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# The endovascular management of open aortic surgery complications with emergency stent-graft repair in high-risk patients

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The aim of the study was to demonstrate the utility of endovascular stent-graft repair for emergency management of aorto-iliac surgery complications. Between 1997 and 2004, in our institute, 201 patients underwent transluminal endovascular graft placement. In 3 patients (1.4%), previously submitted to conventional aortic surgery, endovascular treatment was carried out due to the occurrence of late complications: 1 secondary aortocaval fistula, 1 impending rupture of aortic pseudoaneurysm and 1 secondary aorto-enteric fistula. All candidates were high surgical risk patients (ASA III-IV) suitable for endoprosthesis positioning by endovascular stent-graft implantation presenting with severe worsening conditions in an emergency situation. The patients were treated under local anesthesia and mild sedation. After treatment there was complete resolution of the clinical presentation and an improvement of general conditions in all 3 patients. In the 1<sup>st</sup> patient legs edema disappeared and in the 2<sup>nd</sup> patient mesogastric pain is absent, respectively at 30 and 8 months. The 3<sup>rd</sup> patient, with secondary aorto-enteric fistula, was submitted 2 months later to aortic graft removal and axillo-bifemoral bypass because of infection development. For the treatment of abdominal aortic surgery complications in high risk patients, particularly in emergency situations, endovascular approach is a feasible and safe alternative to conventional open repair. Further evaluation of this technique and longer follow-up will determine its exact role in the management of these life-threatening complications.

**KEY WORDS:** Aorta - Cava vein - Fistula - Pseudoaneurysm - Emergency - Endovascular surgical procedures.

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Recent advances in endovascular treatment of non-ruptured aortic aneurysms and more recently also in ruptured abdominal aortic aneurysms (AAA) have opened, in selected cases, new treatment options even for the management of situations such as traumatic aortic injuries,<sup>1</sup> pseudoaneurysms and various fistulas involving aorto-iliac district.<sup>2-5</sup> Previous reported series describe this kind of approach.<sup>6,7</sup> Although the long-term durability of endovascular grafting remains still unknown, this minimally invasive approach has the potential to overcome the problems encountered with standard open repair and, also in patients previously submitted to aortic surgery, provides an attractive alternative particularly in high-risk patients and in emergency situations.

Our purpose is to evaluate the results of endovascular stent-graft repair for emergency management of aorto-iliac surgery complications in high-risk patients. Isolated cases have been already described in literature.<sup>8,9</sup>

We present a series of 3 different cases of open aortic surgery complications treated in emergency situation with aorto-biiliac endograft placement.

Clinical series

In 3 patients, previously submitted to conventional aortic surgery, endovascular treatment was carried out due to the occurrence of late complications (1.4%).<sup>1</sup>





Figure 1.—Perioperative angiography of aorta with bilateral catheterization of iliac axis, before the introduction of the endoprosthesis, showing the fistula between aorta below the anastomosis and the inferior vena cava.

secondary aortocaval fistula, 1 impending rupture and 1 secondary aorto-enteric fistula. All these patients presented with emergency situations. They were preliminarily evaluated in emergency with spiral computed tomography (CT) scan that confirmed the diagnostic suspicion and allowed to evaluate the suitability of endovascular procedure. To enable a fast decision, measurements were rapidly performed solely on axial slices. Imaging showed favourable aortic neck, that in 2 cases was represented by the surgical graft, and suitable iliac anatomy without graft dilatation or anastomotic stenosis. Because of compromised general patient's condition, considering previous aortic surgery and high surgical risk (all of them were classified as an American Society of Anesthesiologist's category III-IV operative risk) the endovascular treatment was preferred to open surgery in all cases and proposed to the patients. Informed consent was obtained. The patient was transferred in a dedicated endovascular surgery room, located just in front of CT room, especially organised for endovascular procedures allowing, if necessary, a sur-

