A case–control study of risk factors for surgical site infection after cesarean delivery in eastern Burkina Faso

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A B S T R A C T

Objective: To identify the risk factors for surgical site infection after cesarean delivery in a rural area in eastern Burkina Faso. *Methods:* A matched case–control study was conducted in Fada N'Gourma Regional Hospital Center and the Diapaga Medical Center with Surgical Antenna using data from 2011–2014. A total of 99 cases of surgical site infection after cesarean delivery were included in the study. Each case was matched with a control patient similar for age, admission date, and facility where the cesarean took place. Risk factors were identified using conditional logistic regression. *Results:* Multivariate analysis identified hyperthermia at admission (OR 2.37; $P = 0.035$), the presence of caput succedaneum in newborns (OR 7.07; $P = 0.001$), and difficult delivery (OR 3.69; $P = 0.019$) as risk factors for surgical site infection. *Conclusion:* Provision of quality prenatal care, use of the partograph during labor, and the responsiveness of health workers during labor can reduce surgical site infection after cesarean delivery.

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1. Introduction

Nosocomial infections are present in all hospital facilities, especially in maternity services, which is a challenge to public health [1]. They are responsible for an increase in morbidity and pose a significant financial cost to the community. A nosocomial infection is one acquired during a hospital stay that was not present at either admission or during incubation, with a free interval of at least 48 hours [2].

Surgical site infection is a common complication of surgical activity and one of the most well-known nosocomial infections. It occurs within 30 days of the intervention and is classified by the USA's Center for Disease Control and Prevention into three types depending on the depth of the infection: superficial infection of the incision, deep infection of the incision, and surgical site infection affecting the organ or space [2].

These infections remain a concern in low-resource countries despite the implementation of prevention and control measures as they cause an extension of the hospital stay by an average of seven days and cause considerable extra cost for the patient. They can be severe and limit the potential benefit of surgery, as well as resulting in morbidity and death [3].

Few studies have been conducted in Africa on surgical site infections after cesarean delivery and this studies has conducted in universitary hospital center [4]. In Nigeria, the incidence of infection of the surgical wound after cesarean was estimated at 9.1% [5]. In Burkina Faso, the prevalence of surgical site infection in a hospital, all interventions combined, varies between 21.3% and 26.2% [6,7] and the incidence was estimated at 5.8% in 2009 [8]. To our knowledge, no study on surgical site infections has been conducted in rural health facilities, which are generally much more under-resourced than university hospitals in urban areas. The objective of the present study was to identify risk factors for surgical site infection after cesarean delivery in rural areas in a regional hospital and a district hospital in the eastern region of Burkina Faso, a country with limited resources for health care.

2. Materials and methods

2.1. Study setting

The study was carried out in the eastern region of Burkina Faso, specifically in the maternity facilities of the regional hospital center (CHR) of Fada N'Gourma and the district hospital of Diapaga Medical Center with Surgical Antenna (CMA). The eastern region was chosen owing to the weak coverage of health facilities and the total fertility rate, which is the highest in the country (7.7 in 2013) [9].

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2.2. Study type

This was a case–control study matching cesarean delivery patients in two hospitals in the eastern region. Each case of surgical site infection after cesarean delivery was matched with a single control of the same age from the same health facility but without surgical site infection after cesarean.

2.3. Population and sampling

The study population consisted of all women who were delivered by cesarean at the hospitals regardless of the mode of admission. From this population, the cases and control patients were selected.

For the cases, all women who underwent a cesarean delivery between January 1, 2011, and December 31, 2014, who had puerperal complications of discharge of pus from the surgical wound (suppuration) were systematically selected. The controls were selected in a sequential manner at a ratio of 1 case for 1 control. Each case of surgical site infection was matched with a control patient according to the following criteria: the first woman who had a cesarean delivery and did not have suppuration, at the same hospital, who was of the same age (± 2 years). In addition, each control was matched to a case who had a cesarean in the same year, and when it was possible, in the same month and even the same week or day as the case. The cases and controls were reviewed for sociodemographic characteristics, clinical admission parameters, and parameters of cesarean delivery.

The sample size was calculated using OpenEpi (www.openepi.com). Because there are several risk factors to consider, we chose the parity of the patient as the primary exposure factor to calculate the size of the sample. In accepting an alpha error of 0.05 and a power of 95% with a ratio of 1 case to 1 control case (case–control: 1: 1) and an odds ratio of 3, we calculated the number of required subjects for the study to be 97 cases and 97 control cases for a sample size of 194.

