International Journal of Gynecology & Obstetrics 73 (2001) 141–145

International Journal of GYNECOLOGY & OBSTETRICS

www.elsevier.com/locate/ijgo

Special article

An international survey of practice variation in the use of antibiotic prophylaxis in cesarean section

W.C. Huskins[a,*], K. Ba-Thike[b], M.R. Festin[c], S. Limpongsanurak[d], P. Lumbiganon[e], A. Peedicayil[f], M. Purwar[g], S. Shenoy[h], D.A. Goldmann[i], J.E. Tolosa[j], Global Network for Perinatal and Reproductive Health[j]

[a] *Mayo Medical School, Rochester, MN, USA*
[b] *Institute of Medicine, Yangon, Myanmar*
[c] *University of the Philippines, Manila, Philippines*
[d] *Chulalongkorn University, Bangkok, Thailand*
[e] *Khon Kaen University, Khon Kaen, Thailand*
[f] *Christian Medical College and Hospital, Vellore, India*
[g] *Government Medical College, Nagpur, India*
[h] *Medical College, Trivandrum, India*
[i] *Harvard Medical School, Boston, MA, USA*
[j] *Thomas Jefferson University, Philadelphia, PA, USA*

Received 25 September 2000; received in revised form 3 January 2001; accepted 10 January 2001

Abstract

Objective: To examine the use of antibiotic prophylaxis in cesarean section in different countries and in relation to a reference regimen. *Method:* Fifty consecutive cesarean sections performed in eight centers in five countries were surveyed. Data from each center were compared to a regimen recommended by the Cochrane Collaboration (one dose of ampicillin or cefazolin administered to all women shortly before the procedure or immediately after cord clamping) using logistic regression with adjustment for procedure type. *Result:* Prophylaxis was used widely, but only four centers administered prophylaxis to all women. Ampicillin and cefazolin were the principal antibiotics used, but broad-spectrum agents and multidrug regimens were also used commonly. Only two centers reliably administered the

* Corresponding author. Division of Pediatric Infectious Diseases, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA. Tel.: +1-507-255-8464; fax: +1-507-255-7767.
E-mail address: huskins.charles@mayo.edu (W.C. Huskins).

PII: S0020-7292(01)00365-4

antibiotic at the appropriate time. The majority of women received only one dose of antibiotic in only three centers. *Conclusion:* The use of antibiotic prophylaxis in cesarean section was variable and often at odds with published recommendations.

Keywords: Cesarean section; Antibiotic prophylaxis; Physician's practice patterns

1. Introduction

Endometritis and wound infection are common, potentially life-threatening complications of cesarean sections [1].

In 1999, the Cochrane Collaboration published two systematic reviews examining the efficacy of antibiotic prophylaxis in preventing infections after a cesarean section [2,3]. One review examined the efficacy of prophylaxis in elective and non-elective procedures, and concluded that prophylaxis has a strong protective effect for all types of cesarean section [2]. The other review examined specific prophylaxis regimens, and concluded that cefazolin and ampicillin — administered as a single dose — were equally efficacious [3]. Broader spectrum antibiotics, multi-drug regimens, and administration of more than one dose were not demonstrated to be more efficacious. There were insufficient data to determine the optimal timing of antibiotic administration (i.e. preoperative administration vs. administration after the umbilical cord is clamped), although a study of non-obstetric surgical procedures demonstrated that prophylaxis was most effective when administered within 2 h of the start of the procedure [4].

The objective of this study was to examine the use of antibiotic prophylaxis in cesarean section in diverse international settings and in relation to the regimen recommended by the Cochrane Collaboration.

2. Materials and methods

Eight university-affiliated, referral obstetric centers participating in the Global Network for Perinatal and Reproductive Health took part in the study, including centers in The Philippines, Thailand, India, Myanmar and the USA. None of the centers had a written protocol for prophylaxis. Data on the use of antibiotic prophylaxis in 50 consecutive cesarean sections were collected using a standardized form. Data included: the date and time of delivery; elective (i.e. no labor or rupture of membranes) vs. non-elective procedure; antibiotic treatment before delivery for other indications; prophylactic antibiotic(s) used, dose, route, and time of administration; total number of prophylactic antibiotic doses administered. Data forms were reviewed by the investigator at each center and analyzed at a central location. The analyses were reported to each investigator confidentially, who confirmed their accuracy.

