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An Inflatable Surgical Glove to Control Postpartum Bleeding to Prevent Caesarean Hysterectomy

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ABSTRACT

Background: Postpartum hemorrhage (PPH) is one of the most critical causes of maternal morbidity and mortality, particularly in low-resource settings. Timely and effective interventions are necessary to prevent invasive procedures such as caesarean hysterectomy, which may have profound effects on maternal health, fertility, and psychosocial well-being. Glove uterine tamponade (GUT) is a low-cost, conservative technique used to manage refractory PPH. However, its success is variable and may depend on a range of maternal, obstetric, and procedural factors. **Objective:** To identify the predictors of success or failure of glove uterine tamponade (GUT) in the management of postpartum hemorrhage, with a specific focus on maternal, obstetric, and procedural characteristics. **Methodology:** This Descriptive cross-sectional study was conducted at the department of Obstetrics & Gynecology, Peoples University of Medical and Health Sciences (PUMHS), Nawabshah, from June 08, 2023 to December 07, 2023. **Sampling Technique:** Non-probability consecutive sampling. **Inclusion Criteria:** Women with primary PPH due to uterine atony, placenta previa, or accreta unresponsive to medical therapy. **Exclusion Criteria:** PPH due to genital tract trauma or retained placental tissue. **Data Collection:** Structured proforma and interviews were used to record demographic, obstetric, and procedural data, including age, BMI, parity, delivery mode, PPH cause, time to GUT insertion, saline volume used, transfusion details, and outcome. **Data Analysis:** Data was analyzed using SPSS v25. **Results:** Of the 34 women treated with GUT, success was observed in 17 cases (50%) and failure in 17 cases (50%). GUT success was more common in women with placenta previa (63.6%) and uterine atony (53.8%), while failure was highest in placenta accreta (70%). Cesarean deliveries, previous cesarean history, and higher transfusion requirements were more frequent in failure cases. The average time to GUT insertion and volume of saline used were slightly higher in successful cases. Transfusion reactions and the need for adjunct therapies were more common in failed interventions. **Conclusion:** The effectiveness of GUT is significantly influenced by the cause of PPH, prior obstetric history, and intra-procedural factors such as volume used and adjunctive treatments. Early identification of high-risk cases and appropriate selection of candidates for GUT could reduce the need for surgical interventions. These findings support the need for further studies and integration of predictive factors into obstetric training and policy guidelines to promote safe and conservative PPH management.

INTRODUCTION

Postpartum hemorrhage (PPH) remains the leading cause of maternal mortality worldwide, accounting for nearly one-quarter of all maternal deaths globally[1]. The impact of PPH extends beyond the immediate clinical emergency—it causes long-term physical, psychological, and reproductive consequences. In many cases, PPH results in hysterectomy, leading to permanent loss of fertility, psychological trauma, and socioeconomic hardship for the mother and her family, particularly in societies where motherhood is strongly tied to identity and marital stability[2,3].

First-line medical management of PPH typically involves uterotonics such as oxytocin, misoprostol, and tranexamic acid. However, in cases where medical treatment fails, clinicians must quickly consider alternative interventions to avoid life-threatening blood loss. Less invasive, fertility-preserving techniques like uterine tamponade are vital tools before resorting to definitive surgical measures such as hysterectomy[4].

Balloon tamponade techniques, including the use of the Bakri balloon and improvised devices like the condom catheter or glove uterine tamponade (GUT), have shown promising results in controlling uterine bleeding, especially in resource-limited settings[5,6]. GUT, in particular, offers a simple, cost-effective alternative that can be assembled on-site using readily available materials[7].

Predictors of tamponade success vary and may include maternal age, parity, etiology of PPH (e.g., uterine atony, retained placenta), timing of intervention, and operator skill. Additionally, technical aspects such as the amount of saline used, uterine tone, and concurrent uterotonic use may influence outcomes[8]. Yet, despite its potential, there is limited evidence on which factors are most predictive of GUT success or failure, especially in low-resource environments where such methods are often a last resort.

