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Major articles

Risk factors for cesarean surgical site infections at a Thai-Myanmar border hospital

Srisuda Assawapalanggool MNS [a], Nongyao Kasatpibal PhD [b,*], Supatra Sirichotiyakul MD [c], Rajin Arora MD [d,e], Watcharin Suntornlimsiri MD [f]

[a] Infection Control Section, Maesot Hospital, Tak, Thailand
[b] Division of Nursing Science, Faculty of Nursing, Chiang Mai University, Chiang Mai, Thailand
[c] Department of Obstetrics and Gynecology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand
[d] Department of Obstetrics and Gynecology, Lampang Hospital, Lampang, Thailand
[e] Collaborative Project to Increase Rural Doctors, Ministry of Public Health, Thailand
[f] Department of Obstetrics and Gynecology, Nakornping Hospital, Chiang Mai, Thailand

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Background: Cesarean surgical site infections (SSIs) are a major challenge in Thai-Myanmar border hospital settings. This study aimed to examine risk factors for SSIs after cesarean section.

Methods: This was a prospective cohort study conducted in a Thai-Myanmar border hospital between January 2007 and December 2012. Data were collected from the medical record database by trained infection control nurses. Stepwise multivariable logistic regression was used for risk factor analysis and expressed as a risk ratio (RR).

Results: The cesarean SSI rate was 5.9% (293 SSIs in 4,988 cases). Of these, 17.1% were incisional SSIs (10.9% superficial and 6.2% deep incisional SSIs), and 82.9% were organ or space SSIs. Risk factors for cesarean organ-space SSIs included a wound class ≥3 (RR, 4.82; 95% confidence interval [CI], 3.41-6.83), ethnic minority (RR, 2.51; 95% CI, 1.61-3.92), hemoglobin <11 g/dL (RR, 2.19; 95% CI, 1.57-3.04), pelvic examination before delivery on ≥5 occasions (RR, 4.16; 95% CI, 2.89-5.99), preterm (RR, 1.98; 95% CI, 1.33-2.95), being a local referral (RR, 3.37; 95% CI, 2.29-4.97), and foul-smelling amniotic fluid (RR, 21.08; 95% CI, 10.23-43.41).

Conclusions: Most cesarean SSIs in this study seem to have a high severity. Their risk factors reflected delayed appropriate perinatal maternal care that resulted in late cesarean delivery. Early prenatal care may help reduce cesarean SSIs among this population.

Cesarean section is a major surgery and has increasing prevalence yearly in most countries.[1] Cesarean surgical site infections (SSIs), especially organ-space SSIs, are serious complications[2] that can result in reoperation, increased medical cost and length of stay, rehospitalization, maternal prolongation of returning to normal function, or mortality.

Incidence of cesarean SSI varies depending on the methodology of study, case definition, case identification ability of observers,[3] and socioeconomic status. Among developed countries, total cesarean SSIs were approximately 1.5%-7.0%.[4,5] Cesarean incisional SSI incidence was approximately 0.18%,[6] and endometritis ranged from 3%-6%,[7,8] The cesarean SSI rates are approximately 6% in underdeveloped countries.[9] In Thailand, the incidences of cesarean SSI and cesarean endometritis are 0.9% and 2.0%, respectively.[1,10]

Various risk factors of cesarean SSIs have been identified. An important risk of cesarean endomyometritis is the cesarean section per se.[11] Other identified risk factors are classified in patient-related conditions (eg, maternal age, socioeconomic status,[12] obesity[13]) and underlying medical problems. These include anemia (hemoglobin level: <11 g/dL)[12]; obstetric-related factors; including parity,[13] zygosity,[14] presence and duration of rupture of amniotic membrane (ROM),[15] number of pelvic examinations (PVs),[16] and presence of meconium-stained amniotic fluid (MSAF)[13]; gestational age <37 weeks (preterm labor)[7]; vaginal procedures performed before cesarean section[16]; associated gynecologic infections[12]; and surgical risk factors.

Potential surgical risks of SSI include a high American Society of Anesthesiology (ASA) score,[13] high wound class, and long

* Address correspondence to Nongyao Kasatpibal, PhD, Division of Nursing Science, Faculty of Nursing, Chiang Mai University, Chiang Mai 50200, Thailand.
E-mail address: nongyaok2003@gmail.com (N. Kasatpibal).
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operation time.[17] According to the National Nosocomial Infections Study (NNIS), these are included in the risk index category.[18] In addition, emergency surgery,[12] type of skin incision and urethrotomy,[19] blood volume lost,[13] and hematoma[12] are identified as potential risks.

Our center is adjacent to the Thai-Myanmar border and serves up to 5 districts, including 4 refugee camps in the service area. Patients attending our center vary considerably in tribes and also conceal a variety of health and environmental problems that are overloaded in the clinic. Health care–associated infections are strongly influenced by an overcrowded setting.[20] Cesarean SSIs in our center comprised at least 3.0% in 2005. The situation is predicted to worsen after the ASEAN Economic Community (AEC) establishment in 2016, which will be characterized by economic immigration.

