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Efficacy of balloon tamponade in the management of postpartum hemorrhage: A clinical study

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Abstract

Background: Balloon tamponade has become an important part of our armamentarium for the management of postpartum hemorrhage. The present study was conducted to assess the relationship between balloon distension and uterine artery blood flow patterns.

Materials & Methods: This study was conducted on 16 females. Obstectric & temponade system (OTS) had a uterine balloon and a vaginal balloon. Blood pressure prior to balloon inflation was recorded. The uterine balloon was carefully and incrementally inflated under ultrasound guidance until it filled and mildly distended the uterine cavity. The time to maximum inflation, volume of saline infused, and pressure within the balloon were recorded during the inflation process or at the final inflation as dictated by clinical conditions, with multiple pressure measurements recorded.

Results: The mean heights of patients was 62± 2.7 inches, weight (145± 12 pounds), Gravidity/Parity (2 [1–6]/1), type of delivery was vaginal (12) and cesarean (4) and gestational age was 37.6± 1.4 weeks. The mean systolic blood pressure was 106.42 mm Hg, maximum volume infusion was 960 mL, pressure at maximum value was 58.22 mm Hg and estimated blood loss was 440 ml.

Conclusion: Intraluminal pressure increases curvilinearly as volume of an intrauterine tamponade balloon is increased. At maximal inflation volume, all of the patients with reversed diastolic flow had intraluminal pressure less than systolic blood pressure.

Keywords: Balloon tamponade, Intraluminal pressure, postpartum hemorrhage

Introduction

Balloon tamponade has become an important part of our armamentarium for the management of Postpartum hemorrhage (PPH). There are now several different devices being used for this purpose, some specifically designed for PPH and some used off-label. These balloon devices have been used following vaginal delivery and cesarean section, in women with postpartum uterine atony and in patients with contracted uteri but bleeding from other causes such as placenta accrete or post abortal hemorrhage [1].

It affects 2.9 to 4.3% of deliveries in North America with 0.3% characterized as severe, and it consistently ranks among the leading causes of pregnancy- related deaths in both developed and low-resource countries. The initial approach to management is the stepwise exclusion of the most common causes, namely retained products of conception, genital tract trauma, and uterine atony, with atony being the most common etiology of PPH. It follows that uterotonic agents are frequently the firstline treatment given their availability, low cost, and ease of administration; however, when they fail or when uterotonics are contraindicated for medical reasons, mechanical methods such as uterine tamponade have been shown to be effective in decreasing hemorrhage due to uterine atony [2].

Georgiou [3] suggested that the pressure-volume relationship in the Bakri balloon is curvilinear and that both in vivo and in vitro, the maximal pressure is attained at around 100 mL of volume and thereafter does not change significantly as volume is increased. The maximum pressure in the balloon never exceeded the systolic pressure at the time of control of the hemorrhage.

Multiple balloons are currently available; however, they are variable in their ease of use. Challenges during balloon filling include the requirement to apply high amounts of physical force to, and repeatedly fill and empty, the syringe used to deliver the fluid to expand the balloon, which can cause delay in achieving adequate tamponade [4]. The present study was conducted to assess the relationship between balloon distension and uterine artery blood flow patterns.

Materials & Methods

This study was conducted in the department of Gynaecology and Obstectrics. It included 16 females. All were informed regarding the study and written consent was obtained. Ethical clearance was obtained before starting the study. General information such as name, age, etc was recorded.

Obstectric & temponade system (OTS) was used for the study which had, a uterine balloon and a vaginal balloon. The vaginal balloon is movable and can provide countertraction and help seat the uterine balloon in the lower segment. Vaginal bleeding can also be controlled by the vaginal tamponade balloon. In all females, blood pressure prior to balloon inflation was recorded. All were given Cap. amoxicillin/clavulanate 500 mg and azithromycin 500 mg orally. The OTS catheter was inserted. The uterine balloon was carefully and incrementally inflated under ultrasound guidance until it filled and mildly distended the uterine cavity. The time to maximum inflation, volume of saline infused, and pressure within the balloon were recorded during the inflation process or at the final inflation as dictated by clinical conditions, with multiple pressure measurements recorded.

