CASE REPORT

Endotension: rupture of abdominal aortic aneurysm

Endotensão: ruptura de aneurisma de aorta abdominal

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Abstract

Aortic endovascular exclusion technique called 'chimney' consists of placing stents through abdominal aortic visceral branches and a prosthesis that excludes the thoraco-abdominal aneurysm. Stents and an aortic endoprosthesis are placed in the renal arteries. This method is primarily used when open surgery is too risky. The mechanism that provides aneurysm sac increase without the visible presence of endoleaks has not been fully elucidated. The expansion of the aneurysm sac, due to endotension, is difficult to diagnose, even with the use of advanced imaging tests. Its diagnosis is made by exclusion. We present a case of a late complication in a high-risk patient after a 'chimney' endovascular procedure. Following the surgery, the patient presented a ruptured aneurysm sac without a visible endoleak. A second intervention was not feasible due to the high risk of occluding all of the branches, and complicated by previous 'chimney'. Endotension is a possible cause of aneurysm rupture and death.

Keywords: aortic rupture; endoleak; postoperative complications.

Resumo

A técnica de exclusão endovascular conhecida como 'chaminé' consiste na colocação de *stent* em ramos viscerais e de endoprótese excluindo o aneurisma toracoabdominal. São colocados *stents* revestidos nas artérias renais e uma endoprótese aórtica, que o método utilizado quando a cirurgia aberta tem risco muito alto. O mecanismo que causa a expansão aneurismática sem a presença detectável de vazamento pelos métodos de imagem não está completamente esclarecido. A expansão do saco aneurismático por endotensão é de difícil diagnóstico, mesmo com o uso de técnicas de imagem avançadas, como tomografia computadorizada e eco-Doppler, sendo o diagnóstico por exclusão. Apresenta-se um caso de complicação tardia após o tratamento endovascular pela técnica da 'chaminé'. Após a cirurgia, o paciente apresentou ruptura sem *endoleak* visível. Outro procedimento endovascular foi impossibilitado pela técnica da 'chaminé', que dificulta novos procedimentos e há alto risco de oclusão dos ramos. Endotensão é causa de ruptura e óbito.

Palavras-chave: ruptura aórtica; *endoleak*; complicações pós-operatórias.

Introduction

With the development of endovascular surgery, a new treatment option for high-risk patients who require conventional aneurysm surgery, but are not suited for standard endovascular procedures, is being considered. The new technique (called 'chimney') is the percutaneous transluminal placement of a stent through the aortic visceral and renal branches[1]. A prosthesis is placed to exclude the thoraco-abdominal aneurysm. This method is mainly used when the aneurysm affects the renal and visceral vessels, and open surgery is considered too risky and not feasible.

One of the complications of an endovascular aneurysm repair (EVAR) is the endoleak, which maintains the flow within the excluded aneurysm sac and pressurises it. These leaks are divided into five kinds, according to their mechanisms and locations. The type-V endoleak, also called endotension, is defined by the persistent or recurrent pressurisation of the aneurysm sac through the parietal thrombi. What differentiates an endoleak from endotension is that, in the latter, pressure is transmitted without the presence of blood flow within the aneurysm[2-4].

The prevalence of endoleaks after an EVAR is highly variable. In the literature, it has been reported to be

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between 2.4 and 45.5%[5]. The clinical importance of endoleaks is directly related to an increased risk of aneurysm rupture[3], although endotension-causing ruptures have rarely been reported[3,6].

Case report

The patient was a 66-year-old male, who was hypertensive, obese, with chronic obstructive pulmonary disease and dyslipidaemic. A computed tomography scan was conducted in October, 2006, and a type-IV thoraco-abdominal aortic aneurysm was diagnosed. Since then, the aneurysm has showed continuous growth in subsequent bi-annual examinations without visible endoleak.

In July, 2008, a computed tomography angiography (CTA) revealed that the aneurysm dilatation in the distal abdominal aorta was juxtarenal and extended up to the bifurcation. The centre of the predominating concentric parietal thrombus had a maximum proximal diameter of 5.2 x 4.1 cm. The CTA presented a lower calibre in the left renal artery, with an ipsilateral renal reduction (Figure 1).

