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# Revascularisation through the obturator foramen of lower limbs with a compromised ipsilateral groin due to infection

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**ABSTRACT**

INTRODUCTION Infra-inguinal vascular reconstruction with active groin infection is a concerning issue. Using resistant grafts to infection is the most adopted approach. However, in absence of these materials in acute situations, the trans-obturator approach allows for limb revascularisation avoiding the infected site. We evaluated the effectiveness of this approach in patients who needed lower limb revascularisation with an ipsilateral groin infection.

MATERIALS AND METHODS A retrospective study was conducted over a four-year period.

RESULTS Over this period, 13 patients underwent trans-obturator reconstructions (13 external iliac–popliteal above-knee and one aortobipopliteal above-knee bypass). Seven patients had been previously revascularised and were admitted for graft infection (six infra-inguinal bypasses, one axillo-bifemoral bypass). Four presented with acute limb ischaemia, three with groin haematoma and one with a groin abscess. The remaining cases consisted of drug-addicted patients with injury of femoral vessels due to self-injection of drugs. The patients underwent reconstructions with autologous grafts which complicated early with groin haematoma. After transobturator revascularisation, the groin underwent debridement with applying vacuum-assisted wound closure device.

CONCLUSION The transobturator approach could be considered as a chance for lower limb revascularisation in case of ipsilateral groin infection. Moreover, avoiding the infected site allowed us to focus separately and safely on the treatment of the inguinal wound.

**KEYWORDS**

Vascular graft infection – Infrainguinal bypass – Transobturator bypass – Obturator foramen

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## Introduction

A compromised groin due to infection is considered a concerning issue for performing infrainguinal vascular reconstruction, because of the high risk of graft infection, thrombosis and disruption of the anastomosis leading to haemorrhage, which all carry a high rate of limb loss. Using grafts that are resistant to infection such as autologous, biosynthetic or antimicrobic grafts is the most adopted approach.[1] However, there are still some issues, such as the availability of a suitable conduit for these materials, especially in acute situations. Moreover, the bacterial load of the inguinal wound needs to be eradicated, otherwise it will compromise even a successful vascular procedure. Using the same groin wound twice for revascularisation, even with autologous grafts, still carries a high risk of complications given that the wound has a significant microbial load. A transobturator approach would enable the limb revascularisation through a different route far from the infected site, would give better control of haemostasis in case of groin haematoma and focuses separately and safely on healing of the groin. The aim of this study was to evaluate the effectiveness of this approach in patients who needed lower limb revascularisation with a compromised ipsilateral groin.

## Material and methods

A retrospective study was conducted to identify all patients who underwent obturator bypass from 2013 to 2017 at the University Hospital of Ferrara. Primary endpoints were perioperative mortality, limb salvage and groin healing. Secondary endpoints were graft patency, early and late complications such as reinfection and anastomotic aneurysms.

### Transobturator technique

With the patient in the supine position, pack the infected site and cover with a dressing. In a case of unilateral bypass, the donor vessel is exposed through a

retroperitoneal approach rather than transperitoneal, as reported in the first description of this technique.[2] We reserve the transperitoneal approach for bilateral reconstruction.

In our practice, we try to locate the obturator foramen from above in the pelvis rather than from below as described later.[3] From the pubic symphysis move a finger laterally over the superior pubic ramus and then its lower margin. With a finger, you can test the obturator foramen. We generally pierce in the centre and deep into the surface of the membrane and do not enlarge the current obturator canal to avoid injuries to the vascular and nervous structures which pass through it.

We then tunnel the graft from the upper incision through the obturator foramen using a tunneller, pushing it deep towards the medial side of the thigh, keeping its tip toward the skin plane. If the surgeon is not familiar with this technique, a small incision can be made to the inguinal crease medially, just beneath the symphysis and the tip of the tunneller can be checked with the finger. Then push the tunneller through the foramen. In case you need to deliver the graft very distally, a counter incision to the medial side of the thigh might be helpful. However, we do not recommend this to avoid as less as possible the exposure of the graft.

Once the graft is tunnelled, we prefer an end-to-end anastomosis to the iliac and proximal superficial femoral artery, end-to-side anastomosis to the distal superficial femoral and popliteal artery.

Once the bypass is fashioned, pack and dress the surgical sites. Then, open the infected wound, ligate the bleeding vessels, remove previous grafts, infected or necrotic tissues and then treat it with a vacuum-assisted wound closure device.

### Follow-up

Postoperative follow-up consisted of clinical and duplex scan examination at one, three and six months and yearly thereafter. The follow-up was at our institution for the first two years and thereafter at the regional outpatient clinic, which refers to our institution in case of abnormal findings from the duplex scan or worsening of the clinical status of the limb.

