Operative technique

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From September 1968 to June 1977, at the Dante Pazzanese State Institute of Cardiology in São Paulo, Brazil, 3264 patients underwent aortocoronary bypass graft surgery.

Table 1 shows the total number of patients, the number of grafts, and related mortality. The hospital mortality for the entire group was 5.6%. The inverted saphenous vein has been used 6536 times, and the internal mammary artery 479 times. There were no significant differences in mortality related to the number of grafts.

All patients were operated on with the aid of extracorporeal circulation, using an original nondisposable bubble oxygenator and moderate hypothermia. We do all the anastomoses in anoxic cardiac arrest by cross-clamping the ascending aorta as distally as possible. The decompression of the left chambers is done through a small longitudinal aortotomy just proximal to the clamp. Between each individual anastomosis the air is eliminated, the aortotomy is occluded, and the coronary circulation reestablished by opening the aortic clamp. The time of cross-clamping is almost always less than 15 minutes for distal anastomosis and less than 8 minutes for proximal anastomosis.

Table 1. Aortocoronary bypass grafts; September 1968 to June 1977

No. of grafts		Mortality	
No. of vessels	No. of patients	No. of patients	%
One	875	45	5.1
Two	1270	75	5.9
Three	903	48	5.3
Four	192	13	6.7
Five	21	2	9.5
Six	3	...	...
Total	3264	183	5.6

Saphenous vein	6536
Mammary artery	479
Total	7015

The proximal anastomosis is performed using three interrupted sutures at each corner and a continuous running suture from each end to the middle on both sides. The suture is done with Prolene 6-0 or 7-0. With anoxic arrest, there is no need for any special measure to control bleeding from the arteriotomy. Thus, the operating field is clear and quiet, making suturing easier. We believe that the clamping of the coronary or its traction with sutures could have some potential disadvantage and probably increases the risk of preoperative infarction. After finishing the coronary anastomosis and restoring the heart beating, the length and position of the vein in the pericardial cavity are selected.

The precise location and direction of the orifice in the aorta are also carefully selected and identified by a stitch. The aorta is then cross-clamped, the aortotomy opened, and a suction tip placed in the ascending portion of the aorta. A small, longitudinal piece of the aortic wall is excised following the direction previously selected and indicated by the stitch.

Then a continuous running suture is utilized with Prolene 6-0. A few sutures are necessary to keep the bypass in its proper position. We utilize the same technique even to insert six individual grafts. The bypass for branches of the circumflex are inserted frequently in the posterior wall of the aorta. Our technique simplifies this insertion because the empty aorta can be easily rotated anteriorly, exposing the posterior wall. The vein runs from the posterior wall of the aorta to the posterior surface of the heart. Only in special cases in which the anatomy is favorable do we use sequential grafts. Using the techniques just described, we have assessed the effectiveness of the bypass operation by looking at (1) incidence of preoperative myocardial infarction; (2) closing bypass in the immediate postoperative phase; (3) hemodynamic and late clinical results.

In one retrospective and two prospective studies (*Table 2*), the incidence of preoperative infarction has been remarkably constant and relatively low, varying from 2% to 5%. Graft permeability was also studied by cineangiography in 50 of this last group of patients, 10 to 15 days after surgery (*Table 3*). The only criterion for this study was acceptance of the study by the patients. There were 125 grafts done in which 10 occlusions occurred (8%). Looking at these 10 occlusions more carefully we found that in five of them the grafts were inserted in previously occluded arteries. In four of the other five patients the artery remained opened, despite graft occlusion, suggesting that the problem was not in the anastomosis, but in the vein itself. In only one patient, both artery and graft were

Table 2. Preoperative myocardial infarction; aortocoronary bypass grafts

	No. of patients	No. of grafts	No.	%	Fatal
September 1968 to June 1971	275	507	10	3.6	1
January 1974 to August 1974	340	730	7	2.0	1
January 1977 to August 1977	373	862	19	5.0	3

Table 3. Postoperative angiograms (10 to 15 days); 50 patients

Number of grafts			125
Closed		10 (8.0%)	
Artery previously occluded	5		
Artery previously open	5		
Artery remains open	4		
Artery closed	1		

Table 4. Ejection fraction; mean ± standard error

	E F pre	Pre	Post paired	T	p value
Total		0.65 ± 0.04	0.70 ± 0.03	1.13	>0.05
Group I	<0.50	0.38 ± 0.03	0.53 ± 0.05	3.48	<0.05
Group II	≥0.50	0.73 ± 0.02	0.75 ± 0.03	0.59	>0.05

Table 5. Late follow-up; aortocoronary bypass grafts; September 1968 to June 1971 (275 patients; 253 surgical survivors)

	June 1973	June 1974	June 1975	June 1976	June 1977
Followed	239	241	245	246	248
Free of symptoms	203 (84.9%)	193 (80.0%)	190 (77.6%)	188 (76.4%)	170 (68.5%)
Deaths	14 (6.1%)	20 (8.2%)	24 (9.8%)	33 (13.4%)	39 (15.7%)
Months of follow-up	24–57	36–69	48–81	60–93	72–105

occluded apparently at the same time. We also analysed the cardiac performance by looking at the ejection fraction within 2 weeks of the operation.

Considering the entire group, there was no significant difference between the ejection fraction before and after operation. If we consider the group of patients in whom the preoperative ejection fraction was less than 0.5, then there was a significant improvement (*Table 4*). To assess the late results, we are doing a sequential clinical evaluation in the first 275 patients operated on between September 1968 and June 1971. This same group is being evaluated yearly.

Of the 253 surgical survivors, we presently have 5 patients lost to follow-up. Thus, we have a 98% complete follow-up for this group. Of the 239 patients evaluated in June 1973 with 24 to 57 months of follow-up, 84.9% were found free of symptoms. This percentage decreased as the time passed. Of the 248 patients evaluated in June 1977, 68.5% were free of symptoms, 72 to 105 months of follow-up (*Table 5*). Most of these patients have been able to return to

Table 6. Late follow-up; aortocoronary bypass grafts; September 1968 to June 1971 (late follow-up June 1977); 275 patients

		Mortality		Annual	
Diseased artery	No.	Hospital	Late	Late	Total
One	51	3 (3.8%)	3 (5.8%)	0.9%	1.8%
Two	103	8 (7.7%)	14 (13.6%)	2.0%	3.3%
Three	121	11 (9.0%)	22 (18.2%)	2.8%	4.2%
Total	275	22 (8.0%)	39 (14.2%)	2.1%	3.4%

Five patients lost to follow-up.

work and, from the standpoint of the patient, the operation has been highly successful. The late mortality rate increases from 6.2% in June 1973 with 24 to 57 months of follow-up to 15.7% in June 1977 with 72 to 105 months of follow-up (*Table 5*). According to the number of diseased vessels, the mortality is 0.9%/yr for one-vessel disease, 2.0%/yr for two-vessel disease, and 2.8%/yr for three-vessel disease (*Table 6*). Finally, the incidence of late myocardial infarction in this same group is 12% with 72 to 105 months follow-up or 1.7%/yr. We believe that our results are comparable to those reported by other groups.