Hypothesis: Infrascrotal, perineal, femorofemoral bypass is an acceptable procedure for treating infection of a prosthetic arterial graft limited to a unilateral groin.

Design: A consecutive sample clinical study with a mean follow-up of 29 months.

Setting: The surgical department of an academic tertiary care center and an affiliated secondary care center.

Patients: Nineteen patients with a mean age of 68 years with prosthetic graft infection at the outflow anastomosis on a femoral artery at the Scarpa triangle underwent an infrascrotal, perineal, femorofemoral bypass, with excision of the graft material limited at the groin. The recipient artery was the profunda femoris artery in 12 cases, the superficial femoral in 5, and the distal common femoral artery in 2.

Main Outcome Measures: Cumulative survival, recurrence of sepsis, primary graft patency, and limb salvage rates expressed by standard life-table analysis.

Results: Postoperative mortality rate was 5%. Cumulative (SE) survival rate was 65% (11.6%) at 3 years. Cumulative (SE) rate of freedom from recurrent sepsis was 88% (8.6%) at 3 years. Cumulative (SE) primary patency and limb salvage rates were 86% (9.4%) and 91% (7.9%), respectively, at 3 years.

Conclusion: Femorofemoral bypass with an infrascrotal perineal approach is a valuable procedure for the treatment of femoral arterial graft infection limited at a unilateral groin.

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From October 1, 1993, to October 31, 2003, nineteen consecutive patients with prostatic arterial graft infection at the outflow anastomosis on a femoral artery at the Scarpa triangle underwent femorofemoral bypass with an infrascrotal perineal approach and excision of the graft at the groin, at the “Francesco Durante” Department of Surgical Sciences and Applied Technologies, Rome University Hospital, Rome, Italy, and one affiliated center. This figure represents 19 (23%) of 85 arterial graft infections treated at both centers in the same period. The study was approved by the local ethics committee; informed consent was obtained from all patients.

All of the patients were men, with a mean age of 68 years (age range, 39-81 years). Fourteen patients (74%) had a history of smoking; 11 (58%) had evidence of coronary artery disease, defined as having a history, clinical symptoms, or electrocardiographic signs of myocardial ischemia; 9 (47%) were medically treated for arterial hypertension; 5 (32%) were receiving oral antidiabetic treatment; 2 (10%) had a history of previous transient ischemic attack or carotid endarterectomy; and 1 (5%) had chronic renal insufficient requiring dialysis. The indication for the initial arterial reconstruction was a disabling claudication in 12 patients (63%), rest pain in 3 (16%), and infrarenal aortic aneurysm repair in 4 (21%).

Infection developed in 3 patients (16%). After revascularizations performed at our institution, whereas 16 (84%) were referred after undergoing operation elsewhere. After the initial grafting, 9 patients (47%) had undergone 1 to 2 previous operations (mean, 1.3) involving the graft at the groin that ultimately became infected. The manifestation of the infection included a draining sinus at the groin in 14 cases (74%), exposure of the graft in 6 (32%), a septic false aneurysm with fluid collection in 5 (26%), and a septic thrombosis in 4 (21%).

All the patients underwent angiography and computed tomographic (CT) scan, as part of their clinical workup. The latest 8 patients of the series also underwent technetium Tc 99m-labeled leukocyte scan (scintiscan)\(^{18,19}\) for a better assessment of the extent of septic involvement of the prostatic graft.

Prosthetic graft infection limited to the groin was diagnosed if: (1) fluid collection associated with draining sinus, false aneurysm, graft thrombosis, or graft exposition at the groin was noted if: (1) fluid collection associated with draining sinus, false aneurysm, graft thrombosis, or graft exposition at the groin was admitted bacterial growth. Cultured, infective agents included Staphylococcus aureus in 8 cases (42%), Staphylococcus epidermidis in 5 (26%), Escherichia coli in 3 (16%), Streptococcus viridans in 2 (10%), Proteus mirabilis in 1 (5%), Diphtheroides in 1 (5%), Acinetobacter species in 1 (5%), Pseudomonas aeruginosa in 1 (5%), Serratia marcescens in 1 (5%), and Corynebacterium in 1 (5%). Five grafts yielded more than 1 bacterial species.

Antibiotic treatment was started in the preoperative period, continued postoperatively, and given for 6 weeks after discharge from the hospital. After bypass, the patients were put to a regimen of low-molecular-weight heparin for 1 month and were then prescribed 100 mg/d of oral aspirin. A control angiogram was always obtained before patient discharge to determine the correct morphology of arterial reconstruction. Postoperative mortality was defined as any death occurring within 30 days of surgery.

