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# Spiral Vein Reconstruction of the Infected Abdominal Aorta Using the Greater Saphenous Vein: Preliminary Results of the Tilburg Experience

**M. van Zitteren*, T.J. van der Steenhoven, D.H.C. Burger, D.P. van Berge Henegouwen, J.M.M. Heyligers, P.W.H.E. Vriens**

*Department of Vascular Surgery, St. Elisabeth Hospital, P.O. Box 90151, 5000 LC Tilburg, The Netherlands*

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Spiral vein;
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Infected aneurysm;
Infected graft;
Arterial reconstruction;
Aorta

**Abstract** *Objectives:* The aim of this study was to evaluate patients, who underwent spiral vein reconstruction of the abdominal aorta to repair infected aneurysms or replace infected aortic grafts.
*Methods:* All spiral vein reconstructions between March 2005 and May 2010 because of vascular infections of the abdominal aorta were retrospectively included. Diagnosis was determined by clinical examination, laboratory results, computed tomography (CT) and positron emission tomography (PET) scan, and microbiological tests. Spiral vein reconstruction consisted of harvesting the greater saphenous vein (GSV) and construction into a spiral graft, aortic reconstruction and a transmesenteric omentumplasty. Primary outcomes were survival and limb salvage. Secondary outcomes included technical, clinical and ongoing success, re-infection, ongoing infection and patency.
*Results:* All five patients survived surgery, and there were no in-hospital deaths. Survival and limb salvage were 100% after median follow-up of 13 months (6—67 months). Further, technical, clinical and continuing success was 100%. There were no re-infections or ongoing infections.
*Conclusions:* Spiral vein reconstruction using the GSV showed good short-term survival and limb salvage. It, therefore, might be considered as an attractive treatment method for vascular infections of the abdominal aorta. Still, more follow-up is needed to evaluate long-term results.


* Corresponding author. Tel.: +31 13 539 2925; fax: +31 13 536 3660.
*E-mail addresses:* m.v.zitteren@elisabeth.nl, info@spiralvein.org (M. van Zitteren).
*URL*: http://www.spiralvein.org.

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Infected grafts (1–6%) and infected aneurysms (<1%) of the abdominal aorta are rare.[1] They remain serious conditions associated with high morbidity and mortality (25–88%),[2] and create reconstructive challenges to vascular surgeons. Standard treatment includes aneurysm resection, extensive debridement, aortic reconstruction and long-term antibiotic treatment.[3] Reconstruction of the abdominal aorta using synthetic grafts is associated with poor survival.[4] *In situ* reconstruction with autologous veins or cryopreserved arterial homografts (CAHs) can potentially eradicate infection and preserve arterial continuity.[5,6] Several studies have proposed the use of the femoral vein as an arterial substitute in vascular infections.[4,7–10] The spiral vein technique was first described by Chiu et al. in a series of 13 dogs in 1974,[11] and attempted in humans with a superior vena cava syndrome by Doty et al. in 1976.[12] Venous lesions have been successfully treated since.[13] However, this technique has been described to a limited extent for aortic reconstructions.[14,15]

We described the first case of a successfully treated, ruptured, infected aneurysm using the greater saphenous vein (GSV) for spiral vein reconstruction in our hospital in 2006.[15] Since then, we treated five patients using this technique. This study describes our experience with the spiral vein reconstruction using the GSV for infected abdominal aortic aneurysms and aortic grafts.

## Methods

### Patients

Patients, treated for infection of the abdominal aorta using the GSV to create a spiral vein graft between March 2005 and May 2010, are included. Infection is defined as having (1) clinical symptoms suggestive for infection, with a positive or negative Gram stain and/or blood culture, or (2) a proven infection by a positive culture and/or Gram stain from blood, the aneurysm wall, graft or periaortic fluids or tissues, and where specific microorganisms are reported.[16] Primary outcomes are survival (in-hospital, 6 months, 2 and 5 years) and limb salvage. Secondary outcomes are feasibility of the procedure, re-infection and patency. Data are retrospectively collected by reviewing patient records. The local ethics committee is informed and it approved the spiral vein technique. Informed consent is provided regarding the use of pictures from the surgical procedure.

