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Original Research Article

Role of Intrauterine Balloon Tamponade in the Management of Severe Postpartum Hemorrhage: A Hospital-Based Observational Study

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Abstract

Introduction: Postpartum hemorrhage (PPH) accounts for a significant proportion of maternal deaths, particularly in low- and middle-income countries. Early recognition and timely management of PPH are essential to prevent severe maternal complications and mortality. Various conservative management techniques such as intrauterine balloon tamponade and uterine compression sutures have been used to control bleeding and preserve the uterus. The present study was conducted to assess the effectiveness of intrauterine balloon tamponade in controlling hemorrhage and preventing hysterectomy.

Materials and Methods: This hospital-based cross-sectional observational study was conducted at Zanana Hospital attached to Sawai Man Singh (SMS) Hospital, Jaipur, Rajasthan, over a period of 18 months from January 2021 to June 2022. A total of 128 patients with severe postpartum hemorrhage were included in the study. Data were collected using a structured questionnaire.

Results: The mean maternal age was 31.6 ± 5.3 years. The majority of cases occurred following cesarean delivery (64.1%). Uterine atony was the most common cause of PPH (64.1%), followed by placenta previa (14.1%) and placenta accreta spectrum disorders (12.5%). Intrauterine balloon tamponade was performed in 104 patients after failure of medical management. Balloon tamponade alone successfully controlled bleeding in 63 patients (60.6%), while 26 patients (25.0%) required additional B-Lynch sutures. Balloon tamponade failed in 15 patients (14.4%). Overall, uterine preservation was achieved in 115 patients (89.8%), whereas hysterectomy was required in 13 patients (10.2%). Placenta accreta spectrum disorders, previous cesarean section, higher estimated blood loss, and greater transfusion requirements were significantly associated with hysterectomy.

Conclusion: Severe postpartum hemorrhage was most commonly caused by uterine atony. Intrauterine balloon tamponade, either alone or in combination with B-Lynch sutures, was effective in controlling hemorrhage in the majority of patients or helped preserve the uterus in most cases. Early recognition of PPH and timely use of conservative surgical techniques may reduce the need for hysterectomy and improve maternal outcomes.

Keywords: B-Lynch Suture; Balloon Tamponade; Hysterectomy; Postpartum Hemorrhage; Uterine Atony.

Introduction

Postpartum hemorrhage (PPH) is one of the major causes of maternal morbidity and mortality worldwide. Despite improvements in obstetric care, it continues to contribute significantly to maternal deaths, especially in low- and middle-income countries. Global estimates suggest that about one-fourth of maternal deaths occur due to postpartum hemorrhage, making it the most common direct cause of maternal mortality. [1]

Postpartum hemorrhage is usually defined as blood loss of 500 mL or more after vaginal delivery or 1000 mL or more after cesarean section, or any amount of bleeding that results in hemodynamic instability. [2] Severe blood loss can occur rapidly and may lead to complications such as hypovolemic shock, disseminated intravascular coagulation, organ failure, and death if not managed promptly. [3] Therefore, early identification and timely management of PPH are essential to reduce maternal morbidity and mortality.

The causes of postpartum hemorrhage are commonly described by the “Four Ts”: tone, tissue, trauma, and thrombin. Among these, uterine atony is the most frequent cause, responsible for nearly 70–80% of cases. [4] Other causes include retained

placental tissue, placenta previa, placenta accreta spectrum disorders, genital tract trauma, and coagulation abnormalities. [5] Several risk factors have been identified for PPH, including prolonged labor, multiple pregnancy, polyhydramnios, previous cesarean section, placenta previa, and placenta accreta spectrum disorders. [6]

Management of postpartum hemorrhage usually follows a stepwise approach. Initial management includes uterine massage and administration of uterotonic drugs such as oxytocin, prostaglandins, and ergometrine. [7] If bleeding continues despite medical treatment, conservative surgical methods are considered before hysterectomy, especially in women who wish to preserve their fertility. [8]

