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Outcomes in the management of vascular prosthetic graft infections

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Despite routine antibiotic prophylaxis and refinements in implantation technique, microbial infection of the vascular prostehesis can occur. Infection involving a vascular graft is difficult to eradicate. We retrospectively analysed the operative registers of our clinic as well as the regular archives, from 2000 until present, searching for reported graft infections which needed excisions and extraanatomical bypasses or for conservative therapy.
There were 50 patients in this interval admitted and treated in Surgical Clinic No 1, out of a total of 950 vascular interventions.
10 of them were early graft infections(< 4 months), 40 were late ones(> 4 months).
Using Szilagyi's classification, 10 were grade I, 17 were grade II and 23 grade III.
We performed 20 graft excisions infrainguinal graft infections, with the removal of the entire graft, radical debridement of infected perigraft tissues, closure of the arteriotomies with mono filament suture and the administration of systemic and topical antibiotics. We attempted graft preservation in 5 cases of infrainguinal prosthetic bypass graft infection (with serial surgical wound debridement, coupled with antibiotic therapy, early muscle flap coverage and repeated wound cultures to identify any development of bacterial resistance or change in the microbial flora. Dissatisfaction with the morbidity and the mortality of treating vascular graft infections, regardless of location, by total graft excision and remote boypass has been the impulse for the expanded application of lately performed in-situ bypasses or even for the prophylactic use of antibiotic-bonded grafts, in carefully selected cases.

Key words: *infection, vascular prothesis, pathology, therapeutic solutions*

Despite routine antibiotic prophylaxis and refinemems in implantation technique, microbial infection of the vascular prostehesis can occur. Infection involving a vascular graft is difficult to eradicate. If not recognized or treated promptly, implant failure will occur by producing sepsis, hemorrhage or thrombosis. Surgical therapy is always required, often coupled with prosthesis excision, because antibiotics alone are insufficient to eradicate an established infectious Process. Management involves graft excision alone, graft preservation within the implant wound, in/situ graft replacement, or graft excision in conjunction with extra-anatomic bypass grafting. Improved results have been reported following both graft excision coupled with extra-anatomic bypass and in-situ replacement procedures.

Even when treatment is successful, the morbidity associated with vascular graft infections is considerable, with outcomes worse than the natural history of the vascular condition that led to graft

The reported incidence of infectioi involving a vascular prosthesis varies from 0.2% to 5% of operations, being influenced by the implant site, indication for intervention, underlying disease and host defense mechanisms.

The presence of a foreign body potentiates the infectivity of bacteria. In 1957, Elek and Conen demonstrated that a single-braided silk suture significantly reduced the inoculum of staphylococci required to produce a local infection[5].

The risk of foreign body infection can be predicted by the tormula Risk of biomaterial infection = Dose of bacterial contamination x virulence/Host resistance.

The initiating event is bacterial adherence to the biomaterial surfaces, followed by colonization and development of "bacterial-laden" biofilm that resists host defenses and antibiotic penetration. Both graft and bacterial characteristics influence the likelihood of colonization.

Bacterial adherence to polyester grafts is 10 to 100 times greater than to polytetrafluoroethylene (PTFE) grafts; gram-positive bacteria produce an extracellular glycocalyx, or "mucin" that promotes adherence to biomaterials in greater numbers than gram-negative bacteria.

The etiologic factors involved in graft colonization are:

1. perioperative contamination via the surgical wound
2. bacteremia seeding of the biomaterial
3. mechanical erosion into bowel or genitourinary tract or through the skin
4. involvement caused by a contiguous infectious process

MATERIAL AND METHOD

We retrospectively analysed the operative registers of our clinic as well as the regular archives, from 2000 until present, searching for reported graft infections which needed excisions and extraanatomical bypasses or for conservative therapy.

There were 50 patients in this interval admitted and treated in Surgical Clinic No. 1, out of a total of 950 vascular interventions.

10 of them were early graft infections (< 4 months), 40 were late ones (>4 months).

Using Szilagyi's [9] classification, 10 were grade I, 17 were grade II and 23 grade III.

In literature, the risk factors for graft infection are:

1. **Bacterial contamination of the graft**

- Faulty sterile technique
- Prolonged preoperative hospital stay
- Emergency surgery
- Extended operative time
- Reoperative vascular procedure
- Simultaneous gastrointestinal procedure;remote infection
- Postoperative superficial wound infection/skin necrosis/seroma/lymphocele.

2. Altered host defenses

Local factors:

– Biomaterial foreign body reaction
– Bacterial slime production (producing a protective biofilm)

Systemic factors:

– Malnutrition
– Leucopenia lvmphoproliferative disorder
– Malignancy
– Corticosteroid administration
– Chemotherapy
– Diabetes mellitus
– Chronic renal failure
– Autoimmune disease

We couldn't determine the impact of all this factors, but we noticed the most frequent one of each group: reoperative vascular procedure (72%) and diabetes mellitus (56%).

