Published online: December 20, 2020

Journal of Molecular and Clinical Medicine

Case Report

Use of a Bakri balloon in the management of presacral hemorrhage

Blanca Segarra Vidal[1,*], Raquel del Moral Rodriguez[2], Anna Serra Rubert[1] and Antonio Llueca Abella[1]

[1]*Multidisciplinary Unit of Abdominal Pelvic Oncologic Surgery (MUAPOS), Hospital General Universitario de Castellon, 12004, Castellon, Spain*

[2]*Department of Gynecology, Hospital de Poniente, 04700, Almeria, Spain*

*Correspondence: blancasv@lcloud.com (Blanca Segarra Vidal)

DOI:10.31083/j.jmcm.2020.04.927

Presacral hemorrhage after pelvic surgery usually results in massive, life-threatening bleeding. It is often difficult to control this presacral hemorrhage with standard hemostasis techniques after rectal mobilization. Mobilization of the rectum is part of the daily maneuvers of most pelvic surgeons. This review shows a common cause of presacral hemorrhage and demonstrates that the Bakri tamponade balloon catheter can control massive pelvic bleeding. A comprehensive, detailed review of the pelvic anatomy and hemostasis techniques used to control presacral hemorrhage was conducted. Also, a case study illustrated the novel use of the Bakri balloon for effective hemorrhage control. The presacral venous plexus or basivertebral sacral veins may be the sources of significant hemorrhage during rectal mobilization. The Bakri balloon effectively targets them. The standard recommendation for safe posterior dissection of the rectum to prevent presacral hemorrhage is approaching the plane between the mesorectal fascia and presacral fascia. We found that the Bakri balloon tamponade effectively controlled presacral hemorrhage and offers advantages over conventional packing. Massive hemorrhage is a potential complication of pelvic surgical procedures. Surgeons should be aware of hemostasis techniques for managing acute pelvic bleeding. We believe that the Bakri balloon should be included as a treatment option.

Keywords

Hemorrhage; bleeding; packing; Bakri balloon; presacral space

1. Introduction

Massive hemorrhage from the pelvic floor is a potential complication of gynecological-obstetric and colorectal surgical procedures. A delay in control of the bleeding can lead to alterations in coagulation with consequent blood loss. A potential site of pelvic bleeding is the sacral venous plexus. Bleeding at this site is often difficult to control with standard hemostasis techniques. The steps in preventing massive pelvic hemorrhage include having a thorough understanding of the pelvic anatomy, anticipating possible risks of bleeding, and having a clear plan to deal with any surgical emergencies along with proper surgical equipment and an expert team of consultants.

When facing pelvic hemorrhage, the surgeon should determine whether the source of bleeding is venous or arterial. This will help determine the proper approach to hemostasis. Once the source of bleeding is identified, options to control it include standard pressure to the bleeding site, suture ligation, application of hemostatic agents, and proximal and distal vessel control with direct suture of large injuries to vessels. The Bakri tamponade balloon catheter is the first uterine tamponade balloon system designed specifically for the treatment of obstetric hemorrhage. However, it may also be used to control persistent, massive pelvic bleeding [1]. This device is a silicone balloon connected to a silicone catheter explicitly designed for the temporary control or reduction of postpartum uterine bleeding when conservative management is warranted. When the balloon is inflated with sterile liquid, it applies pressure to the uterine walls that may provide management of postpartum hemorrhage. As described herein, we successfully used a Bakri tamponade balloon catheter to treat presacral bleeding in a cancer patient and propose that it is an easier, faster, and more effective live-saving measure than conventional packing for the control of intractable pelvic floor hemorrhage.

2. Case presentation

A 66-year-old patient diagnosed with stage IIIC serous papillary adenocarcinoma of the fallopian tube 3 years prior to presentation had a lesion suspicious for pelvic recurrence of the adenocarcinoma with involvement of the bladder and rectum as determined using positron emission tomography/computed tomography. Diagnostic laparoscopy showed a pelvic mass in the vaginal vault fixed to the right lateral pelvic wall, bladder, and rectum and multiple carcinomatosis nodules in the pelvis. The peritoneal carcinomatosis index score was 12, and the Arbeitsgemeinschaft Gynäkologische Onkologie score was positive. The patient had several comorbidities but a good Eastern Cooperative Oncology Group performance status (0) and a history of hysterectomy with bilateral adnexectomy, knee arthroscopy, and carpal tunnel syndrome repair.