In recent years, uterine balloon tamponade has become an important conservative technique for controlling hemorrhage due to uterine atony. This method involves placing a balloon inside the uterine cavity and inflating it with fluid so that pressure is applied to the uterine walls, thereby helping to control bleeding.9 Devices such as the Bakri balloon are commonly used and have shown good results in controlling postpartum hemorrhage.10 Studies have reported that balloon tamponade can successfully control bleeding in more than 80% of cases of refractory PPH, making it an effective uterus-preserving treatment option. [11]

Another conservative surgical technique used in the management of PPH is uterine compression sutures. The B-Lynch uterine compression suture, first described in 1997, works by compressing the uterus mechanically to control bleeding in cases of uterine atony during cesarean section. [12] This technique has gained wide acceptance because it is relatively simple to perform and helps preserve the uterus. [13]

In some situations, both uterine balloon tamponade and compression sutures may be used together to control bleeding. This combined approach applies pressure to the uterus from both inside and outside, which may improve the effectiveness of treatment. [14] Such conservative techniques can reduce the need for hysterectomy, which is generally considered when other methods fail to control hemorrhage. Although hysterectomy can be life-saving, it is associated with increased morbidity and leads to permanent loss of fertility. [15] Although several treatment options are available for the management of severe postpartum hemorrhage, the optimal management approach continues to be studied. Evaluating the causes, management methods, and outcomes of PPH in tertiary care centers can help improve treatment strategies and reduce maternal complications. Therefore, the present study was conducted to evaluate the etiology, management strategies, and outcomes of severe postpartum hemorrhage and to assess the effectiveness of intrauterine balloon tamponade in controlling hemorrhage and preventing hysterectomy among patients managed at Zanana Hospital attached to Sawai Man Singh (SMS) Hospital, Jaipur.

Materials and Methods

The present study was a hospital-based cross-sectional observational study conducted at Zanana Hospital attached to Sawai Man Singh (SMS) Hospital, Jaipur, Rajasthan to assess the effectiveness of intrauterine balloon tamponade in controlling hemorrhage and preventing hysterectomy. The study was carried out over a period of 18 months from January 2021 to June 2022. All patients diagnosed with severe postpartum hemorrhage (PPH) during the study period were evaluated and included according to the eligibility criteria. A total of 128 patients with severe postpartum hemorrhage were included in the study.

Study Population: The study population consisted of women who developed postpartum hemorrhage following vaginal delivery, cesarean section, or pregnancy termination and were managed at the study center during the study period.

Inclusion Criteria

- Women diagnosed with postpartum hemorrhage following delivery during the study period.
- Patients requiring medical or surgical management for postpartum hemorrhage.
- Patients managed at Zanana Hospital attached to SMS Hospital, Jaipur.

Exclusion Criteria

- Patients with incomplete clinical records.
- Patients referred after initial surgical management elsewhere.
- Patients who did not consent to participate in the study.

Sampling Technique: A purposive sampling technique was used for the study. All consecutive patients who developed severe postpartum hemorrhage during the study period and fulfilled the inclusion criteria were included in the study.

Postpartum Hemorrhage: Postpartum hemorrhage was defined as estimated blood loss of ≥500 mL following vaginal delivery or ≥1000 mL following cesarean section, or any amount of bleeding leading to hemodynamic instability requiring medical or surgical intervention.

Enrolment of Participants: All women presenting with postpartum hemorrhage (PPH) at Zanana Hospital attached to Sawai Man Singh (SMS) Hospital, Jaipur, during the study period were

screened for eligibility. Patients who fulfilled the inclusion criteria were enrolled in the study. Eligible patients were included consecutively during the study period until the required sample size was achieved. Prior to enrolment, the purpose and nature of the study were explained to the patients or their relatives in a language they could understand. Written informed consent was obtained from all participants or their legally authorized attendants before inclusion in the study. Confidentiality of patient information was maintained throughout the study, and all data were used only for academic and research purposes.

