

Auditing the appropriateness of cesarean delivery using the Robson classification among women experiencing a maternal near miss

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Abstract

Objective: To evaluate appropriateness of cesarean delivery and cesarean delivery-related morbidity among maternal near misses (MNM) using the Robson ten-group classification system.

Methods: In the present audit study, medical records were assessed for women who experienced MNM and underwent cesarean delivery at three university hospitals in Tehran, Iran, between March 1, 2012, and May 1, 2014. Local auditors assessed cesarean delivery indications and morbidity experienced. All records were re-assessed using Swedish obstetric guidelines. Findings were reported using the Robson ten-group classification system. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated.

Results: Of the 61 women included, cesarean deliveries were more likely to be considered appropriate by local auditors compared with Swedish ones (OR 2.7, 95% CI 1.3–5.7). Cesarean delivery-related morbidity was attributed to near-miss events for 10 (16%) MNMs and was found to have aggravated 25 (41%). Of 16 women classified as Robson group 1–4, cesarean delivery-related MNM was identified in 15 (94%), compared with 13 (43%) of 30 women in group 10. Cesarean delivery with appropriate indication was associated with very low likelihood of cesarean delivery-related MNM (OR 0.2, 95% CI 0.1–0.6).

Conclusion: Cesarean delivery in the absence of appropriate indication could be an unsafe delivery choice. Audits using the Robson classification system facilitate understanding inappropriate cesarean delivery and its impact on maternal health.

KEYWORDS

Cesarean appropriateness; Cesarean delivery; Clinical audit; Iran; Maternal near miss; Robson classification

1 | INTRODUCTION

Cesarean delivery can be a life-saving procedure when it is performed for certain maternal/obstetric and fetal indications. Neither maternal nor perinatal outcomes have been shown to have improved where

cesarean delivery rates exceed 16%–19% at a population level, suggesting the inappropriate use of cesarean delivery in many countries.^{1,2} Furthermore, the risk of maternal near miss (MNM) increases among women undergoing cesarean delivery.^{3,4} WHO defines MNM as “A woman who nearly died but survived a complication that occurred

during pregnancy, childbirth or postpartum up to 42 days".⁵ MNM occurs more frequently than maternal death; therefore, MNM audit can be used as a tool to rapidly analyze obstetric processes and determine whether care services are appropriately provided.⁶

Iran, a middle-income Asian country, has faced a significant rise in cesarean delivery rates from 38% in 2005 to 53% in 2013.^{7,8} Over two-thirds of women undergo cesarean delivery (rate: 74% in 2009) in the capital city, Tehran, where inpatient services are provided in a huge number of public and private hospitals.⁷ Studies in Tehran not only showed a correlation between suboptimal care and MNM, but it also determined an association between cesarean delivery and MNM regardless of maternal characteristics and comorbidity.^{9,10} As the prevalence of obstetric complications was high among women with near-miss morbidity, the association between cesarean delivery and MNM might be confounded by the clinical conditions for which cesarean delivery is indicated. Therefore, the aim of the study was to audit the appropriateness of the indications for cesarean delivery and the cesarean delivery-related morbidity among MNMs at university hospitals in Tehran to better understand the high rates of cesarean delivery and its impact on maternal outcomes.

2 | MATERIALS AND METHODS

The present audit study was part of a larger MNM project conducted at one secondary and two tertiary hospitals affiliated with Shahid Beheshti University of Medical Sciences in Tehran between March 1, 2012, and May 1, 2014. These hospitals had intensive care units for adults and newborns and the labor units were equipped with cardiotocography (CTG) machines. Consultants and residents in obstetrics and gynecology were responsible for maternity care for all women. There were no national or local guidelines for offering vaginal delivery to women with breech presentation or to those with previous cesarean delivery at these hospitals. External cephalic version and trial of vaginal delivery after cesarean delivery were not practiced, and obstetricians rarely carried out instrumental delivery. Midwives'

responsibilities were primarily administrative, maintaining the workforce, and routine measurements of vital signs at labor units.