### Diagnostic work-up

Diagnostic evaluation is performed, if a vascular infection is suspected after clinical examination. Infection parameters are checked (e.g., C-reactive protein (CRP), erythrocyte sedimentation rate, white blood cell count and blood cultures). A computed tomography (CT) scan is performed to determine signs of infection (e.g., perigraft fluid or soft-tissue attenuation, ectopic gas, pseudo-aneurysm, focal bowel wall thickening, intragraft thrombus and hydronephrosis).[17] A fluorodeoxyglucose ($^{18}$F) positron emission tomography (FDG-PET) scan is done to confirm diagnosis of infection. A CT-guided fine-needle aspiration is performed. Antibiotics are given according to microbiological tests. Vein status is evaluated in both legs by duplex ultrasound. Finally, open reconstructive surgery is planned, and pieces taken from the aneurysm wall, prosthetic graft or periaortic tissues are cultured to confirm the causing pathogen and adjust antibiotic strategies when necessary.

### Spiral vein reconstruction

The spiral vein technique for reconstruction of the abdominal aorta includes several steps. The total length of the GSV that is needed to obtain a suitably fitting spiral graft (i.e., no discrepancy in diameter and length) is calculated by using the formula $2\pi r$. Presume that the GSV has a diameter of 3.3 mm, and a graft length of 10 cm and 15 mm in diameter is required. The outline of the GSV will be 1 cm ($2\pi \times (0.033/2)$) and the length needed to fit one turn on a 15-mm diameter tube will be 4.7 cm ($2\pi \times (0.150/2)$). Subsequently, the total length of the GSV that is needed to construct a spiral graft will be 47 cm ((total tube length/the outline of the GSV) $\times$ the GSV length needed for one turn $= (10/1) \times 4.7$). The surgical procedure starts by harvesting the GSV using several small incisions. Side-branches are ligated using vicryl 4/0. Wounds are closed primarily by continuous sutures. Next, the GSV is flushed with heparinised blood. Leakages are sutured with Vascufil 6/0. Then, the GSV is cut open longitudinally over its full length and tightly placed on a 15-mm diameter tube to construct a suitably fitting graft, using continuous sutures (Vascufil 6/0) with 1-mm intervals (Fig. 1). This procedure has been previously described by Heikens et al.[15] Median laparotomy is performed simultaneously. Intravenous heparin (2500–5000 units) is given before clamping the aorta. The infected graft or aneurysm sac is opened, flushed with heparinised water and excised, followed by extensive debridement of the infectious mass on which bacteriological tests are performed. The spiral vein is then used to reconstruct the aorta using a standard inlay technique (Fig. 2). End-to-end anastomoses are constructed using continuous sutures (Vascufil 4/0). Finally, the neo-aorta is protected by coverage of a trans-mesenteric omentumplasty that is fixated using several vicryl 3/0 stitches (Fig. 3). Intravenous antibiotics are given

