ORIGINAL ARTICLE

Post-partum surgical wound infections: incidence after caesarean section in an Italian hospital

L. CHARRIER, P. SERAFINI[*], A. RIBATTI[*], A. CASTELLA[**], G. RABACCHI[*], C.M. ZOTTI
Department of Public Health and Microbiology, University of Turin, Italy; [*] S. Anna Hospital, Turin, Italy; [**] Department of Public Health and Microbiology, University of Turin, Italy

Key words

Caesarean section • Risk factors • Surgical site infection

Summary

Introduction. *Despite international recommendations and general agreement on the fact that more complications arise after caesarean section, Italy ranks first in the number of caesarean sections performed each year. Aim of this cohort study was to estimate the incidence of post-partum wound infections following caesarean section in a sample of low-risk women and to examine the main risk factors correlated.*
Methods. *430 mothers were included in the study. A data collection form was completed with woman's obstetric history, details of the operation and of any infection that occurred during hospital staying. A post-discharge telephone call-up surveillance after delivery was also performed*
Results. *A total of 20 (4.7%) SSIs were recorded. Through post-discharge surveillance, 85% of infections were identified. The time between membrane rupture and start of the operation was found to be associated with the development of infection (p = 0.04). No statistically significant association with any of the other risk factors was found.*
Discussion and conclusion. *From the comparison of current practices with international guideline recommendations we could identify critical points that will need to be addressed in corrective and training interactions, specifically, choice and timing of administration of antibiotics in antimicrobial prophylaxis and timing of showering and shaving.*

Introduction

Among western countries, Italy ranks first in the number of caesarean sections (CSs) performed each year. Over the past two decades, the national mean proportion of CSs climbed from 11-12% in the early 1980s to 35.8% in 2002 [1]. But the increase is not specific to Italy. According to the Caesarean Section-Clinical Guideline published in 2004 by the National Collaborating Centre for Women's and Children's Health, between 1980 and 2001, the percentage of CSs performed in the U.K. rose from 9% to 21%. And although delivery by CS in the U.K. has risen over the past two decades, the four principal clinical causes have not changed: fetal dystocia (22%), failed progress of labor (20%), previous CS (14%) and podalic presentation (11%), while a recent fifth cause is maternal request (7%) [2].
The alarm has also been sounded in the United States, where in the past three decades the proportion of CSs has gone from 5% in 1970 to nearly 30% today, within a range of 10% to 50% depending on the health care workers and the facilities caring for the woman during delivery [3]. The Centers for Disease Control and Prevention (CDC) and the American College of Obstetricians and Gynecologists agree that the percentage of CSs should be reduced, particularly in low-risk women, because it has been widely shown that, unless otherwise indicated and well documented, spontaneous vaginal delivery is safer for the both the mother and child alike [3, 4]. Although appropriate use of CS greatly reduces perinatal morbidity and mortality, associated complications, especially infection, have been correlated with the procedure [4-7]. The published data on the rates of endometritis and surgical site infection (SSI) following CS vary widely, but it is commonly agreed that more complications, particularly infections, arise after CS than after vaginal delivery [2-7]. Moreover, because of the ever shorter length of stay (LOS) in hospital, an accurate estimate of post-partum infection is difficult to make, since most infections develop after discharge [8, 9].
In 2005 a prospective study was conducted to estimate the incidence of post-partum infections following elective and non-elective CS in a sample of low-risk women. The specific objectives were to estimate the incidence of surgical site infections (SSI) and endometritis following CS and to analyze the main risk factors correlated with patient care and management in CS.

Methods

Between April and September 2005, 430 women who had delivered by CS at OIRM-S.Anna Hospital (Turin, Italy) were consecutively enrolled into the study. The sample size was established on the basis of a number of CSs of about 3000 per year, confidence level of 95%