Based on epidemiologic knowledge, risk factors of cesarean SSI in our setting may differ from other regions both in types and strength of association. Exploration of such risk factors is essential for preparedness of forthcoming changes after the AEC launch.

METHODS

Setting

The study was conducted in a crowded and limited-resource tertiary care hospital with 365 beds on the Northwestern Thai-Myanmar border, with an annual average of 800 caesarean cases.

Study design and data collection

The study was approved by the institute's Research Ethical Board, Faculty of Medicine, Chiang Mai University. Data were prospectively collected from January 1, 2007-December 31, 2012, by 2 infection control nurses who had obtained Master's degrees in infection control. Cesarean SSI cases were defined according to the Centers for Disease Control and Prevention's (CDC's) National Healthcare Safety Network criteria.[21] Clinical signs and symptoms and medical records were reviewed through the surveillance system. These included patients demographics, background medical problems, obstetric progression with intervention or operative data, antibiotics administration, vital signs, diagnosis throughout admission, documents of their treatment and any complications, follow-up days, and follow-up method. Wounds were inspected among all patients using aseptic techniques on the third postoperative day and whenever necessary or before discharge. All patients made appointments approximately 1 week and 1 month postoperative at a convenient health center in their community in our network. The 1-week follow-up appointment focused on wound checking, and stitches were removed when necessary. When any wound complications occurred, the patient was referred for consultation. The 1-month follow-up appointment aimed at family planning and gynecologic problem screening. Again, any patient who had a gynecologic problem was referred to our center for consultation. Patients from camps were referred for such purposes by medics or volunteers in the camps. Patients who did not attend any follow-up appointments in our network were classified as lost to follow-up.

Statistical analysis

A statistical software package was used for sample size estimation. Based on the wound class reported in a previous study,[22] the sample size was calculated using a 2-sample comparison of proportions where $\alpha = 0.05$ and $\beta = 0.80$. This resulted in the minimum study size of 2,277 patients. Baseline characteristics were descriptively analyzed. Continuous data were tested between comparison groups using *t* test, Wilcoxon rank-sum test, analysis of variance, or Kruskal-Wallis equality of populations rank test depending on the number of comparison groups and their distribution function. Categorical variables were compared using Fisher exact test and Pearson χ^2 test. Subgroup analysis was estimated in patients with cesarean SSIs for the comparison of risk factors between 2 age groups: <20 and ≥20 years.

Cesarean SSIs were treated under the assumption of being a multinomial variable. Potential risk factors included age group, ethnic minority status, education level, antenatal care (ANC) status, body weight ≥80 kg, anemia, HIV infection, being referred, primigravida, preterm, PVs ≥5 times before surgery, amniotic characteristic, rupture of membrane ≥12 hours, fetal death in utero, ASA score ≥3, wound class ≥3, operation time >55 minutes, emergency operation, blood loss during operation ≥500 mL, presence of urinary tract infection before surgery, midline skin incision, and additional procedure performed during cesarean section. Each variable was univariably analyzed by using multinomial logistic regression.

All significant risk factors were then included in the multivariable regression model where cesarean incisional and cesarean organ-space SSIs were treated as separate dependent variables. The backward stepwise multivariable logistic regression model using a significance level for removal from the model of 0.001 was calculated, and collinearity of the independent variables in the final model was checked.

RESULTS

In total, 5,122 patients underwent cesarean sections. There were 4,988 patients recruited, and 134 patients (2.6%) were lost to follow-up from our postdischarge surveillance system (PDS). These patients were excluded. All patients received antibiotic prophylaxis according to their obstetrician's preference.

We identified 293 of 4,988 patients (5.9%) that encountered cesarean SSIs. Of these, 17.1% were classified as incisional SSI (10.9% superficial and 6.2% deep incisional SSIs), and 82.9% were classified as organ-space SSI. Most SSI cases (88.7%) were diagnosed before discharge. The other 11.3% were detected in our PDS (Table 1). The

Table 1
Caesarean SSI classification and surveillance method (N = 4,988)

	Superficial incisional SSIs (n = 32)		Deep incisional SSIs (n = 18)		Organ-space SSIs (n = 243)		Total (n = 293)	
Characteristics	n	%	n	%	n	%	n	%
Caesarean SSI rate	32	0.6	18	0.4	243	4.9	293	5.9
Surveillance method								
In-hospital surveillance	24	75.0	12	66.7	224	92.2	260	88.7
Postdischarge surveillance	8	25.0	6	33.3	19	7.8	33	11.3
Hospital OPD	1	12.5	1	16.7	13	68.4	15	45.5
Other health care service centers	7	87.5	5	83.3	6	31.6	18	54.5

OPD, obstetrics and gynecology outpatient department; *SSI*, surgical site infection.