Technical considerations in coronary bypass operations

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The first operations for coronary bypass in our hospital were performed more than 13 years ago when congenital anomalies were repaired using small caliber Dacron fabric tubes to create a two-coronary system. In the ensuing years the autologous saphenous vein (for special situations, the cephalic vein) has replaced the fabric graft and is used almost exclusively for all types of myocardial revascularization. The pedicled internal mammary artery was used occasionally in the past, but only rarely at the present since results with the saphenous vein appear more satisfactory to us. We believe that careful harvesting and preparation of the saphenous vein is important to provide for the best survival of the free graft. Usually only the vein from one leg is necessary to perform triple, quadruple, or even quintuple procedures, if the vein is removed from ankle to groin. The vein in the other leg is thus preserved for possible future use. After careful ligation of the venous tributaries, the vein is gently distended using heparinized blood drawn from the patient. Electrolyte solutions tend to diffuse through the vein wall and this may lead to subsequent fibrosis and premature graft occlusion.

Most operations are performed using temporary cardiopulmonary bypass with a priming volume of Ringer's lactate and glucose solution, and the patient is maintained normothermic. In complicated cases with anticipated valve repair or replacement, general body hypothermia to 30 C is employed. For patients with depressed left ventricular function, left main coronary lesions or concomitant carotid and renal arterial lesions, we use a pulsatile flow system since it appears to enhance perfusion. After the patient is on full bypass, the ascending aorta is cross-clamped just below the level of the arterial perfusion cannula. The left side of the heart is cleared of blood by placing in the ascending aorta a special perforated needle connected to a roller pump. This technique prevents air from entering the heart and most importantly prevents air from entering the left atrium where it could lead subsequently to systemic embolism. With this technique the surgeon, without concern for air embolism, may remove the aortic clamp repeatedly during the operation to provide intermittent coronary flow to the ischemic myocardium. Cold saline is applied to the empty and ischemic heart and then removed from the pericardium. This tends to dilate the coronary arteries and make them more easily identified on the epicardial surface.

The distal vein-to-coronary anastomoses are performed using 6-0 polypropylene sutures by a simple continuous technique. The surgeon wears optical loupes (3.5 power magnification) and a fiberoptic headlamp to facilitate an accurate and precise placement of sutures. Endarterectomy is avoided, but may be necessary in the distal right coronary artery. After all distal anastomoses have been completed, the aortic cross-clamp is released and replaced by a large partial occlusion clamp. Incisions are made for the proximal anastomoses placing them in a transverse direction, removing with scissors a small ellipse of tissue. Thus, four or five veins may be "stacked" on the ascending aorta in the following ascending order: right, left anterior descending, diagonal, ramus medianus, marginal branches of the circumflex and the posterior circumflex continuation. Proximal anastomoses are performed using 5-0 polypropylene sutures. During the proximal anastomoses the aortic cross-clamp is released and coronary perfusion is restored. If sinus rhythm does not occur spontaneously, it is restored with countershock. A partial occlusion vascular clamp is applied to the ascending aorta and the proximal anastomoses are completed. Vena caval clamps are then released after the aortic partial occlusion clamp is removed. Cardiopulmonary bypass is discontinued slowly. If cardiac function is depressed or questioned, pulsatile assist is used until cardiac function is adequate. The intra-aortic balloon assist may be inserted if subsequent low cardiac output is anticipated. Points to emphasize in our technique are:

1. Careful preparation of the vein graft.
2. Bloodless prime for cardiopulmonary bypass.
3. Expeditious surgery minimizing the duration of total body perfusion and the period of myocardial ischemia.
4. Prevention of air embolism.
5. Pulsatile assist to circulation during and after operation in critical cases.