We followed antibiotic prophylaxis protocols in all of the cases, prior to first vascular intervention.

Present followed international protocols for antibiotic prophylaxis in adults undergoing prosthetic graft or patch implantation during clean surgical procedures are:

– Cefazolin 1-2 g IV slowly prior to induction of anesthesia and repeated (1-2 g) q 8 hours for 24-48 hours, or cefuroxime 1.5 g IV and q 12 hours for total of 6 g; a single dose of Cefazolin 1 g IV is recommended prior to endovascular stent deployment

– When methicillin-resistant Stapylococcus aureus is cultured on body surfaces or is a known important pathogen in hospitalized patients, add Vancomycin lg IV infused over 1 hour.

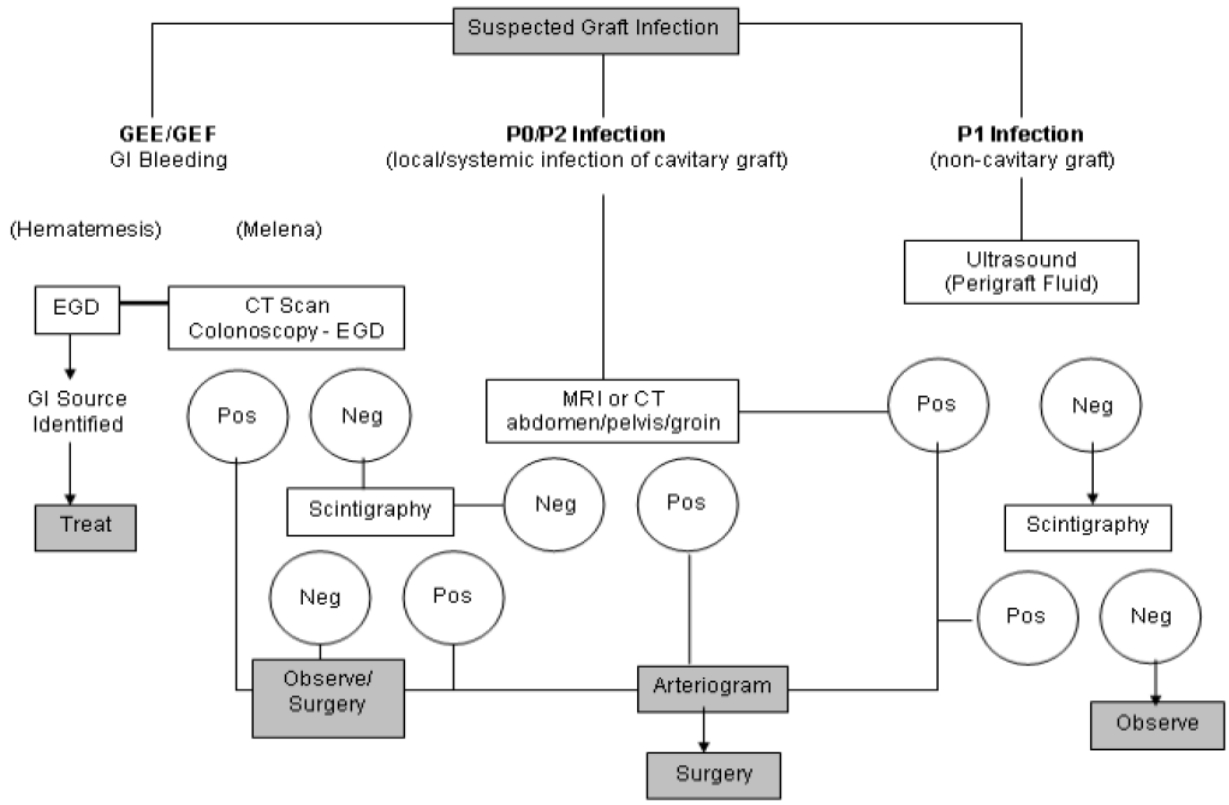
– If the patient has a cephalosporin allergy, give Aztreonam 1 g IV q 8 hours for 24 hours

– If the patient has a Vancomycin allergy, give Clindamycin 900 mg IV over 20-30 minutes followed by 450-900 mg IV q 8 hours for 24 hours

Staphylococcus aureus was the most prevalent pathogen (95%) found affecting our grafts, literature depictions are as well showing it accounting for one fourth to one half of infections depending on the implant site. Graft infections due to S. epidermidis or gram-negative bacteria have increased in frequency[3]. This change in the microbiology of graft infection is the result of reporting both early - and late-appearing graft infections, including aortic graft infections. Graft infections associated with negative culture results are caused by S. epidermidis or other coagulase-negative staphylococci, and on occasion by Candida species. Infections due to gram-negative bacteria such as E. coli, Pseuclonionas, Klebsiella, Enterobacter and Proteus species are particularly virulent. Methicillin-resistant S. aureus (MRSA) now accounts for one fourth of early prosthetic graft infections. The recent increase in MRSA wound infections may justify use of specific antibiotic prophylaxis for all vascular device implant procedures.

