Surgical techniques during extra-anatomical vascular reconstruction to treat prosthetic graft infection in the groin

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Abstract:

Prosthetic graft infection is a serious complication after reconstructive vascular surgery and the most common anatomic location of this condition is the groin. Traditionally, removal of the prosthesis to eradicate the infectious source and subsequent extra-anatomic vascular reconstruction to preserve distal perfusion is considered the safest treatment option. Tunneling of the new graft through uninfected tissues is technically challenging and can usually be performed through three different routes, namely the ilio-psoas muscular lacuna, the obturator foramen and the wing of the iliac bone. We report a single center five-year experience using these techniques emphasizing on technical remarks.

INTRODUCTION

Prosthetic graft infection represents one of the most feared complications in vascular surgery. The goals of managing vascular graft infection involve eradication of the local and systemic septic source and maintenance of adequate arterial perfusion in the distal limb. In cases where either the interruption of the arterial graft does not result in critical limb ischemia due to adequate collateralization or the graft is already blocked, simple excision provides the most straightforward treatment option. On the other hand, in case of patent grafts which are essential for distal limb perfusion, several preservation techniques have been proposed which include serial wound debridement, antibiotic-loaded beads, negative pressure and rotational muscle flaps.[1] The strategy of graft preservation is attractive because it avoids the technical challenges and operative risks associated with in-situ or extra-anatomic vascular reconstruction, but this treatment option should be limited in cases of segmental graft infection sparing the anastomoses, single gram-positive rather than polymicrobial or gram-negative infections and extracavitary locations. Subsequently, lots of patients are not candidates for preservation techniques and in this case graft excision along with in-situ or extra-anatomical reconstruction is indicated. Again, in situ reconstruction has been mainly advocated for less invasive infections especially in intra-cavitary location. The rest of the patients presenting with prosthetic graft infections may benefit from graft excision and extra-anatomical reconstruction through uninfected tissue planes. In these cases, several surgical techniques have been described, but these procedures are usually challenging and accompanied by significant perioperative risks. The groin is the most common site of vascular graft infection and 5% infection rates have been reported.[2] We aim to report a single institution case series of infected prosthetic grafts in the groin, in need for graft excision and extra-anatomic bypass giving emphasis on the surgical techniques used to treat these patients.

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CASE SERIES

During a 5-year period 15 cases of graft infection in the groin were identified at our institution. This accounts for 4.2% of all lower limb arterial reconstructions involving the femoral artery during the same time interval (15/357 limbs). The diagnosis of infection was based on surgical, microbiological, and clinical follow-up findings in all patients. Positive microbiological findings or pus around the prosthesis, exposed graft in a disrupted wound, pseudoaneurysms with overlying cellulitis/inflammation were considered indicative of graft infection. On the other hand, in the absence of compatible operative findings and negative microbiology or in patients who were not operated and presented a negative clinical and imaging follow-up for >4months, the graft was declared uninfected. Among our 15 cases, preservation of the graft was possible in 3 and graft excision in another 3 patients. Excision of the infected prosthesis and extra-anatomical reconstruction was necessary in 9 patients (60% of all infected grafts). Overall these involved 2 axillo-bifemoral, 1 aorto-bifemoral, 1 ilio-femoral, 1 femoro-femoral and 4 femoro-popliteal bypass. All grafts were patent and a consensus was made, based on clinical and imaging data, that simple removal of the graft without additional revascularization would most likely result in critical limb ischemia and significant risk for limb loss. The procedures undertaken in order to revascularize the limb through uninfected tissues were 2 ilio-femoral and 1 ilio-popliteal bypass through the wing of the iliac bone, 1 ilio-femoral and 3 ilio-popliteal bypass through the muscular lacuna underneath the iliopsoas fascia and 1 thoracic (descending) aorta - bifemoral bypass and 1 axillo-bifemoral bypass through the obturator foramen. The conduit was ePTFE in all cases. Peri-procedural mortality was 11% (one patient died due to respiratory tract infection) while during 18 months mean follow-up, there were 3 major amputations. Secondary patency was achieved in 5/8 cases during the same time interval (Table 1). All 3 patients that needed amputation presented graft occlusion with critical limb ischemia and no further options for revascularization.

