Patency of Cryopreserved Saphenous Vein Grafts as Conduits for Coronary Artery Bypass Surgery

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Study objective: To determine the angiographic patency of cryopreserved saphenous vein grafts used as conduits during coronary artery bypass surgery and whether this is affected by postoperative immunosuppressive therapy.

Design and setting: A retrospective review of medical records and coronary angiograms of patients at a university hospital.

Patients: Eleven patients undergoing 12 coronary artery bypass operations during which a total of 26 distal coronary anastomoses were created using cryopreserved vein grafts.

Measurements: Eight postoperative coronary angiograms were performed in 10 patients surviving longer than 1 week. All angiograms were performed on the basis of symptoms of suspected myocardial ischemia. Angiographic results, postoperative anticoagulation, and therapy with immunosuppressive agents were analyzed.

Autologous saphenous vein has traditionally been the primary conduit for aortocoronary bypass grafts due to its generally good long-term patency and clinical success.1-6 More recently, internal mammary arteries have supplanted the saphenous vein as the preferred conduit.6-10 However, as life expectancy continues to improve and patients present for repeat revascularization procedures more frequently, the need for alternative conduits has grown. Additionally, a small subset of patients will have inadequate saphenous veins secondary to thrombophlebitis or venous varicosities. It is in these clinical scenarios that the need for alternative conduits in coronary artery bypass surgery is greatest.

Cryopreserved homologous saphenous veins have been one of the alternative conduits used for coronary artery bypass grafting when autologous saphenous veins or internal mammary arteries are not available or are inadequate for complete revascularization. After the initially encouraging results reported by Tice et al11 and Bhayana,12 a number of subsequent authors have published less than favorable long-term patency rates.13-16 The etiology of these poor patency rates likely involves problems of tissue viability and immunologic rejection.

While earlier cryopreservation techniques may have yielded grafts composed of nonviable tissue, newer methods have shown promise in transplanting allograft aortic valves17 and venous allografts as arterial conduits.18-22 This study reports our experience with myocardial revascularization using cryopreserved saphenous vein grafts as conduits during coronary artery bypass surgery. The use of immunosuppressive therapy with azathioprine also will be evaluated.

Results: Seventeen cryopreserved vein grafts were studied; one (6%) was patent, 12 (71%) were occluded, and 4 (23%) were stenosed. In patients treated with azathioprine, seven of the eight cryopreserved vein grafts were occluded. In patients not receiving immunosuppression, five were occluded, three were stenosed, and one was patent. All internal mammary grafts were widely patent.

Conclusion: Cryopreserved vein grafts have a poor angiographic patency which did not appear to be affected by immunosuppressive therapy with azathioprine. The use of this graft should be restricted and alternative arterial conduits utilized.

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Key words: coronary artery bypass; cryopreservation; immunosuppression

Patient Population

Between February 1986 and March 1991, 11 patients underwent 12 operations for coronary artery bypass grafting utilizing cryopreserved saphenous veins as conduits. The mean patient age was 69 years (range, 52 to 81 years). Three of the patients were male and eight were female. The indications for utilizing allogenic cryopreserved saphenous veins were previous harvesting of saphenous veins for coronary artery bypass surgery (n=5), inadequate saphenous veins at the time of surgery (n=1), prior saphenous vein stripping (n=3), bilateral deep vein thrombosis (n=1), and severe venous varicosities (n=1). In addition to coronary revascularization, two patients underwent concomitant aortic valve replacement for aortic stenosis, and one patient underwent mitral valve replacement for
Patient events.

Technique and Management

A cryopreserved vein graft was stored in liquid nitrogen and thawed according to previously described methods.24

Postoperative Management and Follow-up

Ten out of 11 patients survived 11 operations beyond 1 week. Postoperative anticoagulation therapy after these procedures included aspirin alone (n=6), aspirin and dipyridamole (n=2), and coumadin alone (n=3). Additionally, five patients received immunosuppressive therapy with azathioprine at 100 mg/d. Eight follow-up coronary angiograms were performed in seven patients because they had symptoms of unstable angina (n=5), or myocardial infarction (n=1) or they had atypical chest pain (n=2). The angiograms were performed between 10 days and 8 years after cryopreserved vein graft implantation. All three surviving patients who did not have repeat angiography had aortic or mitral valve replacement as the primary procedure during cryopreserved vein graft implantation and were asymptomatic at follow-up visits.

Results

All follow-up coronary angiograms were performed to evaluate symptoms of myocardial ischemia. The three surviving patients who did not have angiographic follow-up had aortic or mitral valve replacement as their primary procedure. The operative procedure, indication for using cryopreserved vein grafts, postoperative medications, interval of clinical follow-up, and angiographic results are displayed in Table 1. Angiographic follow-up was performed in 22 of 32 grafts placed. Of the 17 cryopreserved vein grafts restudied, 1 (6%) was patent, 12 (71%) were occluded, and 4 (23%) were significantly stenosed (Table 2). A point worthy of note here is that all five of the internal mammary artery grafts restudied were widely patent.

In patients treated with azathioprine, seven of the eight cryopreserved vein grafts restudied were occluded and one was stenosed. Of the nine cryopreserved vein grafts restudied in patients who did not receive immunosuppressive therapy, five were occluded.