In the first phase of the larger project, characteristics of MNM were investigated prospectively using the WHO near-miss approach.⁵ During this phase, 82 MNMs (7 in early pregnancy and 75 in the peripartum period) were identified, and of these patients, 61 had a cesarean delivery and 14 had a vaginal delivery. In the second phase, care quality provided to these women was assessed in an audit study, the detailed findings of which have been published elsewhere.^{9,10}

The ethics committee of Shahid Beheshti University of Medical Sciences granted approval to conduct the larger MNM project on January 7, 2012 (Panel number: 129) and the permission to interview women after recovery was given on March 11, 2013 (Panel number: 149). Written informed consent was obtained from women for interviews.

In the present study, only MNMs with a cesarean delivery were included. The Robson ten-group classification system (TGCS), an international classification for monitoring the rational use of cesarean delivery recommended by WHO and the International Federation of Gynecology and Obstetrics (FIGO), was used to categorize cesarean deliveries.^{11,12} TGCS, as shown in Table 1, is currently the most appropriate system by which to classify all women admitted for delivery according to parity, onset of labor, weeks of pregnancy, fetal presentation, and number of fetuses into 10 groups.^{13,14} The appropriateness of cesarean delivery and cesarean delivery-related MNM were assessed for all women in each Robson group. A maternal-fetal medicine physician (SSG), a board-certified obstetrician-gynecologist (SM) and a professor (MF) in obstetrics and gynecology, with no managerial responsibility, comprised the audit team in Tehran. All background data, obstetric history, maternal and perinatal outcomes, the events leading to the MNM, laboratory and pathology reports, and a copy of CTG traces, were obtained by medical record review and a research form was completed with detailed data for each woman. Additional information was obtained through interviews with the women and the professionals responsible for obstetric care at the time of the morbidity events.

TABLE 1 The Robson ten-group classification system.¹³

Group	Description
1	Nulliparous women with single cephalic pregnancy, ≥ 37 wk of gestation in spontaneous labor
2	Nulliparous women with single cephalic pregnancy, ≥ 37 wk of gestation who either had labor induced or were delivered by cesarean delivery before labor
3	Multiparous women without a previous uterine scar, with single cephalic pregnancy, ≥ 37 wk of gestation in spontaneous labor
4	Multiparous women without a previous uterine scar, with single cephalic pregnancy, ≥ 37 wk gestation who either had labor induced or cesarean delivery before labor
5	All multiparous women with at least one previous uterine scar, with single cephalic pregnancy, ≥ 37 wk of gestation
6	All nulliparous women with a single breech pregnancy
7	All multiparous women with a single breech pregnancy, including women with previous uterine scars
8	All women with multiple pregnancies, including women with previous uterine scars
9	All women with a single pregnancy with a transverse or oblique lie, including women with previous uterine scars
10	All women with a single cephalic pregnancy, < 37 wk of gestation, including women with previous scars

During the audit meetings, the main researcher presented each clinical case anonymously to the audit panel. Individual case review was the chosen method for assessing the obstetric care processes leading to near-miss events. The audit panel evaluated whether the indication for cesarean delivery was medically justified, and whether the surgical delivery and operative complications were attributed to the development of near-miss events or aggravated the severity of the morbidity. As an example, cesarean delivery on maternal request was evaluated as an inappropriate indication and a pulmonary embolism that developed postpartum was assessed as an attribute of MNM. However, a repeat cesarean delivery with placenta previa and abnormally invasive placenta (AIP) was assessed as an appropriate indication and the hysterectomy performed was a near-miss event that was aggravated by cesarean delivery. Severe pre-eclampsia was the leading indication for cesarean delivery in our data, followed by fetal distress, placenta previa/AIP, repeat cesarean delivery, and failure to progress. Therefore, the audit panel reviewed the medical records and evaluated whether the clinical process in relation to maternal and fetal conditions indicated cesarean delivery for women with pre-eclampsia. For fetal distress to be a valid indication for cesarean delivery, the CTG trace had to be highly suggestive of fetal asphyxia. The clinical judgment for failure to progress had to demonstrate no labor improvement after at least 2 hours of adequate uterine contractions in active phase of labor.

