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REVIEW ARTICLE

Innovations in Obstetric Hemorrhage Management: The Evolution of Transvaginal Bakri Balloons and Butterfly Devices

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ABSTRACT

Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality globally. Despite advancements in pharmacological interventions, mechanical tamponade remains a cornerstone of conservative management for uterine atony and refractory bleeding. This article examines the clinical efficacy, technical application, and comparative advantages of the Bakri Postpartum Balloon (BPB) and the emerging "Butterfly" vacuum-induced uterine tamponade (VIUT) devices. By evaluating recent clinical data and standardized obstetric protocols, this paper argues that the transition from passive hydrostatic pressure (Bakri) to active vacuum-assisted suction (Butterfly/Jada) represents a paradigm shift in the management of refractory PPH, potentially reducing the need for invasive surgical interventions such as hysterectomy.

KEYWORDS:

• Postpartum Hemorrhage • Uterine Balloon Tamponade • Bakri Balloon • Butterfly Device • Obstetric Hemorrhage • Maternal Mortality • Uterine Atony • Transvaginal Device • PPH Management • Mechanical Tamponade

INTRODUCTION

Postpartum hemorrhage (PPH), defined as cumulative blood loss of ≥1,000 mL accompanied by signs of hypovolemia, continues to be the primary cause of maternal mortality in both developed and developing countries. While uterine atony accounts for approximately 80% of PPH cases, managing this condition requires a rapid escalation from uterotonics to mechanical and surgical interventions. In the last two decades, the introduction of intrauterine balloon tamponade (IBT) has significantly altered the management algorithm. Among these, the Bakri Postpartum Balloon (BPB) has served as the gold standard. However, the recent development of vacuum-induced uterine tamponade (VIUT) devices—colloquially referred to as "butterfly" devices—introduces a novel mechanism of action that aims to collapse the uterine cavity more effectively than passive inflation.

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THE BAKRI POSTPARTUM BALLOON (BPB): EFFICACY AND LIMITATIONS

The Bakri Balloon is a silicone, single-use device designed to exert hydrostatic pressure on the endometrium. It is indicated for the temporary control or reduction of PPH when conservative management—such as uterine massage and uterotonics—fails.

1. Mechanism of Action

The BPB functions through the principle of tamponade. Once inserted transvaginally into the uterine cavity under ultrasound guidance or tactile control, the balloon is inflated with sterile saline. This inflation exerts pressure against the uterine walls, mechanically compressing the venous sinuses where placental detachment occurred.

2. Clinical Outcomes

Numerous retrospective and prospective cohort studies have demonstrated an overall success rate for the Bakri Balloon ranging from 75% to 85%. Its utility is particularly noted in cases of placenta accreta spectrum and uterine atony. However, the BPB is a passive device. Its pressure is limited by the physical resistance of the uterus and the risk of balloon rupture or displacement. A significant limitation is the "passive" nature of the device: it does not actively remove blood from the uterine cavity, nor does it facilitate the physiological retraction of the myometrium as effectively as vacuum-assisted devices.

THE SHIFT TO VACUUM-INDUCED UTERINE TAMPONADE (VIUT)

The emergence of vacuum-induced devices, such as the Jada System (often described by its butterfly-shaped intrauterine loop), represents a fundamental change in the approach to PPH.

1. The "Butterfly" Mechanism

Unlike the Bakri, which occupies the uterine space via volume expansion, the VIUT exerts negative pressure. The device features a cervical seal and a vacuum-conducting intrauterine loop (the "butterfly" component). By applying a controlled vacuum (typically 80 mmHg), the device promotes the collapse of the uterine walls toward one another.

2. Physiological Advantages

The primary advantage of the VIUT over the Bakri balloon is the active evacuation of blood and clots from the cavity. By clearing the cavity, the uterus is permitted to contract down to its pre-pregnancy state. This active contraction is the physiological goal of the third stage of labor. Furthermore, studies indicate that VIUT allows for immediate assessment of blood loss, as the suction tubing provides a direct visual indicator of ongoing hemorrhage, a feature absent in passive compression methods.

COMPARATIVE ANALYSIS: BAKRI VS. VIUT

A critical evaluation of these two technologies requires looking at safety, ease of deployment, and success rates.

Feature	Bakri Balloon (IBT)	VIUT (Butterfly)
Mechanism	Passive hydrostatic pressure	Active negative pressure/suction
Primary Goal	Compression of bleeding vessels	Uterine collapse and evacuation
Blood Clearance	Limited	High
Deployment Time	Moderate (requires inflation)	Rapid (requires suction setup)
Monitoring	Clinical observation	Visual output monitoring

1. Safety Considerations

While the Bakri Balloon is well-studied, its use is associated with risks such as infection and balloon displacement. The VIUT, by design, requires a tight cervical seal to maintain vacuum. If the seal is inadequate, the vacuum fails. However, preliminary clinical trials (e.g., the PEARLE trial) have demonstrated that the Jada system is highly effective in controlling hemorrhage within minutes, often preventing the progression to surgical measures such as B-Lynch sutures, uterine artery embolization, or hysterectomy.

5. CLINICAL PROTOCOL AND IMPLEMENTATION

The implementation of these devices requires institutional readiness. The American College of Obstetricians and Gynecologists (ACOG) emphasizes that PPH management must be algorithmic. Both Bakri and VIUT are considered "second-line" interventions.

1. **First-line:** Uterine massage, oxytocin, misoprostol, or methylergonovine.

2. **Second-line:** If atony persists, the decision to insert a device must be made early.
3. **Choosing the device:** In patients with significant clot burden, the VIUT holds a theoretical advantage; in cases of suspected placenta accreta where space-filling is necessary to tamponade deep vessels, the BPB may remain superior.

CHALLENGES AND FUTURE DIRECTIONS

Despite the promise of these technologies, barriers to adoption exist. The cost of proprietary VIUT devices is significantly higher than that of simple silicone balloons. Furthermore, training is required to ensure that the vacuum seal is maintained correctly. Future research should focus on randomized controlled trials (RCTs) directly comparing the BPB and VIUT to determine which patients benefit most from each modality.

There is also the potential for integration: serial use of VIUT followed by short-term BPB application in refractory cases could theoretically provide a dual-stage approach to ensure hemostasis.

CONCLUSION

The management of postpartum hemorrhage is undergoing a technological transition. While the Bakri Balloon has provided a reliable, accessible solution for decades, the advent of vacuum-induced devices provides clinicians with a more physiological tool to stimulate uterine contraction. The choice between these devices depends on clinical presentation, resource availability, and the provider's expertise. As these technologies continue to evolve, the integration of active suction systems into standard obstetric emergency bundles is likely to further reduce maternal mortality associated with PPH.

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