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Research Article

Bacteriological profile in patients with cesarean infection at Ruhengeri level two teaching Hospital

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Abstract

Background: A cesarean infection is a referral hospital acquired bacterial infection that occurs after deliver by cesarean section which could be emergency or elective. As highlighted by the various researchers that the infections following a cesarean delivery, which some people call a C-section, are common. The wound coming into contact with bacteria or other harmful microbes is a common cause of these infections. The main objective of this study was the assessment of bacteria isolated from cesarean infection patients attending Ruhengeri level two teaching hospital.

Methodology: A cross-sectional study was conducted and total of 30 wound swabs of cesarean were collected from inpatient of Ruhengeri level two teaching hospital. Data were analyzed using SPSS statistical software (version 20).

Results: The results showed that the most predominant bacteria isolated from patients with cesarean infection was *S. aureus* (28.1%) followed by *S. pyogenes* (18.8%), *K. pneumoniae* (18.8%), *P. aeruginosa* (12.5%), *S.epidermidis* (9.4%), *E. coli* (6.3%) and *P. mirabilis*(6.3%). Antibiotics sensitivity test was performed, so this study showed the predominant antibiotic which were sensitively to different bacteria were Chloramphenicol, Gentamycin and Norfloxacin and most bacteria were resistance to Rifampicin and Vancomycin.

Conclusion: This study has shown that there are many bacteria that may be isolated in cesarean infection. It has also shown that some of the isolated bacteria were sensitive and other were resistant to Rifampicin and Vancomycin. The study recommends that Rwandan government should create more clinical microbiological laboratory, in Rwanda, in order to minimize the antibiotic resistance and also on the side of health care providers, especially at Ruhengeri level two teaching hospital, they should use the experienced workers in order to minimise the risks of getting caesarean infection and also to recommend the patients taking care their wound.

Keywords: Cesarean infection, Bacteria, Antibiotics, Bacteriological profile

Introduction

Cesarean section (C-section) is a surgical procedure performed to deliver a baby through an incision made in the mother's abdomen and uterus. While C-sections are often necessary and generally safe, they carry the risk of postoperative complications, including infection. Cesarean infections can occur in various parts of the body, including the surgical wound, uterus, and surrounding pelvic organs, posing significant health risks to both the mother and the baby if not promptly diagnosed and treated. These infections can be caused by a variety of bacteria, including skin flora and nosocomial pathogens, which may gain entry during the surgical procedure or postoperatively. Factors such as prolonged rupture of membranes, prolonged labor, obesity, and diabetes are known to increase the risk of infection following a C-section. Thus, it is crucial to implement preventive measures and adhere to meticulous surgical techniques to minimize the risk of cesarean infections[1]. In recent years, there has been a growing emphasis on optimizing preventive strategies to reduce the incidence of cesarean infections. Antibiotic prophylaxis plays a crucial role in preventing postoperative infections after C-sections. Several studies have evaluated the efficacy of antibiotic prophylaxis in reducing the risk of surgical site infections and endometritis following cesarean delivery. A Cochrane review concluded that antibiotic prophylaxis significantly reduces the risk of post-cesarean infections compared to no prophylaxis, with a lower incidence of endometritis, wound infections, and serious maternal infectious morbidity[2]. However, the choice of antibiotics, timing of administration, and duration of prophylaxis remain areas of debate and ongoing research. Clinicians must balance the benefits of antibiotic prophylaxis in preventing infections with the risks of antimicrobial resistance and adverse effects associated with antibiotic use. Guidelines from professional organizations, such as the American College of Obstetricians and Gynecologists (ACOG), provide recommendations for the use of prophylactic antibiotics in cesarean delivery to minimize the risk of postoperative infections. ACOG recommends administering prophylactic antibiotics before skin incision to achieve adequate tissue concentrations at the time of surgery[3]. The choice of antibiotics should be based on local antimicrobial susceptibility patterns and individual patient factors, such as allergies and comorbidities. Additionally, ACOG advises against the routine use of postoperative antibiotics in uncomplicated cesarean