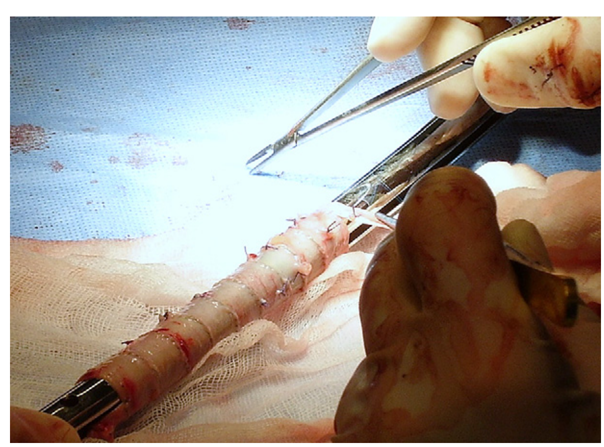

**Figure 1** Construction of the spiral vein graft.

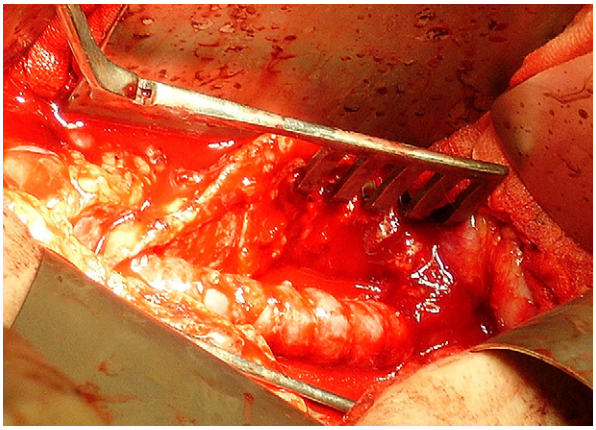

**Figure 2** Reconstruction of the abdominal aorta.

intra-operatively. The type and dose depend on previous microbiological findings.

### Postoperative management and follow-up

All patients are postoperatively monitored at the intensive care unit (ICU). Antibiotics (intravenous) and anticoagulants are continued during hospitalisation. Antibiotics are switched to oral administration before discharge and continued for several months. The type and dose depend on microbiological findings (e.g., microorganism and sensitivity). CT scans are performed before discharge. Routine outpatient follow-up at about 1 week, 3 and 6 months after discharge includes clinical examinations, laboratory assessments and contrast-enhanced CT scans to monitor signs of infection, graft patency and to exclude spiral vein dilatation. Follow-up is extended to annual visits, unless more frequent visits are necessary.

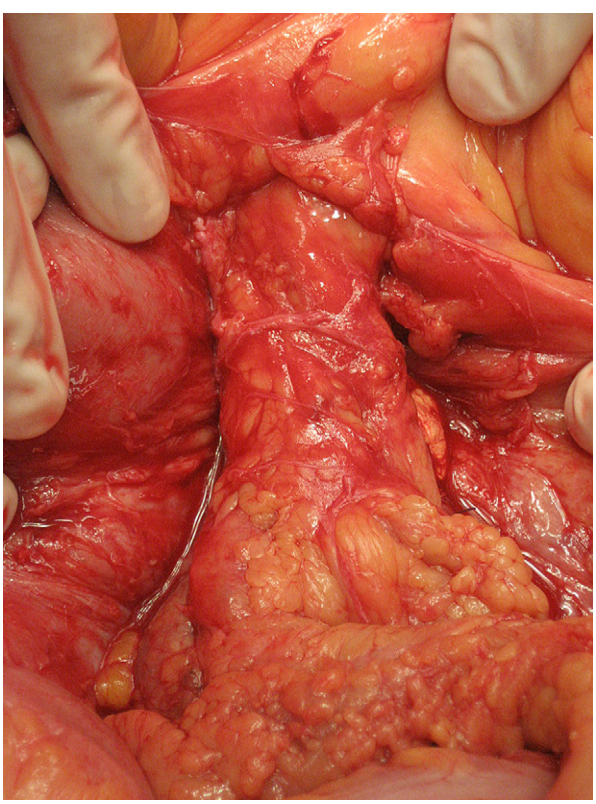

**Figure 3** Trans mesenteric omentumplasty.

### Feasibility

Technical success[18] is defined as proper construction and placement of the spiral vein, without death and must be maintained for at least 30 days postoperatively, and comprises the following: (1) successful harvest of the GSV; (2) successful construction of the spiral vein; (3) successful reconstruction of the abdominal aorta, with no signs of leakage after reconstruction; and (4) no signs of graft failure on contrast-enhanced CT follow-up, such as graft obstruction, thrombosis, dilatation (>20%) or degeneration of the aneurysm at both anastomoses.

### Clinical and continuing success

Clinical success[18] is defined as having no signs of infection, re-infection or ongoing infection at clinical examinations, laboratory results or CT scans. Re-infection is defined as recurrent infection after a period without infection. Ongoing infection is defined as continuing infection with no period wherein infection was absent. Continuing success comprises both technical and clinical success.[18] Duration of successful outcomes is defined as short-term (6 months), mid-term (2 years) and long-term (over 5 years).

