Open stent grafting for abdominal aortic aneurysm in a patient with a severely calcified abdominal aorta

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Abstract

We describe a 74-year-old male who underwent open stent repair for an infrarenal abdominal aortic aneurysm with a severely calcified aortic neck. The stent graft was constructed by covering a 50-mm long Gianturco Z stent (diameter: 20 mm) with a Dacron prosthesis (diameter: 20 mm). The stented Dacron graft was inserted into the calcified aortic neck, was then sutured to the trimmed aneurysmal wall, and was anastomosed to a bifurcated prosthesis. The distal ends of the bifurcated prosthesis were anastomosed to both common femoral arteries, and the terminal aorta was closed. The patient had an uneventful postoperative course. This procedure may be a feasible and safe way to repair infrarenal abdominal aortic aneurysm with a severely calcified aortic neck.

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1. Introduction

Severe calcification of the aorto-iliac region in patients with an abdominal aortic aneurysm would require specific technical consideration for aneurysm resection and arterial reconstruction to the lower extremities. We describe a patient who underwent open stent repair for an infrarenal abdominal aortic aneurysm with a severely calcified aortic neck.

2. Case report

A 74-year-old male was found to have an abdominal aortic aneurysm at a nearby hospital. The aneurysm had a tendency to increase in size as noted in follow-up examinations. The patient was then referred to our hospital for surgical treatment of the abdominal aortic aneurysm. Computed tomography (CT) scanning revealed an infrarenal abdominal aortic aneurysm, with a severely calcified non-aneurysmal neck of the aorta (Fig. 1a, b) and severely calcified iliac arteries (Fig. 1c, d). The aneurysm, which measured 50 mm in diameter, was less calcified than the non-aneurysmal part of the aorta (Fig. 1b). The aortic diameter just below the left renal artery level was 16.4 mm, and the aortic neck length (i.e. distance between the levels of the left renal artery branching and the aneurysm beginning) was 72 mm. Conventional anastomosis of a Dacron graft to the severely calcified non-aneurysmal part of the aorta was not possible because of the high-risk of postoperative anastomotic site rupture. Therefore, proximal stent graft placement and distal conventional arterial reconstruction via laparotomy was indicated.

Preliminarily, a Gianturco Z-stent (GZV-20–50; Cook-Z Stent® Cook Inc, Bjaeverskov, Denmark), which is a self-expanding stainless steel stent (20 mm in diameter; 50 mm in length), was covered with a woven Dacron prosthesis (20 mm in diameter; 100 mm in length; Gelweave®, Vascutek Ltd, Renfrewshire, Scotland). The stent and Dacron prosthesis were then stitched together with 5-0 polypropylene sutures at several of peaks around the edge of the stent opening on the proximal side. The infrarenal abdominal aortic aneurysm was exposed through a midline transperitoneal approach under general anesthesia. After intravenous heparinization (1 mg/kg body weight), the abdominal aorta was occluded at the level of the renal arteries using an occlusion balloon inserted from the left subclavian artery, and the distal clamp was placed just proximal to the aortic bifurcation. The aneurysm was transected and trimmed circumferentially, and the non-aneurysmal terminal aorta was closed just proximal to the aortic bifurcation. The stent graft was placed in the aorta below the renal arteries in a manually compressed state with its non-stented segment cuffed to the inside (Fig. 2a). After placement of the stent graft, the distal edge of the residual aneurysmal wall was trimmed evenly with the distal end of the stent graft, and then the two edges were sewn together with a 4-0 polypropylene suture (Fig. 2a). Subsequently, the non-stented segment of the stent graft was pulled out (Fig. 2b) and anastomosed to a bifurcated woven Dacron prosthesis (18×9 mm; InterGard®, Inter-Vascular Inc, Nontivale, NJ, USA) with a 5-0 polypropylene suture. The distal anastomoses of the bifurcated graft were...
placed to both common femoral arteries with a 5-0 polypropylene suture, and the terminal aorta was closed with a 4-0 polypropylene suture.

![Diagram of stent-graft placement](image)

Fig. 2. Diagrams illustrating the open stent-graft placement procedures. (a), a Gianturco Z stent (20-mm in diameter; 50 mm in length) covered with a 20-mm woven Dacron prosthesis, was placed in the infrarenal aortic neck with the non-stented segment cuffed to the inside. After placement of the stent graft, the distal edge of the residual aneurysmal wall was trimmed evenly with the distal end of the stent graft, and then the two edges were sewn together with a 4-0 polypropylene suture (*); (b), the non-stented segment of the implanted stent graft was then pulled to the outside.

The patient had an uneventful postoperative course and was discharged 28 days after surgery. The postoperative plain abdominal radiograph exhibited no morphological abnormality of the implanted stent graft. The postoperative three-dimensional CT scanning at 19 days after surgery revealed no endoleak into the residual aneurysmal sac.

3. Discussion

Arterial calcification due to atherosclerosis has been associated with the development of abdominal aortic aneurysm. Allison et al. demonstrated this by investigating abdominal aortic CT data from 504 atherosclerotic patients. Their findings showed that the extent of the abdominal aortic diameter at the levels of superior mesenteric artery, aortic bifurcation, and mid-portion between the two, correlated highly with the extent of calcification in the aorta and iliac arteries [1]. Severe calcification of the non-aneurysmal segment (e.g. aortic neck) of the abdominal aorta may compromise anastomosis between the vascular graft and the native aorta, causing anastomotic site rupture and resultant pseudoaneurysm formation postoperatively. Endovascular aneurysm repair (EVAR) is one of the most promising alternatives to treat patients with an abdominal aortic aneurysm with a calcified aortic neck. Use of internal endoconduits has been recommended in EVAR patients with arterial access limitations, such as severely calcified iliac arteries [2, 3]. However, one of the concerns with this technique is that the internal iliac artery is inevitably occluded, which may cause pelvic malperfusion if this technique is applied to both iliac arteries. Also the pres-
ence of iliac artery stenosis or calcification may lead to unexpected arterial injuries. Therefore, we opted for stent graft placement via laparotomy. Kato et al. reported on open stent-graft placement through a median sternotomy in patients with an aortic arch aneurysm or dissection involving the distal arch [4, 5]. Also, combined procedures of open and endovascular stent-graft placement have been performed in repairing thoracoabdominal aneurysms [6, 7] and common iliac aneurysms [8, 9]. To our knowledge, open stent-graft placement via laparotomy in a patient with calcified aorta and iliac arteries, resulting in successful repair of an abdominal aortic aneurysm, has not been described until the present report.

In our patient, because the aortic neck was relatively long (approximately 72 mm), the stent graft was constructed using a whole unit of the Cook-Z stent to secure a 50-mm landing zone, which did not leave unexpected leakage due to sealing failure between the stent graft and the aortic wall despite diffusely calcified thick plaque in the landing zone. The length of the landing zone required to prevent leakage (type IA endoleak) in a patient undergoing endovascular repair of an abdominal aortic aneurysm with a severely calcified aortic neck, has not been determined. Also, moderate or severe calcification in the proximal neck has been demonstrated to have a risk of proximal stent graft deformity followed by stent graft migration and type IA endoleak [10]. In our procedure, the postoperative CT scanning at 19 days after surgery did not exhibit residual aneurysmal sac enlargement, suggesting that our procedure might be a feasible and safe way to repair infrarenal abdominal aortic aneurysm with a severely calcified aortic neck. Further investigation will be required to elucidate the long-term reliability of this procedure.

References