

# Intrauterine Balloon Tamponade in the Management of Postpartum Hemorrhage

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## ABSTRACT

This article reviews our experience with the use of intrauterine tamponade with balloon catheters in the management of severe postpartum hemorrhage. This is a case series report of 23 patients with postpartum hemorrhage unresponsive to medical therapy managed with intrauterine balloon tamponade. We identified these patients by International Classification of Diseases (ICD-9) codes and by reviewing labor and delivery logs. Balloon tamponade was attempted in 23 patients. When properly placed, catheters controlled postpartum hemorrhage in 18 of 20 cases (90%). In two cases, hysterectomy was required despite successful placement of the catheter. For hemorrhage due to uterine atony, our success rate was 100% (11/11 cases). In three cases, technical difficulties led to placement failure. For bleeding due to retained placenta, our success rate was 80% (4/5; failure with placenta percreta). Vaginal bleeding was stopped with the catheter in two of three cases of amniotic fluid embolus and in one case after dilation and curettage for postpartum septic shock. Thus balloon tamponade is an effective adjunct in the treatment of severe postpartum hemorrhage, especially when due to uterine atony when medical therapy fails.

**KEYWORDS:** Postpartum hemorrhage, intrauterine balloon tamponade

Postpartum hemorrhage occurs in ~3% of births.<sup>1-5</sup> Despite advances in medical treatment, obstetric hemorrhage remains the direct cause of > 18% of pregnancy-related deaths in the United States.<sup>3</sup> In most labor and delivery units, a sequence of steps is initiated as soon as the condition is recognized to distinguish the reason for hemorrhage (atony, lacerations, retained placenta, or disseminated intravascular coagulation). Historically, when uterine bleeding persists after administration of uterotonics and curettage, operative therapies must be considered, including laparotomy with uterine, utero-ovarian or hypogastric artery ligation, placement of uterine compression sutures such as the B-Lynch modification, or hysterectomy. The

morbidity of these surgeries and the desire to preserve fertility has led to the development of new therapies including balloon tamponade.

Over the last two decades, balloon tamponade use has been reported for the management of postpartum hemorrhage.<sup>6-14</sup> Success rates for control of postpartum bleeding have ranged from 71<sup>12</sup> to 87%.<sup>14</sup> Different types of balloons have been used successfully for tamponade, including Foley catheters,<sup>6,7,10</sup> Rusch catheters,<sup>11</sup> Sengstaken-Blakemore (C. R. Bard Inc, Covington, GA) tubes,<sup>8,9,12,14,15</sup> and the SOS Bakri catheter (Cook Medical Inc., Bloomington, IN).<sup>13</sup>

The principle of balloon tamponade therapy is to fill the uterine cavity to control bleeding with pressure.

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Balloon tamponade is a readily available, inexpensive procedure that can be performed in the delivery room as a clinical tool to determine if additional more morbid therapies are required or as therapy for postpartum hemorrhage. Further, some balloons have a drainage port to allow blood to escape as a way to monitor continued bleeding.

This article reviews maternal outcomes in cases of postpartum hemorrhage in which balloon catheters were used for tamponade.

