Original Research

Severe maternal morbidity among women with a history of cesarean section at a tertiary referral teaching hospital in the southeast of Iran

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ABSTRACT

Objectives: Although the cesarean section (C-section) is known as a lifesaving procedure, it can also increase the risk of maternal mortality and morbidity. This study was conducted to achieve two objectives: (1) determination of maternal near miss (MNM) indicators and pregnancy outcomes among women with a history of C-section and (2) investigation of the women's experience of near miss events during childbirth to provide a deeper understanding of the weaknesses of care delivery process.
Study design: The present study was conducted using a prospective cross-sectional study using the World Health Organization (organ system dysfunction—based) criteria.
Methods: All subjects were women at more than 22 weeks of gestation who gave birth in Ali ibn Abi Talib Hospital, Zahedan, Iran, and were referred to this hospital for childbirth or those within 42 days of pregnancy termination. Logistic regression was used to predict the risk factors for severe maternal outcomes (SMOs).
Results: Nearly 58% of all MNM cases were related to women with a history of C-section. The MNM ratio was estimated at 8.04 per 1000 live births. Moreover, the frequent causes of SMOs were reported as severe hemorrhage (58.3%), severe pre-eclampsia/eclampsia (27.8%), medical condition (8.3%), and sepsis or severe systemic infection (5.6%). Abnormally invasive placenta (61%) was the most common cause of severe hemorrhage. After adjustment for potential confounder variables, the hemoglobin level of <11 g/dl (odds ratio [OR] = 0.18, 95% confidence interval [CI] = 0.09—0.36) and place of residence (OR = 0.41, 95% CI = 0.19—0.90) remained as independent risk factors for SMOs in the final model of multivariate analysis.
Conclusion: A risk assessment system is needed to diagnose and manage the risk factors for SMOs during prenatal care. In addition, there should be a continuous audit of the indication and number of C-sections performed across health facilities.

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Introduction

According to the World Health Organization (WHO), Iran is among the nine countries that have achieved Millennium Development Goal 5A through decreasing the maternal mortality rate by 80% from 123 women per 100,000 live births in 1990 to 25 women per 100,000 live births in 2015, with an annual reduction of 6.4%.[1] The adoption of maternal health strategies in Iran has resulted in the implementation of more than 90% of deliveries in health facilities.[2]

Based on the evidence, in the lower middle-income countries, passing through the obstetric transition that is accompanied by an increased rate of obstetric interventions in health facilities is a matter of concern.[3] Despite the fact that more than 5–10% of cesarean sections (C-sections) do not improve the maternal-child health, high rates of C-sections are reported universally (e.g. in middle-income countries, namely, Iran).

As indicated in the literature, during 2000–2013, the rate of the C-section increased from 35% to 56.1% in Iran,[4] the most common reason of which was the previous experience of the C-section.[5] The literature also showed that the main factors leading to a high C-section rate are changes in the level of education, income, ethnicity, insurance status, and attitudes toward the C-section at the individual level, as well as weak adherence to evidence-based guidelines, fear of malpractice, reduced capabilities of obstetricians, midwives, and residents, opportunity for high income for healthcare providers, multiple interventions in the delivery process, and overreliance on technology in the organizational context.[4,6,7]

Although the C-section is known as an indicator of access to emergency obstetric care and lifesaving procedure,[8] it has been reported to be accompanied by the increased risk of maternal mortality.[9] Moreover, there is controversy about the safety of vaginal delivery after a C-section. Some studies showed that in low-resource settings, vaginal delivery after a C-section can even increase the risk of maternal morbidity (e.g. uterine rupture and hysterectomy) and mortality. Therefore, in such settings, the focus should be directed toward improving the quality of care.[10]

Given the fact that maternal morbidity occurs 9–100 times higher than maternal mortality, maternal near miss (MNM) reviews have gained interest as an indicator of the quality of maternal care and maternal mortality.[11–14] The MNM is defined as the case of 'a woman who nearly died, but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy.'[15]

There are limited studies investigating near miss events among women with a history of C-section in Iran.[6,16] However, to the best of our knowledge, no studies have examined this issue in Sistan and Baluchestan, Iran. This province has a high maternal mortality rate (i.e. 48.6 cases per 100,000 live births), with a C-section rate of 18% in public hospitals. Moreover, because the C-section is financially profitable for private hospitals, this rate increases to 33.7% in these centers.[17,18]

With this background in mind, this study was conducted to determine MNM indicators and pregnancy outcomes among women with a previous C-section experience in a tertiary referral teaching hospital.