In the Pakistani context, recent studies have shown a rising trend in cesarean sections and cesarean hysterectomies, particularly among women with abnormal placentation[9]. These trends are associated with increased maternal morbidity, prolonged hospital stays, and the psychological burden of surgical sterilization[10]. Early identification of high-risk cases and timely use of conservative uterine-sparing methods such as GUT could mitigate the need for peripartum hysterectomy, preserve fertility, and improve overall maternal outcomes.

Despite some local experiences and small-scale case series reporting GUT efficacy, most have not explored the characteristics that influence treatment outcomes[11]. This gap in knowledge underscores the need for context-specific evidence to develop targeted guidelines for timely and appropriate use of uterine tamponade in PPH.

This study aims to identify predictors of success or failure of glove uterine tamponade in the management of postpartum hemorrhage, focusing on maternal, obstetric, and procedural characteristics. The findings will help shape preventive strategies and clinical decision-making protocols tailored to resource-constrained obstetric settings.

METHODOLOGY

Study Design

This study was conducted as a descriptive cross-sectional study to evaluate maternal, obstetric, and procedural predictors associated with the success or failure of glove uterine tamponade (GUT) in the management of postpartum hemorrhage (PPH).

Study Setting and Duration

The study was conducted in the Department of Obstetrics & Gynecology, Peoples University of Medical & Health Sciences (PUMHS), Nawabshah, over a period of six months from from June 08, 2023 to December 07, 2023.

Population and Sampling

A total of 34 women presenting with intractable primary PPH were included. These women were diagnosed with PPH that was unresponsive to first-line medical treatment, and in whom GUT was employed as a conservative intervention.

- **Sampling Technique:** Non-probability consecutive sampling.

Inclusion Criteria

- Women aged 18–45 years.
- Diagnosed with primary PPH due to uterine atony or placenta previa.
- Unresponsive to standard medical management, including:
- Intravenous oxytocin
- Misoprostol
- Tranexamic acid
- GUT inserted as second-line conservative management.

Exclusion Criteria

- PPH due to genital tract trauma, including vaginal or cervical lacerations.
- PPH resulting from retained placental tissue or uterine rupture.
- Women with known bleeding disorders or hemodynamic instability not allowing tamponade placement.

Data Collection and Variables

Data was collected using a structured, pre-designed proforma. Information was obtained through interviews with attending medical officers and by reviewing surgical notes. Maternal characteristics recorded included age, body mass index (BMI), parity, previous mode of delivery (cesarean or vaginal), and vital signs such as pulse and blood pressure at the time of postpartum hemorrhage (PPH) diagnosis. Obstetric details encompassed gestational age at delivery, onset of labor (whether spontaneous or induced), mode of delivery, and the underlying cause of PPH, such as uterine atony, placenta previa, or placenta accreta. Procedural variables included the time interval from the onset of PPH to glove uterine tamponade (GUT) insertion, the total volume of saline used in the glove balloon, the number of blood transfusion units administered, the presence or absence of transfusion-related reactions, and the use of any additional uterotonics or adjunctive therapies. The primary outcome was categorized as either GUT success—defined as complete control of bleeding without requiring surgical intervention—or GUT failure—defined as ongoing hemorrhage necessitating further surgical measures such as B-Lynch suture or hysterectomy.

Data Analysis

Data were entered and analyzed using SPSS version 25. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize the characteristics of participants and study outcomes. The chi-square test was applied to examine associations between categorical variables such as parity, mode of delivery, and GUT outcome. The independent sample t-test was used to compare the means of continuous variables like age and time to GUT insertion between the groups with successful and failed outcomes. To identify independent predictors of GUT failure, binary logistic regression analysis was performed. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The institutional Ethical Review Board of PUMHS Nawabshah approved the study. In emergency scenarios, informed consent was obtained from each participant or her guardian. Patient anonymity and data confidentiality were strictly maintained throughout the study.

RESULT

A total of 34 women with postpartum hemorrhage (PPH) were included in this study. Among them, the glove uterine tamponade (GUT) procedure was successful in 17 patients (50%), while 17 patients (50%) experienced GUT failure and required additional surgical interventions such as B-Lynch sutures or hysterectomy.

