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Discussion

DR. LAZAR J. GREENFIELD (Ann Arbor, Michigan): I'd like to congratulate Dr. Calligaro on an excellent presentation and express my gratitude for an opportunity to review the manuscript prior to the meeting. This extensive experience with infected peripheral prosthetic arterial grafts is not likely to be envied by other surgeons since graft infection is the nemesis of the vascular surgeon.

It is important to emphasize, as the authors did, that the effort to salvage the graft was considered appropriate in less than half of their cases since their exclusion criteria eliminated occluded grafts, a bleeding episode, or evidence of sepsis. These problems still require graft excision and it was clear from the authors' experience that in all patients there was better wound healing when the graft was excised.

In 35 of 41 occluded grafts, a remnant was left at the anastomosis to preserve patency of the underlying artery, although 6 of these patients later required excision. Since autologous tissue is usually preferred for this type of closure and since not all patients were treated this way, it would be helpful to know how the decision was made to preserve the remnant and whether the closure was reinforced by other healthy tissue.

All of these patients received intravenous antibiotics for approximately 6 weeks and it's presumed that they were then converted to oral antibiotics. The planned duration of antibiotic therapy would be of interest, particularly in those patients who still have a graft remnant.

It's a little surprising that only 9 of the 120 patients were treated with a muscle flap and of these, only 5 healed completely. The manuscript mentions two sartorius flaps that became necrotic, and this is certainly discouraging.

Dr. David Smith in our department has pointed out that the blood supply of the sartorius is segmental and that mobilizing it to fold it over can make it ischemic. A further limitation is the fact that the blood supply is from the superficial femoral artery, which is often obstructed in these patients. His experience has been more favorable with the use of the rectus abdominis, which has a blood supply on a pedicle allowing it to be positioned to cover a graft. He's also been able to demonstrate that healthy muscle can compete very effectively with bacteria to promote healing. I wonder if the authors have had any experience with the use of this particular approach.

Finally, antibiotic therapy and our ability to support the nutritional needs of the patient have improved significantly over the past 20 years. These may also have influenced the authors' results in addition to their superb technique for taking care of the infected wound.

When we reviewed the published literature in 1977, there were reports on only 55 cases of infected femoropopliteal bypass grafts, 21 of which had been treated by leaving the graft in place with an 81% recovery rate. But considering the expected amputation rate of 36% with infected grafts, the authors' suc-

cess is certainly to be commended. However, they may find that they have issued an invitation for the referral of even more patients with infected prosthetic grafts.

DR. JONATHAN B. TOWNE (Milwaukee, Wisconsin): I would like to congratulate Dr. Calligaro on an excellent presentation and excellent results of a difficult clinical problem. The mortality of 12% and major amputation incidence of 13% are excellent results.

The two areas of potential controversy are 1) leaving a partial portion of the fabric prosthesis in the 43 patients with infected thrombosed grafts, and 2) the total graft preservation in 51 other patients. Of the 41 occluded grafts with partial excision, 6, or almost 15%, required subsequent removal of the residual graft because of persistent wound sepsis or hemorrhage.

I feel that this is a preventable problem and also feel that the fabric should be totally removed at the initial procedure and the donor artery repaired primarily or with a vein patch usually accompanied with a muscle flap, as mentioned by Dr. Greenfield.

Of even more interest are the 45 patients with complete graft preservation, of whom 71% healed. How many of these were perioperative wound healing complications versus those that presented at a time remote from the initial procedure?

It has been my feeling that these are two entirely different types of problems. In the patients with remote infections, the graft is usually totally involved and in situ replacement is only feasible in patients with coag-negative staph biofilm type infections. The others require total excision. The grafts which are exposed in the perioperative period often can be successfully treated with techniques suggested by the authors.

Finally, I would like to ask the authors if they have evaluated their data to determine the mortality and major limb amputation rates which occurred because of attempts at graft preservation which perhaps would not have occurred if the more traditional techniques of graft excision and bypass, extra-anatomic bypass, were used.

DR. WESLEY S. MOORE (Los Angeles, California): I, too, would like to thank the authors for giving me the opportunity to review their manuscript. It is packed with information and I think you will all enjoy reading it when it comes out in published form.

They have given us the data on 120 infected grafts from two institutions. This is probably one of the largest series that will be in the literature and therefore clearly deserves our attention.