Methods

This study was conducted based on a prospective cross-sectional study in Ali ibn Abi Talib Hospital, Zahedan, Iran.

Setting

Sistan and Baluchestan, with a population of 2,775,014 people and an area of 181,785 km², is the largest province in Iran. This province is among the most disadvantaged regions in this country[19] and has the highest maternal mortality rate. According to a set of unpublished data, this province covers about 2% of the total population of Iran in 2016 and accounts for 10.78% of the total maternal mortalities occurring in the country.

Ali ibn Abi Talib Hospital is a tertiary referral teaching hospital in Zahedan (i.e. the capital of Sistan and Baluchestan province) with a catchment population of nearly 2,221,544. This hospital is the only referral hospital for women and is affiliated to Zahedan University of Medical Sciences, which accepts referrals from other two hospitals in Zahedan city, other district hospitals, and other rural childbirth settings in the province. As the only tertiary public referral hospital in the capital of the province, it handles approximately 7000 deliveries annually.

Therefore, sampling in this referral hospital can also partly reflect care and referral status in other secondary hospitals. During the study period, the obstetrics department was staffed with 10 obstetricians and 34 midwives. This hospital has two intensive care units (ICUs) with 12 beds.

Participants and data collection procedures

A prospective cross-sectional study was conducted on pregnant women (more than 22 weeks of gestation) who gave birth in Ali ibn Abi Talib Hospital, those referred to this hospital for childbirth, and women within 42 days of pregnancy termination between June 22, 2017, and December 22, 2017. Women who had an abortion or ectopic pregnancy were excluded from the study because our study was focused on the care received by women during labor and delivery; in addition, the denominators were not reliably known for this group.

All women were screened for potential life-threatening conditions (e.g. severe obstetric complications and critical interventions) through daily visits to obstetric wards and other relevant facilities (e.g. ICUs, cardiac care units, internal medicine units, and neurologic units). During the daily visits, the women's medical records were screened for the inclusion and MNM criteria. The MNM cases were identified based on the WHO near miss criteria (i.e. clinical, laboratory, and management criteria for organ system dysfunction).[15,20] Severe maternal outcomes (SMOs) were considered as MNMs and maternal death. For all eligible women (including MNM cases), the data were recorded in the respective forms.

Table 1 — Maternal near miss outcomes and indicators and death in all live births and among women with a history of C-section in Ali ibn Abi Talib Hospital.

	All cases	Previous C-section[a]
Total number of childbirths		3543
Total number of live births in Ali ibn Abi Talib hospital		3480
Total number of women with a history of C-section		1167
Severe maternal outcome (SMO) cases (n)	52	30
Maternal near miss (MNM) cases (n)	48	28
Maternal death (MD) (n)	4	2
Severe maternal outcome ratio (SMOR/1000 live births)	14.9	8.6
MNM incidence ratio (MNM/1000 live births)	13.8	8.0
MNM:mortality ratio (MNM:1 maternal death)	12:1	14:1
Mortality index (MD/(MD+MNM)×100)	8.3%	7.1%

C-section, cesarean section.
[a] Excluded women delivered at other hospitals (referral cases).

The medical records of all women were also assessed to determine the history of C-section. The collected data included demographic characteristics, history of C-section, severe maternal complications, critical intervention or intensive care use (e.g. admission to the ICU, laparotomy, and use of blood products of more than 5 units), and maternal and perinatal outcomes. Generally, on entering the hospital for childbirth, the women did not have a medical history to facilitate the determination of the type of uterine incision or any other complications during the previous C-section.