and an expected infection rate of 5% ± 2%, both for SSI and endometritis [7].
After obtaining informed consent, a data collection form was completed with the patient's demographic data, obstetric history, details of the operation and whether any infection had occurred during her stay in hospital. The data were collected by a student midwife and trained Infection Control Nurses of the hospital staff.
The women were also asked if they could be called by telephone within 30 days after delivery for post-discharge follow-up. During the phone-up structured interviews, information was collected about the post-partum course, and specifically whether problems had developed with the surgical wound, if wound infection and/or endometritis had been diagnosed by their physician and the treatment prescribed.
Case definition of endometritis and SSI were those of the CDC [10].
As our study included a sample of women without pre-existing major clinical conditions (e.g. diabetes, hypertension, severe anemia and multiple comorbidities) as risk factors for postpregnancy infections, we mainly analyzed and discussed factors correlated with patient care and management, such as timing of showering and shaving before CS, labor before CS, type of CS (emergency/urgency vs planned), duration of operation longer than one hour.
Uni and multivariate analysis have been performed in order to detect the association between these risk factors and SSI or endometritis.
Descriptive data are shown as absolute and/or relative frequencies of the different modalities for categorical data and as mean ± SD or median and range for continuous variables.
For all tests the significance level was set at $\alpha = 0.05$
Data were then entered onto an Excel spreadsheet and processed using Stata version 9.2.

Results

Between April and September 2005, the questionnaires of the 430 women recruited into the study were compiled.
Table I summarizes the main characteristics of the sample and of the interventions.
A vaginal swab for detection of *Streptococcus* at 35 weeks gestation was performed in 267 (62%) cases: 226 (84.6%) tested negative. The pathogens identified in the 41 positive cases were *Streptococcus B* (n = 40), and *Ureaplasma* (n = 1); a second microorganism was detected in 2 cases in addition to *Streptococcus B* (*Gardnerella* and *Ureaplasma*).
Data on characteristics of the amniotic fluid were available for 397 women, in 42 (10.6%) of which the result was "abnormal" (= alteration of amniotic fluid volume, colour and/or smell), with a 40.5% prevalence of meconium-tinted fluid.

Intervention

The most frequent indications for CS are shown in Table I. Previous CS was the only motivation for intervention in 103 cases (24% of the total); however, taking only the 152 women who had had a CS, the proportion of this indication rises to 67.8%. Of the 129 cases with a fetal indication for intervention, in 47.3% (61 cases) the cause was abnormal cardiotocography (CTG). Among maternal indications, maternal dystocia accounted for 16.4%.
Caesarean section was performed in 130 (30.2%) women (93% emergency/urgency cases) during labor. Spontaneous labor occurred in 66 (50.8%) of these women and was induced in the remaining cases, mainly by prostaglandin administration (41/64 = 64%). In 12 women with previous CS, labor was spontaneous in 11 and induced in one.

Procedures and practices

Table I shows data about antibiotic prophylaxis that consisted of combined ampicillin + sulbactam, as indicated by the hospital protocol, and the timing of its administration.
Table II lists the other procedures (showering and shaving) and the comparison between the hospital protocol and the literature guidelines recommendations.
Coherent with the hospital protocol, nearly all women (98.8%) received iodine povidone for skin preparation.
The average LOS was 4.7 days. The mean period of time between the operation and suture removal was 6 days.

Tab. I. Characteristics of the sample,of the interventions and of antibiotic prophylaxis. Number of women and percentage (%) if no otherwise stated.

Characteristics		
Age (mean ± SD)		33 ± 5
Years of schooling (mean ± SD)		12.6 ± 4
Number of previous CS		
	0	278 (64.7)
	1	126 (29.3)
	2	26 (6.0)
Type of CS		
	Planned	226 (52.6)
	Emergency/urgency	201 (46.7)
	Missing	3 (0.7)
Indications for CS		
	Fetal indication	129 (30.0)
	Previous CS	115 (26.7)
	Maternal indication	108 (25.1)
	Podalic presentation	47 (11.0)
	Twin birth	25 (5.8)
	Maternal request	4 (0.9)
	Unknown	2 (0.5)
Antibiotic prophylaxis		402 (93.5)
Timing of antibiotic prophylaxis		
	< 1 h before / during intervention	387 (96.3)
	> 1 h before intervention or evening before	11 (2.7)
	Missing	4 (1.0)
Type of incision		
	Pfannenstiel	411 (95.6)
	Stark	5 (1.2)
	Missing	14 (3.2)

Tab. II. Comparison between preoperative practices, hospital protocol indications and international guideline recommendations.

