Original Investigation

Postoperative Care in the Caesarean Intensive Care Unit: Experience from a Tertiary Maternity Hospital

Yılmaz Ergani et al. Caesarean Intensive Care Unit

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Abstract
Objective: We aimed to determine whether follow-up in the intensive care unit for the postoperative first 8 hours is beneficial for early intervention in postpartum hemorrhage.
Material and Methods: In our hospital, all patients are admitted to the intensive care unit for the first 8 hours after cesarean section. Patients with postpartum hemorrhage after cesarean delivery who received medical and/or surgical treatment between 2016 and 2020 were reviewed in the presented study retrospectively.
Results: 36,396 cases who underwent cesarean delivery were reviewed. Three hundred fifty nine patients with postpartum hemorrhage were included in the study. The time between cesarean section and diagnosis of postpartum hemorrhage was 10.1 ± 19.1 hours, and the time between cesarean section and re- laparotomy was 9.26 ± 23.1 hours in the study group. A total of 3 maternal deaths occurred after cesarean section in our hospital. In the last five years, the mortality rate in patients delivered by cesarean section was calculated to be 3.9 per 100,000. The incidence of postpartum hemorrhage in cesarean deliveries at our hospital was calculated to be 1.0%, and the rate of obstetric near-miss events was calculated to be 0.6 per 1000 live births.
Conclusion: Follow-up of patients in the intensive care unit in the first postoperative 8 hours after cesarean section may result in a lower number of re-laparotomies due to postpartum hemorrhage, a shortened interval between cesarean section and re-laparotomy, and a lower maternal mortality rate.
Keywords: Cesarean section, maternal mortality, postpartum hemorrhage, re-laparotomy

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Introduction

Maternal mortality rate is one of the most important health and development indicators of a country. Postpartum hemorrhage (PPH) is the most common cause of maternal mortality (1). The maternal mortality rate in our country was reported to be 13.1 per 100,000 live births (2). Approximately 50% of maternal mortality is caused by postpartum hemorrhage, which occurs within 24 hours after delivery. Therefore, close monitoring of the patient in the first 8 hours after delivery is essential (3). In 2017, the American College of Obstetricians and Gynecologists changed its definition of PPH from the classic definition described above to a cumulative blood loss ≥1000 mL or hemorrhage associated with signs/symptoms of hypovolemia within 24 hours of delivery regardless of route of delivery (4).

The rate of cesarean deliveries has increased worldwide. Considering that postpartum complications are more common in cesarean deliveries than in vaginal deliveries, it is inevitable that postpartum complications will also increase accordingly (5). Among these complications, uterine atony, the inability of the uterine muscles to contract after delivery, is the most critical complication leading to maternal mortality. About 80% of postpartum hemorrhage is caused by uterine atony. Many organizations have published guidelines for the prevention or prompt diagnosis of postpartum hemorrhage, especially uterine atony (4,6). The incidence of uterine atony after cesarean section was 6% in a large cohort study (7).

In the present study, we aimed to investigate whether the follow-up of patients in the intensive care unit after cesarean section (cesarean intensive care unit) leads to early detection or prevention of postoperative complications. Our research question was, "Do postpartum complications differ in frequency in patients followed up in intensive care unit after cesarean section compared with the literature?"

Material and methods

This study was a retrospective, single-center, hospital-based study. The Institutional Review Board approved the study protocol with decision number 10/02/2021/02. From January 1, 2016, to December 31, 2020, patients who underwent a medical or surgical procedure in the first 24 hours after cesarean delivery were identified. In these patients, the interval between the diagnosis of postpartum hemorrhage and the time of re- laparotomy was determined. The amount of red blood cell suspensions or other blood products transfused to the patients was obtained from the medical records, and these results were compared with the literature. Patients who were anemic before cesarean section and had received preoperative or intraoperative blood transfusions were not included. Although previous studies have included cases of uterine atony detected intraoperatively, we excluded intraoperative atony in the present study. We had only those patients who developed postpartum hemorrhage during follow-up in the cesarean intensive care unit.

