Effect of a Combined Hemostatic Technique during Cesarean Section in Placenta Previa

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Objective: Only a few methods, besides cesarean hysterectomy, are available for controlling intractable bleeding in placenta previa. We aimed to evaluate the effect of the combined hemostatic technique during cesarean section for placenta previa.

Methods: We retrospectively reviewed all cesarean deliveries for placental previa performed from April 2013 to December 2018 at Jeonbuk National University Hospital. Medical records were reviewed to determine the amount of red blood cell transfusion, degree of blood loss, and incidence of postpartum hysterectomy and uterine artery embolization between the conventional method and combined technique. Conventional hemostatic technique group undergo usual cesarean section surgery, and combined hemostatic technique comprises temporary bilateral ovarian artery clamping, bilateral uterine artery ligation, and intrauterine Bakri balloon (Cook Medical, Bloomington, IN, USA) tamponade.

Results: There were 135 cesarean deliveries for placenta previa during the study period (conventional hemostatic method, n=100; combined hemostatic technique, n=35). The index of blood loss (conventional vs. combined, 0.22±0.13 vs. 0.22±0.11, P=0.90) was not different between the two groups. However, the mean amount of intraoperative red blood cell transfusion (0.88±2.12 vs. 0.55±0.93 units, P=0.02) was significantly lower in the combined technique group. The incidence of postpartum hysterectomies (5 vs. 0, P=0.025) and postpartum treatments (13 vs. 0, P=0.006) for continuous bleeding after cesarean section was also significantly lower in the combined technique group.

Conclusion: Our findings suggest that combined hemostatic technique is associated with less intraoperative red blood cell transfusion and a decreased rate of postpartum hysterectomy and additional hemostatic procedures after cesarean section for placenta previa.

Key Words: Hemostasis, Cesarean section, Uterine balloon tamponade, Placenta previa

Introduction

Placenta previa is one of the main causes of postpartum hemorrhage and occurs in 3.5 to 4.6 per 1,000 births. Conventionally, hemostasis of cesarean section in placenta previa was performed by suturing the area of bleeding after separation of placenta. Various methods have been attempted to reduce the amount of bleeding at cesarean section, such as uterine compression suture with a B-lymph, intrauterine balloon tamponade, and vascular ligation. However, occasionally massive bleeding occurs, and only a few methods, apart from cesarean hysterectomy, are available for controlling intractable bleeding. The frequency of hysterectomy after cesarean section due to placenta previa is 5.3%, and the perinatal mortality rate in placenta previa is 3 to 4 times higher than in normal pregnancy. In this study, we examined the hemostatic effect of a combined hemostatic technique which comprises temporary bilateral ovarian artery clamping, bilateral uterine artery ligation, and intrauterine Bakri balloon (Cook Medical, Bloomington, IN, USA) tamponade, during a cesarean section for placenta previa. We try to compare the results of our study in various ways and got meaningful results that a new combined hemostatic technique is a good safe alternative method to conventional surgery.
Methods

1. Study design and population

We retrospectively enrolled 135 women who underwent cesarean section for placenta previa at Jeonbuk National University Hospital from April 2013 to December 2018. All placenta previa patients except two patients with placenta percreta were included. Subjects were classified into a control group (n=100) for whom conventional hemostatic techniques were applied and a combined hemostatic technique group (n=35) for whom a combined hemostatic technique was applied during the cesarean section. Conventional hemostatic techniques included uterine compressive suturing, uterine artery ligation, and insertion of vaseline gauze in the uterus; these were applied alone or in combination at the operator’s discretion when postpartum hemorrhage occurred. For the combined hemostatic technique, temporary occlusion of both the ovarian arteries, bilateral uterine artery ligation, and insertion of a Bakri balloon in the uterus were performed simultaneously.

All clinical and hematologic data were obtained by reviewing the patients’ medical records in a retrospective cohort study. Placenta previa type was divided into complete, partial, marginal and low-lying previa depending on the degree of coverage of the internal cervical os. Maternal age, gestational age, obstetric history, placenta previa type, operative time, preoperative and postoperative changes in hemoglobin, amount of bleeding, number of blood transfusions, and number of postoperative fluid infusions were compared between the two groups. Bleeding amount was calculated using the formula called estimated blood loss proposed by Stafford et al., which compares hemoglobin change with the hematocrit before and on the third day after surgery. Moreover, because estimated blood loss does not reflect blood transfusion, the bleeding index was calculated using hemoglobin and amount of blood transfusion compared between the two groups. The bleeding index was derived from the ratio of change in hemoglobin before and after the surgery: bleeding index=(preoperative hemoglobin+unit of transfused red blood cell-postoperative hemoglobin)/(preoperative hemoglobin+unit of transfused red blood cell).