Showering: 351/430 (81.6%)			
Showering: practices (data available for 346 women)			
346 women	Shortly before (7.2%)	Same day (24.9%)	Evening before (67.9%)
Home (n=234)	6 (2.6%)	58 (24.8%)	170 (72.6%)
Ward (n=112)	19 (17%)	28 (25%)	65 (58%)
Showering: International guideline recommendations		**Showering: Hospital protocol**	
Showering with an antiseptic the evening before the operation (CDC, Rec. I B)		No indication	
Shaving: 423/430 (98.4%)			
Shaving: practices (data available for 418 women)			
418 women	Shortly before (80.1%)	Same day (2.2%)	Evening before (17.7%)
Clipper (n = 1)	–	–	1 (100%)
Cream (n = 2)	–	–	2 (100%)
Disposable razor (n = 408)	335 (82.1%)	9 (2.2%)	64 (15.7%)
Other (n = 7)	–	–	7 (100%)
Shaving: International guideline recommendations		**Shaving: Hospital protocol**	
Do not shave (CDC, Rec. I A) If necessary, with electric razor just before operation (CDC, Rec. I A) Insufficient evidence to recommend perineal shaving (NICE, 2004)		Shaving in planned and emergency/urgency caesarean sections shortly before the operation	

Surgical site infection and endometritis

Surgical site infection developed in three women during their stay in hospital; 17 additional infections (85%) were reported by follow-up telephone call-up within 30 days post-discharge. The overall rate of infection was 4.7% (20/430). No cases of endometritis were noted during stay in hospital or in the 30 days after discharge.

Telephone call-up

The telephone call-up disclosed that in 10% of cases (43 women) wound problems developed chiefly at home (38/43 = 88.4%) after discharge. Pain and swelling were the most frequent complaints for which 18.6% of the women sought medical advice from a private gynecologist and 51.2% at the hospital. 256 women (59.5%) referred remission of pain within 1-14 days after delivery and 90 (20.9%) said they were able to take a shower within five days. Sutures were removed at the hospital in 92.5% of cases.

Risk factors and incidence of infection

We present in Table III the results of univariate analysis, as only one of the risk factors investigated was significantly associated with wound infection.

The time between membrane rupture and start of the operation was available for 112/199 (56.3%) women, six of which developed an SSI. This was the unique factor that correlated with SSI, as it resulted significantly longer in the women who developed the infection (p = 0.04).

Tab. III. Risk factors and occurrence of infection.

Risk factors	SSI group (n = 20)	No infection group (n = 410)	p-value
Abnormal amniotic fluid* (number of women and %)	1/18 (5.6)	41/379 (10.8)	n.s.
Positive vaginal swab* (number of women and %)	1/10 (10.0)	40/257 (15.6)	n.s.
Labor before CS (number of women and %)	5/20 (25.0)	125/410 (30.5)	n.s.
Emergency/urgency caesarean section* (number of women and %)	11/20 (55.0)	215/407 (52.8)	n.s.
Shower evening before operation* (number of women and %)	9/16 (56.3)	230/335 (68.7)	n.s.
Shaving evening before operation* (number of women and %)	3/20 (15.0)	71/400 (17.8)	n.s.
Time between membrane rupture and intervention (median and range)**	743.5 (164-1440)	306.5 (5-1816)	0.04
Duration of intervention (median and range)***	40 (20-60)	40 (10-225)	n.s.

*For these categorical variables denominators are different from those expected because data were not available for all women. **Data available for 6 of the women with SSI and 106 of the others. ***Data available for 14 of the women with SSI and 275 of the others.

Tab. IV. Incidence of SSI in relation to NNIS Index.

NNIS Index	Observed SSI Incidence (%) and 95% CI	Expected SSI Incidence (%)
0	4,3 (7/164) 95% CI 0 –12,4	2,71
1	5,3 (2/38) 95% CI 1,2 – 7,4	4,14
2	0/1 (0)	7,53

SSI denotes surgical site infection; NNIS National Nosocomial Infections Surveillance; CI confidence interval.

We could only calculate the National Nosocomial Infections Surveillance (NNIS) index for the 203 women (47.2%) for which data on risk class, ASA score and duration of the operation were available. Table IV shows the occurrence of SSIs stratified by risk category and expected incidence [11].