	Clinical presentation	Prio procedures	Micro-organisms	Management	Graft Reinfection	Graft Patency	Outcome
#1	Szilagyi III, Samson V	Femoro-Femoral	Staphylococcus aureus, Proteus	Ilio-femoral bypass through iliac wing	No	Patent	Deceased, Due to Respiratory tract infection
#2	Szilagyi III, Samson IV	Axillo-BiFemoral	Staphylococcus aureus, Eschericia coli	Thoracic (descending) aorta - bifemoral bypass through right obturator foramen	No	Patent	Alive, good wound closure
#3	Szilagyi III, Samson V	Ilio-Femoral	Staphylococcus aureus	Ilio-femoral bypass underneath muscular lacuna	No	Patent	Alive, good wound closure
#4	Szilagyi III, Samson IV	Aorto-BiFemoral	Enterococcus, Acinetobacter	Graft limb (Previous aorto-bifemoral) to superficial femoral artery bypass through iliac wing	No	Occluded	Alive, Above knee amputation
#5	Szilagyi III, Samson IV	Femoro-Popliteal	Staphylococcus aureus, Pseudomonas aeruginosa	Below Knee ilio-popliteal bypass through iliac wing	No	Patent	Alive, good wound closure
#6	Szilagyi III, Samson IV	Femoro-Popliteal	Enterococcus, Pseudomonas aeruginosa	Below Knee ilio-popliteal bypass through iliac wing	No	Patent	Alive, good wound closure
#7	Szilagyi III, Samson IV	Femoro-Popliteal	Staphylococcus aureus, Acinetobacter	Below Knee ilio-popliteal bypass through muscular lacuna	No	Occluded	Alive, Above knee amputation
#8	Szilagyi III, Samson IV	Femoro-Popliteal	Staphylococcus aureus, Eschericia coli	Below Knee ilio-popliteal bypass through muscular lacuna	No	Occluded	Alive, Above knee amputation
#9	Szilagyi III, Samson IV	Axillo-BiFemoral	Enterococcus, Acinetobacter, Klebsiella	Axilo-bifemoral bypass through obturator foramen	No	Patent	Alive, good wound closure

- **Szilagyi** wound infection classification: I: Infectious involvement of the cutis; II: Infection of the Cutis / Subcutis not involving the graft; III: Graft infection.
- **Samson** classification. I and II similar to previous definitions, III: Graft infection without anastomosis involvement; IV: Graft infection involving the anastomosis, without complications; V: Graft infection associated with complications.

Table 1. Summary of characteristics of patients treated for graft infection in the groin.

From a purely technical perspective, extra-anatomic revascularization and graft excision were always performed during the same operation, with this sequence. Tunneling the new bypass through uninfected tissue planes probably represents the most challenging part of these procedures. Several techniques have been reported to avoid the infected groin and we have used 3 approaches in our series which were based on previous experience with the use of these techniques in our Department.[3,4] The most widely reported approach is the obturator bypass. During this procedure either the common or the external iliac artery can serve as the donor vessel which can be exposed through a standard curvilinear lower quadrant incision and a retroperitoneal approach. The incision usually starts around 1-2 finger-breaths (FB) above the mid-distance between the pubis and the umbilicus and run from the lateral edge of the rectus muscle, obliquely up to 1-2 FB supero-medial to the anterior superior iliac spine (Figure 1).