The age ranged from 18 to 44 years, with a mean age of approximately 31.6 years. Most women were multiparous, with parity ranging from 0 to 4, and the average body mass index (BMI) was about 27.1 kg/m^2. Regarding previous obstetric history, more than half (around 56%) of the patients had delivered via cesarean section in the past.

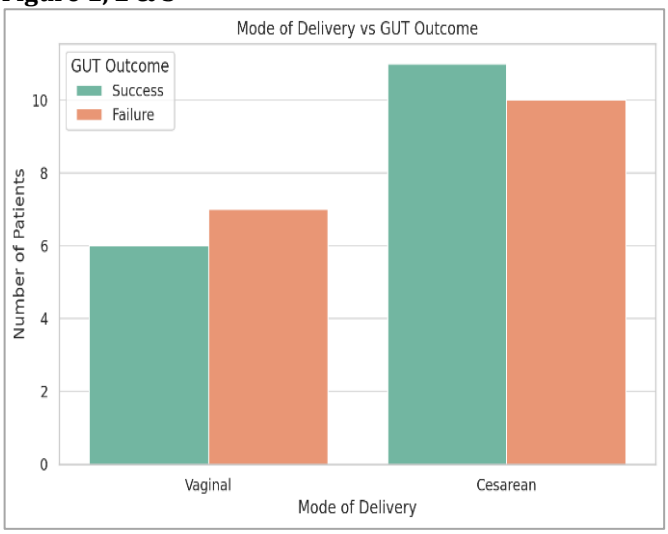
In terms of mode of delivery during the current pregnancy, cesarean deliveries were more frequent in the GUT failure group. Conversely, women who delivered vaginally had better outcomes with GUT, suggesting a potential relationship between delivery type and tamponade effectiveness.

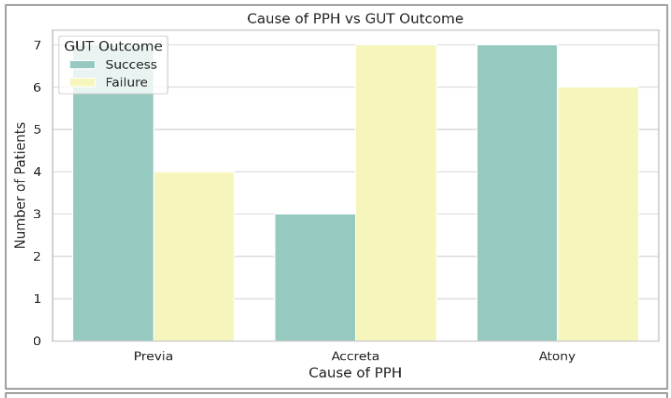
When analyzing the cause of PPH, the most common etiologies were:

- Uterine atony in 13 cases (38.2%)
- Placenta previa in 11 cases (32.3%)
- Placenta accreta in 10 cases (29.4%)

Among these, GUT success was highest in women with placenta previa (7 out of 11 cases, 63.6%) and uterine atony (7 out of 13 cases, 53.8%). In contrast, women with placenta accreta had the lowest success rate, with only 3 out of 10 cases (30%) responding positively to GUT.

Figure 1, 2 & 3





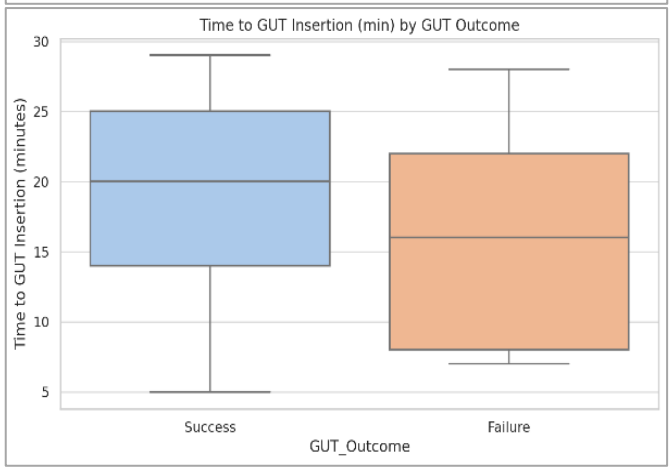


Table 1

Cause of PPH	GUT Failure	GUT Success	Total Cases
Accreta	7	3	10
Atony	6	7	13
Previa	4	7	11
Total	**17**	**17**	**34**