gical conversion. Due to poor conditions and related comorbidities the procedure was performed under local anesthesia (naropine 0.2 mg, 10 mg) and mild sedation (diazepam 5 mg; atropine 0.5 mg). A digital subtraction angiography (DSA) was obtained during procedure in order to evaluate the graft length. As the surgical reconstruction was aorto-aortic tube graft in all the patients, with no evidence of neck or graft dilatation, one 24-15 Vanguard II bifurcated device (Meditech, Boston Scientific, Watertown, USA) was used to exclude the aortocaval fistula and two 23-14-16 Excluder (Gore) bifurcated aortic stent-grafts were placed in the other 2 cases. An 18 F introducer sheath was placed into the surgical exposed right femoral artery after infusion of 5 000 IU of heparin. Intraoperative DSA was performed at the beginning of the procedure confirming the pathological situation. The main branch was released below the level of the renal arteries into the surgical aortic graft. The left femoral artery was catheterised using a standard Seldinger technique and the contralateral limb was deployed. Until post-procedural day 4 patient's respiratory and cardiovascular parameters were always monitored.

*Case 1.*—A 67-year old man, that had previously undergone repair of a ruptured AAA with spontaneous aorto-caval fistula by an 18 mm Dacron tube graft 1 month previously (during the procedure the fistula was sutured with 3/0 polypropylene), was admitted to our hospital with dyspnea, unstable angina, swelling of the lower limbs and a systodiastolic bruit in the mesogastric region.

Blood pressure at hospitalisation was 160/60 mmHg with a heart rate of 60 beat per minute. Blood samples documented mild renal dysfunction (serum creatinine: 1.6 mg/dL, azotemia: 70 mg/dL). An echocardiography revealed the initial dilatation of the right atrial and ventricular cavities. A spiral CT showed the presence of an aorto-caval fistula with early caval enhancement in the arterial phase, without signs of rupture. On hospital day 4 a collapse episode (blood pressure: 80/60 mmHg,  $\text{PaO}_2=182$  mmHg,  $\text{PaCO}_2=25$  mmHg,  $\text{HCO}_3=125$ ) occurred with high output failure and bilateral pleural effusion. An emergency laboratory test revealed also acute renal failure (baseline serum creatinine level of 1.6 mg/dL, azotemia: 183.4 mg/dL) with rapid evolution 14 h later: serum creatinine increase till 10.2 mg/dL, azotemia: 228.3 mg/dL and anuria onset). The patient was cannulated and immediately intravenous administration of bicarbonates and furosemide was started. On the same day, the patient, after appropriate fluid infusion to re-establish adequate systolic blood pressure, underwent a hemodialysis session before being referred for contrast medium necessary for the endoprosthesis placement. A preliminary aortic carrefour DSA was performed at the beginning of the procedure, showing the contrast dye extravasation in the inferior vena cava due to the presence of a high flow fistula just above the aortic carrefour at the distal anastomosis level (Figure 1). A Vanguard II bifurcat-

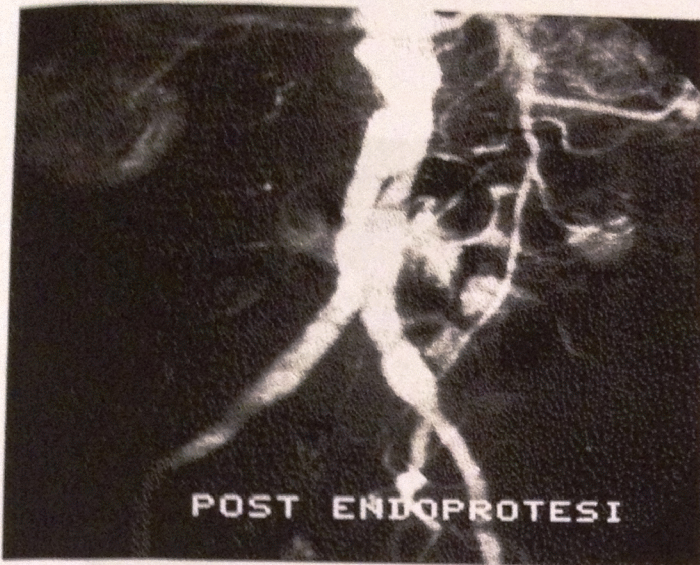


Figure 2.—Postoperative angiogram showing the correct positioning of the endoprosthesis and the exclusion of the fistula.

