Original Article

Surveillance of post-caesarean surgical site infections in a hospital with limited resources, Cambodia

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Abstract

Introduction: In Cambodia, we implemented a pilot surveillance of superficial surgical site infections (SSSI) following caesarean deliveries (CD) in a provincial hospital, to estimate their incidence, describe their clinical management, and determine their causative pathogens.

Methodology: Between October 2010 and February 2011, all women admitted for CD were included in the surveillance. Their clinical condition was monitored for a post-operative period of 30 days, including two assessments performed by surgeons. Cases were clinically diagnosed by surgeons, with bacterial cultures performed.

Results: Of the 222 patients admitted for CD, 176 (79.3%) were monitored for 30 days. Of these, 11 were diagnosed with a SSSI, giving an incidence rate of 6.25% (95% CI 3.2-10.9). Four of the cases (36.4%) were detected after hospital discharge. Length of hospitalization was significantly longer for the SSSI cases. All 222 patients were prescribed antibiotics. Ampicillin was administered intravenously to 98.6% of them, with subsequent oral amoxicillin given to 82.9%. Three of six pus samples collected were positive on culture: two with S*taphylococcus aureus* and one with S*taphylococcus lugdunensis*. One *S.aureus* was methicillin resistant (MRSA). The other was clindamycin and erythromycin resistant.

Conclusion: Surveillance of health-care associated infections in a setting with limited resources is challenging but feasible. Effective post-discharge surveillance was essential for the estimation of the incidence rate of SSSI following caesarean deliveries. This surveillance led to a peer-review of medical practices.

Key words: hospital-acquired infection; infection control; surgical site infection; Cambodia; health system; caesarean delivery

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Introduction

Surgical site infection (SSI) is a common postoperative complication, constituting a major public health problem in terms of mortality, morbidity, prolonged hospital stays, and increased antimicrobial resistance due to the inappropriate use of broad spectrum antibiotics [1,2]. The rates of SSI after caesarean deliveries range from 6% to 27% [3,4], depending on the surveillance methods used to identify infections and the use of antibiotics. Factors which affect post-caesarean section SSI rate include the maternal pre-operative medical and obstetric conditions, the type of surgical procedure, and the absence of antibiotic prophylaxis [5,6,7,8].

In Cambodia, a developing nation in Southeast Asia, many factors locally co-exist and contribute to sub-optimal quality of patient care and increasing the risk of health-care associated infections (HAI): irregular supply of medical consumables, limited hospital operational budgets, low salaries of health staff [9], poor knowledge of infection control practices, irregular repartition of health services causing overload of work [10], and co-existence of other major health problems.

The Cambodian Ministry of Health (MOH) released the first National Strategic Plan (NSP) for Infection Control in 2009. Implementing active surveillance of hospital-acquired infection and monitoring of antimicrobial resistance patterns were defined as major priorities. The rate of SSI was listed as one of the core indicators in the NSP for the assessment of infection control activities in a designated hospital site. Within this framework, we implemented a pilot surveillance of superficial surgical

site infections (SSSI) following caesarean delivery (CD) in a provincial hospital in Cambodia, aiming to estimate, for the first time in the country, their incidence rate, risk factors, causative pathogens, and medical management.

Methodology

Our surveillance was performed in Kampong Cham Provincial Hospital; this 260-bed facility is the only public health referral structure in a province of nearly 2,000,000 people. A total of 2,360 deliveries were performed in 2010 with a monthly average of 60 caesarean sections.

Data collection

All consecutive women admitted for caesarean deliveries between October 2010 and February 2011 were included in the surveillance. The patients' clinical condition was monitored for a post-operative period of 30 days. The inpatient surveillance included daily clinical evaluation conducted by midwives (wound inspection and temperature recording). Assessments were performed by surgeons on post-operative day 5 and at discharge. After discharge, two assessments were conducted by surgeons at the outpatient department, on postoperative days 15 and 30. Digital pictures of the surgical wound were taken on post-operative days 5, 15 and 30. Diagnosis of SSSIs was clinically confirmed by attending surgeons. Patients were reimbursed for travel expenses incurred for the post-discharge assessments. Patients who failed to come back were interviewed via phone by a surgeon.