After approval of secondary cytoreduction by the multidisciplinary tumor board at Hospital General de Castellón in Castel-

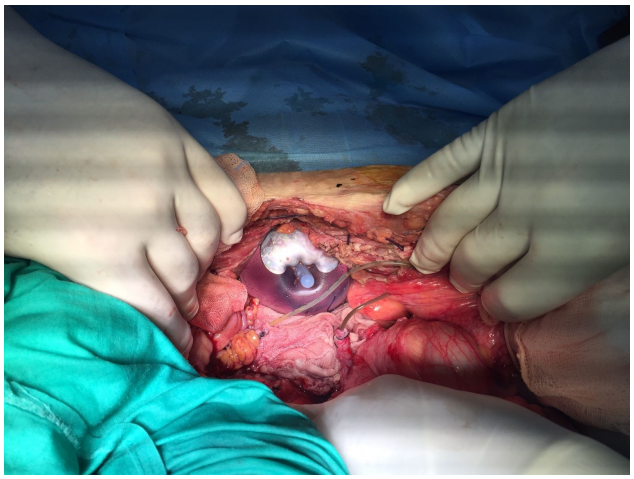

Fig. 1. A Bakri ballon in place surrounded by gauze.

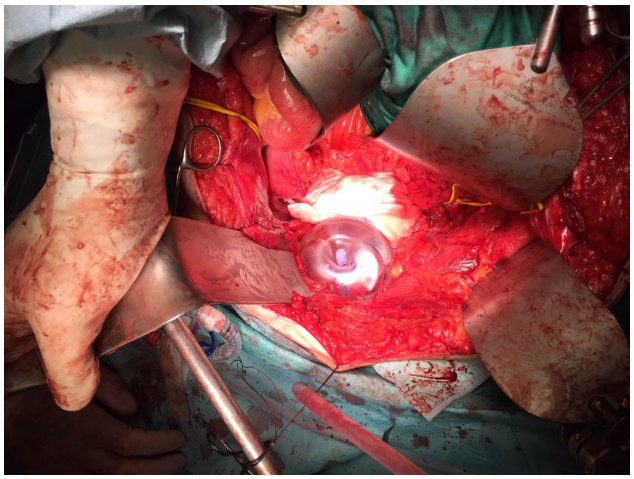

Fig. 2. Wide dissection of the pelvis and pressure packing with a Bakri balloon.

lón, Spain, the surgeon discussed the potential treatment options with the patient. The patient and the gynecologic oncology team decided to proceed with a tumor-reductive surgery and a peritonectomy. The intraoperative findings included a tumor recurrence infiltrating the mid-distal third of the rectum and the urinary bladder at the level of the trigone. The patient underwent complete surgery consisting of a pelvic exenteration, which included resection of the rectum, urinary bladder, and tumor recurrence with the largest diameter of 10 cm. During mobilization of the rectum, hemorrhage occurred at the level of the presacral veins. Direct electrocoagulation of the bleeding vessels was attempted with a monopolar electrocautery device in spray coagulation mode. This was followed by bipolar coagulation and suture ligation without success. Given that the bleeding was not controlled and exposure of the active bleeding zone of the presacral area was limited, surgeons decided to remove the mass to improve the exposure. During this time, the patient became hemodynamically unstable, with hypotension, tachycardia, and low urinary output. The patient's blood loss at that time was estimated to be 4000 mL, and she went into hemorrhagic shock. Packing of the pelvis with placement of a Bakri balloon was then performed (Fig. 1 and 2).