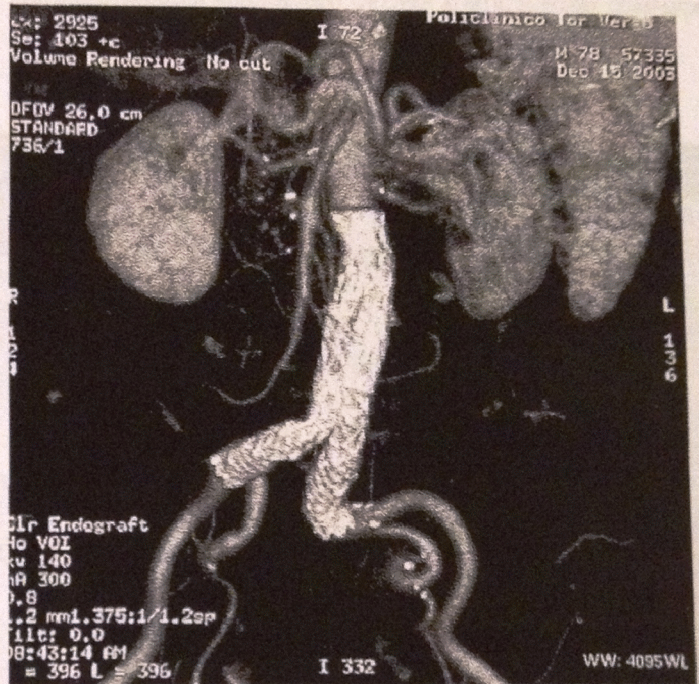


Figure 4.—Postoperative MSCT scan 6 month later after endovascular repair, showing the correct position of the stent graft.



Figure 3.—Preoperative CT scan after conventional surgical AAA repair, showing the false aneurysm, originating from distal aortic anastomosis.

formed as the patient was immediately transferred to the intensive care unit. In the postoperative period the patient underwent supporting hemodialysis twice. Five days after the procedure, renal function turned normal and a conventional DSA (Figure 2) was performed confirming the exclusion of the fistula. Beside, an excessive length of ipsilateral graft limb, covering the internal iliac ostium, was observed. On hospital day 12 the patient was discharged.

*Case 2.*—A 76-year old man underwent elective repair of an AAA 2 months, before with an 18 mm tube Dacron graft, in another Institution. Relevant past medical history included myocardial infarction 3 years before and severe chronic obstructive pulmonary disease. The clinical examination showed a pain in the mesogastric region. The abdominal echography showed a retroperitoneal mass and a CT scan revealed an evident false aneurysm of the distal aortic anastomosis with 6 cm diameter, confirmed by DSA (Figure 3). The CT scan showed also no presence of gas or liquid surrounding the vascular graft, suggesting for infective etiology. Owing to the patient's cardiac history, the symptomatology and considering the favourable anatomical findings observed on CT scan, an Excluder stent-graft 23-14-16 (Gore) was proposed and placed on the same day. A completion arteriogram demonstrated good sealing on the distal anastomosis, no signs of endoleak. A CT scan performed after 3 days confirms the exclusion of the pseudoaneurysm. The patient was discharged in good general conditions on postoperative day 6. A CT scan performed after 6 months (Figure 4) showed a resolution of the pseudoaneurysm without signs of infection

cd aortic stent-graft was implanted. Because of worsening condition during the procedure (pulmonary edema development, arterial pressure 90/40 mmHg, pH: 7.15, bases excess: -12) after complete device deployment no angiographic control was per-



