

## Successful Endovascular Management of Intraoperative Graft Limb Occlusion and Iliac Artery Rupture Occurred during Endovascular Abdominal Aortic Aneurysm Repair

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For high-risk patients, endovascular aortic aneurysm repair (EVAR) is a good option but may lead to serious complications, which should be addressed immediately. A 75-year-old man with a history of abdominal surgery underwent EVAR for an aneurysm of the abdominal aorta and iliac arteries. During EVAR, iliac artery rupture and graft limb occlusion occurred, and they were successfully managed by the additional deployment of an iliac stent graft and balloon thrombectomy, respectively. We, herein, report a rare case of the simultaneous development of the two fatal complications treated by the endovascular technique.

Key words: 1. Aneurysm  
2. Aorta, abdominal  
3. Stent  
4. Rupture  
5. Thrombosis

### CASE REPORT

A 75-year-old man visited the emergency room with anemia and dizziness. He was taking warfarin for deep vein thrombosis and had a hemoglobin level of 4.5 g/dL. The prothrombin time (international normalized ratio) was 6.28. He had undergone low anterior resection and partial bladder resection with adjuvant chemotherapy to treat sigmoid colon cancer 3 years earlier. He had also undergone incisional ventral hernia repair. He did not show hematochezia, melena, or abdominal tenderness/rebound tenderness. The anemia and the prolongation of the prothrombin time were easily corrected; thus, continuous bleeding was not suspected. Nevertheless, in

order to rule out gastrointestinal bleeding as a cause of the severe anemia, abdominal computed tomography (CT) was performed. However, there was no evidence of intra-abdominal bleeding. Instead, a 55-mm abdominal aortic aneurysm with eccentric bulging combined with a right common iliac artery aneurysm (Fig. 1A, B). The aneurysm size increased by 10 mm compared with the size 2 years previously. Because severe intra-abdominal adhesion and wound problems after laparotomy were expected, endovascular aortic aneurysm repair (EVAR) was recommended instead of open surgery. EVAR was started with the deployment of a bifurcated main body using an aortic stent graft of 30×30×40 mm and an inner bare stent 32×32×50 mm in size (S&G Biotech Inc.,

