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Original Article

Impact of clinical audits on cesarean section rate

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ABSTRACT

Objective: Many countries have noted a substantial increase in the cesarean section rate (CSR). Several methods for lowering the CSR have been described. Understanding the impact of clinical audits on the CSR may aid in lowering CSR. Thus, our aim is to elucidate the effect of clinical audits on the CSR.
Materials and Methods: We retrospectively analyzed 3781 pregnant women who gave birth in a medical center between January 2008 and January 2011. Pregnant women who delivered between January 2008 and July 2009 were enrolled as the pre-audit group ($n = 1592$). After August 2009, all cesarean section cases that were audited were enrolled in the audit group ($n = 2189$). The CSR was compared between groups.
Results: The overall CSR (34.5% vs. 31.1%, adjusted odds ratio [OR] = 0.83, $p = 0.008$) and the cesarean section rate due to dystocia (9.6% vs. 6.2%, $p < 0.001$) were significantly lower in the audit group than the pre-audit group. However, there was no significant difference in the rate of operative vaginal delivery between groups. Consensus on the unnecessity for cesarean section was achieved in 16 (8.2%) of 195 audit cases in the monthly audit conference. In nulliparous pregnant women ($n = 2148$), multivariate analysis revealed that clinical audit (OR = 0.78), maternal age (OR = 1.10), gestational age at delivery (OR = 0.80), and fetal body weight at birth (OR = 1.0005) were independent predictors of cesarean section (all $p < 0.05$). Most variables of maternal and perinatal morbidity and mortality did not differ before and after audits were implemented.
Conclusion: Clinical audits appear to be an effective strategy for reducing the CSR. Therefore, we recommend strict monitoring of the indications in dystocia for cesarean section to reduce the CSR.

Introduction

The World Health Organization recommends an optimal cesarean section rate (CSR) of no more than 15% [1]. Although a higher rate is not considered beneficial for public health, many countries have noted a substantial increase in the CSR [2–5]. Although the reasons for this increase are unclear, the increase in maternal age, maternal requests, and fears of litigation are implicated [2,6].

Several methods for lowering the CSR have been described, including audits and feedback, quality improvement, and multifaceted programs [7]. In one meta-analysis study, the CSR was only reduced by 13% using audit and feedback alone; however, the CSR decreased by 27% when audit and feedback were part of a multifaceted strategy [7]. Multifaceted strategy included practice guidelines, active management of labor, corrective measures when guidelines are not followed, hospital payment, malpractice reform, and confidential provider feedback [7–9].

Accordingly, the Taiwanese government closely monitors the CSR of each hospital in Taiwan in the interest of public health. In 2009, in response to an increase in the CSR in our hospital, we decided to perform clinical audits to review the indications for each cesarean section (CS). Therefore, this retrospective analysis aimed

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to evaluate the effect of clinical audits on the CSR and determine the factors influencing the procedure rate.

Materials and methods

We retrospectively studied all pregnant women who delivered in the Department of Obstetrics & Gynecology of Far Eastern Memorial Hospital between January 2008 and January 2011. The Research Ethics Committee of Far Eastern Memorial Hospital approved this study

The clinical histories of all patients were obtained by medical record review. The patients included in this study gave birth under the supervision of eight obstetricians who worked in the hospital during the study period.

Monthly clinical audits and feedback on CS cases were implemented in August 2009. Thereafter, all CS cases were briefly audited in triweekly obstetric morning meetings. Cases with ambiguous CS indications were reviewed in greater detail during the monthly CSR audit conference to determine whether or not CS was appropriate. Consensus on the indication for CS was reached by all eight members of the obstetric staff participating in the audit conference on the basis of the following specific criteria. Dystocia was defined as cervical os dilatation ≥ 4 cm, arrest of dilation for at least 2 hours, and well-forced uterine contractions [10,11] during the study period. However, we used the criteria of cervical os dilatation ≥ 6 cm [12] and arrest of dilatation for at least 3 hours in the CSR audit starting in 2014 (i.e., not in the study period). Periodic fetal heart beat monitoring was used in cases of low-risk pregnancy. Fetal distress was defined as clinically significant prolonged variable deceleration (i.e., deceleration of fetal heart rate < 70 beats/min lasting > 2 minutes [13,14]) or late deceleration of fetal heart beat as demonstrated by cardiotocography. Most obstetricians in our institute opted to monitor the fetal heartbeat pattern carefully if only one episode of prolonged variable deceleration occurred. If prolonged variable decelerations frequently recurred, we performed a CS or an interventional delivery such as vacuum-assisted delivery.