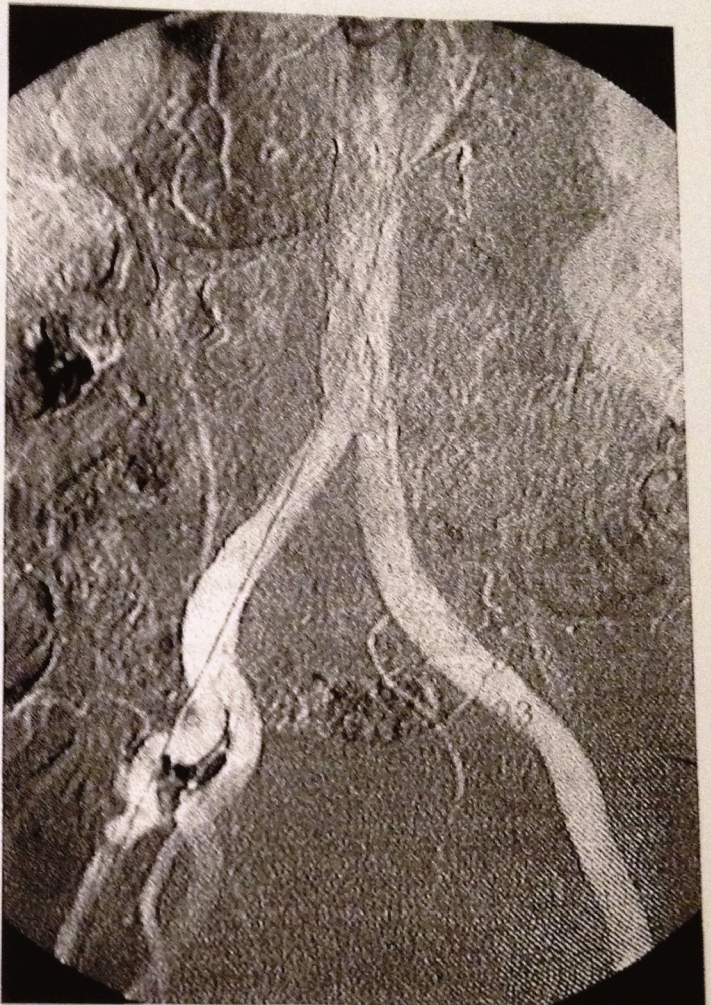


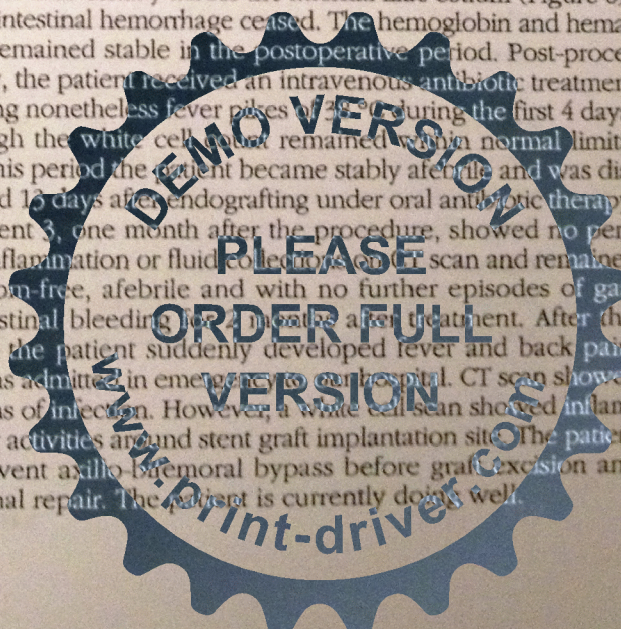
Figure 5.—Preoperative DSA showing distal anastomotic pseudoaneurysm in aorto-enteric fistula case.

Figure 6.—Postoperative DSA demonstrating pseudoaneurysm complete exclusion.