deliveries, as the benefits may not outweigh the risks of promoting antimicrobial resistance[1]. In addition to antibiotic prophylaxis, other measures can help reduce the risk of cesarean infections. Proper skin preparation before surgery using antiseptic agents is essential to minimize the microbial load on the skin and reduce the risk of surgical site infections. A randomized trial comparing different skin antiseptic agents at cesarean delivery found that chlorhexidine-alcohol was more effective than iodine-alcohol in reducing the risk of surgical site infections and endometritis[4]. Adequate perioperative care, including maintaining normothermia, optimizing glycemic control, and ensuring meticulous surgical technique, can further contribute to preventing cesarean infections. Despite these preventive efforts, cesarean infections may still occur, necessitating prompt diagnosis and treatment. Clinical signs of cesarean infection may include fever, abdominal or pelvic pain, uterine tenderness, foul-smelling vaginal discharge, and wound complications such as erythema, swelling, or purulent drainage. Early recognition of these signs, coupled with appropriate microbiological investigations, is essential for timely initiation of antimicrobial therapy tailored to the identified pathogens. Broad-spectrum antibiotics covering common organisms implicated in post-cesarean infections, such as Staphylococcus aureus, Streptococcus species, Escherichia coli, and anaerobic bacteria, are typically initiated empirically pending culture results[1].Cesarean infections remain a significant concern in obstetric practice, with the potential to cause substantial maternal morbidity and mortality. While preventive measures such as antibiotic prophylaxis and meticulous surgical technique have been effective in reducing the incidence of cesarean infections, ongoing research is needed to optimize strategies for infection prevention and management. Collaborative efforts between clinicians, researchers, and healthcare organizations are essential to develop evidence-based guidelines and implement best practices aimed at improving outcomes for mothers and babies undergoing cesarean delivery. By prioritizing infection prevention and timely intervention, healthcare providers can minimize the burden of cesarean infections and promote safe and successful childbirth experiences. Therefore, this study aimed at isolation and identification of bacteria in patients with cesarean infection at Ruhengeri Level two teaching Hospital

Methodology of the study

Study area

This study was conducted at Ruhengeri Level two teaching Hospital which is a public hospital located at in Muhoza sector, Musanze district, Northern Province of Rwanda.

Study design

A Cross-sectional study was performed on patients with cesarean infection. The qualified inpatients were approached and requested to give samples and answer to a voluntary consent form to register in the study.

Study population and sample size

The study population include patients with cesarean infection attending Ruhengeri level two teaching Hospital. 30 pus swab Samples were collected in a sterile container; the collected samples were transported to the clinical microbiology laboratory for analysis at INES-Ruhengeri.

Statistical analysis

Data were checked for completeness, inconsistencies, and missing values and then coded, entered using MS excel spreadsheet. Then cleaned and analyzed using SPSS version 20. Descriptive statistics were computed to determine frequencies and summary statistics (mean, standard deviation, and percentage) to describe the study population in relation to socio-demographic and other relevant variables. Data were presented using tables, graphs and figures. Chi square was also used for association.

RESULTS

Demographic characteristics of study participants

Demographic information of study participants for a cross-section study were summarized in the table1. The age, education level, economic status, employment status and marital status were investigated as variables for demographic characteristics by estimate the frequency and percentage.

Table 1: Demographic characteristics of study participants (N=30)

Variables	chacteristics	Age's						Total	
		[19-23]		[24-28]		[29-33			
		F	%	F	%	F	%	F	%
Education level	Bachelor's	0	0	1	3	0	0	1	3
	None	1	3.5	1	3.5	0	0	2	7
	Primary	7	23	7	23	2	7	16	53
	Secondary	6	20	4	14	1	3	11	37
Economic status	CAT 1	2	7	2	7	1	3	5	17
	CAT 2	7	23	5	17	1	3	13	43
	CAT 3	5	17	6	20	1	3	12	40
Employment status	Employment	0	0	2	7	1	3	3	10
	Unemployment	14	47	11	37	2	7	27	91
Marital status	Married	11	37	13	43	3	10	27	90
	Single	3	10	0	0	0	0	3	10
Total		14	47	13	44	3	10	30	100

A total 30 patients investigated in this study, the patients who studied primary participated with high frequency was 7 with 23 %. Economic status, category 2 participated highly with 7 patients which account 23%, unemployed patients participated highly compared to others with 14/47% and on marital status, married patient participated high with 13/43%.

Isolated bacteria from cesarean infection

Table 2: Identification of bacteria that were associated with cesarean infection

Bacteria isolated	Frequency	Valid Percentages
S.pyogenes	6	18.8
S. aureus	9	28.1
S.epidermidis	3	9.4
E. coli	2	6.3
P.aerogenosa	4	12.5
K.pneumoniae	6	18.8
P.mirabilis	2	6.3
Total	32	100.0

The table above shows the isolated bacteria from cesarean infection where the most isolated bacterium was *S.aureus* with 28.1% while the least isolated bacteria were *E. coli* and *P.mirabilis* with 6.3%.