Statistical analysis

The data were analyzed using SPSS, version 16 (IBM, Armonk, NY, USA). The MNM indicators were calculated using the instructions of the WHO for calculating the indicators[15] as shown in Table 1. Because denominators were unknown for the women giving birth in other childbirth settings, the MNM indicators were calculated for the women who delivered only at Ali ibn Abi Talib Hospital.

The chi-squared and Fisher exact tests were used to analyze the categorical and binary data. Furthermore, two-tailed tests were used to compare the variables between the two groups. In addition, the association between some independent variables and SMOs among women with a history of C-section was estimated using odds ratio (OR) and 95% confidence interval (CI). The data were categorized based on the assumption that adolescent women face higher risks of complication during pregnancy and childbirth. The data were classified based on residency in rural areas and lack of insurance coverage that can affect access to appropriate medical care.

A logistic regression model was used to estimate the association between SMOs (0 = without SMO, 1 = SMO) and independent variables (i.e. type of delivery, parity, education level, place of residence, insurance coverage, and anemia). All independent variables were considered categorical (dichotomous). The variables having a P-value of more than 0.25 in the bivariate analysis (age and the number of previous C-sections) were not included in the multivariate logistic regression model. The forward Likelihood ratio (LR) method was adopted in logistic regression to study the role of each independent variable in an SMO event among the women with a history of

C-section. The two-tailed tests were also used to compare the variables between the control and intervention groups. A P-value less than 0.05 was considered statistically significant.

Results

During the study period, 5 cases of MNMs occurred among the women with an abortion or ectopic pregnancy. However, as mentioned before, these five cases (i.e. 4 abortions and 1 ectopic pregnancy) were excluded from the study because the denominators were not reliably known for them. A total of 3543 childbirths were recorded in Ali ibn Abi Talib Hospital during the data collection period, 3480 cases of which were live births.

All women were followed up from the onset of their admission up to discharge. In addition, all MNM cases were followed up from the onset of their admission or diagnosis up to 42 days postpartum. In total, 52 cases of SMOs (i.e. 48 MNM

Table 2 — Morbidity factors in women with SMO (n = 36).

Morbidity factors	With SMO N (%)
Women with severe complications	
Severe hemorrhage	21 (58.3)[a]
Severe pre-eclampsia/eclampsia	10 (27.8)
Sepsis or severe systemic infection	2 (5.6)
Other medical conditions	3 (8.3)
Organ system failure[b]	
Cardiovascular	6 (16.7)
Respiratory	8 (22.2)
Renal	8 (22.2)
Coagulation/hematological	25 (69.4)
Hepatic	4 (11.1)
Neurological	6 (16.7)
Uterine/hysterectomy	16 (44.4)

SMO, severe maternal outcome; WHO, World Health Organization.
[a] Abnormally invasive placenta (61%, 13/21) was the most common cause of severe hemorrhage.
[b] World Health Organization: Evaluating the quality of care for severe pregnancy complications. The WHO near-miss approach for maternal health. (http://apps.who.int/iris/handle/10665/44692), 2011.

cases plus 4 maternal deaths) occurred during the research period, denoting nearly 1 case per 67 women.

Of the 3480 included women, 33.5% (1167/3480) of the subjects had undergone at least one C-section previously. Nearly 58% (30/52) of all SMO cases (28 MNM cases and 2 maternal deaths) were related to women with a history of C-section (Table 1). The results showed that in women with a history of C-section, the ratio of SMO to non-SMO was 1/39. It must be mentioned that the referral cases (n = 16; i.e. 6 women with a history of C-section and 10 women with a history of vaginal delivery) were excluded in the calculation of MNM indicators because the denominator (i.e. the number of live births) was not specified for these referral cases (Table 1).

It is also important to note that all other analyses (except for the prenatal hemoglobin level that was not also available for referral cases) were performed on the MNM cases with a history of C-section (n = 36; i.e. 30 cases giving birth at Ali ibn Abi Talib and 6 cases referring from other childbirth facilities).