The balloon, with the stopcock at the distal part of its inflation port detached, was inserted through the laparotomy incision, and the port was passed through the opened vagina using forceps. When proper tamponade position was achieved at the level of the presacral vessels, the balloon was inflated gradually up to 500 mL with a sterile normal saline solution through the reattached stopcock. Continuous traction was performed by anchoring the balloon shaft to the thigh, and the drainage port was connected to the fluid collection bag. Surgical gauze was placed around the Bakri balloon to reinforce the compression and keep the balloon in position due to the wide pelvic resection to ensure control of bleeding and prevent movement of the balloon in the pelvis. The bleeding was then controlled. A ureterostomy and colostomy were performed afterward, and the patient was administered intravenous antibiotics with piperacillin-tazobactam 4 g/0.5 g every 8 hours.

After stabilization of the patient in the intensive care unit, she underwent reoperation 48 hours later. With removal of the pelvic packing, reduction of the Bakri balloon compression, and removal of surgical compresses, bleeding persisted in the S3-S4 area. This time, the bleeding was controlled by suturing several presacral veins that converged in the area of the hemorrhage and applying a fibrin sealant patch (TACHOSIL; Takeda Canada Inc., Toronto, Ontario, Canada). Next, a Bricker urostomy and end-to-end ileoileal anastomosis were performed. The patient recovered for 16 days in the intensive care unit and then was discharged home 26 days after her reoperation.

3. Discussion

The presacral space includes areolar connective tissue, branches of the sacral plexus, the middle sacral vessels, iliolumbar and middle hemorrhoids, and the associated lymphatics. The presacral venous plexus may be the source of significant hemorrhage during mobilization of the rectum. The vascular anatomy of the sacral venous plexus is complex. It constitutes a wide network of veins primarily formed by the anastomosis between the medial and lateral sacral veins on the anterior sacral surface. This plexus receives contributions from the lumbar veins of the posterior abdominal wall and the basivertebral veins that pass through the sacral foramen. The standard recommendation for safely performing a posterior dissection of the rectum is to approach the plane between the fascia proper of the rectum (mesorectal fascia) and the presacral fascia [2]. The presacral fascia, which is tightly attached to the surface of the sacrum, covers the sacral plexus, pudendal nerve, sympathetic sacrum, and presacral venous plexus. The adventitia of the presacral veins is intimately linked with the adjacent periosteum of the sacral foramen and can be easily lacerated during pelvic surgeries. The presacral fascia joins the superior sacrorectal ligament over the left primitive iliac vein. Below this vein, the presacral fascia continues with Waldeyer's fascia. The site with the highest risk of vessel injury in this lower part of the sacrum is where Waldeyer's fascia is thinnest and joins directly to the presacral fascia. When injured, the veins at this site may be the source of additional hemorrhage.

Waldeyer's fascia arises from the presacral fascia and spreads caudally to join the mesorectal parietal fascia above the anorectal junction. It has two components: one posteriorly covering the

Table 1. Hemostasis techniques used for presacral hemorrhage.

Packing techniques
Traditional pelvic packing
Silicone rubber (SILASTIC) tissue expander
Perineal Sengstaken-Blakemore tube
Inflatable sterile saline bag
Breast implant sizer
Muscle tamponade
Foley catheter-condom balloon tamponade
Bakri tamponade balloon
Tacking techniques
Metallic thumbtacks
Topical hemostatic agents
Hemostatic matrix and absorbable hemostat
Oxidized cellulose and cyanoacrylate glue
Bone cement
Bone wax
Direct/indirect electrocoagulation and suture
Muscle fragment welding
Spray electrocautery
Argon beam coagulation
Bipolar coagulation
Circular suture ligation

presacral vessels and another more superficially covering the hypogastric and sacral splanchnic nerves (referred to as the prehypogastric nerve fascia) [3]. This layer of connective tissues is located just within the retrorectal space**,** which is a posterior avascular space, and divides this space into inferior and superior compartments [4]. Another anterior avascular space exists which is termed the "holy plane", but it has no fascia-like structures. The holy plane lies between the viscera fascia enveloping the mesorectum and the mesorectal parietal fascia. During surgery of rectal cancer, the gain of access to this space and keeping the dissection on it, are essential.