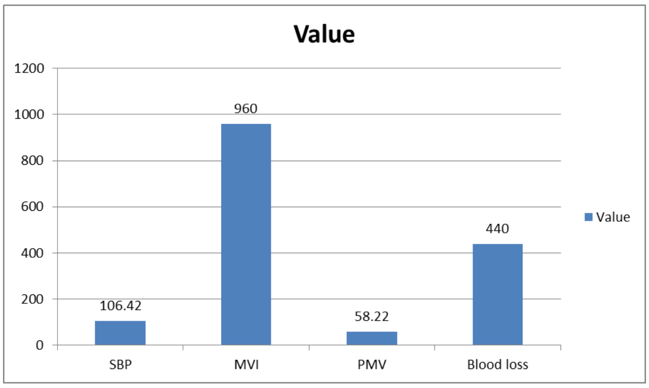
Two-dimensional ultrasound evaluation of the uterus before and during the balloon inflation was also performed in eight of the patients studied, and color and pulsed wave Doppler examinations of the uterine artery flow velocity pattern were recorded as clinical circumstances allowed. The amount of blood draining from the drainage channel of the catheter was recorded. Following completion of these assessments, the balloon was deflated and the catheter was removed. After OTS catheter removal, all were given amoxicillin/clavulanate 500 mg orally at 12 and 24 hours and azithromycin 250 mg orally at 24 hours postpartum. Results thus obtained were subjected to statistical analysis using chi- square test. P value less than 0.05 was considered significant.

Results

Table I: Demographic record of patients

S. no	Parameters	Value
1.	Height	62± 2.7 inches
2.	Weight	145± 12 pounds
3.	Gravidity/Parity	2 [1–6]/1
4.	Type of delivery	Vaginal- 12, Cesarean- 4
5.	Gestational age	37.6± 1.4 weeks

Table I shows that mean heights of patients was 62± 2.7 inches, weight (145± 12 pounds), Gravidity/Parity (2 [1–6]/1), type of delivery was vaginal (12) and cesarean (4) and gestational age was 37.6± 1.4 weeks.



Graph I: Volume pressure data of patients

Graph I shows that mean systolic blood pressure was 106.42 mm Hg, maximum volume infusion was 960 mL, pressure at maximum value was 58.22 mm Hg and estimated blood loss was 440 ml.

Discussion

Balloons that are not designed for PPH management are often simple to use but frequently have a low-volume capacity, which necessitates the placement of multiple balloons. Balloons that were designed for PPH management allow infusion of an adequate volume of fluid to tamponade the postpartum uterus and have a wide-caliber catheter to allow easy drainage of blood from above the balloon when it is inflated inside the uterus. However, both PPH-specific and simpler balloons can be difficult to fill due to high intraluminal pressures in the system [5].

The mechanism of action is still unclear. It may be due to distension of the uterine wall causing increased wall pressure and global decreased perfusion pressure, local surface contact of the balloon material with open venous sinuses leading to reduced oozing, stretching of the uterine wall and reflex contraction of the uterine musculature, and direct pressure on the uterine arteries at the level of the lower segment and cervix decreasing distal perfusion pressure [6].

In this study, we found that mean heights of patients was 62± 2.7 inches, weight (145± 12 pounds), Gravidity/Parity (2 [1–6]/1), type of delivery was vaginal (12) and cesarean (4) and gestational age was 37.6± 1.4 weeks. This is similar to Kramer *et al* [7].

Cho *et al* [8] demonstrated cessation of bleeding in a PPH patient after 320 mL of saline was placed in an intrauterine Senstaken-Blakemore tube. Postplacement ultrasound in their case demonstrated that the inflated balloon was not in the fundus but in the lower uterine segment and that it was not tamponading an area of myometrium sufficient to be effective at controlling PPH. They suggested that the mechanism of action was by uterine artery compression rather than direct myometrial tamponade.

The mean systolic blood pressure was 106.42 mm Hg, maximum volume infusion was 960 mL, pressure at maximum value was 58.22 mm Hg and estimated blood loss was 440 ml. This is in agreement with Clark *et al*. [9] Among FDA-approved uterine tamponade balloons, the ebb exhibited the lowest intraluminal pressure during inflation, but the value of this finding requires further research in vivo to understand its significance. Factors such as the residual tension in the uterine wall musculature, the elasticity and contractility of the muscle, whether or not there is chorioamnionitis, and which segment of the uterus is atonic play important role. It is also possible that lower resistance balloon may be safely filled to higher than the recommended volumes without rupturing.

Neither a high intraluminal pressure nor excessive volume is required to achieve adequate tamponade [10]. Studies on the efficacy of tamponade balloons demonstrate adequate hemostasis at a wide range of volumes, most of which are well below the recommended maximum filling volume.

Conclusion

Intraluminal pressure increases curvilinearly as volume of an intrauterine tamponade balloon is increased. At maximal inflation volume, all of the patients with reversed diastolic flow had intraluminal pressure less than systolic blood pressure.

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