Near miss cases were identified according to the organ dysfunction criteria (Table 2). The most common organ dysfunctions among women with SMOs (i.e. MNMs and maternal death) included coagulation/hematological diseases (69.4%) and uterine dysfunction (44.4%). Furthermore, severe hemorrhage (58.3%) and severe pre-eclampsia/eclampsia (27.8%)

were identified as the direct obstetric causes of SMOs. It is important to mention that 52% (13/25) of abnormally invasive placenta (AIP) cases led to SMOs; on the other hand, severe hemorrhage was mainly associated with AIP (61%, 13/21).

In the present study, 5.2% (n = 61) of the cases had a vaginal delivery after a C-section, and 94.8% (n = 1106) of them underwent a C-section again (Table 3). Based on the Hosmer–Lemeshow goodness-of-fit test, the model fit the data well (chi-squared = 0.04, df = 1, P = 0.8). In the univariate model, SMOs showed a significant association with the hemoglobin level (OR = 0.17, 95% CI = 0.08–0.34; P < 0.01) and place of residence (OR = 0.36, 95% CI = 0.17–0.77; P = 0.009). In addition, women with higher education were less likely to develop SMOs (OR = 0.45, 95% CI = 0.20–1.01); however, this association was not statistically significant at the probability level of 0.05.

Consequently, the aforementioned variables and all variables with a P-value of <0.25 (i.e. the type of delivery, parity, and insurance coverage) were included in the multiple logistic regression model. After adjustment for potential confounder variables, anemia (i.e. a hemoglobin level of <11 g/dl) and the place of residence remained as independent risk factors for SMOs in the final model of multivariate analysis. In addition, pregnancy outcomes and

Table 3 – Univariate and multiple logistic regression analysis of the variables associated with SMO among women with a history of C-section (n = 1167).

Variables	Total no. of women with a history of C-section N = 1167 (%)	Women with SMO N = 36[b](3.1%)	Univariate OR (95% CI)	Multivariate OR (95% CI)
Type of delivery				
Vaginal delivery[a]	61 (5.2)	4 (6.6)	1	NS
C-section	1106 (94.8)	32 (2.9)	0.4 (0.14–1.24)	
Age (years)				
<19[a]	38 (3.3)	2 (5.3)	1	–
≥19	1129 (96.7)	34 (3.0)	0.55 (0.12–2.41)	
Education				
≤ Primary school[a]	724 (62.0)	28 (3.9)	1	NS
≥Secondary school	443 (38.0)	8 (1.8)	0.45 (0.20–1.01)	
Residence				
Rural[a]	150 (13.0)	10 (6.7)	1	0.41 (0.19–0.90)
Urban	1016 (87.0)	26 (2.6)	0.36 (0.17–0.77)[a]	
Insurance				
No[a]	121 (10.4)	6 (5)	1	NS
Yes	1046 (89.6)	30 (2.9)	0.56 (0.23–1.38)	
Parity				
>1[a]	833 (71.4)	29 (3.5)	1	NS
1	334 (28.6)	7 (2.1)	1.68 (0.37–3.88)	
Hb level[c]				
<11[a]	238 (20.5)	15 (6.3)	1	0.18 (0.09–0.36)[b]
≥11	923 (79.5)	15 (1.6)	0.17 (0.08–0.34)[a]	
Number of C-sections				
1[a]	514 (44.0)	14 (2.7)	1	–
≥2	653 (56.0)	22 (3.4)	1.24 (0.63–2.45)	

C-section, cesarean section; SMO, sever maternal outcome; Hb, hemoglobin; OR, odds ratio; CI, confidence interval; NS, not significant.
*Significant at P < 0.01.
**Significant at P < 0.05.
[a] Reference group.
[b] Includes referrals.
[c] Referral cases were deleted because prenatal Hb was not available.