After the application of direct pressure on a presacral hemorrhage, multiple techniques can be used to control this life-threatening bleeding [5, 6]. In 1985, Qinyao *et al*. [7] described the use of small, thin steel plates called thumbtacks to control this complication, application of which initially gained popularity among surgeons. The surgeon should not lose precious time with ineffective or even harmful manipulations like ligation of bilateral internal iliac arteries or veins because they are useless in controlling severe presacral bleeding. However, nowadays, thumbtacks are not commonly used because of difficulty in placement and reports of failure due to presacral hematomas, chronic pain, thumbtack detachment, thumbtack migration, and perianal extrusion of the plates. Also, thumbtacks may not always be available in the operating room [8, 9]. Other researchers have proposed many alternatives, such as the ProTack device (Covidien, Dublin, Ireland), which attaches hemostatic sponges to the sacrum with helical endoscopic "tackers" [10].

The use of glue combined with other topical hemostatic materials for hemorrhage control has proven effective. In a didactic video, Hokenstad [11] illustrated a variety of modalities for the same purpose, such as a gelatin matrix combined with thrombin (FLOSEAL; Baxter, Deerfield, IL), which is an effective topical hemostatic, and oxidized regenerated cellulose (SURGICEL FIBRILLAR; Johnson and Johnson, New Brunswick, NJ), which is an absorbable hemostat mesh. The use of these materials does not carry a risk of infection or secondary complications of foreign bodies because they are absorbable [12]. Also, these materials can be used in locations with irregular surfaces, such as the sacrum. Oxidized cellulose is also used in combination with cyanoacrylate glue similarly to that described by Chen *et al*. [13] and Zhang *et al*. [14] who controlled massive presacral bleeding in five patients using an absorbable hemostatic gauze made of chemically treated cellulose and spread with medical adhesive (alpha-cyanoacrylate) compressing the blood vessels. Another successful approach to achieving hemostasis has been the use of cyanoacrylate glue [15]. Others have proposed the use of bone cement (polymethylmethacrylate) for orthopedic procedures [16] and bone wax [17].

Researchers have evaluated electrocoagulation and suture methods for hemostasis in multiple studies. Several variations of these techniques have emerged that have proven effective, such as bipolar coagulation in spray mode with continuous aspiration. A unique approach is indirect coagulation techniques using muscle fragments. This technique consists of resecting a fragment of the anterior abdominal rectus muscle (~2 $\times$ 2 cm), transferring it to the damaged presacral area, and pressing on the zone of bleeding by applying coagulation with monopolar energy using a long dissection forceps at maximum power until achieving optimal coagulation. In 1994, Xu and Lin [18] reported on the use of this technique in 11 patients with presacral hemorrhage. Of note is that if the fragment of the anterior abdominal rectus muscle does not remain attached to the bone, it does not imply failure of the technique [19]. Jiang *et al*. [20] demonstrated another simple, effective suture technique consisting of suturing in circles by ligating the presacral veins around the bleeding site while applying continuous pressure. The authors highlighted that the tissues that must be included in the suture ligation are the presacral fascia, presacral veins, and deep connective tissue.

Foley catheter-condom as a pelvis pressure tampon tool, may be another simple and effective method that can easily control pelvic bleeding. A balloon tamponade tool is formed with a Foley catheter and a condom, that it is a material straightforward to get in any medical center. The tampon may be inflated up to 2200 mL until there is no need to use additional gauzes because it can be inflated to much larger volumes than the Bakri balloon. Moreover, the condom volume could be decreased according to the urine output, as the Bakri balloon [21].

Surgical packing should not be seen as a "bailout" technique for managing hemorrhages. Instead, it is a specific skill that, when used thoughtfully, complements the other surgical skills essential for managing massive bleeding. Therefore, pelvic packing should be part of the armamentarium available to control bleeding in inaccessible surgical areas.

The bakri tamponade balloon catheter is the first uterine tamponade balloon system designed specifically for the treatment of obstetric hemorrhage [22]. It consists of a silicone balloon with

Table 2. Differences between conventional packing and the Bakri tamponade balloon.

