, the sample size was 55 in each group, giving a total sample size of 110 participants. To accommodate for expected 10% attrition, the formula: calculated sample size multiplied by 100/100-x was applied. Where x is 10 in this case. Therefore 100/90 =1.1. The sample size was therefore 55 x 1.1=60.5. A sample size of 61 was needed in each group (total of 122).

Having obtained ethical approval for this study, all consecutive and consenting women scheduled for caesarean section and meeting the inclusion criteria were enrolled into the study. Inclusion criteria included all women who had emergency or elective caesarean section. The following women were excluded: All women who refused to give consent for the study, women with features of chorioamnionitis and pregnant women on antibiotics before surgery.

Relevant information from all patients including recognizable risk factors for wound infection was retrieved. Prolonged labour was defined as labour duration more than 12 hours while prolonged rupture of membranes was defined as rupture of membranes more than 24 hours.

Caesarean section was performed by Consultants or Senior residents using an agreed protocol and through a Pfannenstiel incision to gain access to the lower segment. Sub umbilical midline incision was used for any woman with previous sub umbilical midline incision. Haemostasis was assured by ligation of the bleeding vessels. Uterine incision was closed with Polyglactin suture size 2, followed by Polyglactin suture size 00 for the peritoneal layers (Visceral and Parietal). The rectus sheet was closed continuously with Nylon suture size 1 and plain chromic catgut suture size 00 was used for the appositions of subcutaneous layer. The skin was closed subcuticularly using polyglactin suture size 00.

The wounds were inspected on the fourth post-operative day, Wound infection was diagnosed if there was either clinical or microbiological evidence. Clinical evidence of wound infection included fever, tachycardia, erythematous reaction around the wound site, warmth and tenderness, purulent discharge while microbiological evidence was based on the findings from wound swab microscopy and culture. Wound dressings removed after collecting wound swab if any and the wound dressed thereafter till discharge. All the subjects were interviewed on day four post-operative day using a standardized questionnaire. The information was coded and fed into Statistical Package for Social Sciences (SPSS) version 17. The presence of association between hypothesized risk factors and wound infection were tested using univariate analysis. Test of significance based on 95% confidence interval of Chi square was used to determine significant variables. Logistic regression was used to determine the independent risk factors for wound infection. P value was set at <0.05.

3. RESULTS

During the study period, a total of 122 women were enrolled for the study, two women were excluded from the analysis because of

incomplete data, thus data from 120 eligible women were used for analysis. Fifteen (15) women had post caesarean wound infection, given a post caesarean wound infection rate of 12.5% in Nnamdi Azikiwe University Teaching Hospital, Nnewi. Twelve (20%) women out of the sixty women among those that had emergency caesarean section developed wound infection; while only 3 (5%) women had wound infection among the elective group .This was statistically significant. (X^2=6.171, P value=0.013).

Table 1 summarizes the demographics of women who had either elective or emergency caesarean section. More than half of women in both groups were more than 30 years. Most of the women who had elective caesarean section 44(73.3%) were of parity 1-4 while most of those who had emergency caesarean section 31 (51.7%) were nulliparous. The most common indication for elective caesarean was 2 previous caesarean section 29 (48.3%) while cephalopelvic disproportion was the commonest indication for emergency caesarean section.

Table 2 summarizes comparison between wound infection and variables The factors associated with increased risk of wound infection following emergency caesarean section were duration of labour more than 12 hours (P value <0.001) duration of membrane rupture more than 24 hours (P value =0.002) use of sub umbilical midline incision (P =0.04) and post operative haematocrit <30% (P value =0.04).

Three women among those that had elective caesarean section and eight women among those that had emergency caesarean section received blood transfusion however; none of these women had wound infection.

Following Logistic regression, (Table 3), only three variables retained significant association with post caesarean wound infection. These variables were rupture of membrane more than 24 hours (OR=0.11: 95% CI 0.03-0.64: P =0.47) duration of labour more than 12 hours (OR=0.07: 95% CI 0.01-0.32: P =0.001), type of incision used (OR=0.21: 95% CI 0.05-0.91) While women with rupture of membrane less than 24 hours had 89.0% lower odds of developing post caesarean wound infection, women with labour duration less than 12 hours have 93.0% lower odds of developing post caesarean wound infection while the use of Pfannenstiel incision has 79% lower odds for wound infection.