All patients diagnosed with postpartum hemorrhage were managed according to standard obstetric management protocols followed at the study center. Initial management included uterine massage and administration of uterotonic agents such as oxytocin and prostaglandins to promote uterine contraction. Simultaneously, intravenous fluids were administered and blood samples were sent for hemoglobin estimation and blood grouping and cross-matching. In cases where bleeding persisted despite medical management, additional interventions were performed to control hemorrhage. These included intrauterine balloon tamponade as a conservative surgical procedure to control uterine bleeding. If adequate hemostasis was not achieved with balloon tamponade alone, additional surgical procedures such as B-Lynch uterine compression sutures were applied.

Patients with persistent bleeding despite these measures were further managed with advanced surgical procedures such as uterine artery ligation or hysterectomy, depending on the clinical condition of the patient and the severity of hemorrhage. Throughout the management, patients were closely monitored for hemodynamic stability and requirement of blood transfusion, including packed red blood cells and fresh frozen plasma as indicated. All clinical findings, interventions, and outcomes were recorded using the structured questionnaire designed for the study.

Data for the present study were collected using a structured questionnaire (data collection proforma) designed for the study. This questionnaire included sections related to demographic details, obstetric history, clinical findings, and management of postpartum hemorrhage. The collected information included maternal age, parity, gestational age at delivery, mode of delivery, and birth weight of the neonate. Details regarding the etiology of postpartum hemorrhage were also recorded, including uterine atony, placenta previa, placenta accreta spectrum disorders, retained placental tissue, and genital tract trauma. The questionnaire also captured information regarding the severity and management of hemorrhage, including estimated blood loss, hemoglobin level before transfusion, and requirement of blood component transfusion such as packed red blood cells and fresh frozen plasma. Data related to interventions performed for the management of postpartum hemorrhage, including intrauterine balloon tamponade, B-Lynch uterine compression sutures, uterine artery ligation, and hysterectomy, were also recorded. All completed questionnaires were checked for completeness and accuracy before the data were entered into the study database for statistical analysis.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using appropriate statistical methods. Continuous variables such as maternal age, gestational age, birth weight, hemoglobin level, and estimated blood loss were expressed as mean ± standard deviation (SD) or median with range, as appropriate. Categorical variables including parity, mode of delivery, etiology of postpartum hemorrhage, use of balloon tamponade, requirement of B-Lynch sutures, hysterectomy, and other clinical variables were presented as frequency and percentage. The Chi-square test was used to evaluate the association between categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results

[Table-1] In the present study, a total of 128 patients with severe postpartum hemorrhage were included. The mean maternal age was 31.6 ± 5.3 years, with the age ranging from 20 to 43 years. The mean gestational age at delivery was 38.1 ± 2.5 weeks, indicating that most deliveries occurred at term. The mean birth weight of neonates was 3078 ± 452 grams. With respect to parity, 52 patients (40.6%) were primigravida, while 76 patients (59.4%) were multigravida, indicating that postpartum hemorrhage occurred slightly more frequently among multigravida women. A history of previous cesarean section was present in 34 patients (26.6%).

[Table-2] In the present study, the majority of cases occurred following cesarean section (82 patients, 64.1%). Vaginal delivery accounted for 41 cases (32.0%). In addition, 5 cases (3.9%) occurred following second trimester abortion or miscarriage.

In the present study, uterine atony was the most common cause of postpartum hemorrhage in 82(64.1%) cases. Placenta previa was observed in 18 patients (14.1%), while placenta accreta spectrum disorders were present in 16 patients (12.5%). Other causes included retained placental tissue in 7 patients (5.5%) and genital tract trauma in 5 patients (3.9%). The estimated blood loss ranged from 900 mL to 7100 mL, with a median blood loss of 2100 mL. The mean hemoglobin level

before transfusion was 7.3 ± 1.1 g/dL, indicating significant anemia associated with hemorrhage. The median number of packed red blood cell (PRBC) units transfused was 3, with the number of units ranging from 0 to 22. In addition, the median transfusion of fresh frozen plasma (FFP) was 1 unit.

