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Case Report / Olgu Sunumu

Partial removal of endovascular stent grafts: technical considerations in three cases

Endovasküler stent greftlerin kısmi olarak çıkarılması: Üç olgunun teknik değerlendirilmesi

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The endovascular repair of an abdominal aortic aneurysm has become increasingly common during the past decade. However, the endoleak, a complication of endovascular repair, is also on the rise. Most of the endoleaks can be managed with endovascular techniques. In some cases, conversion to open surgery for total or partial removal of the stent-graft may be required. In this article, we report three patients who underwent partial removal of the stent-graft in the light of technical feasibility and possible complications of the procedure.

Key words: Abdominal aortic aneurysm; endovascular repair; partial stent graft removal.

Abdominal aort anevrizmasının endovasküler tamiri, son on yılda giderek yaygın hale gelmiştir. Ancak, endovasküler tamirin bir komplikasyonu olan kaçak oranı da artmaktadır. Kaçakların büyük bir kısmı endovasküler teknikler ile tedavi edilebilmektedir. Bazı olgularda stent-greftin tamamı ya da bir kısmının cerrahi olarak çıkarılabilmesi için açık cerrahi gerekebilir. Bu yazıda stent grefti kısmi olarak çıkartılan üç olgu, işlemin teknik açıdan uygulanabilirliği ve muhtemel komplikasyonları eşliğinde sunuldu.

Anahtar sözcükler: Abdominal aort anevrizması; endovasküler tamir; parsiyel stent greft çıkarılması.

The endovascular repair of an abdominal aortic aneurysm (AAA) has become increasingly common during the past decade. The mortality and morbidity rates and length of hospital stay have decreased, but the need for graft follow-up has remained the same.

The continued perfusion of the aneurysm sac or pressurization after stent graft deployment (an endoleak) constitute the potential shortcomings of this procedure. Most endoleaks are treated via endovascular techniques, and type 1 and 3 endoleaks are associated with an increased risk of a ruptured aneurysm. In some cases, open surgical techniques can be used in the treatment of endoleaks.[1]

Surgical conversion is occasionally necessary for the removal of the stent graft, but primary or secondary conversion to open surgery and explantation are infrequent events. In fact, there have only been a few reports in the literature regarding the operative strategies, techniques and advantages of the partial or complete removal of stent grafts.[2]

Herein, we present our experience and the long-term results for three patients who underwent the partial removal of a stent graft.

CASE REPORT

Case 1– A 76-year-old female who had an 8 cm AAA with a 90° angulated neck was prepared for an endovascular stent graft placement, and a bifurcated stent graft was deployed successfully. At the one-month follow-up, computed tomography (CT) revealed a type 1 proximal endoleak due to the migration of

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the stent graft. Reintervention was planned. An aortic extension was performed with no complications, and a duplex scan examination and contrast-enhanced CT showed no type 1 endoleak during the one-, six-, and 12-month follow-up visits.

However, at the postoperative 15^{th} month, the patient was readmitted with complaints of abdominal pain, and CT showed the recurrence of a proximal type 1 endoleak due to the disconnection of the aortic cuff from the main body (Figure 1).

Therefore, we decided to perform an open repair. A midline laparotomy was performed, and the retroperitoneum was exposed. Proximal control of the abdominal aorta was obtained just above the renal arteries with the aid of nylon tape by looping it around the aorta. No fibrotic reaction was encountered nor were dense adhesions seen during the dissection of the proximal neck. However, the dissection of the distal end of the aorta and iliac arteries was difficult due to dense fibrosis; thus, we did not encircle the distal iliac arteries to control distal back bleeding. Next, the proximal aorta was clamped above the renal arteries, and the aneurysm sac was opened. The thrombus around the stent graft was then evacuated, and the previously deployed aortic extension was removed via gentle traction. The back bleeding from the iliac arteries was controlled by clamping the main body of the stent graft, and the proximal neck of the aneurysm was freed from the adjacent structures and prepared for anastomosis. A 24 mm Dacron graft was then anastomosed to the infrarenal segment of the native aorta. Because the distal limbs of the stent graft were well incorporated into the iliac arteries and no back-bleeding was observed between the stent graft and the native iliac artery orifices, we decided to leave them in-situ. After this, the main body of the stent graft was shortened up to the graft bifurcation. The Dacron graft was then sutured to the stent graft, and the aneurysm sac was wrapped tightly around the grafts after the bleeding was controlled.