Since the establishment of our hospital 30 years ago, all postpartum patients were observed in the post-cesarean intensive care unit during the first 8 hours. Fever, pulse, and blood pressure were measured every 15 minutes for the first 2 hours, every 30 minutes for the second 2 hours, and every 60 minutes for the last 4 hours. In the intensive care unit, patient was attended by four nurses and a senior obstetrician. Complete blood count was obtained at the 2nd and 6th hour postoperatively in the intensive care unit, and uterine tone examination and vaginal bleeding control were performed every 15 minutes (8). The diagnosis PPH is made when the amount of bleeding exceeds 1000 ml in cesarean deliveries; the diagnosis is supported by the deterioration of vital signs and a drop in hemoglobin (Hb) levels. Since risk factors such as the

patient's age, the presence of concomitant diseases, or bleeding disorders increase PPH, the attending nurse cares more intensively for these patients.
All patients received 20 International Unit (IU) of oxytocin (Synpitan fort ®, Deva İlac, Istanbul, Turkey). Ten IU administered intraoperatively, with the remainder administered over 8 hours in the intensive care unit for CS. After completion of the first 8 hours, women with an uneventful postpartum course were transferred to the normal patient room. If patients have postpartum hemorrhage, additional oxytocin (up to 40 IU, Intravenous (IV)), methyl ergonovine ((Metiler ®, Adeka, Samsun, Turkey, 0.2 mg, Intramuscular (IM)), misoprostol (Cytotec ®, Pfizer, Germany, 600-800 µg, Perioral(PO), rectal or sublingual), tranexamic acid (Transamin ®, Daiichi Sankyo, Japan,100 ml, IV) are administered in the cesarean intensive care unit (ICU). In the patients with postpartum hemorrhage who did not respond to drug treatment, we performed bimanual uterine compression and/or uterine balloon tamponades as a secondary line of treatment or as a bridge to a second surgical procedure in case of uterine atony. The following data were obtained from the hospital database and patients' medical records: Age, parity, number of abortions, concomitant diseases, and risk factors for postpartum hemorrhage. Data used for analysis also included type and amount of supplemental uterotonics, amount of blood transfusion and type of blood products transfused, interval between cesarean section and re-laparotomy, and surgical technique used during re-laparotomy. Neonatal data included gestational age at birth, birth weight, and neonatal Apgar scores. Our hospital's protocols used previously published criteria to define Intrauterine Growth Restriction (IUGR) (9). Preeclampsia was defined as sustained blood pressure above 140/90 mmHg in association with proteinuria, maternal signs, symptoms, or laboratory findings (10). Premature preterm rupture of membranes (PPROM) was defined as fetal rupture of membranes before labor at less than 37 weeks. Placental abruption is defined as the detachment of the placenta from the implantation site before delivery.

Statistical analysis

The total number of births during the study period was also obtained from the hospital database. Statistical Package for Social Sciences (SPSS) software for Windows version 23.0 was used for statistical analysis. Descriptive statistics used in the present study included mean, standard deviation, median, minimum and maximum, frequency, and percentages.

Results

During the study period, a total of 77,157 births were recorded in our hospital. Of these, 769 were stillbirths, 36,196 deliveries were by cesarean section, and 6,554 were considered high-risk pregnancies. The remaining 29,642 deliveries by cesarean section were low-risk pregnancies. Over a five-year period, a total of 3 maternal deaths occurred after cesarean section at our hospital. The mortality rate after cesarean delivery was 3.9 per 100,000 live births during the study period. The incidence of postpartum hemorrhage was calculated to be 1.0% (359 cases in 36,196 cesarean deliveries). The causes of maternal death after cesarean delivery were massive postpartum hemorrhage in 2 patients and Disseminated Intravascular Coagulation (DIC) in 1 patient.
359 patients of 36,196 cesarean deliveries received additional medical and/or surgical treatment for postpartum hemorrhage. The mean age of the patients was 28 years, the mean parity was 1 year, and 12 patients (3.4%) required transfusion because of prepartum anemia. Of these patients, 157 had a previous cesarean section. The other indications for cesarean delivery are listed in Table 1.