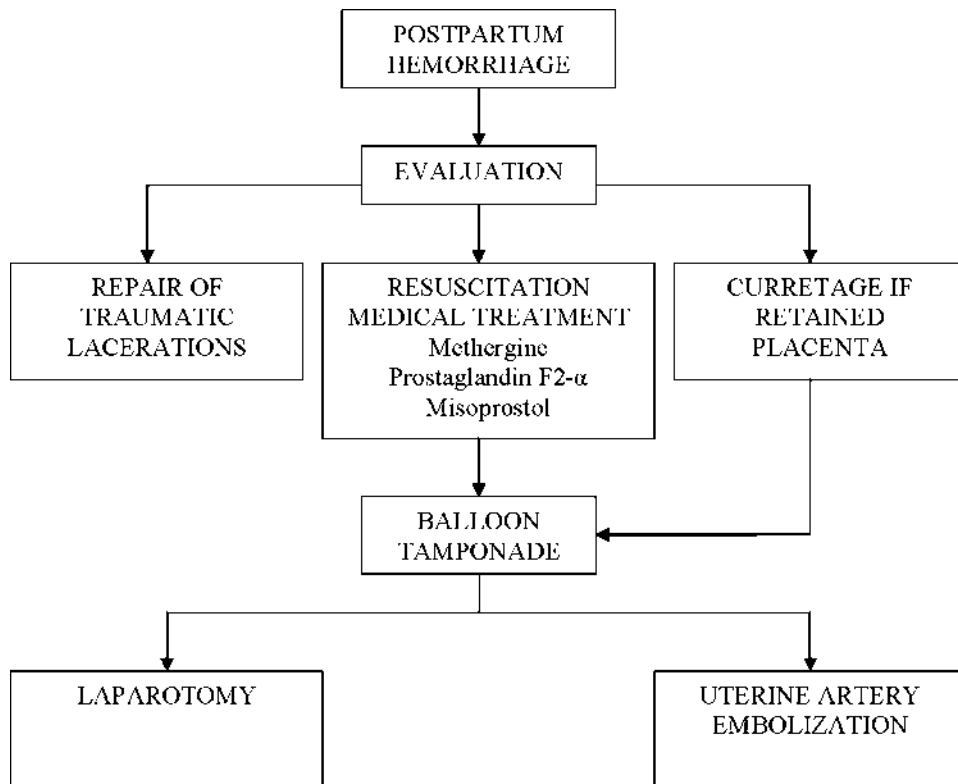
**MATERIALS AND METHODS**

This study was approved by the Exempla Healthcare Institutional Review Board. This is a retrospective case series study of 23 patients with severe postpartum hemorrhage unresponsive to medical treatment, managed with balloon tamponade between September 2003 and September 2005.

Cases were identified using International Classification of Diseases, Clinical Modification (ICD-9-CM) codes for postpartum hemorrhage (666.1 to 666.34), maternal death (646.91), amniotic fluid embolism (673.1 to 673.14), retained placenta (667), blood or blood product transfusions (99.0 to 99.09), postpartum hysterectomy (68.31 to 68.39), uterine artery embolization (99.29), or disseminated intravascular coagulation (286.6). These subjects were then cross-referenced with V codes (V22 to V24) to select only pregnant patients.

We defined postpartum hemorrhage as > 500 mL estimated blood loss after vaginal delivery or >1000 mL after cesarean delivery. Cases unresponsive to standard management were considered severe. During the studied period, out of 9799 deliveries, 330 cases (3.4%) were complicated by postpartum hemorrhage. Only cases in which balloon tamponade was used were abstracted for relevant maternal outcomes.

We began using balloon catheters at our institution in 2003 for selected cases of postpartum hemorrhage unresponsive to medical therapy as part of a management protocol for postpartum hemorrhage. Since July 2004 at Saint Joseph Hospital we have used a protocol for the management of postpartum hemorrhage called Code White. The protocol provides an algorithm for treatment (Fig. 1) and guidelines for multidepartmental assistance. Our Code White kit contains a list of uterotonic agents and doses, balloon catheters and instructions for use, recommendations for the use of blood products, emergency telephone numbers for scheduling uterine artery embolization, diagrams of operative techniques for suture of uterine vessels and the uterus, and additional retractors, instruments, and sponges. Standard therapy after delivery includes oxytocin intravenously followed by intramuscular Methergine, intramuscular prostaglandin F2- $\alpha$ , and rectal misoprostol and curettage, as needed. When these measures fail, balloon catheters, uterine artery embolization, or laparotomy with additional operative



**Figure 1** Algorithm for the treatment of postpartum hemorrhage.



**Figure 2** Magnetic resonance imaging of intrauterine tamponade with the SOS Bakri catheter (balloon inflated with 380 mL of saline).

procedures are performed based on the clinical situation and attending preference.