Conventional packing	Bakri balloon
Reintervention	No reintervention
Withdrawal: yes or no	Vaginal withdrawal
Nonmodifiable pressure	Gradual pressure via external weight and/or grade of filling
Abdominal drainage	Built-in drain
Risk of sepsis	Gradual deflation, possible re-evaluation
Dehiscence predisposition if recent anastomosis	--

Note: recurrence of hemorrhage is possible after both procedures.

a maximum recommended fill volume of 500 mL, although volumes up to 1300 mL have been used, [23] connected to a 24-french silicone catheter, 54 cm in length. the device was designed to be inserted while collapsed into the uterus. When filled with fluid, the balloon adapts to the configuration of the uterine cavity to tamponade uterine bleeding. The central lumen of the catheter allows drainage and is designed to monitor ongoing bleeding above the level of the balloon. To evaluate the success rate and protocol for use of the bakri balloon for the treatment of postpartum hemorrhage, researchers designed a prospective observational multicenter cohort study of the device at 20 hospitals in south china [24]. They recruited women with postpartum bleeding that did not respond to first-line conservative management and received the bakri balloon for the study. A total of 472 women had placement of bakri balloon tamponade, 407 of which (86%) were enrolled (67 after vaginal delivery and 340 either during or after cesarean delivery). The success rate for the bakri balloon in this study was 92% (373/407 women).

Bakri balloon tamponade is one of several strategies to control presacral hemorrhage (Table 1). It compresses the underlying sponges over the bleeding area using vaginal traction, thereby efficiently transferring the pressure to all surfaces of the surgical region at the same rate. It offers the potential advantage of vaginal removal without the need for reoperation after confirmation that the hemorrhage has stopped. The lacerated area responsible for the hemorrhage may be assessed using gradual balloon deflation. The balloon pressure over the bleeding surface may be modified using external weight and/or grade of filling if complete hemostasis has yet to be achieved. Furthermore, the use of a Bakri balloon may prevent abdominal drainage because it also serves as a drain (Table 2). The balloon is placed in the presacral space by passing it inflation port first through the laparotomy or vaginal default while uninflated. The balloon shaft is then pulled through the vaginal canal until the base of the balloon contacts the vaginal vault. Next, the balloon must be filled with sterile saline through the stopcock to a predetermined volume. To maintain tension, the balloon shaft is secured to the patient's leg. Lastly, the drainage port is connected to a fluid collection bag to monitor hemostasis.

In conclusion, the Bakri balloon may be a treatment option for patients with severe pelvic hemorrhage. The surgeon should always have a clear, definitive plan for the management of acute pelvic bleeding and be alert to the fact that a multidisciplinary approach using the expertise of surgeons, anesthesiologists, and intensive care specialists must be used to help prevent severe hemodynamic instability and, potentially, hemorrhagic shock.

Funding

This work was supported by the Fundación Alfonso Martín Escudero, Madrid, Spain.

Ethics approval and consent to participate

The patient gave their informed consent for participated in this case study. The study was conducted in accordance with the Declaration of Helsinki.

Acknowledgements

The authors thank the Research Medical Library at The University of Texas MD Anderson Cancer Center for their professional language editing of the manuscript.

Conflicts of interest

The authors have no conflicts of interest to disclose.

Submitted: September 27, 2020
Accepted: November 10, 2020
Published: December 20, 2020

References

[1] Charoenkwan K. Effective use of the Bakri postpartum balloon for posthysterectomy pelvic floor hemorrhage. *Am. J. Obstet. Gynecol.* 2014; 210: 586. e1-3.

[2] Messick CA, Santos DA. (2018) Management of Bowel Surgery Complications. In Ramirez PT, Frumovitz M, Abu-Rustum NR. Principles of Gynecology Oncology Surgery (pp.245-258). 1nd edn. Elsevier.

[3] Marecik SJ, Al-Khamis A, Kochar K, Park JJ. Robotic resection of presacral (retrorectal) tumors and Waldeyer's fascia. *Dis. Colon Rectum.* 2018; 61: e351-e352.

[4] Jin Z-m, Peng J-Y, Zhu Q-C, Yin L. Waldeyer's fascia: anatomical location and relationship to neighboring fasciae in retrorectal space. *Surg Radiol Anat.* 2011; 33: 851-854.

[5] Binder S, Mitchell G. The control of intractable pelvic hemorrhage by ligation of the hypogastric artery. *S. Afr. Med. J.* 1960; 53: 837-843.