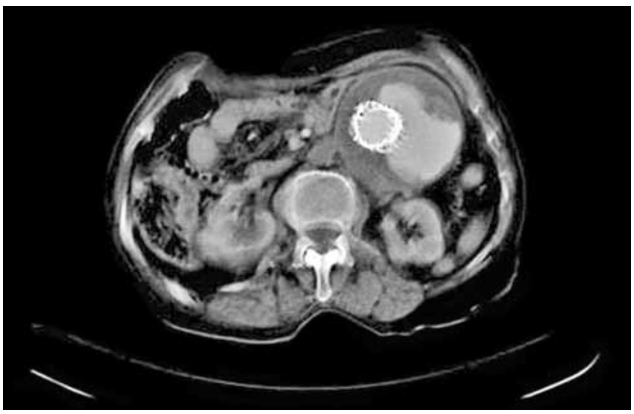

Figure 1. A proximal type 1 endoleak due to the disconnection of the aortic cuff from the main body.

The postoperative period was uneventful, and the patient was discharged from the hospital on the seventh postoperative day. Furthermore, CT showed no endoleaks 28 months after the operation (Figure 2).

Case 2– A 63-year-old male patient who had previously undergone aorta-coronary bypass surgery underwent an endovascular stent graft placement for a 6.5 cm AAA. The first-year CT follow-up was normal, but at the second year, a CT scan showed that the stent graft had migrated, causing a proximal type 1 endoleak and expansion of the aneurysm diameter. Hence, the patient was prepared for aortic cuff placement to repair the type 1 endoleak. However, this procedure failed because the left renal artery orifice had been inadvertently covered with the cuff, so open surgery was undertaken. The proximal neck of the aneurysm was dissected and prepared for anastomosis. Similar to the first case, the fibrosis was more prominent around the iliac arteries because they were hosting the distal limb of the stent graft; therefore, they were not dissected or encircled for the distal control of bleeding. After administration of heparin, the

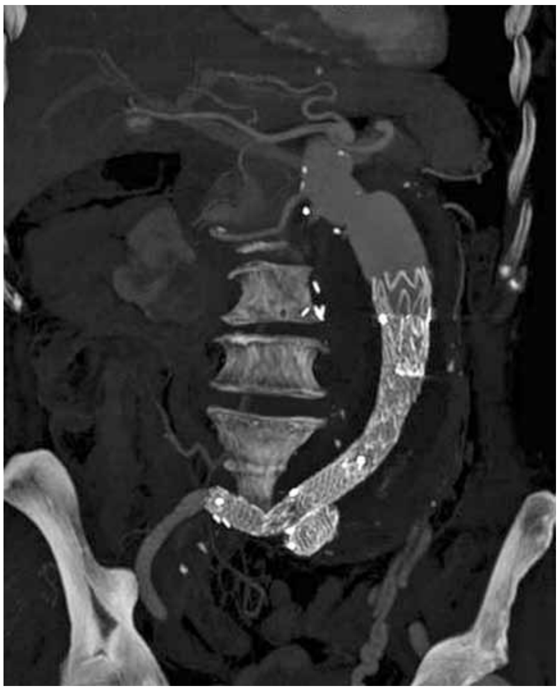

Figure 2. Postoperative computed tomography shown after partial stent greft explants revealed no endoleaks.