Pregnancy outcomes and ICU admission	Total no. of women with a history of C-section N = 1167 (%)	Women with SMO N = 36[a] (3.1%)	P
Table 4 – Pregnancy outcomes and ICU admission among women with a history of C-section (n = 1167).			
Preterm birth (weeks of gestation)			
≤34	106 (9.1)	16 (15.1)	<0.001
>34	1061 (90.9)	20 (1.9)	
Still birth (weeks of gestation)			
Yes: ≤34	20 (1.7)	7 (35.0)	<0.001
>34	8 (0.7)	2 (25.0)	
No	1139 (97.6)	27 (2.4)	
Rupture of the uterus[a]			
Yes	5 (0.4)	4 (80.0)	<0.001
no	1162 (99.6)	32 (2.8)	
Blood transfusion>5 units			
Yes	25 (2.1)	25 (100)	<0.001
No	1142 (97.9)	11 (1.0)	
ICU admission rate			
Yes	23 (2.0)	21 (91.3)	<0.001
No	1144 (99.8)	15 (1.3)	
Length of stay in the ICU (days)			
Mean (SD)	3 (2.8)	21 (7.2)	
Minimum–maximum	1–5	1–30	
Vaginal delivery after the previous C-section (n = 61)			
Laparotomy			
Yes	2 (3.3)	2 (100)	0.003
No	59 (96.7)	2 (3.4)	
Hysterectomy			
Yes	2 (3.3)	2 (100)	<0.001
No	59 (96.7)	2 (3.4)	
Repeated C-section (n = 1106)			
Laparotomy			
Yes	3 (0.3)	2 (66.7)	0.002
No	1103 (99.7)	30 (2.7)	
Hysterectomy			
Yes	14 (1.3)	14 (100)	<0.001
No	1092 (98.7)	18 (1.7)	
Maternal death[b]	–	2	–

ICU, intensive care unit; SMO, severe maternal outcome; SD, standard deviation; C-section, cesarean section; NVD, normal vaginal delivery.
[a] Of these 5 women, 2 were diagnosed after NVD, and 3 were diagnosed during the C-section.
[b] Of these 2 women, 1 woman died owing to thrombotic thrombocytopenic purpura, and 1 addict woman died owing to acute respiratory distress syndrome.

the rate of ICU admission among women with a history of C-section are listed in Table 4.

Discussion

The vaginal delivery rate for women with a history of C-section in these data is 5%. This rate is much lower than the values reported for other centers and may represent an opportunity to reduce the overall number of C-sections. Vaginal delivery after a C-section usually warrants additional prenatal counseling and intrapartum monitoring, with facilities immediately available for recourse to an emergency C-section. Our attempt to compare this rate within Iran was hindered by the lack of available data at a national level.

As the findings indicated, 57% (30/52) of SMO cases occurred among women with a history of C-section. In addition, in the referral hospital under investigation, the MNM ratios in total and among women with a history of C-section were 13.79 and 8.0 per 1000 live births, respectively. These values are higher than the ratios mentioned by the WHO (6.1/1000 live births) for Iran and other countries with moderate maternal mortality ratios.[21]

Previous studies revealed that Sistan and Baluchestan, with a female illiteracy rate of 32.77% and a Human Development Index of 0.58, is the most disadvantaged province in Iran.[19] According to the literature, geographic disparities and low socio-economic background have a direct association with maternal mortality[19,22] and MNMs.[23] In line with the results of the previous studies,[6,23] our data showed that SMO was more likely to occur among women living in rural areas (OR = 0.41, 95% CI = 0.19–0.90; P = 0.02) and was affected by anemia (i.e. a hemoglobin level of <11; OR = 0.18, 95% CI = 0.93–0.36; P < 0.001). In Sistan and Baluchestan province, the women living in rural areas face greater challenges owing to their geographical conditions (e.g. extremely low population density and longer travel distance to an emergency care center) and demographic factors (e.g. high poverty rates and a low education level).[24]

Meanwhile, previous studies in Iran showed that Sistan and Baluchestan province has the highest total fertility rate (more than 3.5 births per woman), compared with the national average (nearly 2 births per women).[25] A previous C-section increases the risk of AIP and consequently maternal mortality owing to the incidence of a life-threatening hemorrhage at the time of placental removal.[26,27] In line with the previous studies,[6,28] the results of the present study showed that direct obstetric conditions (e.g. severe hemorrhage and severe pre-eclampsia/eclampsia) were the major reasons for SMOs.