Local status of the groin and limbs and patency of the bypass were assessed at 4 weeks after operation and twice every 12 months by clinical examination and duplex scanning. Failure to detect a pulse by physical examination combined with duplex and/or arteriographic confirmation of graft occlusion defined graft thrombosis. Thrombectomy of an occluded graft or redo bypass grafting was not attempted in this series.
As main results, patient survival, local and systemic control of sepsis, primary graft patency, and limb salvage rate were considered. They were expressed by standard life-table analysis.²⁰

Primary patency was defined as continuous graft patency, uninterrupted by any surgical or radiologic revision. Local control of sepsis was defined as complete wound healing without recurrence of collection, draining sinuses, and false aneurysms at the groin as well as along the course of the graft. Systemic control of sepsis was defined as the absence of fever, leukocytosis, or evidence of extension of the infection to any part of the bypass-related prosthetic graft material. Limb salvage was defined as the preservation of a functional limb below the ankle level, and any amputation above the ankle level was defined as a major amputation.

RESULTS

One patient died in the postoperative period of myocardial infarction, resulting in a postoperative mortality rate of 5%, rising to 7% if infection of aortofemoral grafts is only considered. Nonfatal complications included 2 cases of myocardial ischemia, 1 case of respiratory distress syndrome, and 1 case of renal failure, which could be successfully managed with appropriate medical treatment. No postoperative bypass occlusion occurred nor was a postoperative major amputation ever required.

The mean length of operation was 3 hours (range, 2-4.7 hours). The mean postoperative length of stay was 13 days (range, 8-20 days). The 18 patients who survived the operation were followed up for a mean period of 29 months (range, 7-114 months).

Eleven late deaths occurred; 4 were due to myocardial infarction, 2 to lung cancer, 2 to cerebral hemorrhage, 1 to intestinal infarction, 1 to systemic sepsis originating from the remaining prosthetic arterial graft, and 1 to multiorgan system failure after major amputation for an occluded bypass. Overall, cumulative (SE) survival rate was 65%(11.6%) at 3 years (Figure 2).

Local septic recurrence did not develop in any patient, whereas systemic sepsis developed in 2 patients at 7 and 13 months after undergoing perineal bypass. One patient had infection of the remaining, intracavitary portion of an aortobifemoral graft, with the infraperineal graft remaining patent and well incorporated; he underwent total aortofemoral graft removal, axillo-unifemoral bypass, with reimplantation of the proximal portion of the.
Infraperineal graft on the axillofemoral graft but died of septic shock on postoperative day 2. The isolated, infecting agents were the same at both operations, *Pseudomonas* species and *S marcescens*. Recurrent systemic infection developing from the remaining portion of prosthetic material concerned 1 (7.7%) of 13 followed up aortofemoral grafts.

One patient had infection of the remaining intracavitary part of common iliac to common femoral artery graft, with the infraperineal bypass remaining intact. This patient underwent total graft removal via a retroperitoneal access, fully recovered from sepsis, and died of disseminated lung cancer 31 months later. The isolated infecting agent at both operations was *P mirabilis*. The overall, cumulative (SE) rate of freedom from systemic infection was 88% (8.6%) at 3 years (Figure 3).

Two grafts thrombosed during follow-up, thus requiring 2 major amputations (11%) for lack of distal outflow, whereas 1 failing graft could be revised and successfully prolonged to the above-knee popliteal artery, remaining patent at 27 months. No graft underwent septic complications during the length of follow-up. Overall, the cumulative (SE) primary patency rate was 86% (9.4%) at 3 years (Figure 4). An overall cumulative (SE) limb salvage rate of 91% (7.9%) was observed at 3 years.

**COMMENT**

Indications for infrascrotal, perineal bypass, when dealing with prosthetic vascular graft infection at the groin, usually include unilateral sepsis of an aorto-iliofemoral graft, the crossover suprapubic branch of an axillo-bifemoral or femorofemoral graft, and a prosthetic patch at the common femoral artery’s bifurcation. The infection of an iliofemoral or aortofemoral graft at the groin is the most common indication for perineal bypass. In the present series two thirds of the revascularizations were performed for the unilateral sepsis of an infrarenal, aortobifemoral graft; after partial excision of the graft, limited at one groin, the contralateral limb of the graft itself, spared infection, was used as an inflow site for revascularization. Complete removal of the infected graft and extra-anatomical or in situ revascularization with autogenous material remains the standard treatment of an aortofemoral graft infection.

Complete excision of a graft in the infrarenal aortic position with extra-anatomical or in situ revascularization, still carries with it a significant quota of early and late complications. Drawbacks of these standard methods, include perioperative mortality rates usually over 10%, prolonged length of the operation, and a significant rate of revisions of performed arterial reconstructions, either for recurrent sepsis or degenerative changes in the newly implanted grafts. Operative revisions may be required in up to 24% of axillofemoral bypasses, whose reported actuarial primary patency rate is of 73% and 80%, respectively, at 5 and 3 years. Provided that systemic sepsis or infection of the remaining portion of an aortofemoral graft can reasonably be excluded, partial excision of the graft itself may be attempted. This principle can be extended to other prosthetic grafts, such as axillofemoral grafts.

*Figure 3.* Overall cumulative rate of freedom from systemic sepsis after infrascrotal, perineal, femorofemoral bypass. The numbers above the dotted line indicate the number of patients at risk for each interval.

