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High incidence of surgical site infections after caesarean deliveries in cameroonian referral hospitals: A Prospective Cohort Study

Incidence élevée des infections du site opératoire après césarienne dans les hôpitaux de référence camerounais : une étude de cohorte prospective

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Article Original

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ABSTRACT

Background: Cesarean section, as a surgical procedure, exposes patients to a specific risk of surgical site infection (SSI), which is a major cause of postpartum maternal morbidity. This study aimed to estimate the incidence of post-cesarean SSIs and identify associated risk factors in two referral hospitals in Douala, Cameroon.

Methods: Between February and July 2022, 444 women who underwent cesarean section at Laquintinie Hospital and the Douala Gyneco-Obstetric and Pediatric Hospital were included in a prospective cohort study. Clinical, obstetric, and perioperative data were collected using a standardized questionnaire. Cases of SSI (n = 45) were monitored. Multivariate logistic regression was used to identify factors associated with SSIs ($p < 0.05$).

Results: The overall incidence of SSIs was 10.13%, higher at Laquintinie Hospital (11.11%) than at the Gyneco-Obstetric Hospital (6.45%). Independent risk factors identified included: obesity (Adjusted OR = 5.9; p = 0.032), preoperative anemia (Adjusted OR = 4.7; p = 0.030), diabetes (Adjusted OR = 15.7; p = 0.013). Perioperative blood transfusion was significantly associated with a reduction in risk (Adjusted OR = 0.05; p = 0.013).

Conclusion: Post-cesarean SSIs are common in referral hospitals in Douala. Managing metabolic comorbidities (obesity, diabetes) and hematologic conditions (anemia), as well as optimizing perioperative care, could help reduce this burden.

RESUME

Introduction : La césarienne, en tant qu'intervention chirurgicale, expose les patientes au risque spécifique d'infection du site opératoire (ISO), une cause majeure de morbidité maternelle postpartum. Cette étude visait à estimer l'incidence des ISO post-césarienne et à en identifier les facteurs de risque dans deux hôpitaux de référence à Douala, Cameroun.

Méthodes : Entre février et juillet 2022, 444 femmes ayant accouché par césarienne à l'Hôpital Laquintinie et à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Douala ont été incluses dans une cohorte prospective. Les données cliniques, obstétricales et périopératoires ont été recueillies à l'aide d'un questionnaire standardisé. Les cas d'ISO (n = 45) ont été suivis. Une régression logistique multivariée a permis d'identifier les facteurs associés aux ISO ($p < 0,05$).

Résultats : L'incidence globale des ISO était de 10,13 %, plus élevée à l'Hôpital Laquintinie (11,11 %) qu'à l'Hôpital Gynéco-Obstétrique (6,45 %). Les facteurs de risque indépendants identifiés comprenaient l'obésité (ORa = 5,9 ; p = 0,032), l'anémie préopératoire (ORa = 4,7 ; p = 0,030) et le diabète (ORa = 15,7 ; p = 0,013). La transfusion sanguine périopératoire était associée à une réduction significative du risque (ORa = 0,05 ; p = 0,013).

Conclusion : Les ISO post-césarienne sont fréquentes dans les hôpitaux de référence de Douala. La prise en charge des comorbidités métaboliques (obésité, diabète) et hématologiques (anémie), ainsi que l'optimisation des soins périopératoires, pourraient réduire ce fardeau.