### Statistical methods

Due to the descriptive design of the study, only (summary) descriptive statistics are considered to evaluate outcomes. Therefore, no comparative tests yielding *p*-values are used.

## Results

### Patients

Six patients were diagnosed with an infection of the abdominal aorta and treated by spiral vein reconstruction between March 2005 and May 2010. One was excluded because a composite vein graft was used. Five patients (three men) remained eligible for inclusion (three infected grafts and two infected aneurysms). Clinical presentation is presented in Table 1. Median age was 72 years (70–78 years). Three patients previously underwent an endovascular aneurysm repair (EVAR) procedure, with a median time interval of 58 months (23–63 months) until spiral vein reconstruction. Two underwent another procedure between EVAR and spiral vein surgery. One had a percutaneous transluminal angioplasty (PTA) due to renal artery stenosis. The other underwent open repair of a small type 1a and type 2 endoleak 3 weeks prior to the spiral vein reconstruction. This patient was re-admitted due to rectal blood loss and hypotension caused by a transverse colon fistula after the endoleak repair. Cardiovascular co-morbidity was present in all cases (Table 1).

**Table 1** Patient demographics, clinical presentation and medical history.

| Case no. | Age (years) | Sex | Clinical Presentation | Diagnosis | Comorbidities & prior surgery | Prior procedure | Interval prior procedure to spiral vein reconstruction (months) | Operations between prior procedure and spiral vein reconstruction |
|---|---|---|---|---|---|---|---|---|
| 1 | 78 | Female | Abdominal and back pain, nausea, transpiration, post-prandial pain | Infected AAA + aorta-duodenal fistula | CABG, myocardial infarction, COPD Gold III, hypercholesterolemia | No | – | No |
| 2 | 70 | Female | Abdominal and back pain, fatigue, nausea, abdominal pulsatile mass | Infected AAA + leakage | Hypertension, polycystic kidneys, liver cysts, pneumonia | No | – | No |
| 3 | 71 | Male | Abdominal pain, cold shivering, anorexia | Infected prosthetic graft | Atrial fibrillation, PTCA, TIA, hypertension (renal artery stenosis), COPD Gold III, cholecystectomy, Type 2 diabetes mellitus | EVAR (Talent) | 23 | PTA renal artery (failed) |
| 4 | 72 | Male | Abdominal and back pain, rectal blood loss, hypotension, dizziness | Infected prosthetic graft + transverse colon fistula | Type 1a and Type 2 endoleak, stable angina, hypercholesterolemia, hiatus hernia oesophagei | EVAR (Excluder) | 58 | Median laparotomy due to exploration of the aneurysm sac (small Type 1a and Type 2 endoleak), three weeks prior to spiral vein reconstruction |
| 5 | 77 | Male | Malaise, fever, dyspnea and dry chough | Infected prosthetic graft | CABG, hypertension, Type 2 diabetes mellitus, pleuritis, choledocholithiasis, basal cell carcinoma head, Bilroth I operation | EVAR (Zenith) | 63 | No |

Abbreviations: AAA = aortic abdominal aneurysm, CABG = coronary artery bypass graft, COPD = chronic obstructive pulmonary disease, EVAR = endovascular aneurysm repair, PT(C)A = percutaneous transluminal (coronary) angioplasty, TIA = transient ischemic attack.

## Diagnostic work up

Infection was suspected based on clinical signs (Table 1) and demonstrated by diagnostic work-up (Table 2). Infection parameters were elevated for at least one parameter ($n = 5$), but none had a positive blood culture ($n = 4$). CT-findings were suggestive for infection in all cases and signs of rupture were seen in two cases. Two had fine-needle aspirations and two had a PET-scan, confirming diagnosis. Duplex examinations were performed in elective cases. Infections were caused by several microorganisms, where *Listeria monocytogenes* was present in one case (Table 2).