*Figure 4.* Overall cumulative primary patency rate after infrascrotal, perineal, femorofemoral bypass. The numbers above dotted line indicate the number of patients at risk for each interval.

In the present series, overall operative mortality was limited to 5%, reaching 7% if related to patients undergoing operation for a limited infection of an aortofemoral graft, which favorably compares with results of series dealing with patients undergoing complete aortofemoral graft excision. It may be argued that reports on complete graft excision usually also include patients with graft-enteric fistulas, infected intracavitary portions of the grafts, or systemic sepsis, which are more difficult to treat than those with infection actually limited at the groin. Nevertheless, because of the lack of randomized comparisons between the 2 methods in superposable patients with prosthetic infection limited at the groin, the value of the less aggressive, partial graft excision should be retained.

In the present series, of 13 treated aortofemoral grafts, recurrent systemic sepsis developed in 1 patient (7.7%) with a fatal outcome whereas the overall freedom from systemic sepsis was 88% at 3 years, and no local septic recurrence was observed. These results are superposable to those obtained with more aggressive and radical methods of treatment for which rates of freedom from recurrent sepsis of 82% to 100% are reported. Before attempting limited excision of the graft at the groin, the absence of sepsis, either systemic or extended to the remaining portion of the graft, must be carefully assessed. As a general rule, and especially when dealing with
aortofemoral grafts, when infection at the groin appears the graft should be considered infected in all its portions, unless the contrary is proven. The 2 septic recurrences of this series both occurred in patients who did not undergo a scintiscan as part of their preoperative workup, whereas no recurrences were observed in the patients bearing a scintiscan negative for extension of the graft’s infection beyond the groin. Infrascrotal perineal bypass is applicable only when the donor groin is uninfected, as well as any residual graft portion. We require that the absence of collection at the groin and residual graft at CT scan be supported by a negative scintiscan at the same sites for us to assume that infection is actually sparing them, and consequently, we proceed to perineal bypass. The reported recurrences are reasonably attributable to a nonrecognized, concomitant infection of the remaining portion of the graft. If this would be recognized preoperatively, both patients would be treated by standard complete graft excision. Hopefully, the combination of CT scan and scintiscan will aid in a more sensitive definition of extragroin graft infection and a better selection of patients for partial graft preservation and perineal bypass.

In both the 2 postoperative septic recurrences, the infecting agents involved were gram-negative bacteria. Although this observation does not reach statistical significance, owing to the small sample size of this series, similar results have already been reported that show patients with graft infections caused by gram-negative bacteria are at a higher risk of septic complications and recurrences after conservative treatment.

Patency and limb salvage rate obtained with perineal bypass in the present series are superposable to those obtained with standard, suprapubic, crossover femorofemoral bypass. In the present series, owing to the few cases involved, no statistically significant comparison could be made between the recipient sites, that is, profundus vs superficial femoral artery, the conduit material used for revascularization, that is, autogenous saphenous vein vs PTFE, in terms of patency, limb salvage, or septic recurrence rates. Nevertheless, autogenous saphenous vein remains our first-choice graft material when performing perineal bypass, PTFE being considered as the alternative if the autogenous saphenous vein is unavailable, as it has already been recommended.

When dealing with a unilateral graft infection at the groin, obturator foramen and axillofemoral bypass are both possible alternatives to infraperineal arterial reconstruction. Obturator foramen bypass originates from either the intra-abdominal portion of a graft that becomes infected at the groin, the aorta, or the iliac arteries. It is usually directed toward the popliteal artery as an outflow vessel. Compared with perineal bypass it requires a more extensive dissection, greater blood loss, and a longer graft conduit.

The axillofemoral bypass presents an even longer course of the graft, which usually is of prosthetic material; infraperineal bypass should be preferable, as its shorter length and frequently autogenous material should assure longer patency and limb salvage rates. The axillofemoral bypass remains the best alternative, in case of infraperineal bypass failure. In the lack of prospective, randomized studies comparing these methods, the results of the present series do not contradict this assumption. The low rate of graft revisions in the present series favorably compares with the relatively frequent need for revision of axillofemoral grafts performed for graft infection and further supports infraperineal vs axillofemoral bypass for the treatment of a unilateral graft infection at the groin. Whenever infection is bilateral, the axillary artery remains the donor axis of choice for extra-anatomical arterial reconstruction.

In the present series, long-term survival of the patients was poor, thus limiting the reliability of the results up to 3 years. This reflects the difficult clinical terrain of patients bearing arterial graft infection who often show significant comorbid conditions and unfavorable life habits. Nevertheless, despite this time limitation and the nonrandomized nature of the study, results of infraperineal femorofemoral bypass can be considered satisfactory and superposable to those of standard suprapubic femorofemoral bypass in terms of patency and limb salvage rates.

**CONCLUSION**

The results of this study support the use of femorofemoral bypass with an infrascrotal perineal approach for the treatment of femoral arterial graft infection limited at a unilateral groin.

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