The antibiotics susceptibility pattern of bacteria associated with cesarean infection at Ruhengeri level two teaching Hospital

Table 3: Determination of antibiotic susceptibility pattern of bacteria associated to cesarean infection.

Antibiotics Susceptibility pattern		Isolated bacteria													
		S. pyogenes		*S. aureus*		*S. epidermidis*		*E. coli*		*P. aerogenosa*		*K. pneumoniae*		*P. mirabilis*	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
NX	S	6	100	0	0	3	100	2	100	4	100	6	100	0	0
	R	0	0	0	0	0	0	0	0	0	0	0	0	2	100
	I	0	0	9	100	0	0	0	0	0	0	0	0	0	0
CHL	S	6	100	9	100	3	100	2	100	3	75	6	100	0	0
	R	0	0	0	0	0	0	0	0	1	25	0	0	0	0
	I	0	0	0	0	0	0	0	0	0	0	0	0	2	100
GET	S	6	100	9	100	3	100	2	100	3	75	6	100	0	0
	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	I	0	0	0	0	0	0	0	0	1	25	0	0	2	100
VCM	S	6	100	9	100	0	0	0	0	0	0	0	0	0	0
	R	0	0	0	0	3	100	2	100	4	100	6	100	2	100
	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NV	S	1	17	9	100	1	100	0	0	0	0	0	0	0	0
	R	5	83	0	0	0	0	2	100	4	100	6	100	2	100
	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RIF	S	6	100	9	100	0	0	0	0	3	75	0	0	0	0
	R	0	0	0	0	3	100	2	100	1	25	6	100	2	100
	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Antibiotics sensitivity test was performed, so this study showed the predominant antibiotic which were sensitively to different bacteria were Chloramphenicol, Gentamycin and Norfloxacin and most bacteria were resistant to Rifampicin and vancomycin.

Risk factors associated with cesarean infection patients attending Ruhengeri level two teaching Hospital

Table 4: Association between cesarean infection and associated risk factors among patients at Ruhengeri level two teaching Hospital

Risk factors		E. coli Yes	No	X^2	Df	P value	S aureus Yes	No	X^2	Df	P value	P. aeruginosa Yes	No	X^2	Df	P value
Age	[19-23]	9	5	6.784	2	0.014	9	5	3.47	2	0.824	9	5	4.404	2	0.01
	[24-28]	3	10				3	10				3	10			
	[29-33]	0	3				0	3				3	0			
Marital status	Single	3	0	6.648^a	1	0	2	1	0.44	1	0.132	0	3	7.959	2	0.02
	Married	10	17				10	17				10	17			
Economic status	CAT 1	2	3	17.064	2	0	2	3	0.91	1	0.956	2	3	2.998	2	0.223
	CAT 2	1	12				1	12				1	12			
	CAT 3	3	9				3	9				3	9			
Education level	None	2	0	6.298	3	0.008	2	0	6.85	3	0.004	0	2	1.547	3	0.461
	Primary	3	13				10	6				2	14			
	Secondary	8	3				3	8				3	8			
	Bachelor's	0	1				0	1				0	1			

Risk factors		S. epidermidis Yes	No	X^2	Df	P value	K.pneumonia Yes	No	X^2	Df	P value	P. mirabilis Yes	No	X^2	Df	P value
Age	[19-23]	9	5	.511^a	2	0.775	3	11	6.05	2	0.008	4	10	4.831^a	2	0.006
	[24-28]	3	10				3	10				0	13			
	[29-33]	0	3				3	0				1	2			
Marital status	Single	3	0	0.459	2	0.795	27	28	8.71	2	0.013	7	48	37.881	2	0
	Married	10	17				7	18				8	17			
Economic status	CAT 1	0	5	1.377	2	0.502	2	3	1.86	2	0.396	2	3	0.889	2	0.715
	CAT 2	2	11				1	12				1	12			
	CAT 3	2	10				3	9				3	9			
Education level	None	0	2	0.759	3	0.068	2	0	6.59	3	0.039	2	0	10.023	3	0.003
	Primary	2	14				6	7				6	10			
	Secondary	3	8				9	2				8	3			
	Bachelor's	0	1				0	1				0	1			

