

External Iliac Artery Transection Managed by Iliofemoral Bypass Grafting Using Temporary Balloon Occlusion

Young Un Choi, M.D.¹, Jae Gil Lee, Ph.D.¹, Kwangmin Kim, M.D.²,
Seongyup Kim, M.D.², Keumseok Bae, M.D.², Ji Young Jang, M.D.²,
Pil Young Jung, M.D.², Hongjin Shim, M.D.², Young Jin Youn, M.D.³,
Il Hwan Park, M.D.⁴

¹Department of Surgery, Yonsei University College of Medicine, Seoul, Korea
²Departments of ²Surgery, ³Cardiology, ⁴Thoracic and Cardiovascular Surgery, Yonsei University
Wonju College of Medicine, Wonju, Korea

Received: October 6, 2017

Revised: October 30, 2017

Accepted: November 8, 2017

Correspondence to

Hongjin Shim, M.D.

Trauma and Surgical Critical Care, Department of Surgery, Yonsei University Wonju College of Medicine, 20 Ilsan-ro, Wonju 26426, Korea
Tel: +82-33-741-0990
Fax: +82-33-741-1205
E-mail: simong3@yonsei.ac.kr

Traumatic abdominal vessel injury is rare, but difficult to manage. Approaching the injured vessel and controlling the bleeding is very hard. We experienced the right iliac artery transection managed by iliofemoral bypass grafting using temporary balloon occlusion. Proximal occlusion of an iliac artery with a temporary balloon can be an option or bridge technique for a definite operation in case of iliac artery rupture. So, we present our case.

Keywords: Iliac artery; Balloon occlusion; REBOA

INTRODUCTION

Traumatic abdominal vessel injury is rare, lethal and difficult to manage. The mortality rate of abdominal vessel injuries is as high as 20-60%, with early death occurring due to bleeding and later deaths resulting from multi-organ failure [1]. In arterial injuries, early resuscitation and bleeding control are the most important principles and both of them must be accomplished at the same time. Interventions like temporary ballooning or bypass grafting during operations can be used as controlling techniques.

We experienced a traumatic external iliac artery transection case controlled by a temporary ballooning of the common iliac artery with an endovascular procedure and iliofemoral bypass grafting. This report describes the details of that case.

CASE REPORT

A 12-year-old girl was transferred to the emergency department of a hospital for retroperitoneal hemorrhage. The interval time from the accident to the emergency department (ED) was 167 minutes. She had an injury on her lower abdomen from a bicycle handle. Upon arriving at the hospital, her vital signs were stable and hemoglobin level was 10.6 g/dL. Abdominopelvic computed tomography scan displayed a large amount of hemorrhagic fluid collected at the right retroperitoneal space and anterior abdominal wall with active bleeding (Fig. 1). However, after being transferred to the emergency department, her hemoglobin level went down to 6.7 g/dL and blood pressure was 142/88 mmHg with a pulse rate of 102 beats per minute. Her right leg exhibited a grossly acute limb ischemia pattern (Fig. 2).

An emergency operation was decided and the patient was sent to operation room with a transfusion. For bleeding control, an angiography with a ballooning occlusion was considered before surgery. An angiocatheter was inserted into the left femoral artery and an angiography was conducted with a portable X-ray (C-arm). This procedure was done by a cardiologist. The discontinuation of the

right common iliac artery was checked and temporary occlusion with ballooning of the right common iliac artery was performed. Then, hockey-stick incision was applied to approach retroperitoneal space, however there was a severe bowel edema. Therefore, we used a transperitoneal approach with right-sided paramedian incision of the abdomen. After evacuation of the hematoma, a transection of the right external iliac artery was found, not common iliac artery, and the proximal and distal parts were isolated. Right iliofemoral bypass grafting with polytetrafluoroethylene was applied. The abdomen became distended due to bowel edema during the operation and the temporary abdominal closure technique with a vacuum pack was performed to protect against abdominal compartment syndrome. After the operation, the patient was moved to the trauma intensive care unit with an intubated status and her vital signs were stable. On postoperative day (POD) 3, the open abdomen was closed in the operation room and extubated the next day. On POD 5, she was transferred to the general ward. An electrophysiologic study on POD 16 displayed an incomplete lesion in the peroneal component of the sciatic nerve at or below the gluteal fold level. She was transferred to the rehabilitation department for gait training with completion of wound