The gestational age at delivery in these patients was 36.9 ± 3.2 weeks. 54 women (15%) delivered between 34-37 weeks, and 45 (12.5%) women delivered before 34 weeks. 104 pregnant women were classified as high-risk pregnancies. There were 33 twin pregnancies (9.2%). PPROM was diagnosed in 14 pregnant women (3.9%), preeclampsia in 21 pregnant women (5.9%), and 15 pregnancies ended in stillbirth (4.1%). (Table 2). 21 pregnant women (5.9%) had neonates > 4000 gr, and 45 women (12.3%) had neonates < 2500 gr. The median 1-minute and 5-minute Apgar scores were 9 and 10, respectively, and 59 infants (16.4%) were admitted to the neonatal intensive care unit (Table 2).
37 patients (10.3%) received supplemental oxytocin alone to treat postpartum hemorrhage, and 322 patients (89.7%) received combined medical therapy (oxytocin +/- misoprostol +/- methylergonovine) to treat postpartum hemorrhage. 150 patients (41.7%) received tranexamic acid. Bakri balloon tamponade was performed in 23 patients (6.4%), and 265 patients (73.8%) received transfusion of blood and blood products. The need for blood and blood product transfusion after cesarean section was 0.7% (265/36196*100). The surgical approach for postpartum hemorrhage after re- laparotomy was uterine artery ligation in 7 patients (1.9%) and B-Lynch compression suture in 11 patients (3%). Hysterectomy was required in 7 patients (1.9%). Our hysterectomy rate after cesarean section was 0.02% (7/36196*100).
The diagnosis of postpartum hemorrhage was made 10.1 (± 19.1) hours after the first operation. In cases in which surgical intervention was performed, the mean interval between re- laparotomy and the first operation was 9.26 ± 23.1 hours. 2 patients (0.6%) developed DIC, 3 patients (0.8%) posterior reversible encephalopathy syndrome (PRES), and 2 patients (0.6%) developed eclampsia during follow-up. There was a single case of acute fatty liver (0.3%) and venous thromboembolism (0.3%). Near-miss were noted in 53 patients, and 11 patients (3.1%) required anesthesia intensive care unit. The rate of near miss was calculated to be 0.6 per 1000 live births (Table 3).

Discussion

The present study showed that follow-up in the cesarean intensive care unit is beneficial in early intervention of postpartum complications after cesarean section. The incidence of postpartum hemorrhage after cesarean delivery in our series was 1.0%, which is lower than the previously published incidence. We believe this is due in part to the immediate care provided in the first 8 hours. Although 73.8% of these patients required transfusion of blood and blood products, the need for re- laparotomy was low compared with the literature.
In terms of health economics, monitoring patients in the cesarean intensive care unit is less costly than direct room care because four nurses and one physician are sufficient to provide adequate care. However, it is more costly than direct room transfer because of staffing, medical equipment, devices, ventilators, electricity costs, etc.
Postpartum hemorrhage is the leading and preventable cause of maternal morbidity and mortality worldwide (6,11,12). Early diagnosis, prompt intervention for hemorrhage, and appropriate treatment play a key role in preventing maternal mortality (13, 14). In addition to publications reporting an incidence of 4-6% postpartum hemorrhage (12), there are publications indicating an incidence of massive hemorrhage of approximately 5-15% (15). However, the 5-year incidence of postpartum hemorrhage after cesarean section in our hospital is 1% lower than the previously reported world average. This low incidence may be due to the exclusion of intraoperative atony cases and vaginal deliveries with a lower threshold for postpartum hemorrhage.

As mentioned earlier, intensive care after cesarean section may result in a lower incidence and earlier diagnosis of postpartum hemorrhage. Kalisa et al. reported a blood transfusion rate of 32.5% versus a re-laparotomy rate of 21.4% and a maternal mortality rate of 13.1% (13). In our study, the transfusion rate was 73.8%, the re-laparotomy rate was 3.1%, and the mortality rate after cesarean section was 3.9%. Although the transfusion requirement is higher in patients, the need for repeat laparotomy and the low maternal mortality rate suggest that early treatment is effective; it may also be suggested that the rate of surgical intervention can be reduced by early diagnosis of postpartum hemorrhage. We hypothesize that early diagnosis will increase the response to medical treatment and thus reduce the number of surgical procedures.