Chi-square test was performed to test for association between risk factors and cesarean infection. In this study, Age, marital status, economic status and education level were all statistically associated with *E. coli* with P value=0.041, P value=0.00, P value= 0.00 and P value= 0.008 respectively. Other factors were not statistically significant. *S. aureus* was statistically associated by education level with P value=0.04. age and marital status were associated with *S aeruginosa* with p value= 0.01 and 0.02 respectively. Age, marital status and education level were associated with *K. pneumoniae* with P value=0.008, P value 0.013 and 0.039 respectively. Age, marital status and education level were associated with *P. mirabilis* with P value= 0.006, P value=0.00 and 0.003 respectively

Discussion

Bacterial wound infection of caesarean has been a major public health concern in healthcare which gives a burden to healthcare providers for its management. This is because of the increased trauma to the patient but also because of its burden to the financial resources, long stay in hospital and costly treatment. This study aimed to identify bacteria responsible of infected wound of caesarean, to determine their antimicrobial susceptibility pattern as well as to assess risk factors associated to cesarean infection. The demographic data of patients with infected wound of cesarean were analyzed where people with 19-23 years was predominant (Table 1). Which most similar to the study conducted by other researcher[5]. The range of incidence in Burundi, DRC and Sierra Leone was 1.7-10.4%. Respectively the rate in Kebezi referral center (Curgo hospital) the rate was 10.4%, Lubutu General Hospital the rate was 1.7% and in Gondana Referral Center the rate was 7.3%.[6]. SSI on is a multifactorial process that starts from the perioperative preparation, the patient, the type of surgery, the type of germ

and other factors. As the various studies such as a study in Tanzania showing that *Staphylococcus aureus* as one of the most common bacteria causing SSI in post-caesarean patients, and particular superficial infections[7]. Surgical site infection (SSI) is one of the most common complications following cesarean section, and has an incidence of 3%–15%. It places physical and emotional burdens on the mother herself and a significant financial burden on the health care system. Moreover, SSI is associated with a maternal mortality rate of up to 3%. With the global increase in cesarean section rate, it is expected that the occurrence of SSI will increase in parallel, hence its clinical significance. Given its substantial implications, recognizing the consequences and developing strategies to diagnose, prevent, and treat SSI are essential for reducing post cesarean morbidity and mortality[8]. The indication for CS was obstructed labor/failure to progress in 86 (17.7%) of the patients, of these 13 (15.1%) had wound infection. Sixty-seven (13.8%) patients had severe pre-eclampsia/eclampsia, while only 3 (4.5%) had SSI. The indication in 48 (9.9%) was abnormal lie/breech presentation. all but 11 (22.9%)

presented in labor and had emergency CS[9]. The wound infection rate in this group was 27.8% overall and 60% among those with retained second twin. Similarly, 5 of the 7 patients in whom CS was preceded by pre-labor rupture of membranes (PROM) had wound infection. Among 19 patients who had CS because of fetal distress, 3 (15.7%) had wound infection. Only 1 of 9 patients with prolonged pregnancy had infection and none of 7 cases with antepartum hemorrhage and 17 patients with failed instrumental delivery. Our study is in line with another study which showed that multiple species of bacteria are isolated, although they are typically considered to be relatively of low virulence[10]. As reported by others, the mean duration of labor prior to CS was longer in the cases 10.18(6.8) h. as against 7.13(3.9) h in the controls. Similarly, the skill of the surgeon here depicted by his level of experience just failed to achieve statistical significance, although the mean operating time significantly differed. Prolonged operating time, and poor surgical skills. Majority (83%) of obstructed labor, cord or hand prolapse were referred to our unit from outside clinics perhaps after some non-aseptic manipulations; clearly cord and hand prolapse may aid ascent of microbial pathogens from the lower genital tract to the upper genital tract. Wound infection was confirmed by microbiological studies in 32 cases. Twenty-nine (90.6%) were positive cultures while 3 (9.4%) were sterile. *S. aureus* was isolated in 31.8% of the cultures. This bacterium was shown to be the predominant agent in post-cesarean wound infection[11]. Similarly in our study, *S.aureus* was shown to be isolated at the same range with with a percentage of 28.1%. In research conducted in Israel, *Escherichia coli* is one of the organisms that are often found in caesarean SSI[6]. Which is in line with our study where *E.coli* was also isolated from cesarean infection patients from Ruhengeri level two teaching Hospital

Conclusion

This study was conducted to identify bacteria from cesarean wound infection and associated risk factors. Different risk factors were evaluated among participants. It revealed that almost all risk factors evaluated could be the source of bacteria isolated from their cesarean wound infection. The overall association between contaminations and associated outcomes was statistically significance. However, most of risk factors were found to be statistical significance for overall association with all isolated bacteria.