## Surgical procedure

Two emergency reconstructions were performed. Based on patients' medical history, it was assumed that the GSV was present in both cases. The GSV was harvested using a vein stripper in one case. Preoperative duplex examinations were performed in elective settings. The left GSV was harvested in all cases. It was feasible to construct spiral vein tubes with a diameter of 15 mm and a median length of 10 cm (6.5—11 cm), which is sufficient for reconstruction of the abdominal aorta. Length and diameter of the spiral vein reconstruction can be adjusted according to need. Median laparotomy was performed. The aorta was clamped infrarenal in four cases, but could not be clamped in one case. Therefore, a balloon catheter was inflated suprarenally. Both common iliac arteries were clamped in all cases. Intravenous heparin was given prior to clamping. Intraoperative bacteriological cultures were performed after excision and debridement (Table 2). A transmesenteric omentumplasty was constructed in all patients. Fasciotomy was needed in one emergency case because of a compartment syndrome of the left lower leg. Median peroperative blood loss was 2500 ml (2000—5500 ml) and median duration of surgery was 318 min (243—335 min). All patients received intravenous antibiotics intra-operatively (Table 3).

## Postoperative management and follow-up

All patients survived surgery and there were no in-hospital deaths (in-hospital survival 100%). Median postoperative stay at the ICU was 6 days (1—54 days). One case was complicated by several re-operations due to an abdominal compartment syndrome, ischemic colon and tracheotomy. Another had a re-operation 8 days later due to an abdominal abscess. Intravenous antibiotics were given to all patients postoperatively, according to intra-operative microbiological findings. These were switched to oral administration before discharge and continued for 3 weeks to 10 months. Anticoagulants (thrombocyte aggregation inhibitors) were continued postoperatively. Median postoperative in-hospital stay was 34 days (20—70 days). Two patients were re-admitted due to general malaise 9 and 16 days after discharge, where signs of infection were evaluated. One was carefully monitored, while the other received antibiotics due to faeces cultures that were positive for *Clostridium*. Median follow-up was 13 months ((6—67 months, short term $n = 3$), mid-term ($n = 1$) and long term ($n = 1$)) (see Tables 4 and 5).

## Technical, clinical and continuing success

Spiral vein reconstruction was technically possible in all cases. There were no signs of graft failure and no deaths occurred within 30 days postoperative (technical success 100%). None of the cases required elastic stockings after GSV harvest during follow-up. Two patients had a small fluid collection (one abscess) on postoperative CT scans that resolved during follow-up. All patients survived during follow-up (100% survival), and there were no limb amputations (100% limb salvage). Last follow-up showed no signs suspected for ongoing infection or re-infection (clinical success 100%), and there were no signs of graft failure (Fig. 4) (patency and continuing success 100%). All results reflect short-term ($n = 3$), mid-term ($n = 1$) and long-term follow-up ($n = 1$) (see Table 5).

# Discussion

This study evaluates our experience with five patients, who underwent a spiral vein reconstruction of the abdominal aorta. The GSV is harvested, cut open longitudinally and tightly placed on a 15-mm tube to construct a spiral graft using continuous sutures. A standard inlay method is used for aortic reconstruction, and the neo-aorta is protected by a transmesenteric omentumplasty. All patients survived surgery and there were no in-hospital deaths. Median follow-up was 13 months (6—67 months). Survival and limb salvage were 100% during follow-up, and technical, clinical and continuing success were 100%. There were no re-infections or ongoing infections and the spiral vein was patent in all cases, showing no dilatation, although only one has a long-term follow-up. Antibiotics were continued for 3 weeks to 10 months postoperatively, based on microbiological findings to prevent any ongoing or re-infection.

This study is the first to evaluate preliminary results of spiral vein reconstructions of the abdominal aorta using the GSV. Continued follow-up and prospective inclusion of new patients in future perspectives will enable long-term evaluation of this technique. The retrospective design, small sample size and lack of mid- and long-term follow-up are limitations of this study. Therefore, results should be interpreted with caution, despite encouraging outcomes.