4. DISCUSSION

Caesarean section is one of the most frequently performed obstetric operations. The post partum time is a challenging period for women, as a result of stressors such as fluctuations in hormonal levels, caring for the newborn baby and recovery from the actual delivery process. When coupled with recovery from major abdominal surgery and surgical site infection, physiological and psychological well being will inevitably be compromised [19].

Table 1. Sociodemographic variables of participants and indication for caesarean section

Variables	Groups	Elective	Emergency
AGE	<30	24 (40.0)	23 (38.3)
	≥30	36 (60.0)	37 (61.7)
PARITY	Nullipara	4 (6.7)	31 (51.7)
	1-4	44 (73.3)	17 (28.3)
	Grandmultipara	12 (20.0)	12 (20.0)
BMI	<30	22 (36.7)	44 (73.3)
	≥30	38 (63.3)	16 (26.6)
GA	<37 weeks	10 (16.7)	11 (18.3)
	≥ 37 weeks	50 (83.3)	49 (81.7)
Indications for C/S	Fetal distress	0 (0.0)	11 (18.3)
	CPD	0 (0.0)	26 (43.3)
	2 or more previous C/S	29 (48.3)	0 (0.0)
	1 previous C/S + any other complication	26 (43.3)	12 (20.0)
	Placenta Abruptio	0 (0.0)	7 (11.7)
	Placenta praevia	1 (1.7)	4 (6.7)
	Transverse lie	4 (6.7)	0 (0.0)

BMI= Body mass index, GA= Gestational age, C/S= Caesarean section, CPD= Cephalopelvic disproportion

Table 2. Comparison between wound infection and variables

Variables		Emergency wound infection		P value	Elective wound infection		P value
		Yes	No		Yes	No	
Age	<30	4	19	0.690	2	22	0.333
	≥30	8	29		1	35	
Parity	Nullipara	7	24	0.873	1	3	
	1-4	3	14		1	43	0.114
	Grandmultipara	2	10		1	11	
Body mass Index	≥30kg/m^2	10	34	0.381	1	21	0.902
	<30 kg/m^2	2	14		2	36	
Social status	High	0	4	0.201	0	10	0.722
	Middle	2	17		2	33	
	Low	10	27		1	14	
Booking Status	Booked	2	14	0.135			Not Applicable
	Unbooked	14	30				
Duration of labour	≤12 hours	4	40	<0.001			Not Applicable
	>12hours	8	8				
Duration of membrane rupture	≤24hours	3	35	0.002			Not Applicable
	>24 hours	9	13				
Type of Incision	Pfannenstiel	5	35	0.040	2	52	0.230
	Subumbilical midline	7	13		1	6	
Number of vaginal examination	<6	4	19	0.690			Not Applicable
	≥6	8	29				
Duration of Surgery	≤ 1 hour	4	22	0.434	1	39	0.209
	>1 hour	8	26		2	18	
Post operative Haematocrit	<30	7	13	0.040	0	4	0.684
	≥30	5	35		3	54	
Duration of admission	≤ 8days	1	41	<0.001	2	50	0.296
	> 8days	11	7		1	7	

Table 3. Logistic regression of wound infection on patients' characteristics

Variable		Wound Infection		P value	OR(CI)
		Yes	No		
Duration of membrane rupture	≤24hours	3	35	0.003	0.11(0.03-0.47)
	>24 hours	9	13		
Duration of labour	≤ 12 hours	4	40	0.001	0.07(0.01-0.32)
	>12 hours	8	8		
Post operative haematocrit	<30%	7	13	0.551	1.64(0.34-8.24)
	≥30%	5	35		
Type of incision	Pfannenstiel	5	35	0.038	0.21(0.05-0.91)
	SUML	7	13		

SUML= Sub umbilical midline incision

The incidence of post caesarean wound infection has been found to be higher following emergency than elective caesarean section [20]. In the present study, the overall incidence of wound infection was 12.5%. This was similar to 10% reported by Ezechi et al. [20] in Lagos. The incidence of post-caesarean wound infection among those who had emergency caesarean section was 20% compared to only 5% among those who had elective caesarean. This was

similar to findings of Hassan et al in 2008 where wound infection rate following caesarean section were seen in 16.5% of emergency cases and 4.34% in the elective group [21].