Sweden has a well-recognized obstetric care service, with a national cesarean delivery rate of 16% and one of the lowest levels in the world of lifetime risk of maternal death, at 1 in 12 900 women.^{15,16} Therefore, the Swedish obstetric guidelines were employed to reassess the choice of delivery method after the first audit round. Two Swedish consultant obstetricians reached consensus on the appropriateness of indication for cesarean delivery when there was any ambiguity in the care process and decision making. First, frequency of cesarean delivery and the indications for each Robson group were established to identify the major contributors to the overall number of cesarean deliveries. The appropriateness rate for each group, based on the results of the first and second audit rounds, were then determined.

Subsequently, the frequency of cesarean delivery-related MNM (attribution and aggravation) in relation with appropriateness of cesarean delivery was calculated.

Data were analyzed using OpenEpi version 3.01 (www.openepi.com). Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to present the associations.

3 | RESULTS

During the present study, 13 169 deliveries took place in the study sites, of which 8513 were cesarean deliveries, giving a cesarean delivery rate of 65%. There were 82 MNMs recorded. The incidence of MNM for every 1000 cesarean deliveries was 2.4 times higher compared with the incidence for every 1000 vaginal deliveries (7.2 vs 3; OR 2.4, 95% CI 1.3–4.3). The cesarean delivery rate among women with near-miss morbidity was 74% (61/82). A large proportion of women who had cesarean delivery (62% [38/61]) had near-miss events that occurred in the postpartum period, with early (92% [35/38]) or late (8% [3/38]) onsets, whereas a relative minority (38% [23/61]) developed near-miss morbidity prepartum. Hypertensive disorders, postpartum hemorrhage, and placenta previa including AIP were the main obstetric causes of MNM.

As Table 2 demonstrates, almost half of the cesarean deliveries (50% [30/61]) were performed for women with preterm pregnancy classified in Robson's group 10. More than one-quarter of women (26% [16/61]) were nulliparous or multiparous with cephalic, term pregnancy, without previous uterine scar (groups 1, 2, 3, and 4), and, of these, group 3 was the largest group (44% [7/16]). Group 5 and group 8 comprised 11% (7/61) and 10% (6/61) of cesarean deliveries, respectively.

Regarding indications for cesarean delivery (Table 2), severe pre-eclampsia and fetal distress were the two main documented indications. In the majority of cases, women in Group 10 had a cesarean delivery before labor pains had started, with severe pre-eclampsia and placenta previa as the two most common indications. However, the main indications for cesarean delivery in Robson groups 1–4 were fetal distress

TABLE 2 Cesarean frequency and indications in each Robson group among 61 MNMs.^{a,b}

Robson groups	Number of MNMs	Severe pre-eclampsia	Fetal distress	Placenta previa/AIP/UR	Repeat cesarean	Failure to progress	Placental abruption	Other	Maternal request
1	4 (6)	1	2	—	—	1	—	—	—
2	4 (6)	1	—	1	—	1	—	—	1
3	7 (11)	—	4	—	—	3	—	—	—
4	1 (2)	—	1	—	—	—	—	—	—
5	7 (11)	—	1	—	6	—	—	—	—
6	1 (2)	1	—	—	—	—	—	—	—
7	1 (2)	1	—	—	—	—	—	—	—
8	6 (10)	3	—	—	—	—	—	3	—
10	30 (50)	16	1	5	—	—	4	4	—
Total	61 (100)	23 (37)	9 (15)	6 (10)	6 (10)	5 (8)	4 (7)	7 (11)	1 (2)

Abbreviations: AIP, abnormally invasive placenta; MNM, maternal near miss; UR, uterine rupture.