A diagnostic work-up approach, surgical procedure and postoperative management are presented as treatment algorithm, but could have limitations in emergency situations where (1) patients are unstable or (2) infection is diagnosed intra-operatively. In these cases, a vein stripper can be used to rapidly harvest the GSV.[15] Lack of available veins could occur in (3) patients with prior bypass surgery or (4) mismatching of the spiral graft in emergency settings (e.g., no prior duplex ultrasounds). Alternatively, composite vein grafts or veins from the arms might be used. However, in the emergency case with prior bypass surgery, there was still enough GSV left to construct a spiral vein. Finally, it is not recommended to harvest veins in patients with (5) prior deep vein thrombosis or pulmonary embolisms. Autologous deep veins, CAHs and silver-coated or

**Table 2** Diagnostic work-up.

| Case no. | Infection parameters | Blood culture | CT-scan | PET-scan | CT-scan fine needle aspiration culture | Duplex examination | Intraoperative tissue culture |
|---|---|---|---|---|---|---|---|
| 1 | CRP 9.8<br>Leukocytes 11.8<br>ESR 71<br>Hb 7.3 | NA | AAA 4.3 cm with thrombus at the aneurysm wall, several periaortic lymph nodes, aortoduodenal fistula | NA | NA | NA | *E. coli* |
| 2 | Leukocytes 13.4<br>ESR 35<br>Hb 7.9 | No growth | AAA with extensive plaques at the aneurysm wall, hematoma at aneurysm sac (rupture) | NA | NA | NA | *Prevotella* species |
| 3 | CRP 242<br>Leukocytes 9.7<br>Hb 7.7 | No growth | Increase diameter aneurysm, suggestive for graft infection | Increased FDG uptake at site of graft and aneurysm wall | Coagulase negative staphylococcus | Deep and superficial system is open, sufficient diameters | *Listeria monocytogenes* |
| 4 | CRP 66<br>Leukocytes 12.2<br>Hb 5.5 | No growth | Enlarged aneurysm wall, possible fistula, air bubble in aneurysm, suggestive for infection | NA | NA | Deep and superficial system is open, sufficient diameters | *Proteus mirabilis, E. coli* |
| 5 | CRP 194<br>Leukocytes 6.6<br>Hb 6.9 | No growth | Increase fluid and tissues at site of EVAR, suggestive for infection | Increased FDG activity at graft, suspected for infection | No growth | Deep system with wide diameters, GSV bilaterally narrow and absent in right lower leg, SSV narrow right | No microorganisms |

Abbreviations: AAA = aortic abdominal aneurysm, CRP = C-Reactive Protein, ESR = erythrocyte sedimentation rate, GSV = greater saphenous vein, Hb = hemoglobin, SSV = smaller saphenous vein, NA = not available.

**Table 3** Operative details.

| Case no. | Vein used | Length harvested (cm) | Length spiral graft (cm) | Surgery outcome | ASA | Urgency | Duration surgery (minutes) | Peroperative blood loss (ml) | Antiseptic solutions/ Antibiotics | Anticoagulants intra-operative | Intraoperative adjuncts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | GSV left | 47 | 10 | Survival | 3 | Emergency | 245 | 2500 | Co-trimoxazole (iv) | Heparin (units NA) | — |
| 2 | GSV left | 40 | 6.5 | Survival | 4 | Emergency | 243 | 2000 | Augmentin (iv) | Heparin 2500 units | Gentafoam, floseal |
| 3 | GSV left | 38 | 8 | Survival | 4 | Elective | 318 | 2500 | Vancomycin (iv) and Rifampicin | Heparin 2500 units | Gentafoam |
| 4 | GSV left | 60 | 11 | Survival | 4 | Elective | 335 | NA | Metronidazole (iv) and Ciprofloxacin (iv) | Heparin 2500 units | Gentafoam |
| 5 | GSV left | 58 | 11 | Survival | 3 | Elective | 335 | 5500 | Kefzol (iv) | Heparin 5000 units | Tachosil, floseal |

Abbreviations: GSV = greater saphenous vein, iv = intravenous, NA = not available.

rifampicin-soaked grafts are alternatives in the aforementioned situations. The presented cases involve only a straight aortic tube and not a bifurcated graft. However, it is technically possible to construct a longer spiral tube as an aorto-uni-iliac (with cross-over venous grafts) and bifurcated spiral graft. Yet, these are not included in the present study.