### Balloon Insertion Technique

The balloon catheters were inserted in the delivery room or in the operating room under epidural anesthesia or intravenous sedation. Until October 2004, the Sengstaken Blakemore tube was used. Subsequently, the SOS Bakri catheter was used exclusively for intrauterine tamponade. The change was made because of the advantage of a single large balloon designed for intrauterine tamponade.

### Transvaginal Insertion

For transvaginal insertion, two methods were used based on attending preference. The anterior and posterior lips of the cervix were grasped with ring forceps and the catheter was inserted into the uterine cavity. Alternatively, the catheter was inserted digitally in the same manner as an intrauterine pressure catheter. At least 15 cm of the catheter was inserted into the uterine cavity to assure proper placement. When the Sengstaken Blakemore catheter was used, its distal end was cut first and the esophageal balloon was filled with sterile saline.

### Insertion at Cesarean Section

If balloon tamponade followed cesarean delivery, the catheter was inserted through the uterine incision (pushing the tip to the fundus and the drainage port through the cervix into the vagina) or transvaginally and inflated after the uterine incision was closed.

### Postinsertion

After catheter insertion, the balloon was inflated with warm sterile normal saline until the uterine fundus was firmly palpable or bleeding was controlled. After the balloon was inflated, it filled the uterine cavity and bleeding was arrested by tamponade (Fig. 2). The SOS Bakri balloon can hold 500 mL (manufacturer's recommendation); the Sengstaken-Blakemore can hold up to 400 mL. We recommended inflation to 300 mL first, followed by reassessment. If bleeding persisted, inflation was continued in 50 to 100 mL aliquots. Gentle traction on the catheter was used to ensure that the balloon was firmly situated in the uterine cavity. Bleeding was evaluated at the outflow port and at the cervix.

### Failed Catheter Placement

Failed catheter placement was defined as either the inability of the operator to insert the catheter inside the uterine cavity or the inability to inflate the balloon after intrauterine insertion.

### Failure of Balloon Tamponade

Failure of balloon tamponade was defined as the persistence of uterine bleeding after the balloon catheter was properly inflated with the need for additional procedures to stop the bleeding.

### Successful Tamponade

The procedure was considered successful if bleeding stopped with balloon inflation. Balloon tamponade was continued as recommended for at least 24 hours. Balloons were deflated gradually over several hours while

monitoring for uterine bleeding. Broad-spectrum antibiotics were administered until removal of the catheters.

## RESULTS

Of 9799 deliveries during this 2-year period, 330 (3.4%) were complicated by postpartum hemorrhage. There were no maternal deaths. Balloon tamponade was attempted in 23 patients, and proper placement was achieved in 20 cases (87%). Bleeding was successfully controlled in 18 (90%) of these 20 cases (confidence interval, 68.3 to 99.8%).

Placement was unsuccessful in three patients. In one, the obstetrician was unable to pass the catheter into the uterine cavity due to obstruction by uterine leiomyomata. A uterine artery embolization with good control of the bleeding was performed. In another, a Sengstaken Blakemore catheter was inserted, but the operator was unable to inflate the balloon (because as the fluid was pushed through the catheter, it came out instantaneously through the vagina). The catheter was removed and a B-Lynch suture was performed followed by uterine artery embolization. When the catheter was examined, a small hole found in the balloon explained why the balloon could not be inflated (probably the hole was made when the tip of the catheter was cut). In the third, a cesarean delivery was complicated by uterine atony. A B-Lynch suture was placed and uterine incision closed. An SOS Bakri catheter placement was attempted, but the surgeon was unable to pass the catheter through the cervix, possibly because of obstruction from the B-Lynch suture. In this case, a cesarean hysterectomy was performed. All these three cases were considered a failure of placement, not failure of tamponade, and they were excluded from further analysis.