Data on patient preoperative conditions were collected by surgeons and operating theatre nurses. They included demographics (age, place of residence), presence of diabetes, and obstetric-related variables such as parity, number of previous laparotomies, quality of amniotic fluid, duration of ruptured membranes, and duration of labour. The following surgery-related variables were also collected: American Society of Anaesthesiologists (ASA) score [11], urgency of the operation, details of anaesthesia and surgical procedures, duration of the operation, volume of blood loss, and administration of antibiotic therapy.

In cases of SSSI suspicion, blood and wound discharge specimens were collected and analyzed by Gram stain and culture, in the hospital laboratory. Antimicrobial susceptibility testing was performed using a standardized panel which included extended-spectrum cephalosporins and quinolones, all of which are available in local pharmacies.

Definitions

SSSI were clinically diagnosed by surgeons according to the criteria of the Centers for Disease Control and Prevention National Nosocomial Infections Surveillance System [12,13]. Patients' preoperative conditions were assessed using the ASA score defined as: (1) healthy; (2) mild systemic disease; (3) severe systemic disease; (4) severe life-threatening systemic disease; (5) moribund; and (6) brain dead [11]. Caesarean section deliveries were classified according to the modified wound classifications [6,7]: (1) no rupture of membranes or labour; (2) $\leq$ 2 hours of membrane rupture without labour, or labour of any length with intact membranes; (3) rupture of membranes > 2 hours; (4) purulent amniotic fluid (defined as a foul odour, and/or a stained or greenish colour).

Statistics

Data consistency and completeness were verified by a part-time Cambodian research assistant under the supervision of the MOH study referent and the research agency coordinator. Data were analyzed using Stata statistical software (version 11; Stata Corp, College Station, TX, USA). Statistical significance for all tests was defined at $p < 0.05$. We used the Fisher's exact test to compare categorical variables and the non-parametric Kruskal Wallis for continuous variables. Univariate analysis was performed to identify risk factors associated with SSSI. Odds ratios (OR) are reported with their 95% confidence intervals (95% CI).

Ethics

The implementation of surveillance of health-care associated infections (HAI) is one of the priorities of the National Strategic Plan for Infection Control of MOH Cambodia. The MOH issued a waiver for ethics approval since strengthening of HAI surveillance did not interfere with routine patient care. The purpose of the data collection was explained to patients, and their verbal consent to participate was acquired prior to inclusion. The Case Report Forms were anonymized on-site and archived at the Department of Hospital Services, MOH.

Results

During the five-month-surveillance period, 222 patients were enrolled in the surveillance program. All

patients attended the compulsory visits with a surgeon at day 5 and at discharge. The proportions of those attending the post-discharge visits was 85% at day 15 and 79% at day 30 (Figure).

Of the 176 patients who were assessed at day 30, eleven were diagnosed with an SSSI, giving an incidence rate of 6.25% (95% CI 3.2-10.9). The diagnosis was made after the seventh day following surgery for six (54.5%) patients, and after discharge in four (36.4%) patients. The hospital duration of stay was twice longer for the SSSI cases: 16 days, versus 7 days for the non-SSSI cases (p = 0.0002).

Characteristics of patients

The median age of the study subjects was 26 years (range: 16 to 47 years). All were residents from the province. On admission, 4.5% of the patients were febrile, 9.9% were hypertensive, and 15.7% had severe or life-threatening conditions (ASA score at 3 or more), including 22 moribund patients. Twenty-five (11.3%) had a gestational age under 37 weeks. Only two presented with diabetes (mellitus or gestational), while 18 (8.1%) reported a previous laparotomy. The most frequent indication for caesarean delivery was feto-pelvic disproportion (Table 1). Multiple indications for caesarean section existed in 6.8% of the cases (n = 15).