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Introduction

Caesarean sections (CS), surgical deliveries through the abdomen, are increasingly favored over vaginal deliveries worldwide. Although the World Health Organization (WHO) recommends CS rates between 10% and 15%, many countries, including Cameroon, report rising CS rates. While CS offers life-saving benefits in certain cases, it is associated with higher complication rates than vaginal delivery, including surgical site infection (SSI) [1–3]. Defined by the European Centre for Disease Control (ECDC) as an infection near a surgical incision involving the skin, deep soft tissue, or any organ/space manipulated within 30 days of the procedure [5], SSIs are the most common healthcare-associated infections globally. In low- and middle-income countries (LMICs) such as Cameroon, the World Health Organization reports SSI rates of up to 11.8% for surgical procedures and 3% to 15% following CS [7]. Despite reductions in SSI rates in developed countries due to antibiotic prophylaxis, improved surgical techniques, and surveillance systems, these measures remain challenging to implement effectively in resource-limited settings [8]. Risk factors linked to SSIs after CS include prolonged labour, high body mass index (BMI), hypertension, long procedure duration, and anaemia [8–12]. In Cameroon, CS rates rose from 12% in 2000 to 21% in 2015 [13]. Local studies report SSI rates of 10.8% at Douala Laquintinie Hospital [13] and 1.80% at Yaoundé Central Hospital [14], though these were limited in duration and scope. This study aimed to determine the incidence and identify the predictors of SSI within 30 days post-CS in two referral hospitals in Douala, to generate robust data for the development of evidence-based management protocols in Cameroon.

Materials and Methods

This prospective cohort study was conducted over six months (February 1 – July 31, 2022) at two referral hospitals in Douala, Cameroon: Laquintinie Hospital and the Douala Gynaeco-Obstetric and Paediatric Hospital (DGOPH). Laquintinie Hospital is a high-volume teaching facility performing over 950 caesarean sections (CS) annually. It serves a diverse population where patients largely bear treatment costs. The obstetric theatre handles both CS and gynecological surgeries, with infection control occasionally challenged by high turnover and the presence of trainees. DGOPH is a first-category public hospital specializing in maternal and child health, performing 550–600 deliveries annually, with about 25% by CS. The hospital enforces stringent infection prevention protocols, including dedicated theatres for obstetric and gynecologic procedures. Surgeries were conducted by obstetricians or senior residents under supervision. All women undergoing CS during the study period were approached for inclusion. Exclusion criteria included: failure to complete the questionnaire, death without a confirmed SSI within 30 days post-CS, or presence of unrelated surgical/infectious complications. Using Cochran's formula for prospective studies, with an assumed 10% SSI incidence (based on prior studies) and a 3% margin of error, a minimum sample size of 384 participants was required [15]. Recruitment followed consecutive convenience sampling. After caesarean section and full recovery from anaesthesia, eligible women were approached and given information about the study. A written consent was required before inclusion in the study. Data were collected using a standardized tool capturing preoperative (sociodemographics, obstetric history, BMI, haemoglobin, etc.), intraoperative (anaesthesia type, surgeon qualification, surgery duration, complications), and postoperative variables (antibiotic use, SSI outcome). SSIs were classified as superficial, deep, or organ/space infections per CDC criteria. Participants were reviewed during hospital stay and followed up to day 30 post-CS. Routine wound checks were done at days 3–4 and then every 2 days until day 12, depending on the hospital. Patients were educated on SSI signs at discharge and encouraged to report any symptoms. All were reassessed on day 30 for final outcome evaluation.

Data were entered in Excel and analyzed using EpiInfo 7. Categorical variables were summarized as frequencies/percentages; continuous variables as means ± standard deviation or medians with interquartile ranges. Bivariate analysis was performed using chi-square tests (significance at $p<0.05$). Significant variables were included in a multivariate logistic regression model to compute adjusted odds ratios (aOR) with 95% confidence intervals. Ethical clearance was obtained from the University of Buea Institutional Review Board (Ref: 2021/1546-01/UB/SG/IRH/FHS). Administrative approvals were secured from both hospitals. All participants gave written informed consent after explanation of the study's objectives, procedures, risks, and their rights.