[Table 3] In the present study, intrauterine balloon tamponade was performed in 104 patients with severe PPH after failure of initial medical management. Among these cases, balloon tamponade alone successfully controlled bleeding in 63 patients (60.6%). In 26 patients (25.0%), additional B-Lynch uterine compression sutures were required along with balloon tamponade to achieve adequate hemostasis. However, balloon tamponade failed to control hemorrhage in 15 patients (14.4%), and these patients required further surgical intervention.

Uterine preservation was achieved in 115 patients (89.8%), indicating successful control of hemorrhage using conservative or uterus-preserving surgical methods. However, hysterectomy was required in 13 patients (10.2%) due to uncontrolled bleeding despite medical and surgical interventions.

[Table 4] Maternal age ≥35 years was observed in 6 patients (46.2%) in the hysterectomy group compared to 30 patients (26.1%) in the non-hysterectomy group, and the difference was not statistically significant (p = 0.118). A history of previous cesarean section was present in 7 patients (53.8%) who required hysterectomy and 27 patients (23.5%) who did not, and this difference was statistically significant (p = 0.021). Placenta accreta spectrum disorders were observed in 8 patients (61.5%) in the hysterectomy group, compared with 8 patients (7.0%) in the non-hysterectomy group, and this association was highly statistically significant (p < 0.001). Estimated blood loss greater than 2500 mL was seen in 9 patients (69.2%) requiring hysterectomy compared with 32 patients (27.8%) who did not require hysterectomy, showing a statistically significant association (p = 0.003). In addition, requirement of ≥4 units of PRBC transfusion was significantly higher among patients who underwent hysterectomy (61.5% vs 21.7%; p = 0.002). Although cesarean delivery was more frequent in the hysterectomy group (76.9%) compared with the non-hysterectomy group (62.6%), the difference was not statistically significant (p = 0.297).

[Table 5] Cesarean delivery was observed in 56 patients (62.9%) in the balloon success group and 10 patients (66.7%) in the balloon failure group, and the difference was not statistically significant (p = 0.768). Uterine atony was present in 62 patients (69.7%) in the success group and 8 patients (53.3%) in the failure group, which was not statistically significant (p = 0.189). Placental causes of postpartum hemorrhage were noted in 27 patients (30.3%) in the success group and 7 patients (46.7%) in the failure group. However, estimated blood loss greater than 2500 mL was significantly more common in patients with balloon tamponade failure (60.0%) compared with those with successful tamponade (30.3%), and this association was statistically significant (p = 0.028). Similarly, requirement of ≥4 units of PRBC transfusion was higher in the balloon failure group (53.3%) compared with the success group (27.0%), which was also statistically significant (p = 0.041). Multiple pregnancy was present in 8 patients (9.0%) in the success group and 2 patients (13.3%) in the failure group, and the difference was not statistically significant (p = 0.589).

Table 1: Demographic and Obstetric Characteristics (n = 128)

Variable	Value
Mean maternal age (years)	31.6 ± 5.3
Age range	20–43
Mean gestational age (weeks)	38.1 ± 2.5
Mean birth weight (g)	3078 ± 452
Primigravida	52 (40.6%)
Multigravida	76 (59.4%)
Previous cesarean section	34 (26.6%)

Table 2: Mode of Delivery in Severe PPH (n = 128)

Mode of Delivery	Number	Percentage
Cesarean section	82	64.1%
Vaginal delivery	41	32.0%
Second trimester abortion / miscarriage	5	3.9%
Total	128	100%

