Bilateral renal artery occlusion due to intraoperative retrograde migration of an abdominal aortic aneurysm endograft

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Retrograde (proximal) migration of an abdominal aortic aneurysm endograft is an extremely rare event during endovascular insertion and may lead to occlusion of the bilateral renal arteries and dialysis-dependent renal failure. This case report describes the intraoperative retrograde migration of a bifurcated abdominal aortic endograft during the initial endovascular procedure after deployment of an extender limb graft into the right iliac artery and associated bilateral renal artery occlusion. This was treated with renal artery bypass, and the patient had a favorable outcome. (J Vasc Surg 2010;51:720-4.)

Retrograde (proximal) migration is an extremely rare complication of endovascular abdominal aortic aneurysm repair (EVAR). In particular, occlusion of the renal artery origins is an uncommon morbidity of EVAR and may lead to acute renal failure in the early postoperative period.[1,2] In addition to the characteristics of proximal aortic neck, such as thrombosis or excessive angulation and endograft size, technical considerations during stent deployment can be a predisposing factor for retrograde migration of the endograft. We present a patient with bilateral renal artery occlusion due to intraoperative retrograde migration of the bifurcated endograft during the initial EVAR procedure and its surgical treatment with renal artery bypass, leading to a favorable outcome.

CASE REPORT

A 79-year-old man presented to our clinic with low back pain that had progressed within the last 3 months. The patient's medical history was significant for diabetes mellitus, chronic obstructive lung disease, and coronary artery bypass grafting 9 years earlier. Physical examination revealed a pulsatile mass in the periumbilical region suggesting an abdominal aortic aneurysm (AAA). Laboratory tests revealed a serum urea nitrogen level of 34 mg/dL and a creatinine level of 1.1 mg/dL.

A computed tomography (CT) scan showed a fusiform infrarenal AAA measuring 78 mm at its maximum diameter. The aneurysmatic segment of the aorta was 13 mm distal to the lowest renal artery (Figs 1 and 2). The internal diameter of the aorta proximal to the aneurysmal portion was 28 mm. There was no thrombosis or luminal irregularity on the neck of the aneurysm; however, the angulation was almost 45°. The right and left iliac arteries were aneurysmal, measuring 19 mm and 18 mm in diameter, respectively. The abdominal aorta and bilateral iliac arteries showed a moderate amount of mural thrombosis. Because the patient had significant comorbidities, EVAR was recommended.

Fig 1. Image shows an infrarenal abdominal aortic aneurysm. The neck was 13 mm inferior to the lowest renal artery.

After evaluation of the proximal neck and radiologic visualization of the renal artery origins (Fig 3), a 32-mm aortic bifurcated device (Anaconda; Vascutek-Terumo, Inchinnan, Scotland) was inserted through the right side and deployed just below the inferior renal artery. The proximal portion of the endograft was placed as high as possible to allow optimal contact area and fixation at the proximal neck without causing obstruction of renal arteries. We did not use ballooning to stabilize the main body. The C-arm was in the anteroposterior (AP) projection during the deployment of the main body and iliac legs. The completion angiogram visualized the bilateral renal artery origins (Fig 4, *A*).

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Fig 2. Computed tomography slices show the preoperative anatomy of the infrarenal abdominal aortic aneurysm that makes an angulation at the neck region.

Fig 3. Intraoperative angiogram shows the abdominal aortic aneurysm.

A flared iliac extension graft (17 × 21 × 130 mm) was uneventfully placed into the left common iliac artery to exclude the iliac aneurysm. In the last step of the procedure, a flared iliac leg delivery system was used to place the right common iliac artery extension, including an outer 17- × 21- × 110-mm sheath. This iliac extension was deployed into the iliac bifurcation to exclude the aneurysm.

We did not perform ballooning to stabilize the endograft. However, completion angiography in the AP projection demonstrated occlusion of both renal arteries and retrograde (proximal) migration of the endograft (Fig 4, *B*). The proximal neck of the endograft was observed to be inferior to the superior mesenteric artery. A 30° caudal and 45° left lateral oblique view also confirmed this event. In addition, intraoperative Doppler ultrasound imaging confirmed the absence of blood flow through the renal arteries. We believed that migration of the endograft could be associated with iatrogenic mobilization during retracting of the outer sheath of the iliac leg or endograft deployment.

After the diagnosis of retrograde migration, a 33-mm balloon catheter (Boston Scientific, Medi-Tech, Ireland) was inflated at the bifurcation of the endograft to pull the device downwards, but the intervention was not successful. It was assumed that failure to pull down the endograft was due to its barbs penetrating the aortic wall at the pararenal level. Thus, an open exploration was immediately performed. A total of 280 mL of nonionic contrast (Xenetix, Guerbet Inc, Roissy Charles de Gaulle, France) was administered.