The criterion for routine labor induction was gestational age > 41 weeks in low-risk women [15,16]. In our hospital, prenatal outpatient visits were undertaken every week after 36 gestational weeks. In addition, we asked pregnant women to count daily fetal movements during the near- and post-term periods [17]. To screen high-risk women in postterm pregnancy, fetal ultrasonography, nonstress testing, biophysical profile studies, or umbilical waveform studies were performed as indicated. Clinical audit records were submitted to the hospital president every month. All obstetric staff members received the audit record after the meeting.

We used the nonparametric Wilcoxon rank–sum test or the Chi-square test where appropriate. Univariate logistic regression analysis was used to analyze the effect of clinical audit on the CSR. Backward stepwise multivariate logistic regression analysis including all variables showing $p < 0.05$ in univariate analysis was performed to analyze the effects of individual variables on the CSR [18]. STATA version 11.0 (Stata Corp., College Station, TX, USA) was used for the statistical analysis. The level of significance was set at $p < 0.05$.

Results

A total of 3781 pregnant women who gave birth under the supervision of a staff obstetrician were included. Among them, 1592 patients gave birth before (pre-audit group) and 2189 patients gave birth after auditing was implemented (audit group). The baseline clinical data of the groups are summarized in Table 1. Maternal age and gestation weeks at delivery differed significantly between the two groups.

Table 1
Baseline demographic data before and after the implementation of clinical cesarean section audits.

Variable	Before audit ($n = 1592$)	After audit ($n = 2189$)	p[a]
Maternal age (y)	30.5 ± 4.4	31.2 ± 4.2	<0.001
Parity	1.5 ± 0.7	1.5 ± 0.7	0.37
Birth body weight (g)	3081 ± 555	3066 ± 529	0.09
Gestational age (wk)	38.3 ± 2.2	38.4 ± 2.2	0.049
Taiwanese mothers	96.3	96.3	0.99
Male infants	53.7	50.8	0.08

Data are expressed as mean ± standard deviation or %.
[a] Wilcoxon rank–sum test or Chi-square test.

The CSRs and indications for CS of the two groups are shown in Table 2. The CSR was significantly lower in the audit (31.1%) than in the pre-audit group [34.5%, odds ratio (OR) = 0.85, 95% confidence interval (CI) = 0.74–0.97, $p = 0.02$; Table 2]. After adjusting for maternal age and gestation weeks at delivery, clinical audit remained an independent predictor of CS (OR = 0.83, 95% CI = 0.72–0.95, $p = 0.008$).

The CSR in cases with dystocia was also significantly lower after auditing was implemented [9.6% (pre-audit) vs. 6.2% (audit), $p < 0.001$; Table 2].

Among all CS cases ($n = 680$), 195 cases were reviewed in greater detail during the monthly clinical audit conferences. Consensus on the unnecessity of CS was achieved in 16 (8.2%) of 195 patients. Among them, nine women, six women, and one woman were diagnosed as induction failure, arrest of labor, and variable deceleration, respectively.

Of the 3781 women reviewed, 2148 (56.8%) were nulliparous. In nulliparous pregnant women ($n = 2148$, Table 3), multivariate analysis revealed that clinical audit (OR = 0.78, 95% CI = 0.65–0.95, $p = 0.01$), advanced maternal age (OR = 1.10, 95% CI = 1.08–1.13, $p < 0.001$), later gestational age at delivery (OR = 0.80, 95% CI = 0.75–0.85, $p < 0.01$), and high fetal body weight at birth (OR = 1.0005, 95% CI = 1.0003–1.0007, $p < 0.001$) were independent predictors of CS (Table 3).

The prevalence of hyperbilirubinemia decreased significantly after the implementation of clinical CS audits (24.6% vs. 16.4%, $p < 0.001$). However, no other variables of maternal or perinatal morbidity or mortality differed before and after the implementation of clinical CS audits (Table 4).

Discussion

The present study revealed that clinical audits significantly reduced the CSR. Despite the small decrease, this can be viewed as a success. Similarly, the meta-analysis of Chaillet et al [7] revealed that audits and feedback effectively reduced the CSR, with a pooled risk ratio of 0.87. This reduction in CSR is believed to be partly attributable to the Hawthorne effect, which is the human tendency to improve performance because of the awareness of being studied [19,20]. Scarella et al [21] also reported a decrease in the CSR when audits were implemented. Thus, the present study provides evidence that audits decrease the CSR.