^aAll values are given as number or number (percentage).

^bNo single pregnancy with transverse or oblique lie (Robson group 9) was recorded among MNMs.

and failure to progress. CTG traces could only confirm the decision made for surgery in 22% (2/9) of the cesarean deliveries indicated by fetal distress while in 78% of these deliveries (7/9), either the CTG traces did not support the indication or no CTG trace was found among medical records. One healthy nulliparous woman, in group 2, developed a pulmonary embolism postpartum, and the indication for cesarean delivery was maternal request. On interview after recovery, the woman revealed that her concern had been the safety of her baby and she had considered cesarean delivery as the safest choice of childbirth. She was unaware of the potential risks that are associated with surgical delivery. While 39% (24/61) of women in the study had had a previous cesarean delivery, only 10% (6/61) of the surgeries were performed for repeat cesarean delivery. Severe pre-eclampsia was the indication for cesarean delivery for 50% (3/6) of the women in group 8.

Table 3 shows the appropriateness of cesarean delivery for each Robson group in the first and the second audit rounds. The odds of appropriate cesarean delivery in the first audit round was 2.7 times higher than the second one (72% [44/61] vs 49% [30/61]; OR 2.7, 95% CI 1.3–5.7). According to the local auditors, 56% (9/16) of indications for cesarean delivery were medically justified for the Robson groups 1–4, whereas the Swedish guidelines approved 19% (3/16) of them (Table 3). Although local auditors assessed all cesarean deliveries (7/7) in group 5, and 83% (5/6) in group 8, as being appropriate, the Swedish auditors assessed indications for cesarean delivery as inappropriate for one in group 5 (14% [1/7]) and for three (50% [3/6]) in group 8. Supplementary Boxes S1–S4 present four examples with the related clinical judgments.

As Table 3 presents, in 57% (35/61) of the women in the study, MNM was either attributed to (16% [10/61]) or aggravated by (41%, 25/61) cesarean delivery. Table 4 summarizes indication for cesarean delivery, audit findings, and subsequent morbidity for ten MNMs attributed to cesarean delivery. For 25 women with MNM, cesarean delivery was considered to contribute to the severity of the subsequent morbidity. As an example, five women with previous cesarean

delivery had placenta previa with AIP and experienced massive bleeding and blood transfusions, as well as obstetric hysterectomy. Further examples are four women who developed postpartum sepsis, and three women who had severe placental abruption with coagulopathy and went on to have severe bleeding during or after cesarean delivery. Cesarean delivery-related MNM was extremely unlikely for an appropriate-indication cesarean delivery (OR 0.2, 95% CI 0.1–0.6).

4 | DISCUSSION

The rates of appropriateness for cesarean delivery varied significantly between the Iranian and Swedish audits. Robson group 10 and groups 1–4 were the main contributors to cesarean delivery among MNMs. While 43% of women in group 10 had cesarean delivery-related MNM, this was present in 94% of women in groups 1–4. The odds of cesarean delivery-related MNM was significantly lower when indications were appropriate.

The frequency of inappropriate cesarean delivery found in the present study agrees with a previous study at university hospitals in Tehran that suggested a high proportion of inappropriate cesarean deliveries were conducted.¹⁷ In accordance with the present study findings, women who are categorized into Robson group 10 have the highest number of obstetric complications and severe maternal morbidity in 27 obstetric units in Brazil.¹⁸ In general, group 10 has consistent obstetric management and is often cited as the reason behind a high cesarean delivery rate in tertiary hospitals.¹³ However, audit analysis in the present study showed that a number of cesarean deliveries for women with preterm pregnancy, group 10, were performed inappropriately, and that the subsequent morbidity was aggravated by cesarean delivery for some women in this group. This finding illustrated that the lower threshold for the decision to proceed with cesarean delivery among obstetricians suggested in previous literature could occur in the case of preterm pregnancies when obstetricians become