Figure 3. An operative view showing the Dacron tube graft anastomosed to the aorta using an end-to-end technique. The distal end of the Dacron graft was then anastomosed to the stent graft.

supraceliac abdominal aorta was clamped, and the aneurysm sac was opened. After the evacuation of a large amount of thrombus, the main trunk of the stent graft was clamped just above the bifurcation to stop back bleeding from the iliac arteries. Despite a generous aortotomy, the extreme external force of the aortic cuff made removing it quite difficult, which necessitated significant traction. The distal limbs of the stent graft were well embedded in the iliac arteries and were left in-situ since an attempt to remove them by extreme traction could have caused an inadvertent iliac artery injury. The main body of the stent graft was then shortened up to the bifurcation by cutting it with scissors. The infrarenal aorta was prepared for anastomosis, and the Dacron tube graft was anastomosed to the aorta in an end-to-end fashion. After that, the distal end of the Dacron graft was anastomosed to the stent graft (Figure 3).

Figure 4. The final angiography showed no endoleaks, and the left renal artery was not visualized after the endovascular graft placement.

In the postoperative period, the patient developed renal insufficiency which required hemodialysis. However, he was discharged two weeks after the operation with good renal function, and CT showed no endoleaks 22 months postoperatively.

Case 3– A 74-year-old man with a 6.1 cm AAA underwent the placement of a stent graft. Under epidural anesthesia, the left and right femoral arteries were explored surgically. The orifice of the left renal artery, which was significantly lower than the right one, was cannulated via the right axillary artery since the neck of the aneurysm was very short. Before introducing the main body of the stent graft, the guiding catheter was placed in the left renal artery to avoid inadvertent coverage of its orifice during the stent graft release.

Next, the stent graft was successfully placed in the infrarenal aorta, and the left renal artery perfusion was deemed to be good. Therefore, the guiding catheter was removed before the final angiography, which showed complete obliteration of the aneurysm sac but no type 1 or type 2 endoleak. However, the left renal artery was not visualized (Figure 4), and we were not able to recatheterize it. The decision was then made to remove the stent graft, and supraceliac control of the aorta was obtained through a midline incision. In addition, the iliac arteries were not dissected for distal control. The endograft limbs were then directly clamped after the opening of the aneurysm sac. Despite a generous aortotomy, the penetration of the proximal hooks into the aorta made the removal of the proximal part of the endograft very difficult; therefore, the graft had to be crimped by a clamp before traction. Furthermore, removal of the distal limbs required significant traction because of the good wall opposition of the endograft; hence, it was left in situ. Afterwards, a Dacron Y graft was anastomosed to the infrarenal aorta in an end-to-end fashion, and the distal limbs of this graft were then anastomosed to the stent graft limbs in the same manner (Figure 5). The patient later developed mild renal insufficiency but did not require hemodialysis.

At postoperative week one, the patient was discharged with good renal function, and the last follow-up CT showed no endoleaks after 24 months.

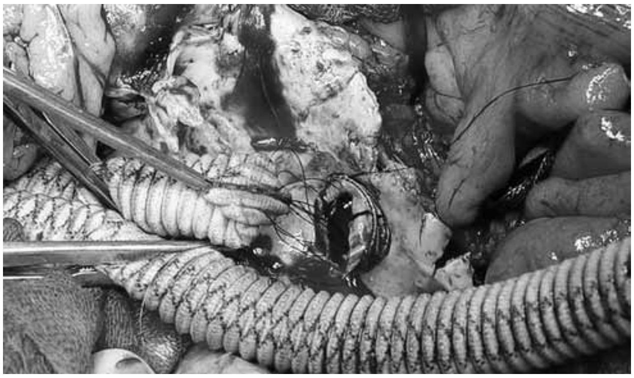
Figure 5. The main body of the stent graft was removed, and the Dacron graft leg was anostomosed to the stent graft limb.