Among all indications for CS, only dystocia was associated with a decreased CSR in the present study. Mohammadi et al [11] reported that the CSR decreased from 40% to 33% particularly because of indications of dystocia, fetal distress, and selective CS. Meanwhile, Liang et al [10] reported that the CSR decreased from 37.0% to 30.7% owing to dystocia. These findings collectively suggest that dystocia

Table 2
Indications for cesarean section prior to and after the implementation of clinical cesarean section audits.

Variables	Before audit ($n = 1592$)	After audit ($n = 2189$)	Odds ratio (95% CI)	p[a]
CSR	34.5	31.1%	0.85 (0.74–0.97)	0.02
Indications for CS				
Dystocia	9.6	6.2	0.63 (0.49–0.80)	<0.001
Previous CS	9.2	9.8	1.07 (0.86–1.34)	0.53
Noncephalic pregnancy	5.4	4.3	0.79 (0.58–1.06)	0.12
Fetal distress	2.4	2.0	0.84 (0.54–1.30)	0.43
Elective CS	1.8	2.1	1.16 (0.72–1.85)	0.54
Multiple pregnancy	1.4	1.8	1.33 (0.79–2.24)	0.29
Severe preeclampsia/eclampsia	0.9	0.6	0.62 (0.29–1.35)	0.23
Other indications	2.2	2.0	0.89 (0.57–1.40)	0.62
Operative vaginal delivery	10.7	10.6	0.99 (0.80–1.22)	0.92
1-min Apgar score	7.8 ± 1.1	7.8 ± 1.0	1.60 (0.76–3.37)	0.22

Data are expressed as mean ± standard deviation or %, unless otherwise indicated.
CI = confidence interval; CS = cesarean section; CSR = cesarean section rate.
[a] Univariate logistic regression analyzing the effect of audits.

Table 3
Predictors of cesarean section in nulliparous pregnant women ($n = 2148$).

Variable	Audit implementation		Univariate analysis			Multivariate analysis[c]		
	Before ($n = 926$)	After ($n = 1222$)	OR	95% CI	p[a]	OR	95% CI	p[b]
Cesarean section rate	34.0%	28.9%	—	—	—	—	—	—
Clinical audit	—	—	0.79	0.66–0.95	0.01	0.78	0.65–0.95	0.01
Maternal age (y)	29.7 ± 4.3	30.2 ± 4.2	1.10	1.07–1.12	<0.001	1.10	1.08–1.13	<0.001
GA at delivery (wk)	38.4 ± 2.2	38.6 ± 2.2	0.88	0.84–0.91	<0.001	0.80	0.75–0.85	<0.01
Body weight at birth (g)	3071 ± 563	3041 ± 535	1.00	0.99–1.00	0.18	1.0005	1.0003–1.0007	<0.001
Percentage of Taiwanese mothers	96.7	96.0	1.46	0.86–2.46	0.16	—	—	—
Percentage of male infants	52.6	49.6	1.10	0.92–1.32	0.31	—	—	—

Data are expressed as mean ± standard deviation or %, unless otherwise indicated.
CI = confidence interval; GA = gestational age; OR = odds ratio.
[a] Univariate logistic regression analysis analyzing the effect of each variable on the cesarean section rate.
[b] Backward stepwise multivariate logistic regression analysis.
[c] $R^2 = 0.05$.

is an important factor responsible for the audit-related decrease in the CSR.

In the present study, induction failure was the factor on which consensus on the unnecessity of CS was most frequently reached.

Table 4
Maternal and perinatal morbidity and mortality before and after the implementation of clinical cesarean section audits.