It is noteworthy that the number of nullipara that had emergency caesarean section was 31 accounting for 51.7% of the subjects in that group compared to 4 (6.7%) among those in elective group. This may be attributed to the fact that nullipara were more likely to have caesarean section compared to multipara. The reasons attributed to this were nulliparous women were more likely to develop pre-eclampsia, cephalopelvic disproportion, prolonged labour and prolonged pregnancy. This also reflected in the increase in the primary caesarean section rate among those that had emergency caesarean section 48(80%). Since 44 (73.3%) of the elective group were multipara, it was not surprising that the repeat caesarean section rate among them was 63.3%.

Multiple vaginal examination in our study did not show any statistically significant contribution for wound infection. This was similar to the finding by Ezechi et al who was of the view that multiple vaginal examinations with sterile gloves were not likely to increase infection rate [20]. Though no significant risk was associated with multiple vaginal examinations, it does not obviate the need for restricting vaginal examination to the minimum necessary and the use of antiseptic technique for its performance.

There was no statistically significant association between previous caesarean section and increased risk of wound infection in this study. Much lower infection rate was observed in the elective group where 63.3% of the patients had previous scar.

Obesity has been implicated as a risk factor for surgical site infection [22]. Possible explanations for increased risk for wound infection in such patients include relative avascularity of adipose tissue or technical difficulties of handling adipose tissue that can result in more traumas to the abdominal wall or difficulties in obliterate dead space in the fatty abdominal wall [22].

The role of prolonged rupture of membranes as a predisposing factor to developing wound infection reported by Ezechi et al. [20] was confirmed in this study. Women with rupture of membrane less than 24 hours had 89.0% lower odds of developing post caesarean wound (OR=0.11: CI. 0.03-0.47). Usually in pregnancy, cervical mucus plug, fetal membranes, and amniotic fluid serve as barriers to infection, however, when fetal membranes are ruptured, the 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 sequelae.

Prolonged labour was noted to be an independent risk factor for wound infection in this study. Women with labour duration less than 12 hours have 93.0% lower odds of developing post caesarean wound infection. This was similar to other studies [23]. This could be attributed to the fact that most patients that had prolonged labour were unbooked and were of low socioeconomic class. Out of the sixteen women that had prolonged labour, 14 (87.5%) were unbooked and 10(62.5%) of them were of low socioeconomic status. These women were likely to labour in a dirty environment and were usually referred to the Teaching Hospital as potential septic cases.

Post operative anaemia (haematocrit <30%) was noted to have a significant association in the emergency caesarean section group with post caesarean wound infection. However, it failed to retain its statistical significance after adjustment was made for confounding factors (OR=1.64: CI 0.33-8.24). 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 uterus. It also causes tissue enzyme and cellular dysfunction. Reduced oxygen delivery can also result in impaired wound healing [24].

5. CONCLUSION

The post caesarean wound infection rate in NAUTH was high. Efforts should be geared towards the prevention of prolonged labour by health education, early intervention and use of partograph. Timely intervention for prolonged rupture of membranes would drastically reduce the incidence of wound infection in our area.

CONSENT

Written informed consent was obtained from the patients for publication of this original research article.

ETHICAL APPROVAL

All authors hereby declare that this research work was approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