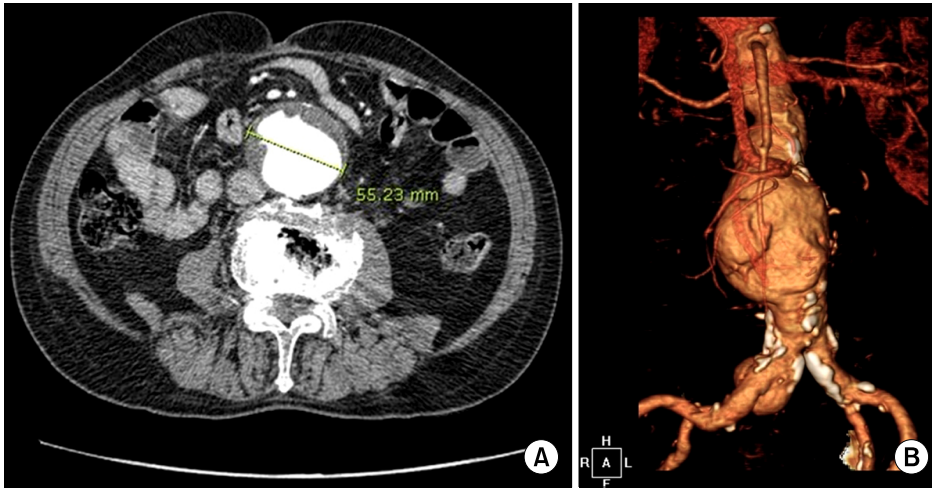
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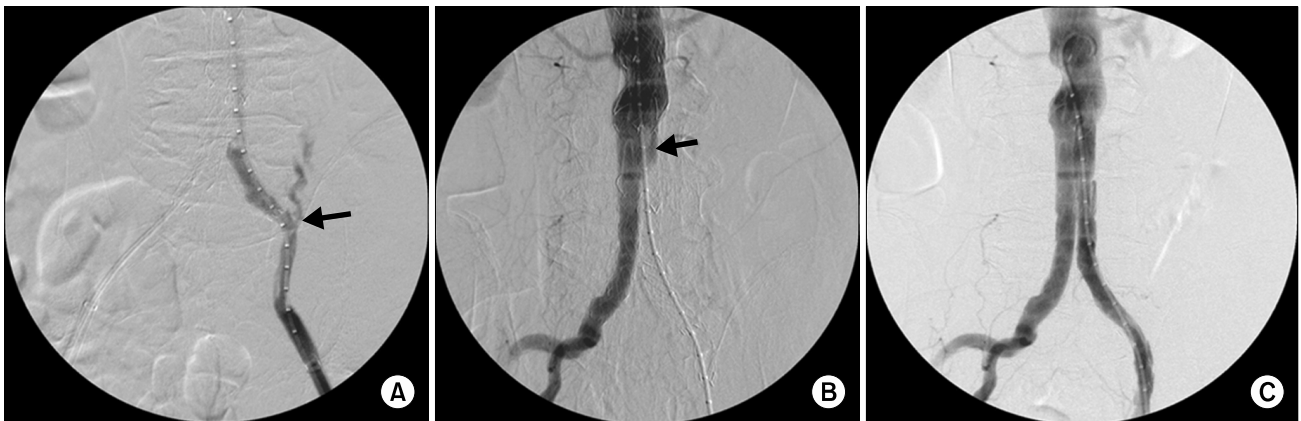
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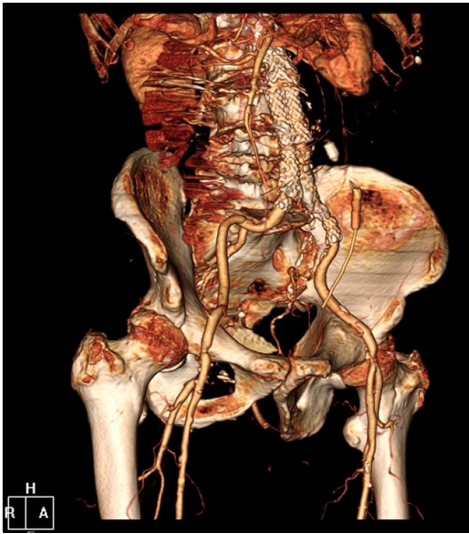
**Fig. 1.** (A) Preoperative computed tomographic angiography shows an abdominal aortic aneurysm. (B) 3-Dimensional reconstruction shows eccentric bulging of the abdominal aortic aneurysm combined with right common iliac artery aneurysm.



**Fig. 2.** (A) Perforation at left proximal external iliac artery (arrow). (B) Occlusion of left graft limb (arrow). (C) Completion angiography showed no further extravasation and no occlusion.

Seongnam, Korea). Subsequent extension of the right graft limb was performed uneventfully using two covered stents (12×12×80 mm and 12×12×60 mm) to exclude the right common iliac artery aneurysm. Dreadful complications occurred during the last procedure of the left graft limb extension. After the selection of the left graft limb and the guide wire exchange to a Lunderquist stiff wire (Cook Inc., Bloomington, IN, USA), a 16F introducer sheath was inserted for the delivery of a limb extension graft, but the tip of the sheath perforated the left proximal external iliac artery during the advancement of the sheath (Fig. 2A). Sheath-pushing against the tortuous iliac artery caused the guide wire to slip back into the sheath, and the dilator tip punctured the arterial wall. Although the extension of the left graft limb was sched-

uled to end at the distal common iliac artery, the extension was promptly determined to be lengthened to the external iliac artery to cover the perforated site. The left graft limb of the main body was reselected, and a stent graft of 12×12×100 mm was deployed. A sheath angiography showed no further extravasation. However, subsequent aortography showed an occlusion of the left graft limb, and acute thrombosis was suspected (Fig. 2B). A prompt balloon thrombectomy was attempted after the left superficial and deep femoral arteries were clamped to prevent distal embolization. A 6F balloon catheter was advanced through the occlusion and withdrawn carefully not to cause disjunction of the overlapped stent grafts. Fresh thrombus was successfully removed, and the graft flows became excellent without any endoleak



**Fig. 3.** Postoperative computed tomographic angiography with 3-dimensional reconstruction.

upon the completion of angiography (Fig. 2C). The patient was extubated and transferred to the general ward on the following day. He was discharged on the fifth postoperative day. Postoperative follow-up CT scan showed no endoleak (Fig. 3). At the 3-month follow-up, the patient was doing well without any symptoms like buttock claudication.