Although many prenatal and intrapartum risk factors have been identified that increase the risk of postpartum hemorrhage, there is no identifiable risk factor for most cases (16). Consistent with the literature, conditions that are considered risk factors for hemorrhage, such as multiple pregnancies, macrosomia, preterm labor, and Placenta Previa, were common in our series.

In the literature, the need for blood transfusion after cesarean section is reported to be 1-7% (17). Although in our setting the need for blood and blood product transfusion after cesarean section was 0.7%, this rate was lower than that reported in the literature. However, 73.8% of these patients with postpartum hemorrhage had blood and blood product transfusion. These results indicate that blood and blood product transfusion after cesarean section was lower than reported in the literature because the ICU allows patients to be diagnosed early and receive early medical intervention. Nevertheless, we are more aggressive with blood transfusions in patients who are diagnosed with postpartum hemorrhage.

A study by Holleboom et al. found that after cesarean section, 7.2% of patients required supplemental oxytocin. (18). In our study, although the need for additional oxytocin was 10.3%, 89.7% of patients with postpartum hemorrhage were controlled with combined uterotonics without further intervention or treatment. We used a combination of these drugs by treating the patient individually during postpartum hemorrhage. The need for additional medical treatment is higher than suggested in the literature, early diagnosis and rapid treatment of postpartum hemorrhage in the cesarean intensive care unit.

Uterine balloon tamponades can temporarily control the bleeding until appropriate management is achieved (16,19). According to a meta-analysis, the rate of use of the Bakri ™ balloon was 0.20%, and two-thirds (67%) of insertions occurred after cesarean delivery (20). In our study, the rate of copper balloon use in patients with postpartum hemorrhage after cesarean delivery is 6.4%, but lower than previously published data. Uterine artery ligation is a procedure that is now abandoned in the literature in the treatment of postpartum hemorrhage (21). It was observed that the effect was not feasible when the cervicovaginal and uteroovarian branches were not ligated. In our study, the incidence of uterine artery ligation was 1.9%. Although it is easy to apply, it is less preferred in re-laparotomy because it is only an anesthetic.

Joseph et al found that the rate of hysterectomies associated with postpartum hemorrhage was 73%, but it was not stated whether peripartum hysterectomies were included here (21). In our study, the rate of hysterectomies related to postpartum hemorrhage was 1.9%. According to another study, the rate of postpartum hysterectomy was 0.38%, excluding peripartum hysterectomies (22), and our rate of hysterectomy after cesarean section was 0.02%, which is far lower than the literature. The low rate of our hysterectomy is probably due to the early

diagnosis of patients in the cesarean intensive care unit and the fact that peripartum hysterectomies were not included in the statistics.

Levin et al. and Akkurt et al. found that the time between cesarean section and re- laparotomy was 25.2 (± 35.6) hours and 15.7 (± 3.2) hours, respectively (23, 24). According to the studies performed, our conclusion is that the time between cesarean section and relaparotomy is less than that reported in the literature, but does not prevent the need for relaparotomy. In addition, the time in the intensive care unit was prolonged in patients who may need re-laparotomy, and their follow-up was continued in this unit until they were taken to the operating room. The incidence of re-laparotomy after cesarean section has been reported in the literature to be 0.2, 0.5, and 0.7 (25-28). In our study, the incidence of re-laparotomy after cesarean section was 0.03% (36.196 for cesarean deliveries). This low rate may be due to the fact that we kept patients in the intensive care unit for 8 hours after cesarean section. The number of patients who required repeat laparotomy may be low because we intervened early and achieved a high blood transfusion rate. The fact that intraoperative bleeding was not considered in this study and the definition of postpartum hemorrhage was > 1000 ml also resulted in these data being lower than those reported in the literature, but to obtain accurate data on postpartum hemorrhage.