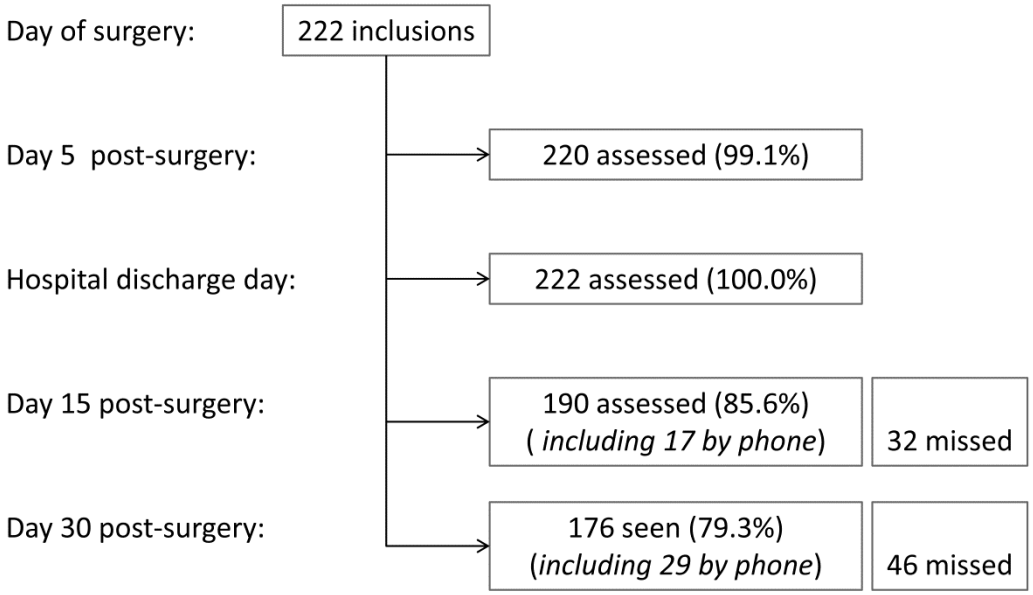
Surgery procedures

Seven patients (3.1%) underwent an elective procedure; the remaining required emergency procedures. In 96.6% of cases, the anaesthetic procedure was rashi-anaesthesia. Skin disinfection of the surgical site using a 10% solution of povidone iodine was performed systematically for all patients but the team never performed any skin surgical scrub prior to disinfection. The median duration of surgery was 25 minutes. (Interquartile range 20 to 30 min.). Suturing was always performed using non-absorbable thread, and in two cases, a drain was inserted after surgery. The total blood loss exceeded 1.5 litres in 14 (6.3%) patients; this included both pre- and post-operative blood loss.

Analysis of risk factors

Univariate analysis was conducted for the 176 (79%) patients who completed 30 days of post-surgery surveillance. No significant association was found between the patients' demographic, medical or surgical conditions and the occurrence of SSSI (Table 2). Patients diagnosed with SSSI were more frequently reported with a feto-pelvic disproportion (OR 3.5; 95% CI: 0.9-12.5; p = 0.05) (Table 2).

Figure. Patient follow-up during surveillance of Superficial Surgical Site Infection at Kampong Cham Hospital, Cambodia, October 2010 to March 2011



n = 222 patients

Table 1. Surgical indication for 222 caesarean sections at Kampong Cham Hospital, Cambodia, October 2010 to Feb. 2011

Indication	No.	(%)
Feto-pelvic disproportion*	82	(36.9)
Breech / twins	55	(24.8)
Placenta praevia + other placenta related problems*	28	(12.6)
Eclampsia / pre-eclampsia	14	(6.3)
Abnormal presentation (face, tranverse)	14	(6.3)
Dystocia (prolonged labor, stop of progression)	14	(6.3)
Acute fetal distress	10	(4.5)
Pre-rupture / rupture of the uterus	6	(2.7)
Repeated caesarean*	5	(2.2)
Fetal conditions (malformation, growth restriction)*	3	(1.3)
Maternal conditions (maternal disease, malformation or injury of the reproductive tract)*	3	(1.3)
Cord abruption	1	(0.4)
Prolonged term*	1	(0.4)
Missing	1	(0.4)