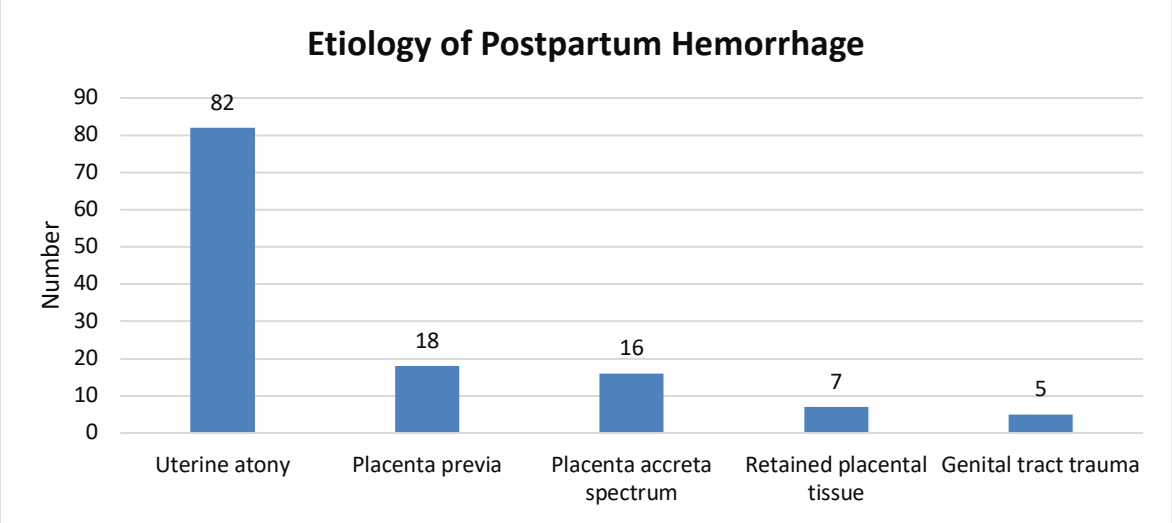

Figure 1: Etiology of Postpartum Hemorrhage (n = 128)

Table 3: Outcome of Balloon Tamponade (n = 104)

Outcome	Number	Percentage
Balloon tamponade alone successful	63	60.6%
Balloon + B-Lynch sutures successful	26	25.0%
Balloon failure	15	14.4%
Total balloon cases	104	100%

Table 4: Risk Factors Associated with Hysterectomy in Severe PPH (n = 128)

Variable	Hysterectomy (n=13)	No Hysterectomy (n=115)	Total	p-value
Maternal age ≥35 years	6 (46.2%)	30 (26.1%)	36	0.118
Previous cesarean section	7 (53.8%)	27 (23.5%)	34	0.021
Placenta accreta spectrum	8 (61.5%)	8 (7.0%)	16	<0.001
Estimated blood loss >2500 mL	9 (69.2%)	32 (27.8%)	41	0.003
PRBC transfusion ≥4 units	8 (61.5%)	25 (21.7%)	33	0.002
Cesarean delivery	10 (76.9%)	72 (62.6%)	82	0.297

Table 5: Predictors of Balloon Tamponade Failure (n = 104)

Variable	Balloon Success (n=89)	Balloon Failure (n=15)	Total	p-value
Cesarean delivery	56 (62.9%)	10 (66.7%)	66	0.768
Uterine atony	62 (69.7%)	8 (53.3%)	70	0.189
Placental causes	27 (30.3%)	7 (46.7%)	34	
Estimated blood loss >2500 mL	27 (30.3%)	9 (60.0%)	36	0.028
PRBC transfusion ≥4 units	24 (27.0%)	8 (53.3%)	32	0.041
Multiple pregnancy	8 (9.0%)	2 (13.3%)	10	0.589

Discussion

The present study was conducted to evaluate the etiology, management strategies, and outcomes of severe postpartum hemorrhage and to assess the effectiveness of intrauterine balloon tamponade in controlling hemorrhage and preventing hysterectomy. Postpartum hemorrhage continues to be a major cause of maternal morbidity and mortality worldwide and remains a significant challenge in obstetric practice, particularly in low- and middle-income countries. [16] In the present study, the mean maternal age was 31.6 ± 5.3 years, and most patients were multigravida. A large proportion of cases occurred following cesarean delivery (64.1%). Similar observations have been reported in several studies, where cesarean delivery and previous cesarean section were identified as important risk factors for severe postpartum hemorrhage due to their association with abnormal placentation and uterine atony. [17]