ACKNOWLEDGEMENT

We acknowledged Professors' Adinma and Ikechebelu who made significant contributions during the research process.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Devjani D, Sonal S, GeetaM, ReenaY Renu D. Risk Factor Analysis and Microbial Etiology of Surgical Site Infections following Lower Segment Caesarean Section. International Journal of Antibiotics. Available: http://dx.doi.org/10.1155/2013/283025.
2. Nell T. Post pregnancy Genital tract and Wound Infections. J Midwifery Women's Health. 2008;53(3)236-246.
3. National Collaborating Centre for Women's and Children's Health. Caesarean section. Clinical Guideline. London. RCOG Press; 2004.
4. Villa J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A. WHO 2005 global survey on maternal and perinatal health research group: Caeserean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet. 2006;367:1819-1829.
5. Althabe F, Sosa C, Belizan J, Gibbons L, Jacquerioz F, Bergel E. Caeserean section rates and maternal and neonatal mortality in low-, medium-, and high-income countries: an ecological study. Birth. 2006;33:270-277.
6. Stanton C, Holtz S. Levels and trends in caesarean birth in the developing world. Stud Fam Plann. 2006;37:41-48.
7. Karl WM. Reducing the complications o caesarean section. In: Advances in Obstetrics and Gynaecology. Volume 20; Chap.9 pg 20:141-152.
8. Brown S, Kurtsikahvi G, Alonso EJ, Aha L, Bochoidez T, Shushtakashiri M, Imnadre P. Prevalence and predictors of SSI in Tbilisi Republic of Georgia. J Hosp Infect 2007;66:160-166.
9. Star RV, Zurawski J, Ismail M. Preoperative vaginal preparation with povidone –iodine and the risk of post caesarean endometritis. Obstet Gynaecol. 2005;105:1024-1029.
10. Gaynes RP, Culvar TC, Edwards SR, Richards C, Telson JS. Surgical site infection [SSI], rate in the United States. 1992-1998. The National Nosocomial Surveillance System Basic SSI risk index. Clin Infect Dis. 2007;33:69-77.
11. Barbut F, Carbonne B, Truchot F, Spielvogel C, Jannet D, Goderel I, Lejeune V, Milliez J. Surgical site infections after cesarean section: results of a five-year prospective surveillance]. J Gynecol Obstet Biol Reprod (Paris). 2004;33(6 Pt 1):487-96.
12. Jido TA, Garba ID. Surgical-site infection following cesarean section in Kano, Nigeria. Ann Med Health Sci Res. 2012;2:33-6.
13. Morhason-Bello IO, Oladukun BO, Obisesan KA, Ojengbede OA, Okuyemi OO. Determinants of post caesarean wound Infection at the University College Hospital, Ibadan Nigeria. Niger J Clin Pract. 2009;12(1):1-5.
14. Ezechi OC, Fasubaa OB, Kalu BKE, Njokanma OF, Okeke GCE. Caeserean morbidity and mortality in a private hospital in Lagos Nigeria. Tropical journal of Obstetrics and Gynaecology. 2002;19(2):97-100.
15. Ramadam AM, Alamrawy SM, Yousef RM. Risk factors of incisional surgical site infection in Shatby Maternity University Hospital; prospective study. MD thesis Department of Community Medicine, faculty Of medicine, Alexandria University 2006;(4).
16. Richard Depp. Caeserean delivery and other surgical procedure. In: Obstetrics-Normal and problem pregnancies. 2nd Edition Churchill Livingstone Publisher. Chap. 20 pg. 660-662.
17. Plowman R, graves N, griffin M. The socio-economic burden of hospital acquired infection. London: Public Health Laboratory Service; 2000.
18. Onwuasigwe C. Sampling and sampling methods; determination of sample size. In

Onwuasigwe C (Ed). Principles and methods of Epidemiology. 2nd edition El Demak, Enugu. 2010;123-157.
19. Swendy TZ. Emergency caesarean section in a Nigerian tertiary health centre. Niger J med. 2008;4:396-398.
20. Ezechi OC, Edet A, Akinlade H, Gab-Okafor CV, Herbertson E. Incidence and risk factors for caesarean wound infection in Lagos, Nigeria. BMC Research Notes. 2009;2:186.
21. Hassan S, Javaid KM, Tariq S. Emergency caesarean section: comparative analysis of problems encountered between patients and elective caesarean section and patients for whom elective caesarean section was planned but ended up in emergency. Professional Medical Journal. 2008;15(2):211-215.
22. Al-Sabbak M, Sadiq R. Wound infection following caesarean section Bas. J. Surg. 2003;185-189.
23. Mitt P, Lang K, Peri A, Maimets M. Surgical-site infections following cesarean section in an Estonian university hospital: Post-discharge surveillance and analysis of risk factors. Infect Control Hosp Epidemiol. 2005;26:449-54.
24. Guo S, DiPietro LA. Factors affecting wound healing. J Dent Res. 2010;89(3):219-229.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=696&id=12&aid=6413