## DISCUSSION

Surgical treatment for abdominal aortic aneurysm is the standard treatment of choice. Although the surgery reduces the risk of rupture of the aortic aneurysm, the mortality of surgery has been reported to be approximately 2% to 8% [1]. In fact, in the high-risk group for surgery, the morbidity is as high as 30% [2]. Thus, for high-risk patients, minimally invasive treatment is preferred. Since the first successful endovascular treatment of an abdominal aortic aneurysm in 1991, this procedure has been performed with increasing frequency for high-risk patients [3]. Recently, with the development of smaller and more precise devices, EVAR has been accepted as a useful treatment method for patients at high risk for postoperative complications and patients refusing surgery [1].

However, EVAR also has many complications related to the procedures, such as ruptures, thrombi within stent grafts, endoleaks, dislocation of the stent grafts, and infections. We

experienced combined iliac artery rupture and graft limb thrombosis, which would cause a fatal outcome unless addressed immediately. Although the main cause of the iliac artery perforation in this case was the fact that the push of the introducer sheath was careless and jerky, one of the keys for successful endovascular repair of aortic aneurysm is adequate vascular access through the femoral and iliac arteries [4]. Calcification, diminished diameter, and severe tortuosity of the iliac arteries have been associated with an increased incidence of iliac injury during EVAR [4]. However, even after careful preoperative assessment, inadvertent iliac rupture can occur and be a source of morbidity and mortality [4]. This case calls attention to the importance of a careful manipulation of wires and catheters during the endovascular procedure. With respect to the management of acute iliac artery rupture, endovascular repair with a stent graft has already been demonstrated with satisfactory short-term and midterm results [5]. Intraoperative invasive arterial blood pressure monitoring, maintenance of stiff wire access, readily available intra-aortic occlusion balloons, and an inventory of iliac stent grafts are the prerequisites for the prompt endovascular management of a ruptured iliac artery during EVAR [4].

Stent graft thrombosis is one of the most life-threatening complications of EVAR. Almost all the previous literature reported delayed or late stent graft thrombosis rather than acute or intraoperative thrombosis as in this case. The incidence rates have been reported to be 2.7% to 23.8% [6], and underlying stenosis or kinks have been pointed out as the main causes. However, the main cause of the acute graft limb thrombosis in this case was thought to be inadequate anticoagulation during the management of the ruptured iliac artery. The goal of the management of the stent graft thrombosis is the restoration of appropriate blood flow to the lower extremities [6]. Therefore, the available treatment methods are thrombectomy, catheter thrombolysis, and extra-anatomical bypass, such as axillo-femoral or cross-femoral bypass. According to the EUROSTAR (European Collaborators on Stent/Graft Techniques for Aortic Aneurysm Repair) registry, as a secondary procedure after EVAR, 11% of the patients required femoro-femoral bypass grafting [7]. In this case, thrombectomy was performed rather than thrombolysis or ex-

tra-anatomical bypass because thrombolysis right after the event of iliac artery perforation was inappropriate, and extra-anatomical bypass should be a second-line treatment option considering that the thrombus was fresh. The limitations of thrombectomy are mainly associated with technical difficulty in the introduction of a catheter into the lumen of the stent graft, particularly in the case of late thrombosis and with the possibility of stent migration or disconnection of graft elements, which can lead to type I or type III endoleaks [7].

To prevent thrombosis in the stent graft, adequate anticoagulation during and after the procedure is necessary. In summary, we report a rare case of combined iliac artery rupture and graft limb occlusion complicating EVAR, which were successfully managed without additional open surgery. Careful manipulation of catheters and guide wires, as well as maintenance of optimal anticoagulation throughout the procedure, is fundamental but the most important requirement for an endovascular procedure. To decide on the best treatment option among the various surgical and endovascular modalities, intraoperative decision making is very important.

#### CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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