*Case 3.*—A 68-year old man who had undergone aorto-aortic grafting with an 18 tube PTFE graft for aneurysmal disease 5 years previously was admitted to the emergency department with massive upper and lower gastrointestinal tract bleeding and hypotension. Relevant past medical history included myocardial infarction 16 years before, pacemaker positioning 5 years before, coronary bypass grafting 3 years before. The patient presented to the emergency department in shock with systolic blood pressures ranging from 60 to 90 mmHg. Hemoglobin was 7.5 g/dL. The hypotensive hemostasis was judged not suitable for the ischemic disease of the patient and an aggressive fluid resuscitation was performed and intravenous antibiotic therapy was begun (tazobactam and sodic piperacillin 2 250 *i.v.* 1 flx3). Simultaneously, an urgent CT scan with intravenous contrast disclosed at the distal anastomosis of the aorto-aortic graft a pseudoaneurysm tightly adherent with the enteric tract. Owing to the patient's poor general conditions and to the needing of fast gastrointestinal tract hemorrhage control, a decision was made to attempt an endovascular exclusion of the fistula. After intraoperative angiogram (Figure 5) an Excluder stent-graft was deployed. A completion arteriogram demonstrated good sealing of the graft, pseudoaneurysm complete exclusion and the con-

tralateral limb distally across the internal iliac ostium (Figure 6). Gastrointestinal hemorrhage ceased. The hemoglobin and hematocrit remained stable in the postoperative period. Post-procedurally, the patient received an intravenous antibiotic treatment showing nonetheless fever spikes of 38.5°C during the first 4 days, although the white cell count remained within normal limits. After this period the patient became stably afebrile and was discharged 13 days after endografting under oral antibiotic therapy.

Patient 3, one month after the procedure, showed no perigraft inflammation or fluid collections on CT scan and remained symptom-free, afebrile and with no further episodes of gastrointestinal bleeding for 2 months after treatment. After this period the patient suddenly developed fever and back pain, and was admitted in emergency to our hospital. CT scan showed no signs of infection. However, a white cell scan showed inflammatory activities around stent graft implantation site. The patient underwent axillo-bifemoral bypass before graft excision and intestinal repair. The patient is currently doing well.



In all patients spiral CT was performed few days after the procedure confirming the correct stent-graft placement and the obliteration of both aortocaval, aorto-enteric fistula and the exclusion of the pseudoaneurysmatic sac. Periodic clinical evaluation and spiral CT scan (1 month, 6 months, and every 6 months) were carried out in all the patients. At respectively 26 and 4 months follow-up, Patients 1 and 2 are in good clinical conditions with no clinical or imaging evidence of complications.

## Discussion

Endovascular techniques are proving to be an acceptable alternative procedure in the management of emergencies in patients unfit or at high risk for an open operation in the presence of a favourable anatomy. In all reported cases, the surgical complication was confined apparently at the distal anastomosis of the graft, suggesting a favourable outcome after endovascular repair. In case of complication at the proximal anastomosis of the graft, especially in short neck, despite the introduction of suprarenal fixation, we do not believe the endovascular approach should offer the same advantages. According to our knowledge, this is the first reported series of emergency treatment of 3 different cases of endovascular aortic surgery complications limited to the distal anastomosis. Given the sudden worsening of general conditions, the high operative risk and a challenging surgical approach due to a hostile abdomen, endovascular treatment of our candidates seemed to be the most suitable thanks to its minimally invasive nature. Owing to the emergency situations, a correct preliminary procedure planning was not possible for the stent-graft's length choice, leading in 2 cases to one internal iliac covering, while the main body diameter choice was easily performed as surgical graft diameter was known (16 mm). In the aortocaval fistula case the internal iliac artery could had been preserved by a more cranial deployment of the main device that was released just above the proximal anastomosis covering the aorto-enteric fistula.

Secondary aortocaval fistula represents a rare complication of aortic surgery that leads to an operation with high morbidity and mortality rates due to physiopathological changes caused by arteriovenous shunting and possible comorbidities.<sup>10</sup> The reported mortality for surgical treatment of spontaneous aortocaval fistulas in patients operated on for AAA ranges between 21% and 55%.<sup>11</sup> Exclusion of a spontaneous aortocaval fistula using an endoprosthesis has been