A CT- and FDG-PET-scan are performed in the diagnostic work-up to assess signs of infection, but cannot reliably determine if periaortic collections with increased FDG uptake are inflamed or infected. A CT-guided fine-needle aspiration of such collection can confirm diagnosis of infection and determine the causing pathogen. Antibiotics can be adjusted according to the antibiogram. The initial CT-scan assesses the ideal biopsy site and patient position to vascular structures and abdominal organs.[19] The biopsy is carefully performed. No bleeding complications were encountered in this series.

Resection and drainage is mandatory in vascular infections. Aortic reconstruction can be performed using prosthetic grafts, extra-anatomic bypasses or *in situ* reconstruction with CAH or autologous veins. Nevertheless, re-infection seems a major disadvantage using prosthetic replacements for infected conditions (5–25%).[3] Disadvantages of the extra-anatomic bypass include re-infection (10–23%), mortality (20%), graft failure (35%) and limb amputation (11%).[3] Using CAH seems advantageous because of resistance to infection and acceptable survival (81% 3-year survival), but is limited due to degeneration, limited availability and higher costs.[5] Autologous venous reconstruction is a favorable method as these veins are bilaterally available, satisfactory in length and diameter, can withstand aortic pressure, have low risk of re-infection, reduce risk of late graft rupture and minimise mortality.[4,20,21] We consider an adjunct omentumplasty, however, as mandatory. Postoperatively, patients receive long-term antibiotics, and could be stopped after 3 months. Disadvantages include possible late degeneration.[20] Patients should be subject to follow-up. Dilatation of the spiral vein graft could be treated by EVAR.

In 2003, Daenens et al. showed their 10 -year experience with autogenous aortic reconstructions using the femoral vein for prosthetic infections in 49 patients.[22] Their 5-year survival rate was 60% (8% in-hospital deaths). Five-year limb salvage and primary patency were 98% and 91%, respectively. No re-infections occurred. The femoral vein is suitable as arterial substitute because of a relative thick wall with an endothelial surface that makes it more resistant to thrombosis, kinking and infections and shows good overall patencies,[22] though femoral vein harvest is a more surgical demanding, time-consuming procedure[6] and includes higher risk of bleeding due to larger diameters of side branches (3%, with 36% mortality), stenosis due to incomplete valvulotomy, risk of discrepancy in diameter (10%) and graft revision (4.6%).[20] Relative venous outflow obstruction is seen in 75–93%,[4,8,20–23] and 18–20% need fasciotomy after total deep vein harvest.[20,24] Despite this, elevated venous pressure seems not to be functional,[4,8,20,22] while others report long-term leg oedema in one-third and (asymptomatic) reflux (11–48%).[20,21,24]

There might be a discrepancy in diameter at the aortic anastomosis, when using the femoral vein as arterial

**Table 4** Postoperative management.

| Case no. | Re-operations | Complications | Stay ICU (days) | In-hospital stay (days) | Continuation antibiotics | Postoperative anticoagulants |
|---|---|---|---|---|---|---|
| 1 | Day 0 abdominal compartment syndrome, Day 2 ischemic intestines, Day 9 closing abdomen, Day 18 tracheotomy | Compartment syndrome (abdominal and left lower leg), ischemic colon, wound dehiscence abdomen, yeast infection (Candida), wound infection groin (Pseudomonas left site), pulmonary oedema, tracheotomy | 54 | 70 | Co-trimoxazole (10 months) | Aspirin |
| 2 | No | — | 7 | 20 | Amoxicillin (6 months) | Aspirin |
| 3 | No | Re-admission due to general malaise: general monitoring | 1 | 34 | Amoxicillin (2.5 months) | Aspirin, Clopidogrel |
| 4 | Day 8 abdominal abscess | Ischemic colon, peritonitis | 6 | 43 | Metronidazole and Ciprofloxacin (6 months) | Aspirin |
| 5 | No | Pneumonia Re-admission due to general malaise: Metronidazole and Vancomycin because of Clostridium in faeces culture | 1 | 24 | Cefuroxime (3 weeks) | Aspirin |

substitute. The spiral vein technique overcomes this problem and the GSV is usable regardless of its diameter. The femoral vein is usable in 80–95% of patients presenting with an infrarenal aortic graft infection,[20,22] while it is always possible to use the GSV for spiral vein reconstruction in this study. Another advantage of autologous veins is the possibility to discontinue antibiotic administration, if signs of infection stay absent.