The patient underwent an endovascular aneurysm exclusion (Powerlink bifurcated stent, Endologix, Inc., Irvine, CA, the USA) with an endovascular revascularization of the renal arteries, celiac trunk, and superior mesenteric artery by the chimney technique (Figure 2).

Two years later, the patient presented with increasing lower abdominal pain, which radiated to the lumbar region and had evolved over three weeks. The patient was conscious and eupneic and showed no signs of shock. The abdomen was slightly distended, produced bowel sounds, and was somewhat painful to palpation. The posterior tibial pulse was bilaterally present, and the left pedal pulse was absent.

The patient was admitted into the Intensive Care Unit (ICU), where he was held under tight blood-pressure control, and a CTA was performed, as an endoleak was suspected from previous procedure. Aneurysm growth was observed (Figure 3).

The aneurysm had a maximum diameter of approximately 13x12 cm. The dilation and tortuosity of the entire abdominal aorta reflected the largest diameter in its infrarenal portion. In the distal region on the same side and near the bifurcation of the iliac artery, irregular areas (suggestive of ulcers) were observed. A ruptured aneurysm wall without a contrast leak was observed on the left anterior side.

Conservative medical management and observation were performed, as the patient was deemed to have a high anaesthetic risk given his age and comorbidities. Angiography was requested to confirm the absence of endoleaks[2]. Therefore, the patient was kept in the ICU with a normo/hypotensive blood pressure and rigorous clinical support. He worsened clinically with no signs of initial