* Conditions which were detectable during the last month of pregnancy

Antibiotics and microbiology testing

Preventive antibiotic treatment was prescribed in all 222 patients. The most common (98.6%) prescription was intravenous ampicilin (1 g, 3 times a day) delivered for a mean duration of 4.2 days. Oral amoxicillin (500 mg, 3 times a day) was subsequently given to 184/218 patients (82.9%) for a mean duration of 3.3 days. Other prescriptions included metronidazole (n = 3) and intravenous ceftriaxone (n = 1). Seven of the 11 patients diagnosed with SSSI were prescribed an additional antibiotic treatment course; the prescriptions included metronidazole (n = 6 patients), cloxacillin (n = 5), ceftriaxone (n = 3), gentamicin (n = 2), and amoxicillin (n = 1). Only 6 of the 11 patients diagnosed with a SSSI had a wound sample collected and cultured for bacterial pathogens. *Staphylococcus aureus* was isolated in two patients and *Staphyloccus lugdunensis* in a third case.

One *S. aureus* was resistant to cefoxitin, erythromycin and oxacillin, fulfilling the definition of methicillin resistant S. *aureus* (MRSA). The other demonstrated in vitro resistance to clindamycin and erythromycin. The *S. lugdunensis* was not sensitive to tetracyclin, to cefoxitin, and to erythromycin.

Discussion

This pilot project provided a first estimate of the incidence rate of superficial surgical site infections following caesarean deliveries and gave an interesting overview of the current surgical procedures and antibiotic prescriptions related to CD in a Cambodian provincial hospital.

In this challenging context with limited resources, we expected a higher SSI incidence rate, close to the findings of a similar study conducted in Vietnam in1997 (9.8%) [6]. Aware of the precariousness of the situation, physicians in this Cambodian provincial hospital strongly adhere to the current Cambodian hospital guidelines which recommend systematic and

Table 2. Univariate Analysis of risk factors for superficial surgical site infections (SSSI) following caesarean section, at Kampong Cham Hospital, Cambodia, from October 2010 to February 2011

Risk factor	SSSI (n = 11) Mean ± SD or No. (%)	no SSSI (n = 165) Mean ± SD or No. (%)	OR	(CI_{95})	*P*
Demographic and medical factors					
age, years	30.0 ± 6.1	27.7 ± 6.3			0.23
had mellitus or gestational diabetes	0 (0.0)	0 (0.0)	1.0		
had previous laparotomy	0 (0.0)	12 (7.3)	1.0		
high blood pressure at admission	1 (9.1)	16 (9.7)	0.9	(0.1 - 7.7)	0.94
ASA score at admission	1.6 ± 1.2	1.7 ± 1.2			0.96
Obstetric factors					
gestational age, weeks	38.9 ± 2.4	38.9 ± 2.3			0.78
duration of labor, hours	16.0 ± 21.3	11.8 ± 12.5			0.83
duration of ruptured membranes, hours	6.9 ± 7.0	4.3 ± 8.3			0.14
purulent amniotic fluid	4 (36.4)	51 (30.9)	1.3	(0.3 - 4.5)	0.71
foeto-pelvien disproportion	7 (63.6)	55 (33.3)	3.5	(0.9 - 12.5)	0.05
Surgical factors					
duration of surgery, in minutes	25.9 ± 7.0	26.9 ± 7.0			0.77
emergency	11 (100.0)	158 (95.8)	1.0		
CD wound class	2.9 ± 1.0	2.6 ± 1.1			0.37
rashi anesthesia	11 (100.0)	159 (96.4)	1.0		
blood loss exceeding 1.5 l	1 (9.1)	7 (4.2)	2.3	(0.2 - 20.2)	0.46

(n = 176 patients with 30 days follow up post-surgery)
SSSI: surgical site infection
SD: standard deviation
OR: odds ratio
CI_{95}: 95% confidence interval; assessment score
ASA score : American Society of Anesthesiologists preoperative
CD: Cesarean Delivery

prolonged post-CD courses of ampicillin/amoxicillin to prevent SSIs. Indeed, medical evidence has shown that prophylactic antibiotics reduce the incidence of SSIs [14,15]. But since the late 1990s, international standards recommend a single-dose prophylaxis regimen [16,17]. The choice of using narrow *versus* broad spectrum antibiotic regimens is currently discussed [18,19] as well as the best timing for prophylaxis initiation, *i.e.*, after cord clamping or before skin incision [20]. From our experience, we would recommend to (1) avoid using new broad spectrum antibiotics; (2) administer the initial dose immediately after the umbilical cord is clamped; (3) consider reducing the duration of antimicrobial prophylaxis.