I don't think any of us would have any quarrel with the 26 patients in which they carried out complete excision, Clearly that was well indicated. Furthermore, I don't have any problem with the 43 patients in which partial excision was carried out. Obviously they didn't leave bits of graft in a sea of pus when they closed the artery. These were in clean areas, and I think that this is a perfectly reasonable thing to do.

Likewise, it is very well recognized that there is an entity of localized graft infection with portions of the graft remote from the infected site remaining sterile. This is well exemplified in patients with aortic bifurcation grafts in which one limb may be infected but the body and the contralateral limb may remain sterile and therefore localized excision is a very appropriate approach to localized infection.

However, the 51 patients in which they carried out or attempted to carry out complete saving of the graft does deserve some comment. They were able to do this with a respectably low mortality rate. There have been six deaths in their last 51 cases for a mortality of 12%. This is comparable to the best reported series, as has been pointed out. Likewise, the fact that they had a 71% long-term salvage of these grafts is truly remarkable.

There have been other reports describing attempts to preserve infected grafts. However, when one reviews those reports, as was pointed out by Dr. Towne, what you'll find is that by far and away the majority of those were infections that occurred in the perioperative interval, and therefore, represent wound infections with graft present, rather than true graft infections. I would submit that it is more likely that the pathology in this instance will behave more like a wound infection than a foreign body infection. These clearly can be managed conservatively in the way that was described, with debridement, antibiotics and topical irrigation. This leads me to my first question.

What was the average time interval between graft implantation and the appearance of wound infection? What percentage of these occurred within the first 30 days as opposed to remote or late graft infection?

My second question has to do with the 13 late excisions; that is, the failures of this conservative approach? How many of those went on to limb loss? Were you able to salvage some legs in those in whom you ultimately had to remove the graft?

And finally, of the 32 patients, that is the 71% that were successful, were those all associated with limb salvage? Specifically, what was the limb salvage rate at 2, 3, or 5 years down the road?

DR. KEITH D. CALLIGARO (Closing discussion): I would like to thank all the discussants for their comments.

Dr. Greenfield, Dr. Towne and Dr. Moore all addressed the issue of partial graft preservation. I'd like to point out that we left a small patch of prosthetic graft in the infected wound. We have had experience in the past of placing either an autologous vein patch or an endarterectomized segment of occluded SFA. We have been very disappointed with that technique, and have found a very high rate of patch blowout when we have placed vein or artery in the infected wound. We think this may be related to weakening of the arterial wall by excising the prosthetic and then either debriding the artery and placing a new patch on it or simply by placing a new patch.

In terms of the duration of the antibiotics, we insist on a minimum of 6 weeks of IV antibiotics. We have not established what is the optimal method to treat these patients regarding long-term antibiotics. There is no prospective randomized study. If we are especially worried about a patient we will give them another 6 weeks of PO antibiotics, especially when we are trying to preserve the entire graft. We do not favor life-long antibiotics for fear that resistant organisms will develop.

Regarding the use of muscle flaps, we tend to shy away now from using sartorius muscle flaps for the reasons that Dr. Greenfield mentioned, namely flap necrosis. We have reported

an updated series of prosthetic and vein graft infections in Annals of Vascular Surgery (1994; 8:31–37) and found that the success rate was reasonably good if the sartorius muscle was not used in the groin. We have used the rectus abdominis muscle and have had good results. We recently tend to use muscle flaps more and more.

Our main point with using secondary intention wound healing is many of these patients are high-risk. In the patient who you do not want to return to the operating room for a muscle flap, we have achieved excellent long-term wound healing and graft preservation rates using secondary intention.

About two thirds of the infections occurred within 1 month of placement of the graft and the other one third presented with a delayed infection up to 7 years later. We have reviewed that data and found there was no difference in successful graft preservation and no difference in the overall results between the two groups.

Another question related to the complications due to complete graft preservation. Although two or three complications or deaths might be attributed to graft preservation, a few of the deaths were due to myocardial infarctions in patients where we didn't do much of anything. We debrided the wound but then kept them in the ICU and they died from MIs. You'd have to assume if we had submitted those patients to total graft excision and a bypass they probably would have died from an MI also, and possibly even more patients would have died from cardiac complications.

When patients presented with late complications of attempted graft preservation and we had to take the graft out, the majority of those patients could be treated with secondary revascularization and their limbs could be salvaged.