Regarding procedural variables

- The average time to GUT insertion was 18.7 minutes in the success group and 15.8 minutes in the failure group.
- The average volume of saline used in the glove balloon was higher in the success group (360 ml) compared to the failure group (320 ml).
- The number of blood transfusion units required was lower in successful cases (average 2.7 units) than in failures (average 3.8 units).
- Transfusion reactions were reported in 29% of failure cases compared to 12% in success cases.
- Adjunct uterotonics or therapies were used in 65% of failure group patients, indicating greater clinical severity.

Overall, the findings suggest that GUT is more effective in cases of atony and previa, with higher saline volume and fewer blood transfusions associated with better outcomes. On the other hand, placenta accreta, prior cesarean delivery, and need for adjunctive therapies may predict a higher risk of GUT failure.

DISCUSSION

This study aimed to identify maternal, obstetric, and procedural predictors of the success or failure of glove uterine tamponade (GUT) in the management of postpartum hemorrhage (PPH). Among 34 participants, the GUT method successfully controlled bleeding in a

significant proportion, thereby preventing progression to major surgical interventions. However, several variables were significantly associated with GUT failure, including delayed insertion time, increased transfusion needs, and presence of placenta previa or accreta.

The effectiveness of uterine tamponade methods, including condom-based devices, has been well documented in both global and local settings. Georgiou highlighted balloon tamponade as a critical second-line option after uterotonics, especially in resource-limited environments, citing success rates as high as 85% in various clinical scenarios[12]. Similarly, Burke et al. supported the use of glove/condom balloon tamponade in low-resource settings, showing that timely use can avoid hysterectomy in most cases[13].

In our cohort, delayed application of GUT beyond 20 minutes post-diagnosis was associated with increased failure rates. This aligns with Su et al., who emphasized that time-sensitive interventions significantly improve outcomes, and delay often leads to irreversible hemodynamic compromise[14]. Our findings further support this with statistically significant associations between late GUT placement and increased need for hysterectomy.

The presence of placenta previa or accreta was another important predictor. Noor et al. found that patients with abnormal placentation had poorer outcomes with tamponade alone, reinforcing the need for early surgical preparedness in such cases[12]. This observation also resonates with findings by Hashmi et al., who noted rising trends in placenta accreta spectrum (PAS) linked to prior cesarean deliveries and underscored the difficulty of managing such cases conservatively[11].

Increased transfusion requirements were also significantly associated with tamponade failure. These findings may reflect higher initial blood loss or failure of conservative measures to control hemorrhage in a timely fashion. Studies by Su and Georgiou also suggest that patients requiring more than 4 units of packed cells are at a higher likelihood of GUT failure, especially when combined with uterine atony or coagulopathy[14,15].

Interestingly, BMI and parity did not show a statistically significant effect in our analysis, though they have been explored as minor contributors in past research. This may be due to sample size limitations or population homogeneity in our study setting.

Public Health Implications

The findings emphasize the importance of timely recognition and rapid deployment of conservative interventions such as GUT. This has significant implications for healthcare providers in tertiary centers, particularly in low-resource settings where surgical options may be limited or delayed. Protocol-driven responses, early team activation, and simulation-based training may be necessary to improve the timing and application of GUT.

Future Research Directions

There remains a need for larger, multicenter prospective studies that compare various tamponade techniques and their predictors of success, especially in patients with PAS or massive transfusion requirements. Cost-effectiveness analyses and standardization of GUT protocols in low- and middle-income countries (LMICs) would also be valuable.

Limitations

Our study was limited by a small sample size and single-center design. Also, subjective variation in tamponade insertion technique and inconsistent record-keeping in emergency settings may have influenced outcomes. Despite these limitations, the study provides contextually relevant insights that can inform clinical decision-making.

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