How to do it

Chunnel debranching for hybrid repair of thoracoabdominal aortic aneurysm

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Abstract

Hybrid repair of a thoracoabdominal aortic aneurysm comprising thoracic endovascular aortic repair and total renovisceral debranching is a feasible alternative to open repair, especially for high-risk patients. However, transperitoneal debranching is a relatively complicated procedure that requires deep dissection around vital abdominal organs. Therefore, we developed a new debranching technique called Chunnel debranching, which was characterized by transaortic tunneling using a covered stent between the target artery and the prosthetic graft anastomosed on the aneurysmal wall using an inclusion technique. This procedure increases the feasibility of renovisceral debranching with fewer dissections than conventional transperitoneal debranching.

Introduction

Open repair of a thoracoabdominal aortic aneurysm (TAAA) is a highly invasive procedure and is associated with higher hospital mortality [1]. Thus, for high-risk patients, thoracic endovascular aortic repair (TEVAR) with total renovisceral debranching through a laparotomy is a feasible alternative [2]. However, this procedure has several concerns, such as the need for a deeper dissection around the proximal segment of the renovisceral arteries that are surrounded by vital abdominal organs, the difficult application in those with severe intraperitoneal adhesions, the possible risk of graft infection [3], and relatively high mortality and morbidity rates [4]. Therefore, for further feasibility of total renovisceral debranching, we developed a novel debranching procedure named as "Chunnel technique" using a covered stent.

Technique

The Chunnel technique is characterized by trans-aortic tunneling using an endoprosthesis (Viabahn, W.L. Gore & Associates, Flagstaff, AZ) similar to the tunnel under the English Channel. In this procedure, the Viabahn is placed from the renovisceral branch through the intra-aortic cavity to the prosthetic graft that is anastomosed on the aneurysmal wall (Figure 1). All procedures were performed using a retroperitoneal approach with an

oblique incision in the left lateral abdomen. After dissection around the thoracoabdominal aorta, a 9–12 mm Dacron prosthesis was anastomosed as an inflow to the left common iliac artery or a prosthetic graft used to replace the abdominal aorta in the presence of severe atherosclerosis, such as an aortic aneurysm. Once the inflow was established, an outflow graft for debranching with an appropriate size for the branch artery (7–9 mm Dacron prosthesis) was anastomosed on the aneurysmal wall with an inclusion technique, using 5-0 or 6-0 polypropylene sutures (Figure 1A). Then a 7F sheath was inserted into the graft apart from the anastomosis, considering the length of the landing zone for the Viabahn. Subsequently, the sheath was moved forward into the aorta by penetrating the aortic wall in the anastomosis. A guidewire was inserted into the target artery using epi-aortic echocardiography and fluoroscopy (Figure 1B). The Viabahn (8–9 mm × 100 mm) was then inserted and deployed between the branch artery and the debranching graft (Figure 1C). Post-ballooning using a balloon catheter was required because the Viabahn should constrict after deployment at the crossing of the aortic wall. Then, the outflow grafts were anastomosed to the inflow graft to complete debranching. The segmental arteries were clipped externally as much as possible using this approach. After all the target branch arteries were debranched, TEVAR was performed concomitantly with or several days after debranching (Figure 1D). To date, this procedure has been performed

in two patients with a high risk of open TAAA repair; the operation time was 9–11 hours, and the volume of blood loss was 1300–4900 ml. All the debranching were successfully performed, and an ischemic time and fluoroscopic time for each branch were 15–20 minutes and 7–54 minutes, respectively. Both patients recovered uneventfully, and successful debranching was confirmed on postoperative computed tomography images (Figure 1E).

Comment

Transperitoneal debranching is a gold standard but relatively invasive because it requires deep dissection around vital abdominal organs. The use of covered stents can simplify this procedure and has previously been reported [5,6]. In such procedures, the deployment of a covered stent in the target artery results in bypass grafting and proximal stumping simultaneously, so that a direct access to the proximal segment of the artery was required. However, these procedures may not be suitable for debranching the celiac trunk and superior mesenteric artery through a laparotomy because of the inconvenient direction for placement of the covered stent, although a laparotomy is required to access the proximal segments of all the renovisceral branches directly and simultaneously. The Chunnel debranching technique using the Viabahn covered stent is a novel procedure that can

resolve such dilemmas through a retroperitoneal approach. Although the debranching of the right renal artery has not been performed because the artery was coincidentally occluded in two cases we experienced, all renovisceral branches, including those located on the opposite side of the aorta, can be debranched without intraperitoneal manipulations. In contrast, we consider the debranching in the narrow aorta and penetration of the aortic wall with a rich intraluminal thrombus are contraindications of this procedure. The former would result in the interference between TEVAR and the Viabahn in the aorta, while the latter is associated with a potential risk of embolic complications. In addition, a possible occlusion of the debranched graft could be fatal. However, in the initial 2-year experience, no procedure-related adverse events were not observed. So far, the use of Viabahn for debranching is off-labeled and requires approval by the institutional review boards. Nevertheless, the Chunnel debranching is a useful option for the hybrid repair of TAAA, especially for high-risk patients for whom neither thoracotomy nor laparotomy would be preferable because of lower respiratory function and history of the previous laparotomy. To date, it requires a relatively long time to perform the procedure because of a highly limited experience and disease complexity. Further improvement of the maneuver will be required to reduce the invasiveness of the procedure.