No endoleak was evident when the aneurysm sac was opened. We could not pull the device down by applying downward pressure with surgical instruments because its hooks firmly penetrated atherosclerotic wall of the aneurysm. The distal end of an 8-mm polytetrafluoroethylene (PTFE) graft was first anastomosed to the left renal artery in an end-to-side fashion with a 6-0 Prolene (Ethicon, Somerville, NJ) suture (Fig 5, *A*). The proximal end of the graft was end-to-side anastomosed to the anterior side of the suprarenal aorta that served as the inflow for the renal bypasses above the endograft.

After revascularization of the left kidney, another 8-mm PTFE graft was first anastomosed to the right renal artery and then to the

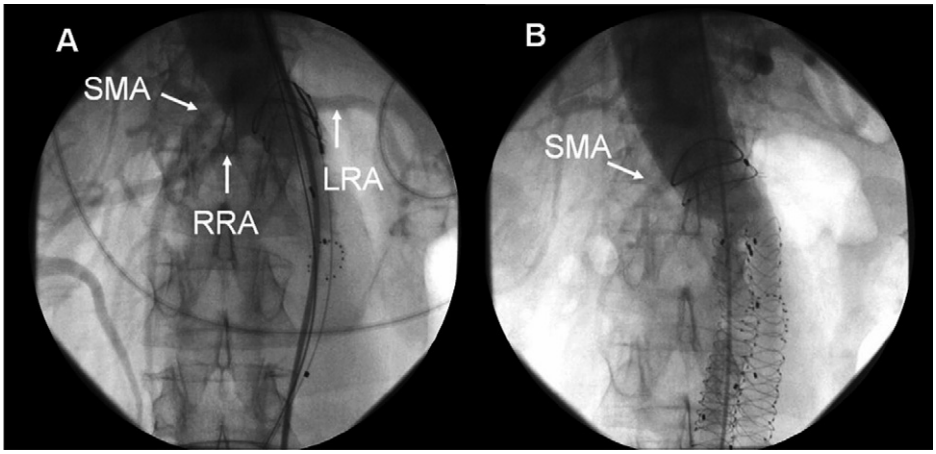

Fig 4. Intraoperative angiogram demonstrates **(A)** the patency of both renal arteries after deployment of the endograft body and **(B)** occlusion of the vessels after placement of iliac artery extension limb graft. *LRA*, Left renal artery; *RRA*, right renal artery; *SMA*, superior mesenteric artery.

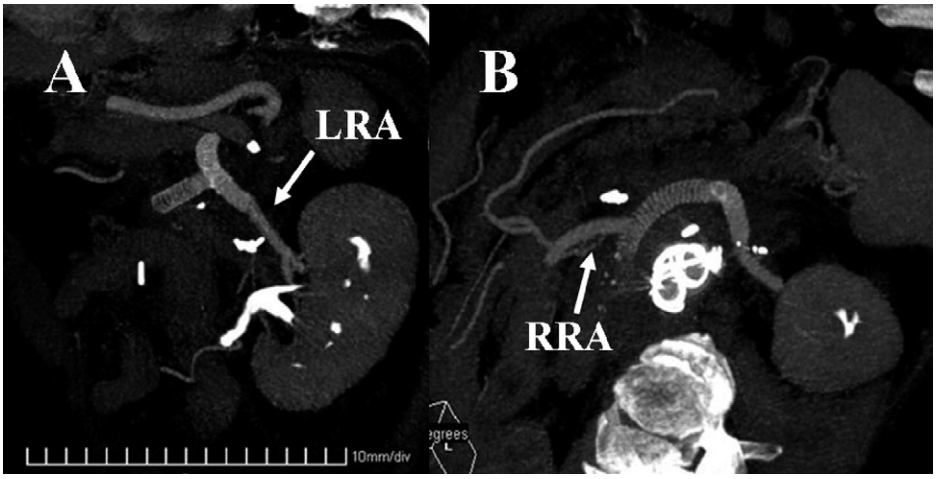

Fig 5. Postoperative computed tomography angiogram demonstrates revascularization of the **(A)** left and **(B)** right renal arteries with synthetic graft interposition. *LRA*, Left renal artery; *RRA*, right renal artery.

prosthetic graft originating from the suprarenal abdominal aorta (Fig 5, *B*). In this way, the ischemic period of the kidneys was technically decreased by composing a Y graft (Fig 6). Total duration of renal ischemia was about 2 hours.

The patient was discharged on postoperative day 7 with a favorable outcome and a slightly elevated serum creatinine level of 1.3 mg/dL. We believed that mainly iatrogenic forces causing upward movement of the delivery system during deployment of the iliac limb led to retrograde migration of the endograft and occlusion of the renal artery origins. In addition, instability of the endograft body after stent deployment and the angulation of the aorta and its relatively short neck facilitated this morbidity.