Discussion and conclusions

Several conclusions that can be drawn from the results of the study specifically concern the management of childbirth and the care procedures in women who underwent CS.

As concerns the occurrence of post-partum infections, 20 SSIs were detected, while no cases of endometritis were recorded during stay in hospital nor within 30 days after delivery according to telephone call-up findings. As zero endometritis was not the expected result, we compared this data with the treatment prescriptions referred by the women during the phone-up interview: only the SSI cases reported an antibiotic treatment after delivery, giving support to the finding of the study.

Confirming the importance of planning and implementing a post-discharge surveillance system was the finding that the majority (85%) of the 20 SSIs were disclosed by telephone call-up within 30 post-operative days. Very few would have been diagnosed if the surveillance period had been limited to stay in hospital. Not even the removal of suture clips seemed to be the right moment for planning an effective surveillance, as it occurred about 6 days after the operation, while the mean LOS was just under 5 days (4.7).

Moreover, as regards infection rate, while the global incidence (4.7%) did not diverge from that expected, SSI rates were higher when stratified by the NNIS index. However, we were able to calculate the NNIS index in less than 50% of cases. This is a limitation to our study and underscores the low quality of medical chart compilation, where often indispensable information for monitoring a specific situation and for drawing comparisons with the published data is missing.

An analysis of the risk factors for the occurrence of infection following CS showed that only the association between the time from membrane rupture to start of the operation and development of infection was statistically significant. None of the other risk factors (abnormal amniotic fluid, positive vaginal swab, labor – spontaneous or induced – before CS, urgent or emergency procedure, showering and shaving the evening before rather than just before the intervention, duration of operation > 1 h) were found to be associated with the development of infection.

Nevertheless, the results of our study revealed several discrepancies between guideline recommendations and local practices as regards SSI prevention and the use of CS.

Data about SSI prophylaxis showed several divergences from recommended guidelines owing in part to the current protocols in the hospital where the study was conducted. Preoperative showering, which the hospital protocol does not mention, was done by most women (82%), but, generally, the night before the operation, without an antiseptic.

Another practice the international recommendations discourage is shaving. The CDC guidelines advise not to shave at all or, if necessary, to shave using clipper just before the operation; the National Institute for Clinical Excellence, which studied the practice specifically in relation to CS, found no evidence for effective prevention of SSI [10, 13]. Our findings show that nearly all women (98.4%) were shaved with a disposable razor. This procedure is coherent with the hospital protocol that requires shaving for both planned and urgent CS. Closely conforming with CDC guidelines was timing of shaving: in 80% of cases shaving was done shortly before the operation. In 20% of women the timing was incorrect because they were shaved the evening before or the same day as the operation.

Although the hospital protocol does not make specific mention of skin preparation, coherent with CDC guidelines, iodine-povidone preparation was carried out in nearly all cases (98.8%).

In over 96% of cases, antibiotic prophylaxis was given within 1 hour before the start of the operation or during the intervention, as indicated in most international and national guidelines [12, 13]. Nevertheless, it remains a 2.7% of women who received antibiotic prophylaxis (against all guideline recommendations) more than 1 h before the operation or even the evening before.

As regards the use of CS, the study shows that 35.3% of the women of our sample had already delivered by CS. Among the indications for this intervention, a previous CS accounted for 25% of all cases and for 68% in the subgroup of women who had already undergone a CS, confirming the high probability that the woman will again undergo a CS for future childbirths. Previous CS was the most frequent indication also in women who had gone into labor; from the medical chart it could be deduced that in only 3/12 cases was the attempt made to have the woman deliver by spontaneous birth.

Lack of completeness of the clinical chart concerning indications for the operation made it difficult to evaluate the appropriateness of the other indications for the intervention. Only in a minority of cases was it possible to trace the choice of performing CS to indications published in the literature (podalic presentation, abnormal CTG, twin birth, placental abnormalities), rather than such generic information as “maternal indication” or

"fetal indication". Maternal request, which in the U.K. data in the NICE report accounts for 7% of indications for CS, was reported in only four (0.9%) cases in our series.
Another criticality regarding the medical chart was the definition of "urgency" or "emergency" of the intervention. The discrepancy between the chart entry and indication for CS made it impossible to identify the real proportion of CSs defined as "urgent" and "emergency" procedures by the literature [14].