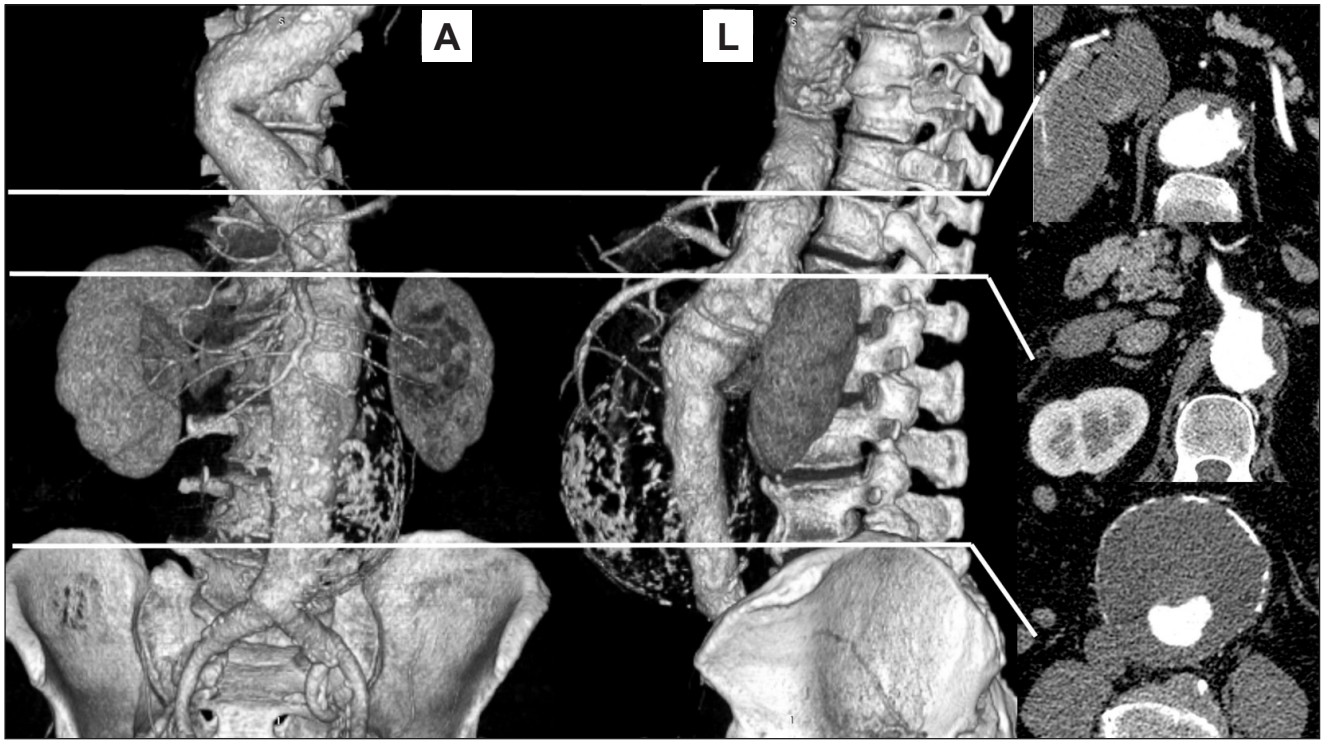

Figure 1. Angio-tomography of the aortic aneurysm.

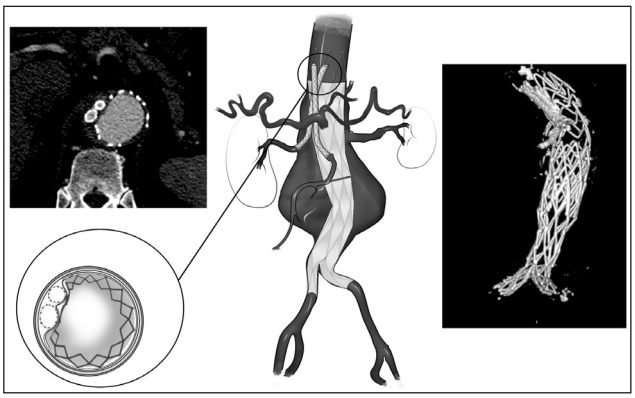

Figure 2. 3D Angio-computed tomography reconstruction and scheme of the chimney procedure, demonstrating the patent and lost branches, and the main endoprosthesis. The axial view demonstrates the chimney seal between grafts.

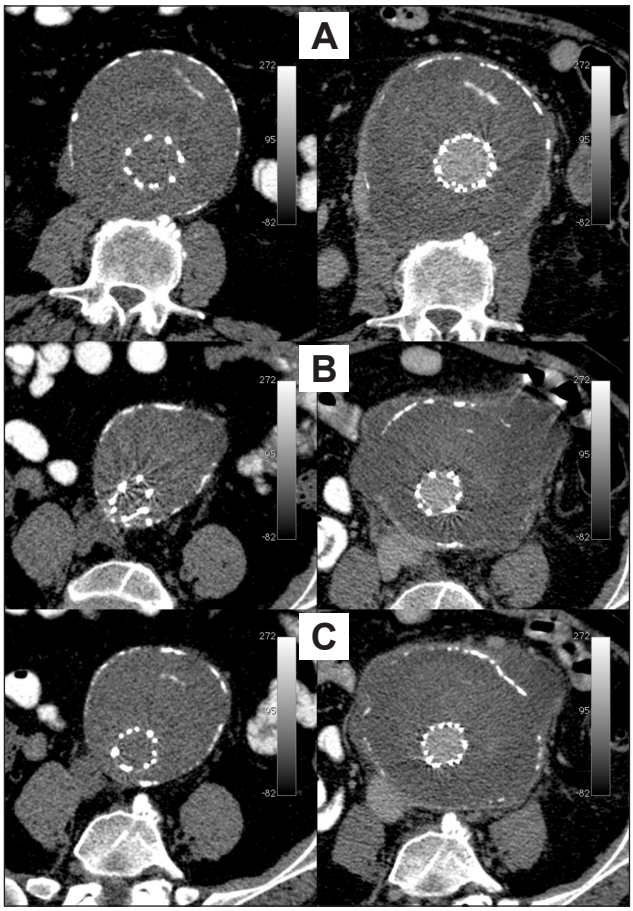

Figure 3. Angio-computed tomography demonstrating the ruptured wall of the aortic aneurysm without a contrast leak. Left images are noncontrasted from before rupture, and right images contrasted after rupture. A: calcium inside aneurysm sac, not to be mistaken with endoleak; B: aneurism growth after the procedure and point of rupture; C: ruptured aneurysm without bleeding or contrast leak.

hypovolemic shock. However, he died three days after his hospital admission, due to sudden hypovolemic shock. Angiography was not performed for it required moving the patient to another facility[2].