TABLE 3 Appropriateness of CD and CD-related MNM reviewed by the local and Swedish auditors in two rounds.^{a,b}

Robson groups	Number of MNMs	Appropriate CD (First round)	Appropriate CD (Second round)	CD-attributed MNM	CD-aggravated MNM	CD-related MNM
1	4 (6)	3 (75)	0	2	2	4 (100)
2	4 (6)	2 (50)	2 (50)	1	2	3 (75)
3	7 (11)	3 (43)	1 (14)	4	3	7 (100)
4	1 (2)	1 (100)	0	0	1	1 (100)
5	7 (11)	7 (100)	6 (86)	1	2	3 (43)
6	1 (2)	1 (100)	1 (100)	0	0	0
7	1 (2)	1 (100)	1 (100)	0	1	1 (100)
8	6 (10)	5 (83)	3 (50)	2	1	3 (50)
10	30 (50)	21 (70)	16 (53)	0	13	13 (43)
Total	61 (100)	44 (72)	30 (49)	10 (16)	25 (41)	35 (57)

Abbreviations: CD, cesarean delivery; MNM, maternal near miss.

^aAll values are given as number (percentage).

^bNo single pregnancy with transverse or oblique lie (Robson group 9) was recorded among MNMs.

TABLE 4 Obstetric outcome summary of 10 women who had a CD-attributed MNM.

Patient	Robson group	CD indication	Audit finding	Complications
1	1	Fetal distress	Aged 31 y, emergency CD in latent phase. Incorrect interpretation of CTG trace. Healthy baby was delivered	Intra-abdominal bleeding postpartum, pre-shock status, re-operation, blood transfusion, and ICU care
2	1	Fetal distress	Aged 21 y, emergency CD in latent phase. Incorrect interpretation of CTG. Healthy baby was delivered	Hematoma in broad ligament, re-operation, blood transfusion, and ICU care. Ureter injury
3	2	Maternal request	Aged 34 y. Inadequate counseling and information interchange	Pulmonary emboli postpartum, and ICU care
4	3	Fetal distress	Aged 40 y, para 3, emergency CD at 8 cm cervical dilatation. Incorrect interpretation of CTG tracing. Healthy baby was delivered	Pulmonary emboli postpartum, long-lasting intubation, and ICU care
5	3	Fetal distress	Aged 39 y, para 2, previous ovarian cystectomy, emergency CD in latent phase. No CTG or document confirming fetal distress was found. Healthy baby was delivered	Bowel injury, re-operation, and long-term care
6	3	Fetal distress	Aged 40 y, para 3, emergency CD in latent phase. No CTG or document confirming fetal distress was found. Healthy baby was delivered	Postpartum hemorrhage and pre-shock status, re-operation and hysterectomy, blood transfusion, and ICU care
7	3	Failure to progress	Aged 26 y, para 1, emergency CD after 1 h in second stage of labor with inadequate contractions	Large hematoma in extension of uterine incision, re-operation and hysterectomy, blood transfusion, and ICU care
8	5	Repeat CD	Aged 31 y, para 5, four vaginal deliveries, one CD, delivered by elective cesarean before labor pains had started	Pelvic hematoma, hysterectomy, pelvic abscess, and long-term care
9	8	Cephalic-breech, twin pregnancy	Aged 23 y, para 0, elective CD at 38 wk of pregnancy	Intra-abdominal bleeding, re-operation, blood transfusion, and ICU care
10	8	Cephalic-breech, twin pregnancy	Aged 32 y, para 1, previous vaginal delivery, 37 wk, emergency CD in active phase of labor	Intra-abdominal bleeding, reoperation, blood transfusion, and ICU care

Abbreviations: CD, cesarean delivery; CTG, cardiotocography; ICU, intensive care unit; MNM, maternal near miss.

used to such practice.^{13,19} Therefore, it could also be suggested that potential exists for the number of preterm deliveries to be reduced, along with the related maternal and perinatal morbidity, by improving the obstetric practice.

