Intrauterine gauze or balloon tamponade for the management of postpartum hemorrhage due to uterine atony during maternal transportation

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Aim: This study aimed to evaluate the effectiveness of intrauterine gauze or balloon tamponade for the management of postpartum hemorrhage due to uterine atony during maternal transportation from private clinics to higher-level facilities.

Methods: A total of 1,428 patients were transported to the Department of Obstetrics, Juntendo University Shizuoka Hospital, between January 2008 and December 2019. Among these, 42 patients had postpartum hemorrhage due to uterine atony. Of the 42 patients, 29 (69.0%) were treated with intrauterine gauze or balloon tamponade before transportation (tamponade group); no intrauterine packing was performed in the remaining 13 (31.0%) (non-tamponade group). The primary outcome was the rate of critical obstetrical hemorrhage at hospital arrival. Secondary outcomes were blood loss before and after transportation, hemoglobin, platelets, fibrinogen, amount of blood transfusion, and rate of transfusion.

Results: The rate of critical obstetrical hemorrhage was significantly lower in the tamponade group (34.5% (10/29)) compared to the non-tamponade group (76.9% (10/13)). Moreover, total blood loss during transportation and after hospital arrival was significantly lower in the tamponade group (487 ± 331 g) compared to the non-tamponade group (1,199 ± 1,012 g).

Conclusion: Intrauterine gauze or balloon tamponade before transportation to higher-level facilities is effective for managing postpartum hemorrhage due to uterine atony.

Introduction

Obstetrical hemorrhage is the leading cause of maternal mortality, accounting for 27.1% of maternal deaths worldwide. More than two-thirds of reported hemorrhage deaths are classified as postpartum hemorrhage (PPH), which is mainly caused by uterine atony. Basic treatments for PPH due to uterine atony include bimanual uterine compression, administration of uterotonic agents, and intrauterine packing. In cases of severe PPH, interventional radiology (angiographic embolization), uterine compression suture, and hysterectomy may also be performed at higher-level facilities.

In Japan, the rate of all deliveries in private clinics remained almost the same from 2010 (48%) to 2017 (46%). When PPH occurs in private clinics and basic treatment fails, patients are transported to higher-level facilities. To save maternal life, it is important to prevent further bleeding during transportation. The Japanese Clinical Practice Guide for Critical Obstetrical Hemorrhage, which was issued by five related societies in 2010 and corrected and revised in 2017, recommends that uterine balloon tamponade be performed before transportation.
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PPH can occur in private clinics at any time, but few reports are available regarding the prognosis of patients after transportation. While intrauterine packing has been recommended as the first-line treatment for PPH, intrauterine packing with gauze or balloon tamponade is not always performed before transportation. Accordingly, the present study aimed to evaluate the effectiveness of intrauterine gauze or balloon tamponade for the management of PPH due to uterine atony during transportation from private clinics.

Materials and methods

Between January 2008 and December 2019, 1,428 patients were transported by ambulance or air ambulance to the Department of Obstetrics, Juntendo University Shizuoka Hospital, for fetal or maternal complications. Among these, 84 patients were diagnosed with PPH prior to transportation, of whom 43 were ultimately diagnosed with uterine atony after transportation. One of the 43 patients who underwent bimanual uterine compression during transportation was excluded, leaving a study population of 42 patients. Of the 42 patients, 29 were treated with intrauterine gauze or balloon tamponade before emergency transportation (tamponade group), and 13 were not treated with tamponade (non-tamponade group).

The primary outcome was the rate of critical obstetrical hemorrhage at hospital arrival. Secondary outcomes were blood loss before transportation, total blood loss during transportation and after hospital arrival, hemoglobin, platelets, fibrinogen, amount of blood transfusion, and rate of transfusion. Other parameters investigated included patient clinical characteristics (i.e., maternal age, weeks of gestation, rate of vaginal delivery, and newborn weight at birth).