### Data analysis and statistical methods

The data on the patency and limb salvage during the follow up were analysed using the Kaplan–Meier method. Fisher's exact test was used to compare categorical variables between different groups.

## Results

Over a four-year period, 13 patients were identified who underwent transobturator reconstructions (13 external iliac–popliteal above-knee and one aortobipopliteal above-knee bypass). In all cases this indication was to perform lower limb revascularisation associated with an ipsilateral groin infection. For all reconstructions an expanded polytetrafluoroethylene (ePTFE) conduit with integral radial reinforcement (GORE® INTERING® vascular graft) of 7 mm in diameter was used to reduce the tunnelling trauma through the obturator foramen. No complications occurred, such as intra- and postoperative bleeding, and there was no postoperative neurological impairment due to bypass tunnelling.

Two groups were identified. One group consisted of patients who suffered from peripheral atherosclerotic disease (PAD group) who had been previously treated with open revascularisation procedures and the second group was drug-addicted patients who had a long history of self-administering drugs through the groin vessels. The drug-addicted patients were younger and had a history of drug abuse which ranged from two to five years characterised by several presentations at the emergency unit for minor skin injuries due to injection such as minor bleeding and infection. One-third of this group were carriers of systemic infections such as HIV, hepatitis B and C. Comorbidities and differences of clinical presentation at the admission between the two groups are summarised in Table 1.

There were six femoropopliteal above-knee bypasses and one axillo-bifemoral bypass in the PAD group. Among these, four grafts were occluded leading to acute limb ischaemia, three presented with groin haematoma due to disruption of the proximal anastomosis, one with groin abscess and three with skin fistulae. All infected grafts were removed: five femoropopliteal ePTFE grafts, one femoropopliteal biosynthetic graft (Omniflow II, LeMaitre Vascular, Inc., Burlington, MA) and one axillo-bifemoral of Dacron knitted material.

In the drug-abuse group, we identified six limbs treated initially with patch angioplasty or replacement using autologous grafts but complicated early during the same inpatient stay with groin haematoma (range 4–10 days).

In accordance to our infectious disease protocol, a short period of broad-spectrum systemic antibiotic therapy with vancomycin was established, which was adjusted according to the results of cultures and antibiograms obtained intraoperatively from wound swabs and specimens of the infected prosthetic grafts. All samples were analysed using the matrix-assisted laser desorption/ionisation–time of flight mass spectrometry technique. Antibiotic therapy was guided by the clinical course of the infection and laboratory inflammation parameters (leukocyte count, C-reactive protein). Systemic antibiotics were maintained for at least two weeks for all patients, then antibiotics were given orally and continued for one week for negative wound cultures (linezolid 600 mg for Gram-positive and quinolone for Gram-negative). All patients were examined with transthoracic echocardiography, which excluded an infective endocarditis.

In drug-addicted patients, all strains of *S. aureus* were methicillin resistant. In three cases *S. epidermidis* was isolated, two in association with methicillin-resistant *S. aureus*. In the PAD-group, strains of intestinal flora were mainly isolated; three patients had a polymicrobial infection (two *Enterococcus faecalis* and *Escherichia coli*, one *E. coli* and *Pseudomonas aeruginosa*).

Groin infection was treated separately, by applying a vacuum-assisted wound closure device with renew of the

**Table 1** Clinical features, microbial species and comorbidities for each group.

| | PAD group (*n*) | Drug-abuse group (*n*) | *P*-value |
|---|---|---|---|
| Limbs: | 8 | 6 | |
| Acute limb ischemia | 4 | 0 | 0.069 |
| Groin haematoma | 3 | 6 | 0.027 |
| Groin abscess | 1 | 6 | 0.0003 |
| Skin fistula | 3 | 6 | 0.027 |
| Microbial species: | | | |
| Staphylococcus aureus | 1 | 3 | 0.159 |
| methicillin-resistant | 0 | 3 | |
| methicillin-sensitive | 1 | 0 | |
| Staphylococcus epidermidis | 0 | 3 | 0.054 |
| Enterococcus faecalis | 3 | 0 | 0.153 |
| Escherichia coli | 3 | 0 | 0.153 |
| Klebsiella pneumonia | 2 | 0 | 0.307 |
| Pseudomonas aeruginosa | 2 | 0 | 0.307 |
| Morganella morganii | 1 | 0 | 0.571 |
| Characteristics: | | | |
| Male | 7 | 6 | |
| Mean age | 72 | 45 | |
| Comorbidities: | | | |
| Diabetes | 4 | 0 | 0.048 |
| Hypertension | 7 | 1 | 0.0046 |
| Smoking history | 7 | 6 | |
| Cardiac history | 3 | 0 | 0.122 |
| Chronic renal failure | 1 | 0 | 0.538 |
| COPD | 1 | 0 | 0.538 |

device every three days per three to four cycles. Negative wound microbial cultures were obtained after two cycles in four of the cases, and after three cycles in the remaining cases. The wound was then treated conservatively until completely healed.