Diagnosis was based on clinical examination, microbiologic methods and operative findings. Clinical evaluation includes: patient history, physical examination, diagnostic testing and vascular imaging (arteriography, contrast-enhanced CT, ultrasonography, NI RI, endoscopy).

Table 1. Algorithm foi evaluation of a suspected prosthetic graft infection, taken from Rutherford Vascular Surgery, sixth edition chapter 59: 879 (written by Bandyk DF, Back MR[1]). GEE, graft-enteric erosion. GEf, graft-enteric fistula. EGD, esophagogastroduodenoscopy; GI, gastrointestinal; Pos, positive; Neg, negative.



RESULTS AND DISCUSSIONS

Management strategies. Treatment should be individualized. The surgeon should select a procedure that the patient can tolerate and that eradicates the clinical manifestations and potential complications of the infectious process. Available treatment options can include graft excision without revascularization[10], graft preservation[2], graft excision coupled with extra- anatomic by-pass[6,8] (conventional management) and graft replacement in situ[11].

The general principles of any chosen treatment are: determining the extent of graft infection, removing the graft, debridement of the arterial wall and perigraft tissues and drainage and antibiotic therapy. Regarding the revascularization of organs and limbs, several vascular groups have demonstrated decreased morbidity and mortality with staged or sequential treatment as compared with traditional treatment (total graft excision followed by immediate extra-anatomic bypass). If a monophasic Doppler arterial signal is present at the ankle after graft excision or if arterial systolic pressure is greater than 40 mm Hg at the ankle or forearm, delayed reconstruction is an option because sufficient collaterals are present to maintain limb viability. In the presence of critical limb ischemia, arterial revascularization should not be delayed because of the associated morbidity from ischemic compartment syndrome and nerve ischemia.

We performed 20 graft excisions for infrainguinal graft infections, with the removal of the entire graft, radical debridement of infected perigraft tissues, closure of the arteriotomies with monofilament suture and the administration of systemic and topical antibiotics. We attempted graft preservation in 5 cases of infrainguinal prosthetic bypass graft infection (with serial surgical wound debridement, coupled with antibiotic therapy, early muscle flap coverage and repeated wound cultures to identify any development of bacterial resistance or change in the microbial flora). We used the staged approach in 20 cases, beginning with drainage of the perigraft abscess, followed in 2 or 3 days bx graft excision and autogenous vein grafting.We performed none in-situ replacements with Rifampin-bonded prosthesis, partly because they were not available until a few years ago, partly because we didn't consider it a proper option, given the case selection.

Calligaro[4] and coworkers recommended specific selection criteria and treatment adjuncts for selective graft preservation for early extracavitary infections, such as: (Table 2)

Table II. Selection criteria and treatment adjuncts for selective graft preservation for early extracavitary infections[9],

Selection criteria for graft preservation:
Patent graft that is not constructed of polyester (Dacron)
Anastomoses are intact and not involved with infection
Patient has no clinical signs of sepsis
Treatment adjuncts for graft preservation:
Repeated and aggressive wound debridement in the operating room
Daily wound dressing change at 8-hour interval using dilute povidone-iodine (1 ml of 1% povidone-iodine in 1L normal saline)
If wound is closed between serial wound debridement, antibiotic(vancomycin,tobramycin)-impregnated methylmethacrylate beads are implanted in the subcutaneous tissue
Administration of culture-specific antibiotics
Rotational muscle coverage of the exposed prosthetic graft segments

For the patients with infection localized to only a portion of an aortofemoral graft, we preferred, for the decreasedmorbidity, the excision of the infected portion of the graft (partial graft excision) and after solving the inguinal infection, a staged[7] extra-anatomical bypass.

As for the gold standard regarding the aortic graft-total graft excision and ex-situ bypass, we only performed 5 of them. 3 patients died and 2 required major amputation.

We performed none total graft excision and in-situ replacement.

We performed none obturator extra-anatomical bypasses, only axillobifemoral ones.

CONCLUSIONS

Dissatisfaction with the morbidity and the mortality of treating vascular graft infections, regardless of location, by total graft excision and remote bypass has been the impulse for the expanded application of lately performed in-situ bypasses, given also the revolutionary materials (antibiotic-coated and bacterial colonization-proof grafts) available and for graft preservation procedures.

Clinical experience with this less aggressive treatment options is evolving and continued progress can be expected.

Prophylactic use of an antibiotic-bonded graft would be of most clinical benefit in patients judged to be at increased risk for infection.

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