Wide use of prophylactic antibiotics puts patients at high risk, driving the emergence of antimicrobial resistant pathogens. In Cambodia, antimicrobial resistance is a growing concern which has already been documented for *Neisseria gonorrhoeae* [21], *S. aureus* [22], *Salmonella* [23,24], *Shigella* [23], and *Escherichia coli* [25]. Nearly 45% of the 20 *S. aureus* strains isolated by the Kampong Cham Hospital laboratory in 2011 were community acquired-methicillin resistant *S. aureus* (MRSA) (Somary N., Personal communication, 2011). Sustaining and developing local microbiology capacities are significant priorities in order to document the emergence of antimicrobial resistance. An achievement of this surveillance was to show the national and international community that a small-

scale and capacity-limited laboratory such as the one existing in this provincial hospital was able to detect MRSA.

Our surveillance also underlines that an effective post-discharge surveillance is essential for ensuring accurate estimates of post-caesarean SSSI rate [26,27] and is feasible in limited-resource settings. Had we not implemented particular procedures after discharge to assess the wound healing process of patients (telephone call, follow-up visits), half of the cases would have been missed. Post-surgery follow-up is not yet routinely performed in Cambodia. Health Equity Funds implemented in Cambodia overcame some barriers to access to health services, by identifying the poor patients and paying user fees to service providers on their behalf [28], but patients still have to borrow money to access health care [29]. Moreover, these schemes do not systematically cover post-surgery follow-up related costs. We observed that our post discharge follow-up rate increased when reimbursement of transportation fees was proposed. However, the sustainability of such a surveillance system is not in place to support the families or to rationalize the costs. In the cases of follow-up of caesarean deliveries, the post-surgery visit at day 30 could be combined with a post-natal visit, which could provide the mothers with obstetric follow-up, contraceptive counselling, and newborn care.

Due to budget constraints, the surveillance duration was restricted to five months and the limited sample size of our study was not sufficient to explore more in depth the potential risk factors for SSSI following CD. However, the surveillance team was able to identify areas for care improvement, in the pre-operative preparation procedures [30,31]. During the surveillance period, we also showed that 54% of the CDs were performed for obstetrical indications which could have been detected through antenatal care, such as feto-pelvic disproportion, history of multiple CD, fetal growth restriction, and some maternal malformations. Patients tended to present late at the maternity (almost 10% were moribund). In most of these cases, the surgery could have been planned, avoiding emergency procedures, which are recognized as a risk factor for complications.

Conclusion

SSI surveillance in such resource-limited settings proved to be feasible but challenging. Several key factors facilitated the implementation of surveillance activities. Both the hospital authorities and the hospital Infection Control Committee were strongly involved since the project's inception. The surveillance objectives were clear and well in line with the national priorities, and they were presented to stakeholders by recognized authorities (MOH and the World Health Organization). All surveillance staff (physicians, surgeons, midwives, nurses, laboratory, and administrative staff) had the opportunity to be involved in the surveillance procedures.

This project provided strong support to the National Infection Control Programme. It provided evidence that such surveillance is feasible even in a provincial setting. It also showed that some practices should change. Strengthening antenatal care and its ties with the surgery and the postnatal care services would benefit women. The surgical prophylaxis recommendations should be revised. HAI surveillance, including post-discharge follow-up, should be sustainably implemented and the presence of MRSA confirmed.

Similarly to what has been shown elsewhere [5], we witnessed that surveillance activities can play an effective role in the reduction of hospital-acquired infections. Providing the maternity staff with regular feedback on the surveillance findings and sharing them with other Cambodian stakeholders sparked discussions about the SSI burden on patients and on health services. This outcome led to a peer review of medical, midwifery, and nursing practices and to debates at local and national levels on possible interventions to reduce HAIs.

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