Failure of intrauterine tamponade to control the bleeding occurred in 2 of the 20 cases. The first was admitted for heavy vaginal bleeding that required transfusion at 15 weeks of gestation. A dilation and evacuation was performed followed by heavy bleeding. Initially, the bleeding was controlled with the SOS Bakri catheter, but then it recurred and a hysterectomy was performed. Placenta previa with percreta was the final diagnosis in this case. The other patient developed amniotic fluid embolism and underwent urgent cesarean delivery. After delivery, severe postpartum hemorrhage with disseminated intravascular coagulation developed. After medical treatment and Bakri catheter placement, free blood flow persisted, and hysterectomy was performed.

## Postpartum Hysterectomy

Postpartum hysterectomy was performed in nine cases during the studied period (0.9 per 1000 deliveries). As detailed earlier, a hysterectomy was performed in two patients after balloon tamponade failure and in one case

after failed catheter placement. In the other six, balloon tamponade was not performed prior to hysterectomy.

## Uterine Artery Embolization

Uterine artery embolization was performed in seven patients during this period. In three patients it was done despite successful balloon tamponade (at the discretion of the attending physician). One was the patient detailed later with recurrent late postpartum hemorrhage; bleeding was controlled for the second time with the SOS Bakri and, despite the success, uterine artery embolization was performed. The second patient had uterine atony after vaginal delivery, controlled with the Bakri catheter; uterine artery embolization was performed to control an expanding labial hematoma in a patient with disseminated intravascular coagulation. The third had atony after vaginal delivery followed by successful balloon tamponade with the SOS Bakri catheter; uterine artery embolization was performed 3 hours later, even though bleeding had already resolved. Embolization was performed after the failure of intrauterine balloon catheter placement in two patients. Another two patients had the procedure done without balloon tamponade.

The mean age of the patients was 27 with a range of 17 to 41 years. The gestational age was between 34 to 41 weeks, with the exception of one patient with severe bleeding at 15 weeks of gestation. Nine patients (45%) were nulliparous, and 11 (55%) were multiparous. Eleven patients were admitted in spontaneous labor, eight for induction and one for elective cesarean section. In 16 patients (80%), labor was either induced or augmented with oxytocin. Ten patients delivered vaginally, nine by cesarean delivery, and one had a dilation and curettage.

Total estimated blood loss was between 1000 mL to 7000 mL (mean, 2695 mL) with a hematocrit fall between 6 and 23% (mean, 15.4%). In 16 subjects (80%), the fall was > 10%; three of four patients with a fall of < 10% received blood before a second hematocrit was drawn. Sixteen patients (80%) received blood transfusions (range, 2 to 14 U of packed red blood cells with a mean of 5 U per patient).

After placental delivery, all subjects received 20 IU of oxytocin in 1 liter of lactated Ringer's solution. Methergine was used in 14 (70%) and prostaglandins in 16 (80%). Prostaglandins were used in all 14 subjects with uterine atony as the primary cause. Overall, 16 of 20 patients received a uterotonic besides oxytocin. Medical treatment was limited to the use of oxytocin in four patients: three with late postpartum hemorrhages and one with amniotic fluid embolism and cardiorespiratory arrest who underwent an emergent cesarean delivery.

In our study group, uterine atony was the cause of hemorrhage for 11 patients. Bleeding was arrested in all

11 patients (100%) where catheter placement was successful. For the five patients with retained placenta, balloon tamponade was successful in four (80%); a hysterectomy was required in one patient for placenta percreta. Bleeding was stopped with balloon tamponade in one patient with septic shock and in two of the three cases with amniotic fluid embolism.

Ten patients delivered vaginally, and the hemorrhage was controlled in all cases. Cesarean delivery occurred in nine patients, and balloon tamponade was successful in eight of them. In one patient with hemorrhage after dilation and curettage, bleeding persisted after balloon tamponade and required surgical treatment.

The incidence of disseminated intravascular coagulation at the time of balloon placement was 40% (8/20 patients).