Table 2—Angiographic Patency of Coronary Artery Bypass Conduits*

<table>
<thead>
<tr>
<th>Graft Type</th>
<th>No. of Grfts</th>
<th>Pat</th>
<th>Occluded</th>
<th>Stenosed</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMA</td>
<td>5</td>
<td>5 (100)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SVG</td>
<td>17</td>
<td>1 (6)</td>
<td>12 (71)</td>
<td>4 (23)</td>
</tr>
</tbody>
</table>

*IMA=internal mammary artery; CVC=cryopreserved vein graft. Numbers in parentheses represent percentages of the total number studied.
Table 3—Studies Evaluating Cryopreserved Vein Graft Patency

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Grafts</th>
<th>Follow-up Period</th>
<th>Graft Patency</th>
<th>Antiplatelet Regime</th>
<th>Immunosuppression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tice et al11</td>
<td>17 CVG, 1 fresh</td>
<td>3 wk-42 mo</td>
<td>6/8, P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bhayana12</td>
<td>25 CVG</td>
<td>4-12 mo</td>
<td>19/22, P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bical et al13</td>
<td>20 CVG, 7 fresh</td>
<td>&lt;3 mo; 8-68 mo</td>
<td>6/7, P</td>
<td>8/10, O</td>
<td>1/10, S</td>
</tr>
<tr>
<td>Gelbfish et al14</td>
<td>61 CVG</td>
<td>8-12 d; 6-12 mo</td>
<td>20/31, P</td>
<td>Aspirin, dipyridamole</td>
<td></td>
</tr>
<tr>
<td>Selke et al15</td>
<td>10 CVG</td>
<td>1-8 wk; 6-30 mo</td>
<td>11/13, O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laub et al16</td>
<td>17 CVG</td>
<td>2-16 mo</td>
<td>2/13, S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present study</td>
<td>26 CVG</td>
<td>10 d-8 yr</td>
<td>7/17, P</td>
<td>Aspirin, dipyridamole</td>
<td></td>
</tr>
</tbody>
</table>

*CVG=cryopreserved vein graft; Fresh=fresh tissue allograft; P=patent; S=stenosed; O=occluded.

...charged, three were stenosed, and one was patent. Additionally, no correlation appeared to exist between graft patency and the target vessel bypassed or the patient’s postoperative anticoagulation regime.

**DISCUSSION**

The present study clearly demonstrates that cryopreserved vein grafts have a poor patency rate when used as conduits for coronary artery bypass surgery. Of the 17 cryopreserved vein grafts restudied, only 1 was widely patent and 12 were occluded during a follow-up period ranging from 10 days to 8 years. In contradiction, all five of the internal mammary grafts studied were patent. Additionally, treatment with azathioprine did not appear to influence patency.

These data concur with earlier studies evaluating the use of cryopreserved vein grafts in coronary artery bypass surgery (Table 3). Tice et al11 initially published encouraging results in 13 patients receiving a total of 18 saphenous vein allografts. Six of 8 allografts restudied between 3 weeks and 42 months were found to be patent. However, this initial success may have been related to the relatively short follow-up period and was followed by a number of subsequent studies reporting less favorable results.13-16

Bical et al13 reported good short-term but poor long-term patency of 27 homologous saphenous veins used for aortocoronary bypass. While the 3-month angiographic follow-up showed 6 of 7 grafts to be patent, 8 of 10 homografts restudied between 8 and 68 months after implantation were occluded.

Gelbfish et al14 studied 61 cryopreserved vein grafts utilized for coronary artery bypass grafting. All patients received antiplatelet therapy with aspirin and dipyridamole. Early angiographic follow-up at 8 to 12 days showed only 65% of the cryopreserved vein grafts to be normal, and 26% were occluded. Recatheterization at 6 to 12 months demonstrated 11 of 13 homografts to be occluded, and one was severely stenotic. Additionally, graft occlusion was not believed to be related to intraoperative blood flow through the graft, distal vessel size, or ABO matching. Data of Selke et al15 are similar to that of Gelbfish et al14 showing marginal short-term and poor long-term patency rates for cryopreserved vein grafts used as conduits in coronary artery bypass surgery.

The cause of allograft failure in the previous studies has been debated, but immunologic rejection of the transplanted tissues is a likely cause.22-25,26 Newer cryopreservation techniques have attempted to decrease the recipient’s immunologic response to allograft implantation.18,21 Recently, Laub et al16 reevaluated the use of cryopreserved vein grafts prepared with more modern preservation methods. The patency rates, however, remained poor. As determined by ultrafast CT or angiography at a mean of 7±2 months postoperatively, they were as follows: internal mammary artery, 93%; saphenous vein graft, 80%; and cryopreserved vein graft, 41%.

Whether immunosuppressive therapy could improve long-term patency in clinical trials is unknown. Experimentally, combinations of systemic immunosuppression after graft implantation and various regimens of immunosuppression with graft preparation have been evaluated in an effort to improve graft patency.29,30,31 This work has met with mixed results. Most recently, cyclosporin has shown promise in decreasing the cellular infiltration seen in rejection.29 The cryopreserved vein grafts used in the present study were not pretreated with cyclosporin, but five patients did receive postoperative therapy with azathioprine. It is possible that higher doses of immunosuppressive agents could improve graft survival, but the clinical risks involved may outweigh the potential benefits.

How then, should the patient requiring extensive coronary revascularization who is without adequate...
saphenous veins be managed? Clearly, the left internal mammary artery should be utilized, and in selective patients both internal mammary arteries can safely be harvested. Further, the right gastroepiploic artery has shown excellent short-term patency rates as has the inferior epigastric artery. Alternative venous conduits, such as the cephalic or basilic vein, have been less promising, suffering from problems of inadequate caliber, friable walls, and variable patency rates. Aggressive percutaneous revascularization also plays an important role, especially in light of the increased morbidity and mortality of repeated coronary artery bypass surgery.

In conclusion, cryopreserved vein grafts have a poor short- and long-term patency rate, which did not appear to be affected by therapy with azathioprine. The use of this graft should be severely restricted, especially in light of the good results with alternative arterial conduits for bypass surgery and the ever-expanding options for percutaneous revascularization.

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