	Before audits (n)	After audits (n)	p[d]
Mothers	1592	2189	
Death	0	0	—
Maternal morbidity	9[a]	8[b]	0.46
Fetuses/Neonates	1609	2223	
Deaths[c]	15	13	0.25
Meconium aspiration syndrome	19	45	0.06
Respiratory distress	154	216	0.91
Hyperbilirubinemia	396	366	<0.001
Pneumonia	2	6	0.48
Grades 3 & 4 intraventricular hemorrhage	2	2	1.00
Cephalohematoma	3	4	1.00
Clavicle fracture	3	6	0.74
Brachial plexus injury	1	1	1.00

[a] Postpartum hemorrhage ($n = 2$), cerebral aneurysm rupture ($n = 2$), vulvovaginal hematoma ($n = 2$), acute respiratory distress ($n = 1$), pneumothorax ($n = 1$), and bladder rupture ($n = 1$).
[b] Postpartum hemorrhage ($n = 5$), cortical blindness ($n = 1$), cervical laceration ($n = 1$), and voiding difficulty ($n = 1$).
[c] Death included fetal death, stillbirth, and neonatal death immediately after delivery.
[d] Chi-square or Fisher's exact tests.

Sheikh et al [22] report that a reduction in the primary CSR was noted in cases of induced labor after the implementation of the guidelines. Scarella et al [21] also found that induced labor for nulliparous women was one of the most important populations responsible for the decrease in the CSR after the audit. McCarthy et al [23] also recommended focusing on the care of nulliparous women with single cephalic fetus at ≥ 37 weeks' gestation, in spontaneous or induced labor, or those undergoing elective CS to reduce the CSR. In nulliparous cases, the CSR is much higher in cases of induced labor than in cases of spontaneous labor [24]. Thus, induced labor appears to be an important factor affecting the CSR.

In their retrospective study, Cheng et al [25] reported that compared to delivery at a later gestational age, those induced at 39 weeks have a lower risk of CS. Nonetheless, Clark et al [26] reported that elective delivery prior to a gestational age of 39 weeks is inappropriate. In addition, our analysis shows that later gestational age at delivery was actually associated with a reduced need for CS (Table 3) and that induction failure was an important cause of unnecessity of CS according to our monthly audits. Therefore, strict monitoring of the criterion of labor induction is an important strategy for reducing the CSR.

Furthermore, maternal age and birth body weight were independently associated with an increased CSR (Table 3). Vrouenraets et al [27] reported that women aged ≥ 30 years and birth weight ≥ 3500 g are significantly associated with an increased CSR. In addition, Bereczky et al [28] reported that in women aged ≥ 35 years, the CSR increases from 46.3% to 51.0% and the incidence of comorbidities and pregnancy-related complications is higher.

We did not observe any increase in maternal or perinatal morbidity or mortality prior to and after the implementation of

clinical CS audits (Table 4). This finding supports the implementation of audits for CS.

Even though encouraging women to consider and choose vaginal birth after CS over repeat elective CS may help reduce the CSR [29,30], this approach might be hindered by the fear of litigation and maternal requests.

The major limitation of this study is its retrospective nature, which may have biased the results. Nevertheless, the large sample size increases the reliability of the results.

In conclusion, clinical audits appear to be an effective strategy for reducing the CSR. Strict monitoring of the indications for CS in dystocia may have the strongest influence on the CSR.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