Results

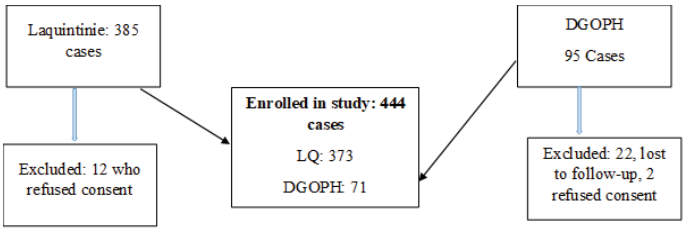

Figure 1: Participants flow diagram

As summarized in Table 1, the median age of the study participants was 29 years, with a mean age of 29.24 ± 6.46 years (range: 18–42 years). The majority of participants (48.4%) were between 20 and 29 years of age. More than half of the participants (55.9%) were unemployed, while nearly half (49.6%) had attained tertiary-level education.

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Table 1: sociodemographic characteristics of the study participants

Variables	Frequency (N=444)	Percentages (%)
Age group (Years)		
<20	47	10.6
20-29	215	48.4
30-39	145	32.7
≥40	37	8.3
Occupation		
Employed	196	44.1
Unemployed	248	55.9
Level of education		
No formal education	37	8.3
secondary	187	42.1
Tertiary	220	49.6

Table 2: general characteristics (personal, obstetrical and surgical) of the study participants

Variables	Frequency (N=444)	Percentages (%)
BMI		
Underweight	9	2.0
Normal weight	103	23.2
Overweight	220	49.5
M. obesity	112	25.3
Previous CS		
No	290	65.3
Yes	154	34.7
Presurgical Hb		
< 10 mg/dl	61	13.7
10-11 mg/dl	183	41.2
>11 mg/dl	200	45.1
Management site		
Study site	271	61.0
Referred	173	39.0
Rupture membranes		
< 12 hours	257	57.9
12- 18 hours	150	33.8
>18 hours	37	8,3
Type of CS	187	42.1
Elective		
Emergency	257	57.9
Grade of surgeon		
G. practitioner/ Resident Obgyn	75	16.9
Obstetrician	369	83.1
Antibiotic use		
Appropriate	304	68.5
Inappropriately	140	31.5
Comorbidity		
None	396	89.2
Diabetes	20	4.5
Others'	28	6.3
Blood transfusion (n=444)		
Yes	23	5.2
No	421	94.8

As detailed in Table 2, the majority of participants (72%, n = 332) had an abnormal body mass index (BMI), with 112 individuals (25.3%) classified as having class II or III obesity. A repeated cesarean section (CS) was performed in 34.7% of cases. Most patients had normal haemoglobin (Hb) levels (≥11 g/dL), although 61 participants (13.7%) were anaemic.

Emergency cesarean sections accounted for 57.9% of procedures. The duration of rupture of membranes (ROM) ranged from 0 to 216 hours, with a mean of 8.2 ± 32.32 hours and a median of 0 hours (interquartile range [IQR]: 0–3 hours). In the majority of cases (57.9%), rupture of membranes (ROM) lasted less than 12 hours. Obstetricians performed the surgeries in most cases (83.1%). The duration of surgery varied between 40 and 80 minutes, with a mean of 56.09 ± 7.98 minutes and a median of 55 minutes (IQR: 50–60 minutes). Adherence to antibiotic guidelines (for prophylaxis or treatment) was documented in 304 patients (68.5%), while 31.5% had either delayed or no antibiotic administration. Diabetes mellitus was identified in 4.5% of the participants.

Among the 444 patients included in this study, a total of 45 individuals developed surgical site infections (SSIs), yielding an overall incidence rate of 10.13%. The incidence of SSI varied by facility, with the DGOPH group showing a lower rate (6.45%, 6 out of 93 patients) compared to the LQ group (11.11%, 39 out of 351 patients). The timing of infection onset revealed that the majority of SSIs (63.33%) occurred between the 6th and 14 postoperative days, with a median time to onset of 9 days (interquartile range [IQR]: 7–12 days). Regarding the classification of infections, deep SSIs were the most common, accounting for 24 cases (53.33%), followed by superficial SSIs in 19 cases (42.22%), and organ/space SSIs in 2 cases (4.45%).