[6] Hata M, Kawahara N, Tomita K. Influence of ligation of the internal iliac veins on the venous plexuses around the sacrum. *J Orthop Surg (Hong Kong).* 1998; 3: 264-271.

[7] Qinyao W, Weijin S, Youren Z, Wenqing Z, Zhengrui H. New concepts in severe presacral hemorrhage during proctectomy. *Arch Surg.* 1985; 120: 1013-1020.

[8] Lacerda-Filho A, Durães LC, Santos HFT. Displacement and perianal extrusion of a hemostatic sacral thumbtack: report of a case. *Female Pelvic Med Reconstr Surg*. 2004; 10: 319-322.

[9] Suh M, Shaikh JR, Dixon AM, Smialek JE. Failure of thumbtacks used in control of presacral hemorrhage. *Am J Forensic Med Pathol.* 1992; 13: 324-325.

[10] van der Vurst TJ, Bodegom ME, Rakic S. Tamponade of presacral

hemorrhage with hemostatic sponges fixed to the sacrum with endoscopic helical tackers: report of two cases. *Dis. Colon Rectum.* 2004; 47: 1550-1553.

[11] Hokenstad ED, Occhino JA. Management of presacral bleeding. *Int Urogynecol J.* 2020; 31: 215-217.

[12] Germanos S, Bolanis I, Saedon M, Baratsis S. Control of presacral venous bleeding during rectal surgery. *Am. J. Surg.* 2010; 200: e33-e35.

[13] Chen Y, Chen F, Xie P, Qiu P, Zhou J, Deng Y. Combined oxidized cellulose and cyanoacrylate glue in the management of severe presacral bleeding. *Surg Today.* 2009; 39: 1016.

[14] Zhang C-H, Song X-M, He Y-L, Han F, Wang L, Xu J-B*, et al.* Use of absorbable hemostatic gauze with medical adhesive is effective for achieving hemostasis in presacral hemorrhage. *Am. J. Surg.* 2012; 203: e5-e8.

[15] Losanoff JE, Richman BW, Jones JW. Cyanoacrylate adhesive in management of severe presacral bleeding. *Dis. Colon Rectum.* 2002; 45: 1118-1119.

[16] Becker A, Koltun L, Shulman C, Sayfan J. Bone cement for control of massive presacral bleeding. *Colorectal Dis.* 2008; 10: 409-410.

[17] Civelek A, Yeğen C, Aktan AÖ. The use of bonewax to control massive presacral bleeding. *Surg Today.* 2002; 32: 944-945.

[18] Xu J, Lin J. Control of presacral hemorrhage with electrocautery through a muscle fragment pressed on the bleeding vein. *J. Am. Coll. Surg.* 1994; 179: 351-352.

[19] Ayuste Jr E, Roxas MFT. Validating the use of rectus muscle fragment welding to control presacral bleeding during rectal mobilization. *Asian J Surg.* 2004; 27: 18-21.

[20] Jiang J, Li X, Wang Y, Qu H, Jin Z, Dai Y. Circular suture ligation of presacral venous plexus to control presacral venous bleeding during rectal mobilization. *J. Gastrointest. Surg.* 2013; 17: 416-420.

[21] Atilgan R, Aslan K, Can B, Sapmaz E. Successful management of pelvic bleeding after caesarean hysterectomy by means of Foley catheter-condom balloon tamponade. *BMJ Case Rep.* 2014; 2014: bcr2014204770.

[22] Bakri Y. Balloon device for control of obstetrical bleeding. *Eur J Obstet Gynecol Reprod Biol*. 1999; 86: S84.

[23] Kaya B, Tuten A, Daglar K, Misirlioglu M, Polat M, Yildirim Y, *et al*. Balloon tamponade for the management of postpartum uterine hemorrhage. *J Perinat Med*. 2014; 42: 745-53.

[24] Wang D, Xu S, Qiu X, Zhu C, Li Z, Wang Z, *et al*. Early usage of Bakri postpartum balloon in the management of postpartum hemorrhage: a large prospective, observational multicenter clinical study in South China. *J Perinat Educ*. 2018; 46: 649-56.