In our study, uterine atony was the most common cause in 64.1% of cases. This finding is consistent with previous reports indicating that uterine atony accounts for approximately 70–80% of postpartum hemorrhage cases. [18] Placental causes such as placenta previa and placenta accreta spectrum disorders formed the next most common etiological group. Similar distributions have been reported in

tertiary care centers where complicated obstetric cases are more frequently managed. [19]

The severity of hemorrhage in the present study was reflected by the median estimated blood loss of 2100 mL and the need for blood component transfusion, with a median transfusion requirement of three units of packed red blood cells. Comparable findings were reported by Diemert et al., who studied the use of intrauterine balloon tamponade for severe postpartum hemorrhage and reported a median blood loss of approximately 2000 mL among affected patients. [20]

In this study, balloon tamponade was used in 104 patients after failure of medical management. Balloon tamponade alone successfully controlled bleeding in 60.6% of patients, while an additional 25.0% required B-Lynch compression sutures for adequate hemostasis. Thus, the overall success rate of uterine preservation with balloon tamponade as part of management was 85.6%. These findings are consistent with previously published studies. Tindell et al. reported that uterine balloon tamponade is effective in controlling hemorrhage in a large proportion of refractory postpartum hemorrhage cases and can significantly reduce the need for more invasive procedures. [21] Similarly, Suarez et al. in a systematic review and meta-analysis reported an overall success rate of approximately 85% for uterine balloon tamponade in the management of postpartum hemorrhage. [22]

In the present study, uterine preservation was achieved in 89.8% of patients, while hysterectomy was required in 10.2% of cases. Hysterectomy remains a life-saving procedure in cases of uncontrolled hemorrhage but is associated with increased morbidity and permanent loss of fertility. Previous studies have also reported similar hysterectomy rates in severe postpartum hemorrhage cases managed in tertiary care settings. [23]

Placenta accreta spectrum disorders, previous cesarean section, estimated blood loss greater than 2500 mL, and requirement of four or more units of packed red blood cells were significantly associated with hysterectomy. These findings are consistent with earlier studies showing that abnormal placentation and previous cesarean delivery significantly increase the risk of severe hemorrhage and peripartum hysterectomy. [24]

Patients with estimated blood loss greater than 2500 mL and those requiring higher transfusion volumes were more likely to experience balloon tamponade failure. This observation suggests that the severity of ongoing hemorrhage is a critical factor influencing the success of conservative management. Similar conclusions have been reported in previous studies, which emphasized that early use of balloon tamponade before the development of severe hemorrhage may improve treatment success. [21]

Conclusion

In the present study, severe postpartum hemorrhage was observed most commonly due to uterine atony, followed by placental causes such as placenta previa and placenta accreta spectrum disorders. The majority of cases occurred following cesarean delivery, and significant blood loss was observed among affected patients, often requiring blood component transfusion.

The findings of the study show that intrauterine balloon tamponade was effective in controlling hemorrhage in a large proportion of patients, either alone or in combination with B-Lynch sutures. This approach helped achieve uterine preservation in most cases, while hysterectomy was required in a smaller proportion of patients when bleeding could not be controlled by conservative methods.

In addition, the study identified that placenta accreta spectrum disorders, previous cesarean section, higher estimated blood loss, and greater transfusion requirements were significantly associated with the need for hysterectomy. Similarly, greater blood loss and higher transfusion requirements were associated with failure of balloon tamponade.

Overall, the study suggests that early recognition of postpartum hemorrhage and timely use of conservative surgical techniques such as balloon tamponade and uterine compression sutures can effectively control bleeding and reduce the need for hysterectomy in many patients.

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