COMMENT

Endograft migration is an uncommon complication of EVAR. Although antegrade migration is a well-described phenomenon that generally develops >12 to 18 months, retrograde migration may rarely occur intraoperatively or in the early postoperative period and lead to acute tubular necrosis and renal failure.[1-6] Only a few articles have described retrograde migration of an abdominal aortic endograft.[1,2] Katzen et al[1] reported occlusion of bilateral renal arteries in the early postoperative period of an uneventful infrarenal procedure. Unfortunately, the patient developed dialysis-dependent renal failure. Therefore, early diagnosis of this event and urgent revascularization of renal arteries may allow a favorable outcome.

The factors related to device migration include excessive angulation and characteristics of the proximal neck, such as thrombosis or calcification, iliac artery aneurysm or tortuosity, device properties, and technical considerations. A dilated proximal neck and inadequate

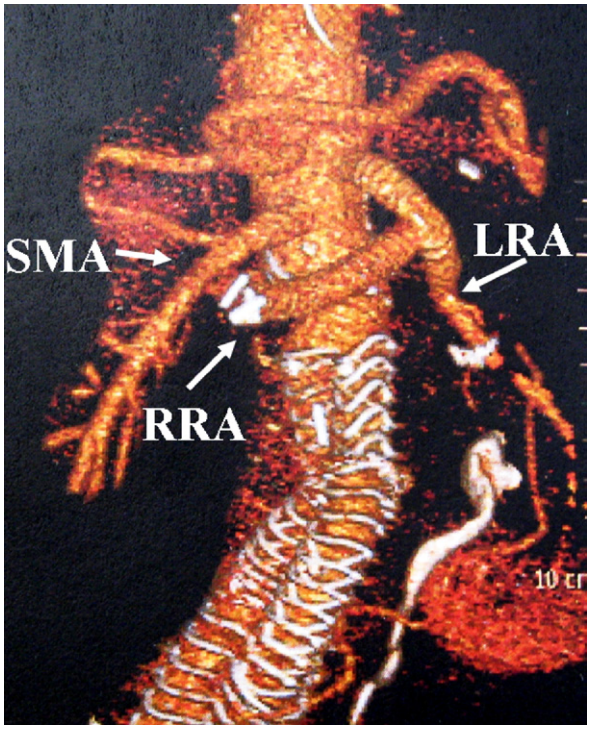

Fig 6. Postoperative 3-dimensional reconstructed computed tomography angiogram demonstrates the aortorenal artery bypass and the bifurcated endograft covering the origins of the renal arteries. *LRA,* Left renal artery; *RRA,* right renal artery; *SMA,* superior mesenteric artery.

proximal fixation may lead to the development of device migration.[3,7,8] Most devices have been designed to prevent endograft movement over time and have penetrating barbs or hooks generally directed downward to avoid antegrade distal, but not retrograde, migration of the proximal neck. Nevertheless, fracture of these structures during deployment can be another reason for migration. On the other hand, release of compression forces after removal of delivery system and localization of the stent close to the renal orifices may lead to migration of endografts. Technical details or maneuvers can also be a predisposing factor for retrograde migration, as proposed previously.[1]

In the current case, mainly iatrogenic forces and mobilization of the delivery system during deployment of the right iliac limb potentially caused upward movement of the device and associated retrograde migration of the endograft body. To deploy an Anaconda endograft, the operator's two hands should be synchronous and stable during retracting of the outer sheath and the removal of the delivery system.

We believe that instability of the device during these maneuvers or applying an uncontrolled force during manipulation led to improper placement and migration of the endograft body. Repositioning of the iliac extension device after retracting its outer sheath could have been a reason, and instability of the endograft body could also have been a predisposing factor. If the hooks do not properly penetrate the aortic wall, instability of the main body can be evident after graft deployment. In such a case, balloon inflation after stent placement can be useful. We also speculated that angulation of the aorta and its relatively short neck for the graft placement facilitated the development of this morbidity.

When retrograde migration causing occlusion of renal arteries occurs, pulling the graft down by using balloon or wire techniques can be the first intervention intraoperatively. A balloon catheter can be inflated at the bifurcation of the endograft body and pulled down by applying pressure. In such an event, a wire could also be inserted from one groin up, passed over the graft bifurcation, and directed into the other groin. After placing a catheter, passed over the wire, the graft could also be pulled down. These methods may not be successful, however, because as in the current case, the endograft devices have penetrating barbs directed downwards to avoid antegrade migration of the proximal neck. We confirmed that the metal pins of the device penetrated the aortic wall, explaining the failure of pulling down with the balloon catheter.

Hedayati et al[2] noted that endovascular interventions can be used as an effective initial strategy, and renal salvage may be achieved after prolonged ischemia. Nonetheless, open surgical approaches, including renal artery bypass to one or both kidneys with aortorenal, iliorenal, hepatorenal, or splenorenal bypass or open surgical repair, should be considered.

CONCLUSIONS

Retrograde migration of an endograft during endovascular repair for abdominal aortic aneurysms is a very rare complication. Careful stabilization of the delivery system handle during retraction of the outer sheath and during deployment of the endograft avoids the risk of the occurrence of iatrogenic morbidities associated with manipulation of the device.

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