Table 3 presents the combined results of the bivariate and multivariate logistic regression analyses assessing potential risk factors for surgical site infections (SSIs). In the bivariate analysis, sociodemographic variables (such as age, education level, and employment status) and procedural factors (including type of cesarean section, surgeon grade, and duration of membrane rupture) were not significantly associated with the occurrence of SSI. In contrast, several clinical parameters demonstrated significant associations. Specifically, obesity (BMI ≥ 30), preoperative anaemia (Hb ≤ 11 g/dL), and the presence of diabetes mellitus were all significantly

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associated with an increased risk of SSI. Additionally, receipt of a blood transfusion showed a trend toward a protective effect in the bivariate analysis. Multivariate logistic regression analysis confirmed these findings. After adjusting for potential confounders, obesity, anaemia, and diabetes remained independent predictors of SSI. Notably, blood transfusion was independently associated with a substantially reduced risk of SSI, suggesting a potential protective role in this population.

Table 3. combined Bivariate and Multivariate Analysis of Risk Factors for Surgical Site Infection (SSI)

Variable	SSI Yes (n=45)	SSI No (n=399)	Unadjusted OR (95% CI)	P value	AdjuSted OR (95%CI)	P value
BMI						
Normal weight	16 (35.6%)	87 (21.8%)	Ref	–	Ref	–
Overweight	9 (20.0%)	211 (52.9%)	0.48 (0.13–1.81)	0.20	–	–
Obesity	20 (44.4%)	92 (23.1%)	0.021 (0.01–0.93)	0.03	5.9 (1.17–30.0)	0.032
Presurgical Hb						
Anaemic (≤11 g/dL)	16 (35.6%)	228 (57.1%)	4.7 (1.2–19.5)	0.03	4.7 (1.2–19.5)	0.03
Non-anaemic	29 (64.4%)	171 (42.9%)	Ref	–	Ref	–
Comorbidities						
None	37 (82.2%)	359 (90.0%)	Ref	–	Ref	–
Diabetes	8 (17.8%)	12 (3.0%)	8.4 (1.06–28.0)	0.04	15.7 (1.7–24.4)	0.013
Others	0	28 (7.0%)	–			
Previous C-section (NS)	9 (20%)	154 (38.6%)	0.56 (0.04–2.93)	0.54	-	-
Antibiotic Use (NS)	37 (82.2%)	262 (65.6%)	1.5 (0.3–7.5)	0.62	-	-

Discussion

This study assessed the incidence and determinants of surgical site infections (SSI) following caesarean section in two Cameroonian referral hospitals. Through active surveillance for 30 days post-operatively, in accordance with international criteria [4], we obtained a more accurate estimation of SSI incidence than studies relying solely on inpatient follow-up.

The cumulative SSI incidence was 10.13%. Although not the primary focus of this study, we observed a numerical difference between the two sites: Laquintinie Hospital (LQ) reported 11.11% and Douala Gynaeco-Obstetric and Paediatric Hospital (DGOPH) 6.45%. This difference was not statistically significant. The observed variation may nonetheless reflect contextual differences; for instance, DGOPH had implemented written infection prevention protocols in maternity and operating theatres, a measure not consistently in place at LQ. Furthermore, LQ serves a more economically diverse population and hosts numerous trainees, factors which could potentially affect compliance with aseptic techniques. Previous studies in resource-limited settings have reported wide variability in SSI rates. For example, Fouedjio et al. [14] documented a lower incidence (1.81%), likely due to its retrospective design, brief follow-up, and restriction to hospital stay surveillance. Such methodological limitations are known to underestimate true SSI rates [16]. Other reports in comparable settings show similar SSI rates to ours [8,11,17,18], whereas some Asian and sub-Saharan African studies report markedly higher incidences—ranging from 18.8% [6] to 20.7% [19]. These figures contrast with rates in high-income countries (1–3.9%) [16, 20, 21], underscoring gaps in infection control infrastructure and practice.