Critical obstetrical hemorrhage was defined as persistent bleeding and abnormal vital signs (e.g., oliguria and peripheral circulatory failure), a shock index (SI: heart rate/systolic blood pressure) ≥ 1.5, or an obstetrical disseminated intravascular coagulation (DIC) score ≥ 8 (or a fibrinogen level ≤ 150 mg/dl). In our hospital, an abnormal vital sign is defined as an SI ≥ 1.0; therefore, both persistent bleeding and an SI ≥ 1.0 were included in the definition of critical obstetrical hemorrhage.

Values are shown as mean ± SEM. All parameters were evaluated with the Wilcoxon signed-rank test or Fisher’s exact test. P < 0.05 was considered statistically significant.

Results

The two groups showed no significant differences in characteristics (Table 1). The number of transportation cases in which patients were treated with intrauterine gauze or balloon tamponade has been on the rise in recent years, with 22 cases (95.7%) in the last three years (Figure 1). None of the 42 patients required hysterectomies.

The rate of critical obstetrical hemorrhage was significantly lower in the tamponade group (34.5% (10/29)) compared to the non-tamponade group (76.9% (10/13)). Persistent bleeding and abnormal vital signs (SI ≥ 1.0) were significantly less common in the tamponade group compared to the non-tamponade group (Table 2). Blood

| Variable                      | Gauze or balloon tamponade (n = 29) | No procedure (n = 13) | P          |
|-------------------------------|-------------------------------------|-----------------------|------------|
| Age (y)                       | 32.5 ± 5.7                          | 31.9 ± 6.3            | 0.96 W     |
| Gestational age (week)        | 39.1 ± 1.4                          | 38.4 ± 1.2            | 0.71 W     |
| Rate of vaginal delivery (%)  | 72.4 (21/29)                        | 76.9 (10/13)          | 0.53^      |
| Birth weight (g)              | 3,146 ± 274                        | 3,017 ± 690           | 0.73 W     |
| Time (min)                    | 259 ± 191                          | 428 ± 385             | 0.17 W     |

Table 1. Clinical characteristics of transported patients with PPH

Time: time from delivery to hospital arrival

Values are shown as mean ± SEM. Differences between the two groups were analyzed using the Wilcoxon signed-rank test (W) or Fisher’s exact test (F), with P < 0.05 being considered significant.
loss before transportation did not differ significantly between the two groups, but total blood loss during transportation and after hospital arrival was significantly lower in the tamponade group (487 ± 331 g) compared to the non-tamponade group (1,199 ± 1,012 g). Hemoglobin, platelets, and fibrinogen upon hospital arrival showed no significant differences between the two groups. In total, 48.3% (14/29) of patients in the tamponade group and 61.5% (8/13) of patients in the non-tamponade group received blood transfusions (Table 3).

**Table 2. Details of critical obstetrical hemorrhage**

| Values                          | Gauze or balloon tamponade (n = 29) | No procedure (n = 13) | P       |
|---------------------------------|-------------------------------------|-----------------------|---------|
| Persistent bleeding and SI ≥ 1.0| 27.6% (8/29)                        | 76.9% (10/13)         | 0.0058<sup>W</sup> |
| SI ≥ 1.5                        | 6.9% (2/29)                         | 23.1% (3/13)          | 0.16<sup>W</sup>  |
| DIC score ≥ 8                   | 6.9% (2/29)                         | 23.1% (3/13)          | 0.16<sup>F</sup>  |
| Fibrinogen level ≤ 150 mg/dl    | 27.6% (8/29)                        | 38.5% (5/13)          | 0.49<sup>W</sup>  |

Differences between the two groups were analyzed using the Wilcoxon signed-rank test (W) or Fisher’s exact test (F), with P < 0.05 being considered significant.