References

[1] World Health Organization. Appropriate technology for birth. Lancet 1985;2:436–7.
[2] Caesarean section on the rise. Lancet 2000 Nov 18;356(9243):1697.
[3] Charoenboon C, Srisupundit K, Tongsong T. Rise in cesarean section rate over a 20-year period in a public sector hospital in northern Thailand. Arch Gynecol Obstet 2013;287:47–52.
[4] Tampakoudis P, Assimakopoulos E, Grimbizis G, Zafrakas M, Tampakoudis G, Mantalenakis S, et al. Cesarean section rates and indications in Greece: data from a 24-year period in a teaching hospital. Clin Exp Obstet Gynecol 2004;31:289–92.
[5] Khawaja M, Jurdi R, Kabakian-Khasholian T. Rising trends in cesarean section rates in Egypt. Birth 2004;31:12–6.
[6] Robson MS. Can we reduce the caesarean section rate? Best Pract Res Clin Obstet Gynaecol 2001;15:179–94.
[7] Chaillet N, Dumont A. Evidence-based strategies for reducing cesarean section rates: a meta-analysis. Birth 2007;34:53–64.
[8] Poma PA. Effect of departmental policies on cesarean delivery rates: a community hospital experience. Obstet Gynecol 1998;91:1013–8.
[9] Lagrew Jr DC, Morgan MA. Decreasing the cesarean section rate in a private hospital: success without mandated clinical changes. Am J Obstet Gynecol 1996;174:184–91.
[10] Liang WH, Yuan CC, Hung JH, Yang ML, Yang MJ, Chen YJ, et al. Effect of peer review and trial of labor on lowering cesarean section rates. J Chin Med Assoc 2004;67:281–6.
[11] Mohammadi S, Källestål C, Essén B. Clinical audits: a practical strategy for reducing cesarean section rates in a general hospital in Tehran, Iran. J Reprod Med 2012;57:43–8.
[12] Zhang J, Landy HJ, Branch DW, Burkman R, Haberman S, Gregory KD, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes. Obstet Gynecol 2010;116:1281–7.
[13] American College of Obstetricians and Gynecologists: ACOG technical bulletin. Fetal heart rate patterns: monitoring, interpretation, and management. Number 207, July 1995 (replaces No. 132, September 1989). Int J Gynaecol Obstet 1995;51:65–74.
[14] Electronic fetal heart rate monitoring: research guidelines for interpretation. National Institute of Child Health and Human Development Research Planning Workshop. Am J Obstet Gynecol 1997 Dec;177(6):1385–90.
[15] Costa ML, Cecatti JG, Milanez HM, Souza JP, Gülmezoglu M. Audit and feedback: effects on professional obstetrical practice and healthcare outcomes in a university hospital. Acta Obstet Gynecol Scand 2009;88:793–800.
[16] Gülmezoglu AM, Crowther CA, Middleton P, Heatley E. Induction of labour for improving birth outcomes for women at or beyond term. Cochrane Database Syst Rev 2012;6:CD004945.
[17] Moore TR, Piacquadio K. A prospective evaluation of fetal movement screening to reduce the incidence of antepartum fetal death. Am J Obstet Gynecol 1989;160:1075–80.
[18] Altman DG. Relation between several variables. In: Altman DG, editor. Practical statistics for medical research. London: Chapman & Hall; 1991. p. 325–64.
[19] Roethlisberger FJ, Dickson WJ, editors. Management and the worker. Cambridge, MA: Harvard University Press; 1939.
[20] Wickstrom G, Bendix T. The 'Hawthorne effect'—what did the original Hawthorne studies actually show? Scand J Work Environ Health 2000;26:363–7.
[21] Scarella A, Chamy V, Sepúlveda M, Belizán JM. Medical audit using the Ten Group Classification System and its impact on the cesarean section rate. Eur J Obstet Gynecol Reprod Biol 2011;154:136–40.
[22] Sheikh L, Tehseen S, Gowani SA, Bhurgri H, Rizvi JH, Kagazwala S. Reducing the rate of primary caesarean sections—an audit. J Pak Med Assoc 2008;58:444–8.
[23] McCarthy FP, Rigg L, Cady L, Cullinane F. A new way of looking at caesarean section births. Aust N Z J Obstet Gynaecol 2007;47:316–20.
[24] Foley ME, Alarab M, Daly L, Keane D, Rath A, O'Herlihy C. The continuing effectiveness of active management of first labor, despite a doubling in overall nulliparous cesarean delivery. Am J Obstet Gynecol 2004;191:891–5.
[25] Cheng YW, Kaimal AJ, Snowden JM, Nicholson JM, Caughey AB. Induction of labor compared to expectant management in low-risk women and associated perinatal outcomes. Am J Obstet Gynecol 2012;207:502.e1–8.
[26] Clark SL, Miller DD, Belfort MA, Dildy GA, Frye DK, Meyers JA. Neonatal and maternal outcomes associated with elective term delivery. Am J Obstet Gynecol 2009;200:156.e1–4.
[27] Vrouenraets FP, Roumen FJ, Dehing CJ, van den Akker ES, Aarts MJ, Scheve EJ. Bishop score and risk of cesarean delivery after induction of labor in nulliparous women. Obstet Gynecol 2005;105:690–7.
[28] Bereczky LK, Kiss SL, Szabó B. Increased frequency of gestational and delivery-related complications in women of 35 years of age and above. J Obstet Gynaecol 2015;35:115–20.
[29] Quinlivan JA, Petersen RW, Nichols CN. Patient preference the leading indication for elective caesarean section in public patients—results of a 2-year prospective audit in a teaching hospital. Aust N Z J Obstet Gynaecol 1999;39:207–14.
[30] Singh T, Justin CW, Haloob RK. An audit on trends of vaginal delivery after one previous caesarean section. J Obstet Gynaecol 2004;24:135–8.