Acknowledgments

Conflict of interest

Authors declare no conflict of interest

Authors contributions

Habanabakize Jean Baptiste and Kanobayita Nadia conducted the laboratory experiments of this study. Ishimwe Alain Prudence designed this study and wrote the manuscript. Ntezirizaza Evariste and Uwiringiyimana Athanasie participated in this study by proof reading and correct the manuscript as well as analyzing the data to get good results.

Availability of raw data and material

Raw data and information on material should be obtained from the corresponding author upon request.

References

1. ACOG Practice Bulletin No. 195. Prevention of infection after gynecologic procedures. Obstetrics & Gynecology. 2018;131(6):e172-e189. https://doi.org/10.1097/AOG.0000000000002670 PMid:29794678

2. Smaill, F. M., & Grivell, R. M. Antibiotic prophylaxis versus no prophylaxis for preventing infection after cesarean section. Cochrane Database of Systematic Reviews. 2014;(10):CD007482. https://doi.org/10.1002/14651858.CD007482.pub3 PMid:25350672 PMCid:PMC8078551

3. ACOG Practice Bulletin No. 199. Use of prophylactic antibiotics in labor and delivery. Obstetrics & Gynecology, 2018;132(3):e103-e119. https://doi.org/10.1097/AOG.0000000000002833 PMid:30134425

4. Tuuli, M. G., Liu, J., Stout, M. J., Martin, S., Cahill, A. G., & Odibo, A. O. A randomized trial comparing skin antiseptic agents at cesarean delivery. New England Journal of Medicine, 2016;374(7):647-655. https://doi.org/10.1056/NEJMoa1511048 PMid:26844840 PMCid:PMC4777327

5. Garbacz, K., Jarzembowski, T., Kwapisz, E., Daca, A., & Witkowski, J. Do the oral Staphylococcus aureus strains from denture wearers have a greater pathogenicity potential? Journalof of oral microbiology, 2018;11(1):1536193. https://doi.org/10.1080/20002297.2018.1536193 PMid:30598731 PMCid:PMC6225501

6. Zuarez-Easton, S., Zafran, N., Garmi, G., & Salim, R. Postcesarean wound infection: prevalence, impact, prevention, and management challenges. International journal of women's health, 2017;9(1):81-82. https://doi.org/10.2147/IJWH.S98876 PMid:28255256 PMCid:PMC5322852

7. Filbert J Mpogoro, Stephen E Mshana,corresponding, 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. Princeton Medical Center. 2014;40(8):300-400. https://doi.org/10.1186/2047-2994-3-25 PMid:25126415 PMCid:PMC4131772

8. Harzif, A. K., Wicaksono, M. D., Kallista, A., Emeraldi, M., & Pratama, G. Overview of risk factor and bacterial pattern in patient with surgical site infection after caesarean section in Ciptomangunkusumo Hospital from 2016 to 2018. Infection Prevention in Practice, 2020;2(4):120-200. https://doi.org/10.1016/j.infpip.2020.100090 PMid:34368724 PMCid:PMC8336288

9. Liu, D., Yu, J., Li, L., Ai, Q., Feng, J., Song, C., & Li, H. Bacterial community structure associated with elective cesarean section versus vaginal delivery in Chinese newborns. Journal of pediatric gastroenterology and nutrition, 2015;60(2):240-246. https://doi.org/10.1097/MPG.0000000000000606 PMid:25625578

10. Leduc, D., Biringer, A., Lee, L., Dy, J., Corbett, T., Duperron, L., & Senikas, V. Induction of labour. Journal of Obstetrics and Gynaecology Canada, 2019;35(9):840-857. https://doi.org/10.1016/S1701-2163(15)30842-2 PMid:24099451

11. Timmer, T., Verhofstad, M. J., Leenen, L. P., Moons, K. G., & Van Beeck, E. F. Long-term (> 6 years) quality of life after surgical intensive care admission. Critical Care, 2018;14(1):1-2. https://doi.org/10.1186/cc8669 PMCid:PMC2934380