Vascular infections are mostly caused by *Staphylococcus aureus*, *Salmonella* and *Streptococcus* sp.[25,26] *L. monocytogenes* was found in one patient. This Gram-positive pathogen is an uncommon, but serious, cause of vascular

**Table 5** Follow-up.

| Case no. | Follow-up | | | Outcomes[c] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Signs of infection[a] | Last CT-findings | Months[b] | Technical success | Clinical success | Ongoing success[b] | Limb salvage | Patency | Survival |
| 1 | No | No signs of infection, patent venous conduit | 67 | Yes | Yes | Yes | Yes | Yes | Yes, long-term survival |
| 2 | No | No signs of infection, patent venous conduit | 31 | Yes | Yes | Yes | Yes | Yes | Yes, mid-term survival |
| 3 | No | No signs of infection, patent venous conduit | 13 | Yes | Yes | Yes | Yes | Yes | Yes, short-term survival |
| 4 | No | No signs of infection, patent venous conduit. | 13 | Yes | Yes | Yes | Yes | Yes | Yes, short-term survival |
| 5 | No | Decrease small periaortic fluid collection. No signs of infection. Patent venous conduit. | 6 | Yes | Yes | Yes | Yes | Yes | Yes, short-term survival |

[a] Signs of infection at last follow-up, including re-infection and ongoing infection.
[b] Until November 1st 2010.
[c] Short-term $\geq$6 months, mid-term $\geq$2 years, long-term $\geq$5 years.

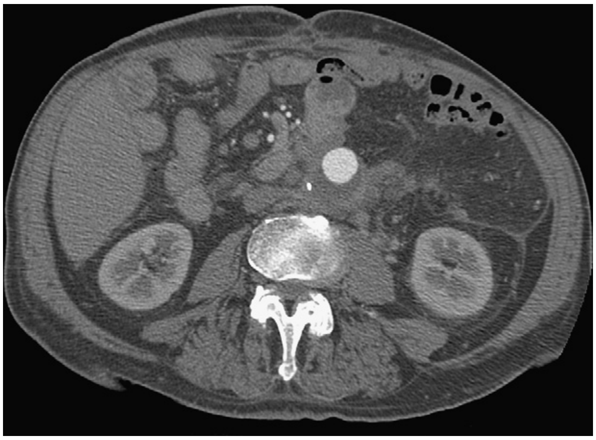

**Figure 4** Postoperative CT-scan with spiral vein *in situ*.

infections and often affects neonates, pregnant women, the immunosuppressed and elderly.[27] Yet, it seems to become a more common pathogen as it is widespread through our environment (5% of humans are asymptomatic faecal carriers).[25] The first case has been described in 1965[28] and only 24 cases of vascular infections caused by *L. monocytogenes* have been reported worldwide until 2008.[26] However, the bacteriological spectrum of primary infected aorto-iliac aneurysms seems wider than previously reported as *L. monocytogenes* is identified in four of 26 patients in a single-center study.[29] Three of these 26 patients were treated with a venous conduit, two times using the femoral vein and one patient was treated with a GSV femoro—femoral bypass. The in-hospital mortality was 23% overall.[29]

## Conclusion

Standard surgical treatment for infected abdominal aortic aneurysms or aortic grafts is undisputed and consists of resection, extensive debridement, aortic reconstruction and antibiotic administration. Spiral vein reconstruction using the GSV shows a 100% survival, limb salvage, patency, technical, clinical and ongoing success in this study. This technique might be considered as an alternative for the use of deep leg veins, CAH and silver-coated or rifampicin-soaked grafts. Nevertheless, more studies and follow-up are needed to evaluate long-term results.

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