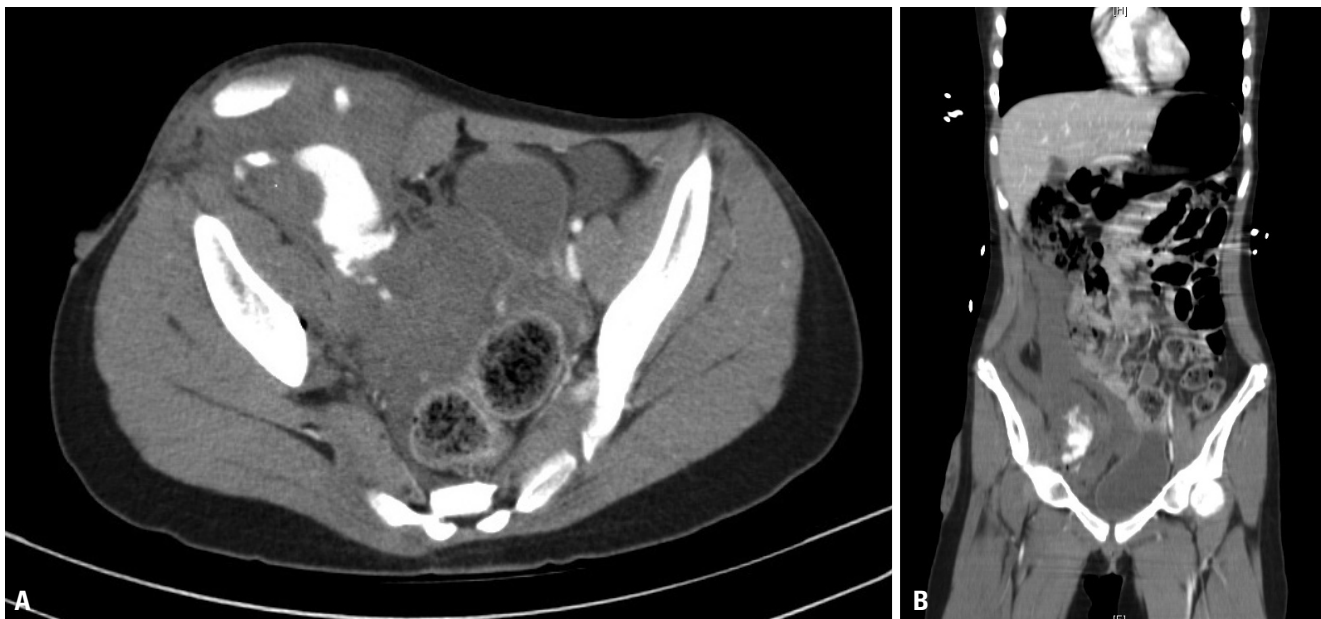


Fig. 1. (A) Preoperative abdominopelvic computed tomography showing a large amount of hemorrhagic fluid collected at the right extraperitoneal space and anterior abdominal wall with active bleeding. (B) On coronal view.



Fig. 2. Acute limb ischemia shown on the right leg at the emergency department.

management on POD 25. On a manual muscle test, motor power weakness of the right lower extremity with a poor to fair grade improved to a good and fair grade 24 days after transferring. Moreover, the right foot drop with a poor grade of dorsiflexor motor power checked when gaiting was improved with the application of an ankle foot orthotic and gait training. On POD 50, she was discharged and no new or worsening of complications occurred.

DISCUSSION

In all vascular injuries, the time it takes to control proximal and distal bleeding is the most important factor in predicting outcomes [2]. There are several strategies to control abdominal bleeding. However, massive bleeding interferes with the approach to the bleeding site which frustrates surgeons. Intraabdominal packing is the usual method for venous or oozing bleeding [3]; however, it is not effective for controlling arterial bleeding.