2.4. Data collection

The data were retrospectively collected in the CHR of Fada and CMA of Diapaga from April 1–30, 2015. Sociodemographic data, clinical admission parameters, and parameters of cesarean delivery were extracted from patient medical records.

2.5. Data analysis

The data were entered on Epi data software, and statistical analysis was performed using Stata version 13.1 (Stata Corp LP, College Station, TX, USA). The suppuration of the surgical wound was considered to be the dependent variable. The following variables were selected: ethnicity, parity, residence, employment, hemoglobin at admission (anemia was defined according to policy standards and protocols in force in Burkina Faso with a level of hemoglobin less than 11 g/dL), temperature at admission (hyperthermia was defined as a temperature greater than 37.5°C), ASA classification (American Society of Anesthesiologists), state of the amniotic sac at admission, complete dilation with the head in the vulva at admission, presence of a caput succedaneum on the newborn, duration of labor, duration of intervention, difficult delivery, state of the newborn, weight of the newborn, type of indication, time of the cesarean delivery, and the qualification of the healthcare worker who performed the procedure.

The quantitative variables were transformed into dichotomous or ordinal qualitative variables. For the research of risk factors, variables were grouped into categories: sociodemographic factors, clinical factors at admission, and factors related to the cesarean operation. We performed a descriptive analysis of the variables considered as risk factors, and then we sought, through univariate analysis, the association of each of the variables with the suppuration of the surgical wound using the McNemar test. Adjustment was made by conditional logistic regression. A variable was included in the multivariate model when its level of significance had a P value less than 0.20 in univariate analysis. The selected explanatory variables were included in the multivariate model using a stepwise forward procedure. The prioritization of the explanatory variables was made on the basis of the value of the odds ratio (OR). At each step, a comparison test was performed using the Akaike Information Criterion (AIC) for choosing the best model. Only variables with significant level of improvement of the model were kept in the building process of the final model. The level of significance was set at 0.05. For the specification of the model, we used the link test. For a P value greater than 0.05, the model was considered well specified.

2.6. Ethical considerations

The protocol received the approval of the national ethics committee for health research at its regular session on April 1, 2015, deliberation No. 2015-4-050. The respect for anonymity and the confidentiality of the medical information collected from the clinical records of patients were safeguarded by the codification of information collection tools.

3. Results

For the period 2011–2014, we identified 102 cases of suppuration after cesarean; of these, 99 were included in the study owing to missing data in three cases. The statistical analysis used 99 cases of suppuration matched with 99 control cases.

3.1. Basic characteristics of the sample

Regarding sociodemographic characteristics, the 15–24 years age group was the most represented in the sample and 42.4% of cases compared with 36.3% of controls were primiparous. Temperature was taken in 195 patients and 63.3% of those who had a surgical site infection had fever compared with 33% in the control group (Table 1). For the clinical parameters on admission, the majority of patients were referred.

3.2. Risk factors for surgical site infection

Using univariate analysis, no sociodemographic factors were associated with surgical site infection after cesarean delivery (Table 2); however, it was observed that compared with multiparous women, primiparous women had a higher risk of infection (OR 6.37; 95% CI, 1.12–36.19). For the clinical parameters of the patient at the beginning of the study, six risk factors were significantly associated with surgical site infection after cesarean delivery: hyperthermia upon admittance ($P<0.001$), anemia upon admittance ($P=0.002$), a pre-anesthetic ASA score greater than or equal to 2 ($P=0.02$), rupture of the amniotic sac upon admittance ($P=0.011$), complete dilation with the fetal head at the vulva ($P=0.021$), and the presence of a caput succedaneum on the newborn ($P<0.001$). The cesarean delivery parameters that were significantly associated with surgical site infection were difficult extraction of the fetus ($P=0.001$), the weight of the newborn ($P<0.001$), and the type of indication ($P=0.006$) (Table 2).

Using multivariate analysis, the final conditional logistic regression model including risk factors found significant associations between risk of surgical site infection and hyperthermia upon admittance (aOR 2.37; 95% CI, 1.9–5.3; $P=0.035$), caput succedaneum (aOR 7.0; 95% CI, 2.5–16.7; $P=0.001$), and difficult extraction of the fetus (aOR 3.69; 1.26–6.3; $P=0.02$) (Table 3).

4. Discussion

The present study showed that hyperthermia at admission was a risk factor for surgical site infection after cesarean delivery. For