described as a possible treatment of first choice,<sup>3,5</sup> and also as in our previously reported case in case of recurrent aortocaval fistula.<sup>12</sup> According to our experience, aortic endografting of a secondary aortocaval fistula seems to be an effective alternative option to the open repair for high risk patients. In our case the renal and cardiac failure and the favourable anatomy of the aorta and of the iliac vessels demonstrated by CT, suggested the possibility of an endovascular treatment. The administration of intravenous contrast dye should be considered among the disadvantages of this therapeutic option, potentially reducing renal function, already compromised by the hemodynamic changes produced by the fistula, with the necessary postponing of the treatment. Nevertheless, a reduced surgical trauma and the supporting hemodialysis allowed to complete the treatment successfully with the normalization of renal function after 5 days. Emergency treatment of secondary aortocaval fistula may not always be necessary and there may be sufficient time to obtain a suitable endograft. In acute cases, however, delay may contribute to a poor outcome, so an "off-the shelf" device would be needed for the endovascular repair.

Secondary aortocaval fistula remains a devastating complication of aortic prosthetic grafting, with an observed incidence between 0.36% and 1.6% and conventional open surgical options are accompanied by high rates of morbidity with a mortality rate varying from 25% to 90%<sup>13</sup> making minimally invasive techniques even more attractive in this setting. In general, secondary aorto-enteric fistulas are one of the most challenging diagnostic and therapeutic problems encountered by vascular surgeons. The diagnosis should always be suspected among patients with a history of abdominal arterial reconstructive surgery presenting with gastrointestinal tract hemorrhage. Usually diagnosis in stable patients is best obtained with CT and/or endoscopy, but the unstable patient mandates resuscitation and exploration. The use of an endovascular approach enables the contemporary control of hemorrhage and the stabilization of the patient with an angiographic diagnostic confirmation. The presence, on the other hand, of an endovascular surgery room in our institution allows a rapid surgical conversion when complications should occur. Short-term result in our case was excellent, but although stent-graft can effectively control bleeding endograft used to repair a secondary aortic enteric fistula is particularly at risk because the source

of the infection and fistulas communication are not removed, as in conventional surgery, raising doubts about the long survival of the endograft in the face of continuing infection. Some authors<sup>9,14</sup> demonstrated no sequelae after the procedure and no sign of infection over a 2 years follow-up. Our experience is similar to the one of Chuter *et al.*<sup>15</sup> that reported the endovascular repair of an aortoduodenal fistula in an afebrile patient with a normal leukocyte count. Eight months after implantation the endograft had to get removed because of recurrent infection. However, 2 months after endovascular treatment our patient was sufficiently fit to undergo conventional open surgery. Thereby, endovascular grafting may play an important role in the management of secondary aortic enteric fistula as it provides in critically ill individuals a short-term control of massive bleeding using a minimally invasive approach. This allows both the stabilization and improvement of the clinical status of the patient and the reduction of the surgical risk of a future open surgery.<sup>16</sup> According to this policy this late complication underscores the need for diligent surveillance because of the potential for reinfection.

Pseudoaneurysm may develop early and late after surgery as a consequence of defects in the suture, in the artery or in the graft<sup>17</sup> and may be associated to poor outcome following the rupture.<sup>18,19</sup> In our case the possible consequences due to a second conventional surgical procedure after rupture led us to perform a less invasive procedure with good results.

Between 1997 and 2003, in our institute, 170 patients underwent transluminal endovascular graft placement. The emergency situation described in the 3 patients (1.7%), is little but is relevant because is life threatening.

As a final consideration, we believe that the presence of a previously deployed graft may stabilize with a long proximal neck the newly introduced endograft, solving the problem of a primary endovascular approach regarding distal migration, dilation or shrinkage due to impact with the aneurysmal sac.<sup>20-22</sup>

### Conclusions

Endovascular treatment of open aortic surgery complications is possible and represents in high risk patients a minimally invasive method of halting life-threatening in emergency situations. In certain cases

it could represent a valid alternative to open repair as a long term solution, in other cases it may be useful to improve patient's clinical conditions, lessening the morbidity and mortality of subsequent surgery. Further evaluation of this technique and longer follow-up is necessary to define its role in the management of these aortic surgery complications especially regarding secondary aortic enteric fistula.

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