**Table 3. Outcomes of transported patients with PPH**

| Outcome                              | Gauze or balloon tamponade (n = 29) | No procedure (n = 13) | P       |
|--------------------------------------|-------------------------------------|-----------------------|---------|
| Rate of critical obstetrical hemorrhage (%) | 34.5% (10/29)               | 76.9 (10/13)          | 0.0186<sup>F</sup> |
| Blood loss                           |                                     |                       |         |
| 1) Before transportation (g)         | 1,976 ± 690                        | 1,824 ± 746           | 0.41<sup>W</sup>  |
| 2) During transportation and after hospital arrival (g) | 487 ± 331                       | 1,199 ± 1,012         | 0.0127<sup>W</sup> |
| Hemoglobin (g/dl)                    | 8.7 ± 2.1                          | 7.6 ± 2.4             | 0.17<sup>W</sup>  |
| Platelets (10<sup>11</sup>/μl)       | 170.3 ± 44.3                       | 166.5 ± 68.0          | 0.66<sup>W</sup>  |
| Fibrinogen (mg/dl)                   | 228.3 ± 101.5                      | 200.0 ± 116.2         | 0.47<sup>W</sup>  |
| Blood transfusion                    |                                     |                       |         |
| 1) Number of RBC units               | 3.7 ± 5.1                          | 5.7 ± 6.4             | 0.35<sup>W</sup>  |
| 2) Number of FFP units               | 4.2 ± 7.5                          | 6.6 ± 11.6            | 0.20<sup>W</sup>  |
| 3) Number of PC units                | 0                                  | 0.7 ± 2.8             | 0.41<sup>W</sup>  |
| Rate of blood transfusion (%)        | 48.3 (14/29)                       | 61.5 (8/13)           | 0.51<sup>F</sup>  |

Values are shown as mean ± SEM. Differences between the two groups were analyzed using the Wilcoxon signed-rank test (W) or Fisher’s exact test (F), with P < 0.05 being considered significant.

Discussion

This study demonstrated that intrauterine gauze or balloon tamponade before transportation is an effective approach for managing critical obstetrical hemorrhage and reducing blood loss. In the tamponade group, some patients required no further treatment upon arrival at our hospital, as bleeding had almost completely stopped. On the other hand, significantly more patients had persistent bleeding and abnormal vital signs in the non-tamponade group, with increased blood loss during transportation and subsequent DIC. These findings suggest that intrauterine gauze or balloon tamponade should be performed to reduce bleeding, especially during transportation to higher-level facilities, in patients with PPH due to uterine atony.

Previous studies reported on the effectiveness of intrauterine balloon tamponade for PPH, similar to the present study. Several national guidelines recommend intrauterine balloon tamponade as the first-line hemostatic treatment for PPH. A few studies, however, have noted difficulties or failure in using the balloon approach. In the present study, insertion of a balloon before transportation was not feasible in one patient who had intrauterine gauze tamponade, and in another patient, the inserted balloon fell into the vagina when the patient arrived at our hospital (i.e., balloon prolapse). Intrauterine balloon tamponade, the balloon is inserted into the uterine cavity and inflated with saline under transabdominal ultrasound guidance. This, however, may be difficult in private obstetrical clinics under emergency situations due to the lack of sufficient staff or resources. Moreover, balloon displacement occurs in roughly 10% of cases. A new balloon device needs to be developed which can be inserted more easily and is not likely to fall into the vagina. Meanwhile, intrauterine gauze tamponade is an easy procedure that requires no complicated techniques or devices.

It is also advantageous in that gauze tamponade better
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conforms to the shape of the uterus or vagina and can be individualized for each patient. Furthermore, some studies have reported that complications, such as uterine rupture\(^1\) and perforation,\(^2\) are less common compared to balloon tamponade. Intrauterine gauze tamponade can thus offer an effective alternative in cases where balloon tamponade is too difficult to perform before transportation.

The limitation of the present study is the small sample size. A larger sample size will be necessary to clarify differences between intrauterine gauze and balloon tamponade.

In conclusion, intrauterine gauze or balloon tamponade before transportation to higher-level facilities is an effective treatment for PPH due to uterine atony, as it prevents critical obstetrical hemorrhage and blood loss. Moreover, no major adverse events or specific treatment-associated morbidity were observed due to intrauterine gauze or balloon tamponade. Intrauterine gauze or balloon tamponade should be performed to reduce bleeding, especially during transportation, for the management of PPH due to uterine atony.

**Conflict of interest**

The authors declare no conflicts of interest related to this study.

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