To compare results among the centers, logistic regression was performed on the entire set of 400 records using SPSS for Windows (version 9.0, SPSS Inc, Chicago, IL, USA). Separate models were constructed for the following dependent variables: receipt of antibiotics before delivery for other indications; receipt of antimicrobial prophylaxis; receipt of the antibiotic within a period from 2 h before to 30 min after the time of birth; receipt of one dose of prophylaxis. Dummy variables for the centers were included in each model as independent variables. A variable for procedure type (i.e. elective vs. non-elective) was included to as an adjustment for case-mix. Center B was used as the reference hospital in this analysis because the use of prophylaxis in this center (i.e. the percentage of women receiving prophylaxis, the percentage of women receiving the antibiotic within a period from 2 h before to 30 min after the time of birth, and the percentage receiving one dose of prophylaxis) corresponded most closely to the regimen recommended by the Cochrane Collaboration (Table 1 and Fig. 1). Center B used antibiotics other than ampicillin or cefazolin for prophylaxis (Table 1), but these

Table 1
Use of antibiotic prophylaxis in cesarean sections in eight university obstetric centers in five countries[a]

	Obstetric center							
	A	B	C	D	E	F	G	H
% of CS in which women received antibiotic treatment before delivery for indications other than prophylaxis[b]	0	10%	16%	24%[d]	4%	0	56%[d]	42%[d]
% of CS in which prophylaxis was administered[c]	78%	100%	100%	74%	100%	94%	100%	21%
Antibiotics utilized for prophylaxis (% of regimens)								
Ampicillin	67%	6%	0	0	2%	98%	68%	83%
Ampicillin plus gentamicin or metronidazole	0	2%	98%	0	2%	0	0	0
Ampicillin/clavulanate	0	11%	0	0	0	0	0	0
Cefazolin	33%	0	0	89%	88%	0	32%	0
Cefuroxime	0	31%	0	0	0	0	0	0
Cefoxitin	0	49%	0	0	0	0	0	0
Clindamycin	0	0	0	7%	0	0	0	0
Other	0	0	2%	4%	8%	2%	0	17%
% of regimens in which only 1 antibiotic dose was administered	69%	89%	0[d]	86%	2%[d]	2%[d]	0[d]	17%[d]

[a] CS, cesarean section.
[b] Fifty consecutive procedures were examined. Procedures in which an antibiotic was administered before delivery for indications other than prophylaxis were excluded from further analyses reported in the table.
[c] The numbers of procedures analyzed in each center were: A 50, B 45, C 42, D 38, E 48, F 50, G 22, H 29.
[d] $P < 0.05$ compared to Hospital B.

antibiotics are as effective, although more expensive, than those recommended by the Cochrane Collaboration [3]. The antibiotics used for prophylaxis were not analyzed by logistic regression because the diversity of antibiotics in use did not lend itself to this type of analysis.

3. Results

Non-elective cesarean sections comprised the majority of procedures in all of the centers (median 74%, range 68–94%). The percentage of women who received antibiotic treatment prior to delivery for indications other than prophylaxis varied widely (Table 1), and was significantly more common in centers D ($P = 0.028$), G ($P < 0.001$), and H ($P < 0.001$). These women were excluded from further analyses.

Antibiotic prophylaxis was administered in the majority of cesarean sections in seven centers (Table 1), but only four centers (B, C, E and G) administered prophylaxis for all procedures. There was no difference in the utilization of prophylaxis among the centers, either with or without adjustment for the type of procedure. A variety of antibiotics were used for prophylaxis, although most regimens included either ampicillin or a first- or second-generation cephalosporin (Table 1). The time interval between delivery and administration of the antibiotic was highly variable (Fig. 1). Three centers (F, G, H) usually administered the antibiotic before delivery and five (A–E) usually administered it after delivery. Only two centers (D, H) administered the antibiotic within the period of time ranging from 2 h before delivery to 30 min after delivery in $\geq 95\%$ of procedures. Significantly more women were administered the antibiotic outside this period in centers C ($P < 0.001$), F ($P = 0.005$), and G ($P = 0.011$). In three centers (A, B, D), the majority of women received only one dose of antibiotic (Table 1). Significantly more women received more than one dose in centers C ($P < 0.001$), E ($P < 0.001$), F ($P < 0.001$), G ($P < 0.001$), and H ($P = 0.009$). Prophylaxis was continued for approximately 5 days in center G and 9 days in center C.