2. Operation method

The abdominal incision was a modified pfannenstiel incision to create sufficient space to access the uterus from the abdominal cavity after the fetus was delivered, without the separation of the placenta. Regardless of the placental position, the uterus was transversely incised to deliver the fetus. Thereafter, the uterus was lifted from the peritoneal cavity without separating the placenta, and both the infundibulopelvic ligaments were temporarily occluded using kelly forceps. Subsequently, the uterine arteries were ligated bilaterally using absorbable sutures beneath the level of the uterine incision. After placental separation, the cut edges of both corners of the uterine incision were approximated with a suture, without closure of the central portion to allow reverse insertion of the Bakri balloon from uterus to vagina. A Bakri balloon was placed in the low segment of the uterus and interrupted sutures were applied to the central portion of the incision site of the uterus. Bakri balloon was inflated until hemorrhage stopped. After inflation of Bakri balloon, temporary occlusion of infundibulopelvic ligaments was removed. To prevent the Bakri balloon from being expelled through the cervix, a loose circular suture was placed at the lower part of the hysterotomy and an intraperitoneal drain was placed through the abdominal cavity as necessary. The average saline injection volume of Bakri balloon was about 200 mL and was removed 24 hours after surgery. All processes were performed regardless of the amount of bleeding and no direct suture was performed on the area of bleeding.

3. Statistical analysis

Maternal age, number of gestational weeks, obstetric history, placenta previa type, operative time, preoperative and postoperative changes in hemoglobin, amount of bleeding, number of blood transfusions, and number of postoperative fluid infusions were compared between the two groups by using Student’s t-test. Statistical significance was defined as P<0.05.

Results

1. Demographic findings

The average ages of the two groups did not differ significantly (conventional vs. combined hemostatic technique, 34.32±3.84 vs. 33.09±3.57, P=0.09). The ratio between primigravida and multigravida, and history of previous delivery were also not
significantly different in the two groups. Gestational age at the time of operation was slightly higher in the combined hemostatic technique group but this was not statistically significant (36.51±0.23 vs. 37.57±0.15 weeks, P=0.06) (Table 1).

2. Estimated blood loss

Total operative time (95.8±32 vs. 87.40±19.29 minutes, P=0.229), and preoperative (11.35±0.15 vs. 11.35±0.27 g/dL, P=0.71) and postoperative hemoglobin (9.67±0.10 vs. 9.35±0.17 g/dL, P=0.118) were not significantly different between the two groups. Estimated blood loss and the bleeding index were also not significantly different between the groups. However, intraoperative red blood cell transfusion and fluid infusion were significantly lower in the combined hemostatic technique group (2.38±0.48 vs. 0.55±0.28 units, P=0.002; 2,045.31±196.63 vs. 1,584.86±108.13 mL, P=0.042, respectively) (Table 2).

3. Postoperative outcomes and management

No significant difference was observed regarding length of hospitalization or amount of intraperitoneal drainage. However,
in the combined hemostatic technique group, additional postoperative procedures (13 vs. 0, \(P=0.006\)) such as admission to the intensive care unit, uterine artery embolization, intrauterine gauze packing, and hysterectomy (5 vs. 0, \(P=0.025\), respectively), were not required (Table 3).

### Discussion

We have found advantages in both intraoperative and postoperative outcomes in the combined hemostatic technique group compared with the conventional group. During surgery, the combined hemostatic technique group required less blood transfusion and intravenous fluid injection. After surgery, the combined hemostatic technique group required no other procedure for control of hemorrhage.

Placenta previa is one of the most important obstetric complications causing massive bleeding both before and after parturition. With the increased use of ultrasonography in the obstetric examination, diagnosis of placenta previa is often made at periodic medical examinations, and in most cases, cesarean delivery is required, except in a few cases of placenta previa low-lying. Massive bleeding due to the removal of the placenta at cesarean section for placenta previa may occur, especially when the placenta is adherent. Fan et al. conducted a meta-analysis involving 5,146 women diagnosed with placenta previa and reported a 27.4% incidence of postpartum hemorrhage. In Asia, the incidence of postpartum hemorrhage from placenta previa was 20.7%; thus, its frequency was higher than that in normal pregnancy.

The frequency of cesarean hysterectomy or uterine artery embolization is higher, particularly when the placenta is adherent. A systematic review revealed that, when expectant therapy was performed, cesarean hysterectomy was required in 19% of cases. But when massive bleeding is occurred in surgery so uterine preservation procedures, including uterine compression sutures such as B–lynch, intrauterine balloon tamponade, and uterine artery embolization, were performed, cesarean hysterectomy was required in 31% of cases. However, predicting massive hemorrhage in placenta previa is difficult despite several reports of attempts at prediction using with variable predicting factors. Procedures such as the B–lynch, multiple square suture, sandwich technique combining B–lynch and balloon tamponade, and recently introduced descending aorta ligation, have been developed to reduce bleeding and maternal mortality and preserve the uterus at the time of cesarean section for placenta previa. However, there remains no evidence regarding the efficacy of any specific procedure. Consequently, cesarean hysterectomy remains the most common procedure to prevent postpartum hemorrhage.