Groups 3 and 1 are low-risk obstetric populations including women who can potentially deliver vaginally.²⁰ As the results of the present study show, the majority of indications for cesarean delivery in these two groups were fetal distress and failure to progress, while only a minority of the indications were clinically approved by the audits undertaken. Moreover, the experienced morbidity in these Robson groups was either directly attributed to, or became aggravated by, cesarean delivery. Severe morbidity and the burden that the family faced after cesarean delivery indicated by maternal request could potentially have been preventable if the underlying reason for such request had been determined. The ethics surrounding the field of cesarean delivery are complicated, and autonomy-based obligations should adhere to the informed consent process provided by trained obstetric professionals during prenatal consultations.²¹ In addition, women's choice should be balanced against beneficence-based obligations to the mother and fetus when obstetricians make decisions.^{21,22} The increased risk of severe maternal outcome with cesarean delivery

has been shown in previous studies.^{9,23} However, the combination of the TGCS and clinical audit in the present study revealed how obstetric practice in a low-risk population can lead to near-miss events. The cesarean delivery appropriateness rate was significantly low among those women in the low-risk groups delivered by cesarean due to fetal distress and failure to progress. Therefore, promoting evidence-based decision making in obstetrics, and better practice—including the proper assessment and documentation of CTG traces—can potentially decrease cesarean delivery rates and the frequency of near-miss events in the hospitals studied.

To our knowledge, the present study was the first to use a combination of audit and the TGCS for assessing the appropriateness of cesarean delivery in settings within Iran where this mode of delivery is considered to be overused. This combination offered a logical framework to analyze and understand cesarean delivery appropriateness and its impact on maternal health outcomes.²⁴ Moreover, the audit comparison between Iranian and Swedish professionals was an original idea to illustrate the marked variation in obstetric decision making in countries with high and low rates of cesarean delivery. The results of the study could be seen to be representative of other university hospitals in Tehran as they serve women with similar

maternal and medical characteristics, and have comparable resources and educational guidelines. However, the findings of the study are not transferable to other public and private hospitals throughout Iran because of differences in clientele, care capabilities, and, subsequently, obstetric practice.

The study had some limitations. First, the analysis was based on a limited number of patients and this may have affected the related measures. Second, inadequate documentation of medical records, including CTG traces that did not support clinical decision making or were absent, may have adversely affected the clinical judgments. Finally, the Swedish auditors might have judged the obstetric management based on medical resources and supplies that were not available in hospitals in Iran.

The present study suggested that, at hospitals where cesarean delivery was overused, a number of cesareans were performed with ambiguous indications. Cesarean deliveries, specifically those performed in low-risk obstetric populations, could result in MNM, and without a medically justifiable indication, can be a harmful choice in childbirth. The Robson classification and audits are valuable tools in tackling questionable indications for cesarean delivery, and they can be used to improve the appropriateness and therefore lower the rates of cesarean delivery.^{24,25} To keep childbirth as safe as possible, cesarean delivery should only be performed when clear maternal and perinatal health benefits exist.

AUTHOR CONTRIBUTIONS

S.S.G. contributed to data collection, data analysis, interpretation of data, and writing and revising the manuscript. B.E. contributed to data collection, interpretation of data, and revising the manuscript. M.F. contributed to data collection and revising the manuscript. A.M.-L. contributed to interpretation of data, and revising the manuscript. S.M. contributed to the conception and design of the study, data collection, data analysis, and writing and revising the manuscript.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Box S1. Example of cesarean section (CS) in Robson group 1 and the clinical judgments in two audit rounds.

Box S2. Example of cesarean section (CS) in Robson group 3 and the clinical judgments in two audit rounds.

Box S3. Example of cesarean section (CS) in Robson group 8 and the clinical judgments in two audit rounds.

Box S4. Example of cesarean section (CS) in Robson group 10 and the clinical judgments in two audit rounds.