Therefore, to prevent SMOs among women with a history of C-section, the managers need to assess the rate of the C-section at the facility level. As a result, they can provide a reference for the estimation of the adequate or excessive use of the C-section and adherence to or absence of clear evidence-based guidelines to prevent an unnecessary primary C-section[25] without compromising maternal and fetal health.

Moreover, based on the evidence, along with the high frequency of the direct obstetric causes of maternal mortality in the province under investigation, indirect causes are also growing.[3] Socio-economic disparities can affect the access to a variety of social goods (e.g. nutrition and medical care) that shapes individuals' (healthcare) behaviors and consequently causes poor health outcomes.[29] According to the literature, there is a positive association between socio-economic disparities and chronic diseases.[30]

Based on the evidence, there is a significant increase in the rate of maternal death owing to indirect medical causes (e.g. a range of communicable and non-communicable diseases and nutritional disorders) in the middle-income countries, such as Iran.[31] This can probably explain the high frequency (42.9%) of medical conditions, namely, renal failure, thrombotic thrombocytopenic purpura, and acute respiratory distress syndrome, associated with SMOs in the present study. Therefore, in line

with the WHO[28] and previous studies,[31] policymakers should collect high-quality data and provide appropriate evidence-based multidisciplinary care to respond to the high number of maternal deaths caused by indirect obstetric causes.

In the present study, the rate of uterine rupture after vaginal delivery (0.43%) was within the range reported for spontaneous labor in the previous studies (0.15—0.98%).[32] Although the uterine rupture rate was within the normal range, the following important points should be noted. First, SMO events were more common among women who attempted vaginal delivery after a C-section (6.6%, 4/61), compared with those undergoing a C-section (2.9%, 32/1106). Therefore, it is important to pay attention to the severity of adverse events in cases undergoing vaginal delivery after a C-section to justify their safety in any specific context.[33]

Limitations of the study

The present study has some limitations that should be taken into account. Our sample size for SMOs is small ($n = 36$) to present a definite conclusion on the subjects under the study. Therefore, it is essential to perform further studies with a larger sample size to justify maternal and neonatal adverse outcomes. Second, an integrated information system was not accessible to provide information for a number of potential confounding factors (e.g. the number and quality of antenatal care services received by women from health facilities). Therefore, it was not possible to adjust the results for such antenatal variables. Third, the investigation of women who were referred to only one referral hospital in the capital city of the province can limit the generalizability of the findings. Despite these limitations, the present study is valuable as it provided in-depth information about the root causes of near miss events among women with a history of C-section in a disadvantaged province with a high maternal mortality rate in Iran.

Conclusion

In the context under study with a low Human Development Index and a high total fertility rate, in addition to direct obstetric causes, the medical condition of women plays an important role in the incidence of SMO events. A (contextual) risk assessment system requires the identification and management of the contributory factors for SMOs during prenatal care.

In addition, there should be an audit of the C-section rate, such as the Robson ten-group classification system, to monitor and compare C-section rates at a specific setting over time. This system will help to gain an understanding of the drivers of the C-section trend in a special health facility. Therefore, the managers can implement appropriate evidence-based strategies and decrease the number of unnecessary primary C-sections.[34]

Author statements

Ethical considerations

This study was performed after obtaining the approval of the Ethics Committee of Zahedan University of Medical Sciences, Zahedan, Iran (July 9, 2017; IR.AUMS.REC: 1396.83). In addition, permission was obtained from the director of Ali ibn Abi Talib Hospital.

Competing interests

The authors of the present study declare no conflicts of interest.

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