Additionally, as a preoperative procedure, prophylactic internal iliac artery catheterization has been attempted; however, about 8% of patients required hysterectomy, and postoperative internal iliac artery thrombus was reported in some cases and required removal.

In our study, the combined hemostatic technique was primarily aimed at reducing the blood loss after the separation of the placenta during a cesarean section for placenta previa. To achieve this, it was necessary to occlude the blood vessels supplying the uterus before the placenta was removed. Both the ovarian arteries were temporarily occluded, and the ascending branch of the uterine artery was ligated bilaterally with absorbable sutures. This notably reduced the amount of bleeding after placenta removal, ensuring a good operative field of view, and providing time for the next stage of the surgery by reducing unnecessary blood loss during the insertion of the Bakri balloon. Another purpose of the combined hemostatic technique was to reduce delayed blood loss postoperatively os as to preserve the uterus and prevent the need for additional procedures such as hysterectomy or uterine artery embolization to achieve be-

| Parameter                  | Conventional hemostatic technique group (n=100) | Combined hemostatic technique group (n=35) | \(P\)-value |
|----------------------------|-----------------------------------------------|------------------------------------------|-------------|
| Hospital stay (days)       | 6.31±0.12                                     | 6.31±0.11                                | 0.980       |
| Drainage amount            |                                              |                                          |             |
| Bakri (mL)                 | 64.26±44.15                                   |                                          |             |
| Intrapitoneal drain (mL)   | 298.84±63.98                                  | 187.65±29.79                            | 0.129       |
| Follow-up procedure        | 13                                            | 0                                        | 0.006       |
| ICU admission              | 3                                             | 0                                        | 0.415       |
| UAE                        | 2                                             | 0                                        | 0.508       |
| Hysterectomy               | 5                                             | 0                                        | 0.025       |
| Gauze packing              | 3                                             | 0                                        | 0.415       |

Values are presented as mean±standard deviation or number. Abbreviations: ICU, intensive care unit; UAE, uterine artery embolization.
mostasis. Some small studies reported using a single Foley catheter, Sengstaken-Blakemore tube, or Bakri balloon tamponade to prevent delayed hemorrhage in placenta previa, which can occur when uterine blood vessels within the placental bed are exposed in the lower part of the uterus.\textsuperscript{21-23} We applied Bakri balloon tamponade at the low segment of the uterus, and this successfully compressed the exposed vessels, avoiding the need for further postoperative procedures.

In this study, hemoglobin was measured before the surgery and 72 hours after the surgery. Depending on whether red blood cell transfusion was performed, the change in the amount of blood loss and hemoglobin was calculated and compared to measure the hemostatic effect of the combined hemostatic technique. However, because of the nature of the cesarean section, it was difficult to accurately measure the amount of blood that did not contain amniotic fluid. Moreover, variations in hemoglobin and hematocrit occurred because of the postoperative fluid injection and urine output. As a result, no statistical difference was detected in the change in postoperative hemoglobin or hematocrit, and even in comparison of blood loss using estimated blood loss or bleeding index. However, in patients who received blood transfusion, there was a significant difference in amounts of red blood cell transfusion and intraoperative fluid injection. This means that the combined hemostatic technique could provide a more stable condition with respect to vital signs such as blood pressure and heart rate, in patients with massive bleeding who required intraoperative blood transfusion. Additionally, no additional operation time was required compared to the conventional technique. Moreover, when comparing the requirement for postoperative procedures, a notable difference was detected between the groups. Compared with the control group that required a total of 13 postoperative treatments, including 5 cesarean hysterectomies and 2 uterine artery embolizations, the experimental group using the combined hemostatic technique required no postoperative procedures (13 vs. 0, \( P = 0.006 \)).

In conclusion, cesarean section using the combined hemostatic technique seems a safe surgical method for ensuring postoperative hematologic stability and for reducing maternal blood transfusion and postoperative procedures, including cesarean hysterectomy. Prediction of the amount of bleeding is difficult, and the combined hemostatic technique requires no extra preoperative preparation apart from the Bakri balloon. Thus, it can be applied immediately in cases of abrupt massive bleeding, with no additional operation time. Moreover, using modified pfannenstiel skin incision, it was possible to obtain a cosmetic advantage and secure adequate view and access. At 5 weeks postoperatively, normal uterine artery Doppler flow was assessed via transvaginal ultrasonography. This is possible when uterine involution occurs after delivery and when the uterine artery, which was compressed between the absorbable sutures and uterine muscles, is recommunicated with a high arterial pressure. Thus, we conclude that the combined hemostatic technique is a useful method for reducing major complications of placenta previa surgery in a safe manner. However, we did not attempt the combined hemostatic technique in patients with placenta percreta, so its efficacy in this situation is yet to be determined.

**Conflict of interest**

No potential conflict of interest relevant to this article was reported.

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