A systematic review reported that postpartum hemorrhage rates and associated mortality are higher in low- and middle-income countries. The rate of postpartum near-miss was 2.1 per 1000 live births. Our study is significantly lower than the literature with a near-miss rate of 0.6 per 1000 live births after cesarean section (29). We believe that the rate is lower than near-miss literature because we were able to diagnose and treat early, thanks to intensive care after cesarean section.

Study Limitations

Our study has some limitations. First of all, we do not have a control group because all patients are admitted to the intensive care unit after cesarean section according to the protocol of our hospital. Not including cases with intraoperative atony may have resulted in a falsely low incidence of postpartum hemorrhage. Future prospective randomized studies, including a control group, are needed to support our findings. Retrospective design and incomplete data were the other limitations. This study can be enriched with multicenter studies, and a control group can be added.

Conclusions

Compared with published data, the advantage of CS intensive care may be earlier detection of postpartum hemorrhage, resulting in less blood loss and lower maternal mortality rate after cesarean section. CS Intensive care may be associated with a decrease in mortality rates after cesarean delivery and near-miss events.

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Table 1. Characteristics of patients

	Study Population (n=359)
Age*	28 (16-45)
Gravida*	2 (1-9)
Parity*	1 (0-7)
Abortion*	0 (0-5)
Pre-partum transfusion	12 (3.4 %)
Indications for caesarean	
Placenta previa	6 (1.7 %)
Fetal distress	61 (17 %)

Labor arrest	61 (17 %)
Ablatio placenta	17 (4.7%)
Severe preeclampsia	11 (3.1 %)
Macrosomic fetus	16 (4.5 %)
Previous caesarean	157 (43.7 %)
Non-vertex presentation	24 (6.7 %)
Umbilical cord prolapsus	6 (1.7 %)
* Data are given as median (minimum-maximum) or n (%).	

Table 2. Obstetric and neonatal outcomes	
	Study Population (n=359)
Gestational age	
Mean (± standard deviation)	36.9 (± 3.2)
34 - 37 weeks	54 (15 %)
< 34 weeks	45 (12.5 %)
>37 weeks	260 (72.4 %)
High-risk pregnancies	
Twin pregnancy	33 (9.2 %)
Preeclampsia	21 (5.9 %)
Placenta previa	6 (1.7 %)
PPROM	14 (3.9 %)
IUGR	15 (4.1 %)
Stillbirth	15 (4.1 %)
Neonatal birth weight, grams	
Mean (± standard deviation)	3064 (± 727)
> 4000	21 (5.9 %)
< 2500	45 (12.3 %)
Neonatal Apgar scores	
1 minute*	9 (0-9)
5 minute*	10 (0-10)
NICU admission	59 (16.4 %)
* Data are given as median (minimum-maximum) or n(%).	

Table 3. Treatment for postpartum bleeding	
	Study Population (n=359)
Uterotonics	
Additional Oxytocin	37 (10.3 %)
Combined (Oxytocin +/- misoprostol +/- methylergonovine)	322 (89.7 %)
Tranexamic acid use	150 (41.7 %)
Bakri balloon tamponade	23 (6.4 %)
Blood and blood product transfusion	265 (73.8%)
Re-laparatomy	11 (3.1 %)
Surgical procedures undergone re-laparatomy	
Uterine artery ligation	7 (1.9 %)
Hysterectomy	7 (1.9 %)
B-Lynch	11 (3 %)
The interval between diagnosis and primary operation time, hours *	10.1 (± 19.1)
The interval between re-laparotomy and primary operation time , hours *	9.26 (± 23.1)
Postpartum complications	
DIC	2 (0.6 %)
Eclampsia	2 (0.6 %)
Acute fatty liver	1 (0.3 %)
Venous thromboembolism	1 (0.3 %)
PRES	3 (0.8 %)
Near miss events	53 (14 %)
Need for anesthesia intensive care unit	11 (3.1 %)
* Data are given as mean ± standard deviation or n (%).	