There were no consistent patterns of use among

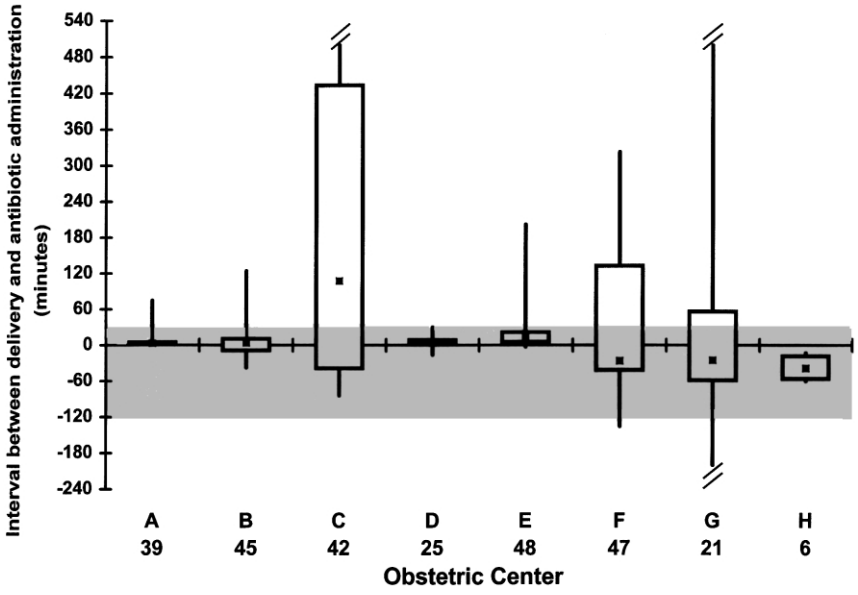

Fig. 1. Distribution of the interval of time between delivery and administration of antibiotic prophylaxis in cesarean section in eight university obstetric centers in five countries. The number of cesarean sections for which the interval could be calculated is indicated below the letter code for each center. Negative values indicate prophylaxis was administered before the delivery; positive values indicate prophylaxis was given after the delivery. Boxplots of the distribution of the interval (in minutes) indicate the following: the solid square (■) represents the 50th percentile (median). The lower and upper bounds of the open vertical rectangle (□) represent the 25th and 75th percentiles, respectively. The lower and upper bounds of the lines extending above and below the open vertical rectangle represent the 5th and 95th percentiles, respectively. The shaded region represents a period from 2 h (120 min) before delivery to 30 min after delivery. Significantly more women were administered the antibiotic outside this period in centers C ($P < 0.001$), F ($P = 0.005$), and G ($P = 0.011$).

centers within the same country, except that all of the centers in India used more than one dose of prophylaxis.

4. Discussion

This survey found substantial variation in the use of antibiotic prophylaxis in cesarean section among eight university-affiliated, referral obstetric centers in diverse international settings. Compared to the regimen recommended by the Cochrane Collaboration, prophylaxis was underused (e.g. prophylaxis was not administered to all women), over-used (e.g. unnecessarily broad-spectrum agents were used, > 1 dose of antibiotic was administered), and mis-used (e.g. administered either before or long after a period during which it is likely to be efficacious). Although hospital costs were not quantified, regimens using a second-generation cephalosporin, multiple antibiotics, or multiple doses are likely to have increased the cost of prophylaxis unnecessarily.

Each center identified at least one area for improvement that can be expected to reduce the incidence of postcesarean infection, reduce the cost of care, or decrease antibiotic pressure that leads to the development of antimicrobial resistance. The network is currently implementing a multi-center intervention to improve the use of prophylaxis based on a successful model conducted in Colombian hospitals [5]. The intervention will include an educational module, evaluation and improvement of the system for prescribing and administering prophylaxis in each center using standard quality improvement tools, and repeat surveys to evaluate the impact of the intervention. Systems improvements are necessary because current systems are likely to contain administrative and logistical barriers to improvement.

For example, in Colombia, delay in administering the antibiotic was caused by the fact that the antibiotic was not available when it was needed [5]. One hospital reduced this delay dramatically by including a vial of antibiotic in the packet of surgical supplies that accompanied the woman to the cesarean delivery room. In another hospital, a small supply of antibiotic was maintained in the operating room specifically for this purpose.

The study demonstrates that simple quantitative surveys can be used to benchmark critical components of patient care and identify areas for improvement in diverse international settings. This approach could be used to conduct multi-institutional surveys of other well-defined prophylaxis regimens, such as regimens to prevent perinatal transmission of group B streptococcal, hepatitis B virus, and human immunodeficiency virus infection.

Acknowledgments

The authors would like to thank the following persons for their assistance in completing this study: Dr Jadsada Thinkhamrop, Khon Kaen University; Michelle DiVito and Kim Fuller, Thomas Jefferson University. The Global Network for Perinatal and Reproductive Health is supported in part by grants awarded by the Rockefeller Foundation, the International Clinical Epidemiology Network (INCLEN) and Thomas Jefferson University.

References

[1] Cunningham FG. Infectious diseases and the puerperium. In: Cunningham FG, Gant NF, McDonald PC, Gilstrap LC, Leveno K, Hankins G, Clark SL, editors. Williams Obstetrics. 20th ed. Stamford, CT: Appleton & Lange, 1997:547–567.

[2] Smaill F, Hofmeyr GJ. Antibiotic prophylaxis for cesarean section (Cochrane review). The Cochrane Library, 1999:2.

[3] Hopkins L, Smaill F. Antibiotic prophylaxis regimens and drugs for cesarean section (Cochrane review). The Cochrane Library, 1999:2.

[4] Classen DC, Evans RS, Pestotnik SI, Horn SD, Menlove RL, Burke JP. The timing of prophylactic administration of antibiotics and the risk of surgical wound infection. N Engl J Med 1992;326:281–286.

[5] Weinberg M, Fuentes JM, Ruiz AI, Lozano FW, Angel E, Gaitan H, et al. Reducing infections among women undergoing cesarean section in Colombia using continuous quality improvement methods. Arch Int Med (in press).