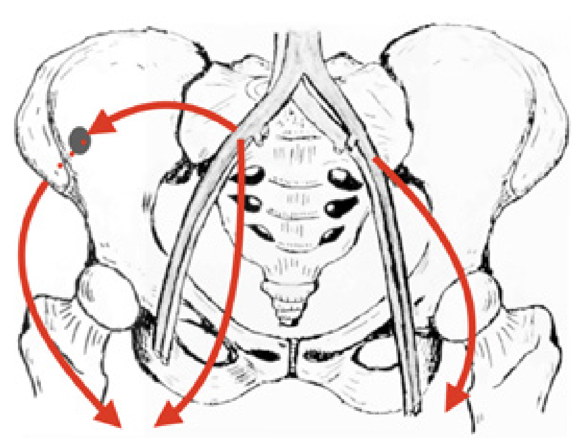

Figure 1. Schematic of the possible extranatomic bypass routes.

Through this incision the abdominal muscles are divided and the peritoneal sac is bluntly mobilized in order to approach the iliac vessels. Through the same incision the obturator foramen is approached. Taking into account that the obturator nerve and artery perforate the obturator membrane at the posterolateral aspect of the foramen, it is advisable to make the surgical incision at its anteromedial side. Since the membrane is very dence, sharp rather than blunt dissection should be applied. Regarding the target vessel, the mid-thigh superficial femoral artery or the popliteal artery are most often used which are exposed through standard surgical incisions. We prefer this approach when the distal target vessel is the superficial femoral or popliteal artery. The profunda femoral artery may also be used but its exposure from the posteromedial side can be technically challenging and risks entering the infected groin. We prefer to make the tunnel in the potential space between the adductor longus and brevis anteriorly and the adductor magnus muscle posteriorely. Since the longus and brevis muscles arise from the anterior while the magnus from the posterior rim of the external surface of the obturator foramen, one can understand that this approach leads directly to the obturator foramen. Direction of tunneling can either be from inferior to superior or vice versa.

Regarding the other two surgical approaches, the retroperitoneal exposure of the iliac arteries is performed as already described. If the route through the wing of the iliac bone is used, the internal surface of the iliac wing is approached through the same incision used to expose the iliac arteries, 1-2 FB below the iliac crest. Then a separate short skin incision is performed 1-2 FB below the anterior superior iliac spine at its lateral side, to approach the external surface of the iliac wing. With the aid of a drill, the bone is penetrated from the outside keeping an oblique, upward direction. The void in the bone should be ≈8-10mm wide in order to accommodate a 6-8mm vascular graft without a risk of stenosis (Figure 2).

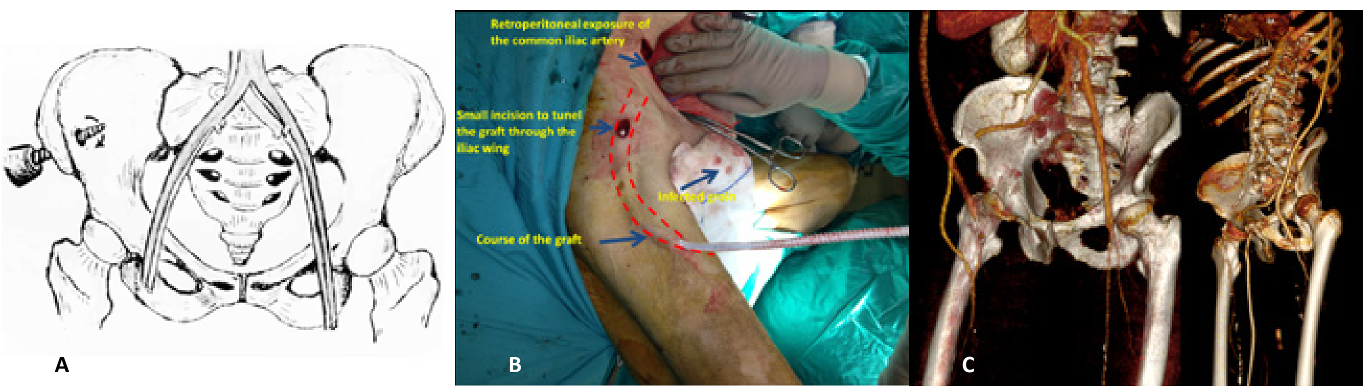

Figure 2. **A.** Schematic of the tunneling of the iliac bone (with a 8-10mm drill) to facilitate passing of the graft.
B. Intra-operative capture emphasizing technical remarks of the procedure.
C. 3D reconstruction of a graft that passed through the wing of the iliac bone and another passed through the obturator foramen.