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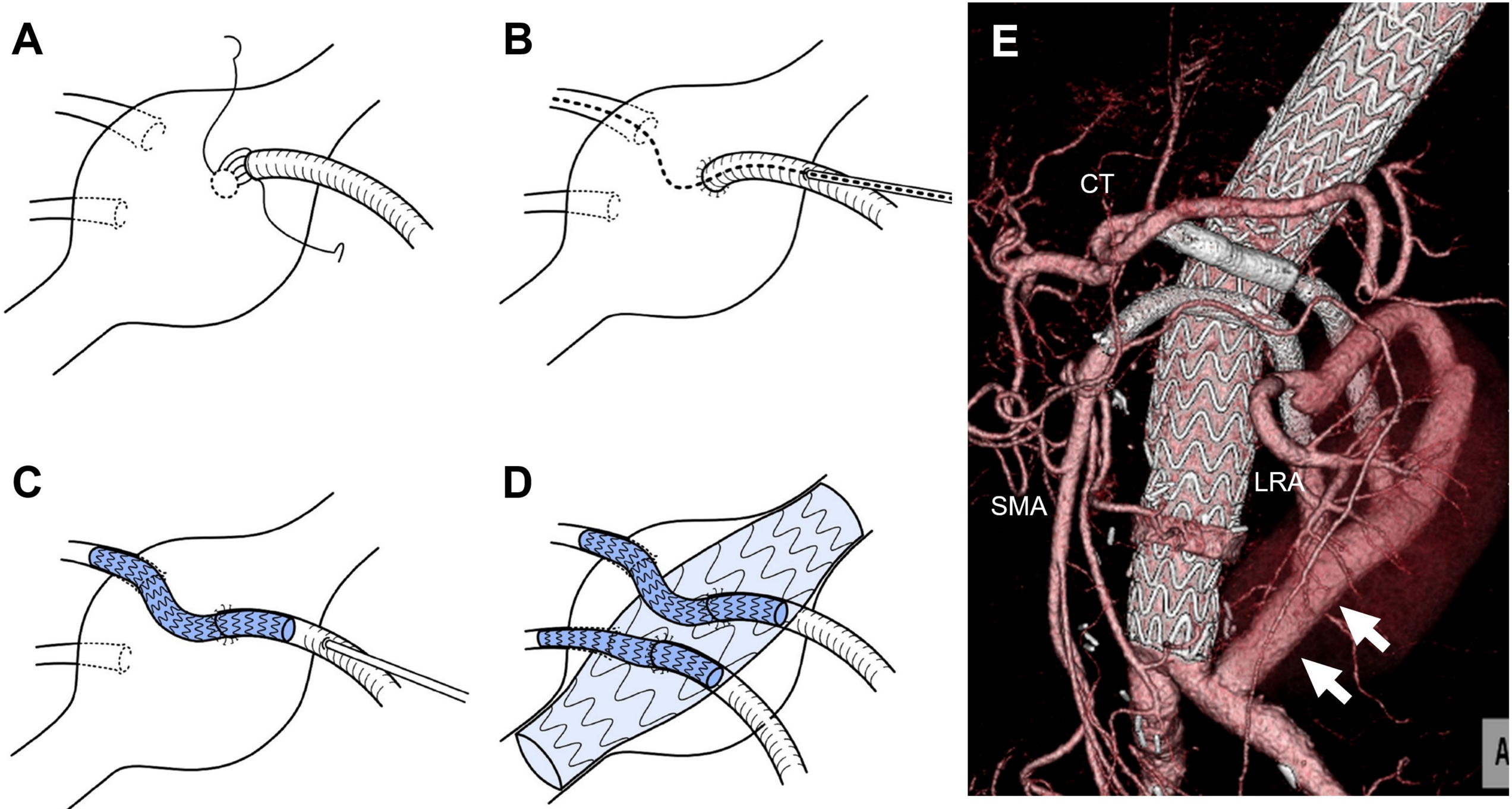
Figure legends

Figure 1. Schematic presentation of the Chunnel debranching: (A) anastomosis of the graft on the aneurysmal wall; (B) guidewire engagement into the target artery; (D) deployment of Viabahn across the aortic wall; (D) TEVAR after completion of debranching; (E) inflow graft anastomosed on the iliac artery (white arrow) connected to the CT and the SMA with the Viabahn and the LRA with direct anastomosis.

CT, celiac trunk; LRA, left renal artery; SMA, superior mesenteric artery; TEVAR, thoracic endovascular aortic repair.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