Therefore, besides the discrepancies between guideline recommendations and local practices as regards the SSI prevention, the lack of a standardized system for reporting indications for CS in the clinical documentation make evaluation of an appropriate use of the procedure difficult. This should raise attention to the need to implement organizational, procedural and care and training interventions that would help health care givers in making appropriate choices based on evidence of efficacy for indicating CS and in its management.

References

[1] Di Lallo D. *Appunti sul taglio cesareo*. Tendenze Nuove 2005;3:329-33.

[2] National Collaborating Centre for Women's and Children's Health. *Caesarean Section. Clinical Guideline*. London: RCOG Press 2004.

[3] Childbirth Connection. *What Every Pregnant Woman Needs to Know About Cesarean Section*. Second Edition, revised. New York: Childbirth Connection 2006.

[4] Zelop C, Heffner LJ. *The Downside of Cesarean Delivery: Short- and Long-Term Complications*. Clin Obstet Gynecol. 2004;47:386-93.

[5] Chaim W, Bashiri A, Bar-David J, Shoham-Vardi I, Mazor M. *Prevalence and Clinical Significance of Postpartum Endometritis and Wound Infection*. Infect Dis Obstet Gynecol 2000;8:77-82.

[6] Liu S, Liston RM, Joseph KS, Heaman M, Sauve R, Kramer MS and for the Maternal Health Study Group of the Canadian Perinatal Surveillance System. *Maternal mortality and severe morbidity associated with low-risk planned cesarean delivery versus planned vaginal delivery at term.* Can Med Ass J 2007;176:455-60.

[7] Tharpe N. *Postpregnancy Genital Tract and Wound Infections.* J Midwifery Womens Health 2008;53:236-46.

[8] Yokoe DS, Christiansen CL, Johnson R, Johnson R, Sands KE, Livingston J, et al. *Epidemiology of and Surveillance for Postpartum Infections*. Emerg Infect Dis 2001;7:837-41.

[9] Noy D, Creedy D. *Postdischarge surveillance of surgical site infections: a multi-method approach to data collection*. Am J Infect Control 2002;30:417-24.

[10] Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. *Guideline for Prevention of Surgical Site Infection, 1999*. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control 1999;27:97-132.

[11] National Nosocomial Infections Surveillance (NNIS). *System report, data summary from January 1992 through June 2004, issued October 2004*. Am J Infect Control 2004;32:470-85.

[12] National Institute for Clinical Excellence. *Caesarean section*. April 2004. Available from: http://www.nice.org.uk/nicemedia/pdf/CG013fullguideline.pdf [Last access: March 2009].

[13] Piano Nazionale Linee Guida (PNLG). *Antibioticoprofilassi perioperatoria nell'adulto. 2003*. [Italian] Available from: http://www.snlg-iss.it/cms/files/PNLG_antib_impa.pdf [Last access: March 2009].

[14] Lucas DN, Yentis SM, Kinsella SM, Holdcroft A, May AE, Wee M, et al. *Urgency of caesarean section: a new classification*. J R Soc Med. 2000;93:346-50.

■ Received on July 6, 2009. Accepted on August 27, 2009.

■ Acknowledgements: We wish to thank R. Accorrà, M.P. Cossu, G. Guareschi and F. Pastorino for their contribution to the study, and Kenneth Britsch for the translation of this paper.
Details of ethics approval
The S. Anna Hospital Ethics Committee approved the study (prot. N. 67/04).
Funding
This study was performed with a Grant of Piemonte Region n. 396 (2003-2005) "Le infezioni chirurgiche nel post-parto: studio di incidenza su parti cesarei e parti vaginali" (Post-partum infections: cohort studies for caesarean and vaginal deliveries).

■ Correspondence: Lorena Charrier, Dept. of Public Health and Microbiology, via Santena 5 bis, 10126 Turin, Italy - Tel. +39 011 670 5838 - Fax +39 011 236 5838 - E-mail: lorena.charrier@unito.it