In the case of tunneling the graft through the muscular lacuna underneath the iliopsoas fascia a transverse incision of the fascia is performed and the route of the tunnel is directed downward and laterally. In this technique the graft is passed lateral to the femoral nerve. Finally, the tunnel reaches the anterolateral side of the upper third of the thigh and then deviates medially to reach the target vessel.

DISCUSSION

In general, prosthetic graft infection in the groin represents a significant source of morbidity after lower limb revascularization procedures and there have been reports suggesting that its occurrence may reach rates as high as 10.6%.[5] A higher risk for major amputation, need for surgical revision and readmission have been recorded for patients with surgical site infection compared to those without.[5] The relative risk for major amputation has been recently reported to be 10-times higher among subjects with graft infection, which is indicative of the significant burden that this complication carries for patients and healthcare professionals.[2] In our series one peri-operative death was recorded, while during 18-months of follow-up 3 major amputations were performed which is close to rates previously reported in the literature.[6] Our results are limited by the low sample volume but most relevant reports share the same limitation. The most recent study on the subject reported on 18 obturator canal bypass procedures performed during 18-years, while others have reported surgical treatment of 14 patients during a similar time interval.[3,6] Nevertheless, besides reporting results in our patient population, the main focus of the present report is to discuss surgical options during extra-anatomical arterial reconstruction in the groin and highlight the technical remarks of these procedures. We believe that these techniques may be useful and relevant in the clinical setting, since removal of the infected prosthesis and extra-anatomical reconstruction (as opposed to simple excision of the prosthesis or graft preservation techniques) is required in the majority of these cases (60% in the current series and 79% in previous reports).[2]

In this regard, we describe three alternative routes to pass a new conduit in patients with a prosthetic graft infection in the groin, needing graft excision and extra-anatomic reconstruction. Each of these techniques has specific advantages and limitations. The obturator bypass cannot be used if infection is present at the medial side of the thigh, involving the adductor muscles. The lateral tunneling during passing a graft through the muscular lacuna can be used in case of limited groin infection not involving the upper thigh. Its origin can be either the common or the external iliac artery. In the presence of extensive groin infection tunneling through the iliac wing provides a better route to avoid entering the groin but may be more technically challenging. Moreover, during this approach using the common iliac artery is recommended as opposed to the external iliac in order to ensure a smooth course of the graft and avoid kinking due to a vertical take-off from the external iliac. An alternative to these techniques is the axillo-femoral or axillo-popliteal bypass, but this is clearly disadvantaged by the significantly longer conduits for which a considerably shorter patency is anticipated.

All patients included in the current series were treated using synthetic grafts, routed through extra-anatomical planes. An alternative option would be to perform in-situ reconstruction using venous conduits, such as the femoral vein, but this technique has mostly been used during treatment of intra-cavitary infections and would only apply in 2/9 of our patients.[7] Moreover, the extent of infection was considered significant and several microbial species (including gram negative) were cultivated in all current cases which could have conferred a higher risk of re-infection in case in-situ rather than extra-anatomical arterial reconstruction was performed. Others have suggested the use of autologous venous grafts even during extra-anatomic revascularization in an attempt to reduce the risk of re-infection.[8] Nevertheless, taking into account that this risk is similarly low if synthetic grafts are used, as long as they are routed extra-anatomically, the additional burden accompanying preparation of autogenous grafts may not be justified. The poor general condition of most of our patients along with the low experience of our center with these techniques, were additional reasons to prefer the use of synthetic grafts.

CONCLUSION

Prosthetic graft infection in the groin is a feared complication in vascular surgery, which usually requires complex surgical procedures to be treated. Despite the fact that the techniques described here may be technically demanding, we believe that they can broaden the armamentarium of the vascular surgeon and aid in the surgical management of this challenging condition.

No conflict of interest.

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