Multivariate logistic regression confirmed that obesity (aOR = 5.9; CI: 1.17–30.0; p=0.032), anaemia (aOR = 4.7; CI: 1.2–19.5; p=0.03), and diabetes (aOR = 15.7; CI: 1.7–24.4; p=0.013) were independent risk factors. The identification of these factors is consistent with the well-established pathophysiological mechanisms that compromise immune function and wound healing [22-25]. The strength of our prospective design likely allowed for a more accurate capture of these comorbidities and their true effect on SSI risk. Surprisingly, blood transfusion remained associated with protection (aOR = 0.05; CI: 0.008–0.39; p=0.004). This counterintuitive finding may be influenced by confounders, such as the clinical context of transfusion (e.g., correction of severe baseline anaemia), or sample size limitations, and requires further study. These risk factors diverge from those identified in some previous Cameroonian research [14, 26], a difference that may reflect variations in clinical practice, such as the rarity of midline incisions and the supervised nature of resident-performed surgery at our sites.

Our finding related to anaemia is consistent with other literature in low-resource settings, where it impairs wound healing [1, 29, 22]. The protective association of transfusion, however, contrasts with studies implicating it in immunomodulation and increased risk [27]. In our cohort, it may have supported improved tissue oxygenation in severely anaemic women, thereby enhancing healing. Although inappropriate antibiotic use was not statistically significant, its higher occurrence at LQ—manifested by delayed prophylaxis in emergencies and inconsistent postoperative therapy—is concerning and aligns with its documented role in increasing SSI risk [5, 23, 30-32]. Conversely, factors frequently implicated in SSI—such as number of vaginal exams or prolonged rupture of membranes—were not significant in our cohort, possibly due to strong procedural oversight and effective case management in these referral

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centers.

Strengths and Limitations

This study's prospective design with active 30-day follow-up is a key strength, enhancing the accuracy of SSI detection. However, several limitations exist. The use of consecutive convenience sampling may limit the generalizability of findings. Follow-up challenges, including participant attrition due to changed contact details, introduced potential follow-up bias. Certain variables, such as the number of vaginal examinations, relied on medical records or recall and may be subject to inaccuracy. While a broad range of risk factors was assessed, unmeasured confounders—such as surgical techniques and antibiotic timing—may have influenced outcomes. Additionally, as the study was conducted in two urban tertiary hospitals, findings may not be generalizable to rural or lower-level healthcare settings in Cameroon.

Conclusion

This prospective study in two tertiary hospitals in Cameroon found a high incidence of post-cesarean SSIs, exceeding rates observed in high-income settings. Obesity, diabetes, and preoperative anemia were identified as independent risk factors, emphasizing the need for targeted maternal health interventions and strengthened infection prevention protocols.

The observed protective association with perioperative blood transfusion, while notable, should be interpreted cautiously, likely reflecting residual confounding or selection bias. This finding highlights the need for further studies specifically designed to explore this relationship.

Future research should focus on evaluating antibiotic stewardship, surgical techniques, and perioperative practices in resource-limited settings to inform context-specific strategies aimed at reducing SSI rates and improving obstetric outcomes.

Authors' Contributions: RT, TNN, FGMN, and EMEM conceptualized and designed the study. Participant recruitment at the study sites was conducted by HE, DK, and EMEM. DK also contributed to recruitment and critically reviewed the manuscript. The manuscript was drafted by RT, EMEM, DK, and FGMN. HE, TNN, and MNN revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

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Ethics Approval and Consent to Participate: Ethical clearance was obtained from the Institutional Review Board of the Faculty of Health Sciences, University of Buea (Ref. No. 2021/1546-01/UB/SG/IRH/FHS). Administrative authorization was granted by the Directors of Laquintinie Hospital and Douala Gynaeco-Obstetric and Pediatric Hospital. Written informed consent was obtained from all participants after full disclosure of the study's objectives, procedures, potential risks and benefits, and the voluntary nature of participation.

Competing Interests: The authors declare that they have no competing interests.

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