Mean follow-up was 24 months (range 3–48 months). Technical success was 100%. Thirty-day survival, limb salvage and graft patency rates were 100%. Primary patency, limb salvage rates at six months of 92.8%, at 12 months 84.6%, and at 24 months 75% and 83.3%. In all cases, limb loss consisted of above-knee amputations. Secondary patency at one and two years, respectively, was 92.8% (Figure 1). No reinfection or anastomotic aneurysm occurred. The average time of groin healing was 20 days (range 8–60 days).

## Discussion

Traditionally, the treatment of an infected infrainguinal bypass consists in its explantation and then performing a new bypass using materials resistant to infections, such as autologous, biosynthetic and prosthetic grafts impregnated with antimicrobial agents, with good results reported in literature.[1,4–7] Autologous veins serve as the best graft and the great saphenous vein is mostly used. However, the vein may be unsuitable in diameter or length, it may be diseased or may have been used in other interventions. Some authors recommend the superficial femoral vein,[8] with good results, even though it may be not familiar to many surgeons and might be time consuming and increase the risk of bleeding. A prosthetic ePTFE graft is frequently used for vascular reconstruction and may fit well for an obturator bypass considering that it will be placed in a extra-anatomical route far from the infected site. Using an ePTFE conduit with integral reinforcement might reduce the trauma during tunnelling through the obturator foramen, even though authors have described safe use of an ePTFE conduit with external ring reinforcement, with reported complications of coxalgia due to obturator nerve injury only for an oversized diameter.[9]

This would be a reasonable approach, especially in a specific subset of patients such as those in the PAD group, who often suffer from multiple comorbidities, and especially from diabetes, and are expected to have an insufficient response to infection due to their compromised immune system. The same immune deficiency issues are present even in drug-addicted patients carrying the same concerns as patients in the PAD group. Further concerns, such as polymicrobial infections, the increasing resistance even to latest-generation antibiotics, have become more challenging to set up an adequate antibiotic therapy advocating the importance of involvement of a multidisciplinary team.[6,7]

Active infection has been reported to be an independent risk for further graft infection, but focusing solely on the treatment of the surgical site without limb revascularisation carries a high risk of limb loss.[11,12] Using a different route for tunnelling the graft enables us to focus on a thorough and safe treatment of the infected site. Despite targeted antibiotic therapy, several debridement procedures are needed to remove necrotic and infected tissues according to the concept of 'wound sterilisation'. Some authors include within this concept the use of a muscle flap for the coverage to enhance healing and to achieve graft preservation, with recurrent infection rate variable from 7% to 15%.[12–14] The introduction of the vacuum-assisted wound closure device with or without muscle-flap coverage has improved the success rate of graft preservation, although in some cases a failure of this approach is demonstrated because of bleeding at the anastomosis.[15–17]

In our experience, applying a vacuum-assisted wound closure device was successful in eradicating the bacterial load in the wound and was safe in the case of an obturator

approach, as there are no graft anastomoses lying on the wound bed.

The obturator approach, however, has some drawbacks. First, since it is considered to be an extra-anatomical bypass, it is expected to have a low patency rate. However, there are no substantial data to determine its long-term effectiveness and durability, since there are few papers in the literature with a long follow-up. Masaki *et al* report a primary patency rate at three and five years, respectively, of 69% and 43%.[9] Bath *et al* report a primary patency rate at 24 months of 65%, an overall survival and limb salvage, respectively, of 83% and 81% at three years.[18] In our series, the results seem to be more than satisfying in terms of primary patency and limb salvage compared even with those described for traditional extra-anatomical bypasses, with 69% to 85% primary patency and 8–27% limb loss rate at one year.[19]

Our series includes few patients, but it is one of the largest cohort studies reporting the treatment of groin infection in drug abusers. Another limitation is related to the necessity to access the iliac artery and the retroperitoneal approach raising the invasiveness of the procedure and the learning curve for carrying out this procedure, especially in the endovascular era.

## Conclusion

Revascularisation with a transobturator approach for groins compromised by infection could be considered as a chance to provide inflow to the limb. Moreover, avoiding the infected site it allows the surgeon to focus separately and safely on the treatment of the inguinal wound.

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