Discussion

The chimney technique essentially consists of deploying a covered stent parallel to the main aortic stent-graft. It protrudes similarly to a chimney and preserves the flow of the vital side branches, which are covered by the aortic stent graft. The chimney technique enables the use of a standard off-the-shelf endoprosthesis to treat a lesion, with an inadequate fixation zone and it provides an alternative to a fenestrated stent graft in urgent cases and in aneurysms with challenging neck morphologies. This technique also enables the rebuilding of the side branches of the aorta that might have been involuntarily covered during the endovascular repair[1,7].

Several theories have been proposed in an attempt to elucidate the mechanisms of expansion of the aneurysm sac, without the presence of a detectable endoleak. These include increased porosity of the prosthesis[5], direct transmission of pressure from the stent to the lumen of the aneurysm sac[4,8], and a low flow endoleak which is undetectable by the imaging methods[2,9]. Mennander et al. found five patients (3.1%) with endotension within 160 patients who underwent endovascular aneurysm repair, and endoleaks were not detected. Three suffered aneurysm sac ruptures during the study period, but none of them presented clinical evidence of major bleeding[9].

The best explanation for these cases may be the association of more than one of the aforementioned theories. Of these, the exudate is the most accepted one that may explain the cases of endotension. However, in this case, it cannot be exclusively attributed to the exudate, since there are no studies demonstrating the effectiveness of the chimney seal between the endoprosthesis (Figure 2).

The continuous sweating through the endoprosthesis may result in the rupture of the sac without any evident hemodynamic changes. But also, the sac rupture may cause endoprosthesis migration due to sudden morphologic changes of the aneurismal sac and lack of satisfactory anchoring of the stent-graft. Patients with aneurysm sac enlargements after EVAR may be difficult to diagnose. Therefore, the first step is to check for the presence of endoleaks. Multi-slice CT, high-resolution Doppler echocardiography, and angiography were the most widely used imaging modalities at the beginning of the investigation.

Endotension has also been measured by indirect methods using arterial punctures[6,10].

In the present case, the endoprosthesis expanded polytetrafluoroethylene (ePTFE) graft material had low porosity. We cannot exclude the possibility that the increased pressure in the aneurysm sac was developed due to the passage of exudates through the prosthesis material or the sealing difficulty associated with the chimney technique.

Kougias et al. have recently reported a less-invasive technique, which uses stent-based reinforcement with the deployment of new graft components to re-line the endograft and to minimize the porosity-related endotension. This technique is applicable to patients with a porous endoprosthesis[6]. However, it does not apply to this case because stent reinforcement would increase the main radial graft strength and possibly occlude the parallel visceral branches.

Conclusions

The development of aneurysm sac expansion due to endotension is difficult to diagnose, even with the use of advanced imaging tests, such as multi-slice CT, Doppler echocardiography, and angiography, as they may not be sufficiently sensitive to detect small endoleaks. By definition in endotension, there must be no leaks. This technical limitation of imaging may falsely categorize a patient as having endotension when the actual reason for the expansion is a very small, but persistent, endoleak. The chimney technique may be associated with an apparently technically successful procedure because images do not show any endoleaks between stents. There may be small endoleaks that are responsible for future sac expansion and rupture.

Endotension diagnosis is currently made by exclusion and therefore should encourage the development of new techniques, which would allow the detection of small pressure changes in the aneurysm sac. Aneurysm sac pressure measured by an implantable remote sensor may help to elucidate endotension causes[11].

The chimney technique is not a standard procedure and should only be performed in few selected cases, because it can compromise the ability to perform further procedures to treat possible complications. The sealing of the chimney technique is not guaranteed, as our current imaging techniques are not sufficiently sensitive to detect small endoleaks[2]. Even without any detectable endoleaks, and the aneurysm sac may grow due to endotension or undetectable endoleaks, this aneurysm sac may rupture and cause death. In the event of an aneurysm sac rupture, after a chimney procedure, no endovascular procedure is safe, and open surgery that was once avoided now has a higher risk and is characterized by even greater technical difficulties[3,5,8-10].

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