For massive abdominal hemorrhages, an aortic cross clamping (ACC) can be a bridge technique for definitive operations. As the ACC separates systemic circulation from the outflow of the heart, bleeding control from the main vessel including ligation or a bypass graft would be easier. Yet, the ACC technique is hard to achieve in situations accompanied by severe bleeding and there are still no concrete guidelines and protocols for performing the procedure.

Another option for a massive abdominal hemorrhage

is resuscitative endovascular balloon occlusion of the aorta (REBOA) [4]. It places an endovascular balloon into the aorta to stop bleeding or control blood flow distal to the balloon in hypovolemic shock and traumatic arrest states [5]. In 1954, Hughes [6] reported the use of an intra-aortic balloon catheter tamponade for controlling intraabdominal hemorrhage in men and in 1989, Gupta et al. [7] discussed the role of an intra-aortic balloon occlusion in penetrating abdominal trauma. Avaro et al. [8] reported that an endovascular aortic occlusion that is performed in forty minutes increases the survival rate in an experimental model of hemorrhagic shock by abdominal trauma. It is clear that the REBOA procedure keeps the perfusion to the heart and brain so that hypovolemic shock can be avoided for a short period of time. However, this procedure can be a bridge skill to move patients in poor conditions from the emergency department or intensive care unit to the operating or angiography room [9]. In 2017, a consensus was obtained at a meeting held in Sweden. Since the procedure was just recently established, its effectiveness is now being announced in several small studies and its indications are being set. Even though its indications are different depending on the country and hospital, it is typically used in hemorrhagic shock, blunt or penetrating abdominal trauma, hemorrhagic pelvic bone fracture, and aneurysmal rupture of the abdominal aorta in patients who are in or about to arrest. However, the crucial complication of REBOA is the ischemia such as limb amputation and organ failure which is as high as 13% [10]. For a more clear and improved option than aortic clamping, more studies with hemorrhage-related mortality are needed [5].

Iliac vascular injuries represent 11% of cardiovascular injuries, and 26% of those have combined injuries such as a pelvic bone fracture and internal organ injuries [11,12]. An iliac vascular injury can cause a massive hemorrhage and result in hypovolemic shock. The mortality rate ranges from 42-58% when accompanied by an aorta or inferior vena cava injury [2]. For surgical management, an end-to-end anastomosis with appropriate mobilization can be applied to large vessel injuries. Moreover, polytetrafluoroethylene bypass grafting or saphenous vein interposition grafting can be applied when adequate mobilization cannot be achieved. However, the operative approach to

retroperitoneum and vascular exposure is relatively difficult and requires a significant amount of time. Moreover, a blind dissection to large vessels in the retroperitoneum can cause unintended vessel or nerve injuries. Therefore, other options should be considered. The shunt can be used for temporary distal circulation in iliac artery injuries.

Martinelli et al. [13] reported that a blinded intra-aortic balloon occlusion procedure can help critically ill patients with refractory hemorrhagic shock due to a pelvic bone fracture. It can be a bridge strategy until the injured vessel is exposed. Radiologic embolization of an internal iliac artery or its branches is commonly used in a pelvic bone fracture [14]. For non-operative management, an endovascular balloon can also help control hemorrhages and facilitate selective occlusion of an injured point.

In our case, the rupture of the right external iliac artery caused massive bleeding and a large hematoma at the extraperitoneal and intraperitoneal spaces. Temporary occlusion with a balloon was applied to control bleeding after the angiography. This procedure had many advantages in this situation. First, it temporarily clamped the arterial bleeding site and a clear operation view was secured. Second, since the procedure involved a highly selective occlusion, unnecessary organ ischemia was avoided. This point makes this procedure a better option than REBOA. Third, it was a temporary procedure that allowed the reperfusion to follow thereafter, which is better than angiocoilization. Fourth, the procedure can be applied to large arteries, which can be difficult in the embolization process. Fifth, since the procedure was being performed at the same time as the operation, it saved time.