DISCUSSION

Currently, endovascular stent graft implantation is accepted as an viable alternative to conventional open surgery for the treatment of an abdominal aortic aneurysm. However, in some cases, early and late failures can lead to primary or secondary conversion to open repair. In the literature, there have been very few articles about the rate of conversion to an open repair or the surgical techniques involved in stent graft removal. The rate for primary conversion to open repair has been reported to be between 0.8-6%.[3,4] Most primary conversions are due to a type 1 endoleak secondary to stent graft misdeployment or migration or renal artery occlusion by the stent graft. These two complications are usually associated with the angulation and morphology of the proximal aneurysm neck. Primary conversion is less likely to be performed due to a rupture during the endovascular procedure. The mortality rate of conversion is similar to that of primary conventional surgery that involves ruptured aortic aneurysms.

Significant mortality and morbidity is associated with the removal of stent grafts, and in the literature, the mortality rates vary between 0-28.5% for this procedure. The high death rate can be attributed to the emergency conditions, the more frequent need for suprarenal clamping, and the development of renal failure due to the occlusion of the renal artery or high contrast usage.[4,5]

The operative approach depends on the presence of suprarenal stents with hooks or barbs, the origin of the endoleak (proximal or distal fixation site), the periaortic adhesions and the inflammatory reaction related to them, and the decision for either elective or emergency repair. In addition, retroperitoneal or midline approaches are equally effective, with the choice mostly depending on the surgeon's preference.[5]

Suprarenal stent grafts with barbs or hooks or renal occlusion secondary to coverage by the main body of the endograft require supraceliac aortic clamping, which facilitates the atraumatic removal of the proximal portion of the stent graft. The clamp can be moved to the infrarenal portion of the aorta after the removal of the stent graft in order to decrease the visceral and renal ischemia time. We used the midline intraperitoneal approach with supraceliac or infrarenal clamping according to the design of the stent grafts in our cases.

An important technical point that should not be overlooked is the presence of periaortic dense adhesions and the inflammatory reaction associated with them. Lyden et al.[2] found a 26% fibrotic reaction in the juxtarenal aorta related to late explants, with the penetration of the aortic wall by stent graft barbs and hooks being responsible for the inflammation. In our cases, we saw dense inflammatory reactions only around the iliac arteries at the distal attachment side.

Safe removal of the stent graft is crucial, and in the literature, two main techniques have been described to accomplish this task: simple traction and the collapse of the stent graft either by using metal cutters or by reducing the stent graft size using clamps while pouring cold saline on the nitinol wire.[1,2,5] We applied simple traction successfully in the first two cases, but in the third case, the hooks and increased external force of the proximal ring made the removal of the stent graft more difficult. Therefore, we crimped and reduced the diameter of the stent graft by using a clamp before pulling it out. In our experience, removal of the distal limbs has been a more challenging procedure due to the good wall apposition of the long segment of the stent graft in the iliac arteries. In fact, this was the main reason for the partial removal of the stent grafts in our cases.

In the first two cases, we did not cut the stent struts during the shortening of the main body of the stent graft but divided the stents by cutting them parallel to the struts while leaving some fabric. The three-piece modular design of the stent graft made it possible to remove only the main body and leave the limbs in situ. When we compared the suturability of the stent graft, we found that the circular stent frame without connecting bars was better than the V-shaped stent frame with connecting bars.

In addition, we have seen increased needle hole bleeding from the suture line between the stent graft and the new proximal Dacron graft after the completion of anastomosis, with the reason for this being the thin wall of the stent graft. Fibrin glue is normally used to control the bleeding. Our major concern is the development of a pseudoaneurysm in the long-term follow-up. However, in these three cases, we saw no pseudoaneurysm formation during the follow-up period, which averaged 26 months. Additionally, Lipsitz et al.[6] reported no pseudoaneurysm formation in seven patients who had a partial resection of a stent graft with hybrid reconstruction after an average follow-up of 22 months.

In conclusion, in our experience, when the complete stent graft removal is technically difficult, partial stent graft removal is a simple option because it requires less aortic dissection and a shorter operative time. Furthermore, midterm follow-up results have been acceptable with this procedure.

Declaration of conflicting interests

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