The Sengstaken-Blakemore was used 5 times and the SOS Bakri 15 times. Sengstaken-Blakemore and the SOS Bakri catheters were similarly successful in controlling bleeding. A minimum of 120 mL and a maximum of 750 mL (SOS Bakri) of fluid was used to inflate the balloons for tamponade. For the Sengstaken-Blakemore, the average was 286 mL. For the SOS Bakri, the average was 282 mL. Duration of balloon tamponade ranged from 2 to 59 hours with a mean of 18 hours.

### Delayed Postpartum Hemorrhage

In four patients, hemorrhage occurred > 24 hours after delivery and balloon tamponade was successful in all four cases. One patient (mentioned earlier) developed hemorrhage 11 days postpartum; a dilation and curettage was performed and an SOS Bakri catheter used to control the bleeding. The pathology report diagnosed a retained placenta as the cause of bleeding. Five days later, the patient returned to the emergency department with uterine bleeding, and dilation and curettage was performed again followed by an SOS Bakri catheter to control bleeding. The patient was again discharged home, and the pathology report suggested placenta accreta based on finding placental fragments with myometrium on curettage.

No adverse effects were apparent from the use of the balloons other than the inconvenience of prolonged monitoring. There were no reports of excessive uterine tension or suture line breakage as a result of inflation after closure of a uterine incision.

### DISCUSSION

We found that balloon tamponade was highly effective in the management of postpartum hemorrhage unresponsive to standard therapy. Further, balloon tamponade was highly successful (11/11 cases) in controlling hemorrhage due to uterine atony when the catheter was properly placed. It was also effective as an adjunctive

therapy in cases of retained placenta, placenta accreta, amniotic fluid embolus, and septic shock with disseminated intravascular coagulation. Our study offers practical data on catheter placement including the range of volumes used to inflate the balloons and duration of therapy. We have provided an algorithm for postpartum hemorrhage that includes the use of balloon tamponade.

The advantages of using balloon tamponade include its ease of use, rapid placement, immediate results, and ability to measure further bleeding after the catheter is placed. Using balloon tamponade in a management algorithm will allow the clinician to decide quickly if more morbid therapies are needed. If bleeding persists, laparotomy or uterine artery embolization should be considered.

Although we observed no difference in the effectiveness of the Sengstaken-Blakemore tube and the SOS Bakri catheter, we feel the latter has advantages over the former. First, the SOS Bakri catheter is made of silicon instead of latex. Second, it has only two ports (one to inflate the balloon and one for drainage) as opposed to three in the Sengstaken-Blakemore. Third, as the SOS Bakri is inflated, the tip of the catheter is surrounded by the balloon, which diminishes the theoretical risk of uterine perforation. Finally, the SOS Bakri is packaged sterilely, whereas the Sengstaken-Blakemore tube must be sterilized by ethylene oxide or steam autoclave prior to use.

We acknowledge the limitations of this case series. Although all cases had significant postpartum hemorrhage based on poor response to initial treatment, observed blood loss, and the need for blood product replacement, the use of the catheters was at the discretion of the attending. We did not include a comparison group of patients with similar blood loss who did not have balloon tamponade. Uterine artery embolization was performed despite the arrest of bleeding in two cases.

Our series is the largest to date and includes cases of uterine atony. In the five cases reported by Bakri,<sup>13</sup> the indications for the use of the catheter were limited to postpartum hemorrhage in patients with a low-lying placenta or previa in the absence of uterine atony. Condous<sup>14</sup> studied 16 cases of postpartum hemorrhage and used balloon tamponade not only for uterine atony but also for other conditions. Seror et al<sup>12</sup> reported on 17 patients with atony or retained products treated with balloon tamponade for postpartum bleeding who failed medical therapy. Bleeding was controlled in 71% of their patients.

Although our results strongly support the use of the balloon tamponade for postpartum hemorrhage, unanswered questions remain. Future studies should address the duration of therapy and the amount of fluid or balloon pressure required to stop hemorrhage. Because of the ease of use, low cost, availability, low morbidity,

and success of these catheters, we recommend that labor and delivery units stock balloon catheters for use in cases of postpartum hemorrhage unresponsive to medical treatment.

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