However there can also be disadvantages. First, the routine appliance of REBOA is not easy and the appliance can be considered case by case. Second, this procedure needs a highly selective angiography, therefore the expert and equipments of angiography are needed. In the future, we need a prospective study about the effectiveness of temporary ballooning of an artery in the trauma field.

In conclusion, the proximal occlusion of an iliac artery with a temporary balloon is an option or bridge for a definite operation in cases of iliac artery rupture.

REFERENCES

1. Kobayashi LM, Costantini TW, Coimbra R. Mesenteric vascular injuries. In: Dua A, Desai SS, Holcomb JB, Burgess AR, Freischlag JA, eds. *Clinical review of vascular trauma*. Heidelberg: Springer Medical Publishing; 2014:213-24.
2. Burch JM, Richardson RJ, Martin RR, Mattox KL. Penetrating iliac vascular injuries: recent experience with 233 consecutive patients. *J Trauma* 1990;30:1450-9.
3. Feliciano DV, Moore EE, Biffl WL. Western trauma association critical decisions in trauma: management of abdominal vascular trauma. *J Trauma Acute Care Surg* 2015;79:1079-88.
4. Stannard A, Eliason JL, Rasmussen TE. Resuscitative endovascular balloon occlusion of the aorta (REBOA) as an adjunct for hemorrhagic shock. *J Trauma* 2011;71:1869-72.
5. Biffl WL, Fox CJ, Moore EE. The role of REBOA in the control of exsanguinating torso hemorrhage. *J Trauma Acute Care Surg* 2015;78:1054-8.
6. Hughes CW. Use of an intra-aortic balloon catheter tamponade for controlling intra-abdominal hemorrhage in man. *Surgery* 1954;36:65-8.
7. Gupta BK, Khaneja SC, Flores L, Eastlick L, Longmore W, Shafiq GW. The role of intra-aortic balloon occlusion in penetrating abdominal trauma. *J Trauma* 1989;29:861-5.
8. Avaro JP, Mardelle V, Roch A, Gil C, de Biasi C, Oliver M, et al. Forty-minute endovascular aortic occlusion increases survival in an experimental model of uncontrolled hemorrhagic shock caused by abdominal trauma. *J Trauma* 2011;71:720-5; discussion 725-6.
9. Brenner ML, Moore LJ, DuBose JJ, Tyson GH, McNutt MK, Albarado RP, et al. A clinical series of resuscitative endovascular balloon occlusion of the aorta for hemorrhage control and resuscitation. *J Trauma Acute Care Surg* 2013;75:506-11.
10. Taylor JR 3rd, Harvin JA, Martin C, Holcomb JB, Moore LJ. Vascular complications from resuscitative endovascular balloon occlusion of the aorta: life over limb? *J Trauma Acute Care Surg* 2017;83(1 Suppl 1):S120-3.
11. Asensio JA, Petrone P, Roldán G, Kuncir E, Rowe VL, Chan L, et al. Analysis of 185 iliac vessel injuries: risk factors and predictors of outcome. *Arch Surg* 2003;138:1187-93; discussion 119-4.
12. Mattox KL, Feliciano DV, Burch J, Beall AC Jr, Jordan GL Jr, DeBakey ME. Five thousand seven hundred sixty cardiovascular injuries in 4459 patients. Epidemiologic evolution 1958 to 1987. *Ann Surg* 1989;209:698-705; discussion 706-7.

13. Martinelli T, Thony F, Decléty P, Sengel C, Broux C, Tonetti J, et al. Intra-aortic balloon occlusion to salvage patients with life-threatening hemorrhagic shocks from pelvic fractures. *J Trauma* 2010;68:942-8.
14. Velmahos GC, Demetriades D, Chahwan S, Gomez H, Hanks SE, Murrey JA, et al. Angiographic embolization for arrest of bleeding after penetrating trauma to the abdomen. *Am J Surg* 1999;178:367-73.