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Over the past two and one-half years, aorto-coronary bypass with saphenous vein grafts has gained clinical acceptance as a treatment for patients with symptoms of acute angina pectoris secondary to coronary artery disease.

From January 1969 to September 1971, 150 patients have undergone total body perfusion for aorto-coronary bypass grafts at The Johns Hopkins Hospital. The purpose of this paper is to discuss the technique used at this institution.

PATIENT SERIES

The age span of these patients was 33-66 years old with an average body weight of 65-75 kg. The Bentley adult Q100 Oxygenator¹ was joined with a Travenol-Sarns Standard Double Roller Pump apparatus.² The circuitry used (Figure 1) consists of a 1/2 inch venous return line draining directly to the oxygenator.

Venous pressure during bypass was controlled by raising or lowering the oxygenator height, utilizing the Travenol motorized mast. A two liter 5M0391 Travenol cardiomy blood reservoir was used for the blood return from the two intracardiac suckers and the left ventricular vent.

Standard ascending aortic cannulation for arterial blood return was used in all cases. The priming solution was 1500 cc. lactated Ringer's, 500 cc. fresh (72 hours or less) ACD blood, 100 cc. 50% Dextrose USP, and 6000 USP units sodium heparin. Prior to cannulation, the patient was given an initial heparin dose of 400 units/kg. of body weight and supplements of one-half the initial dose were given at two and one-half hour intervals during bypass.

During cardiopulmonary bypass, the rate of blood flow to the patient was adjusted to maintain a perfusion pressure between 60-80 mm. Hg, which ordinarily provided an average flow rate of 2.4 liters per square meter body surface area per minute or 60-70 mg./kg. of body weight. Normothermia (37°C.) was maintained on all total bypass procedures.

Gas flow (100% oxygen) was adjusted to two liters per minute for each liter per minute of blood flow. The hematocrit was maintained between 32-28% by the addition of lactated Ringer's or whole ACD blood converted with 200 units of sodium heparin. Arterial pressure, central venous pressure and urine output were continuously measured while blood gases were determined hourly. Sodium bicarbonate was added hourly at the rate of 40 meq./l. to counteract metabolic acidosis. At the end of the procedure, blood gases and a potassium level were done.

RESULTS

Of the 150 patients undergoing coronary artery bypass, there were 11 hospital deaths (7%). Ten of the deaths resulted from low output and/or severe postoperative arrhythmias which in turn were related to pre-existing severe myocardial disease. The additional death followed a pulmonary embolus one week postoperative. We had no evidence that these deaths were in any way related to cardiopulmonary bypass. Of the 139 remaining patients, no evidence of complications resulting from the perfusion were observed.

SYMPOSIUM

GIVEN: The aortocoronary bypass graft.

QUESTION: Describe the rationale, technique and pump-oxygenator circuitry your team favors for this procedure.

Blood gas determinations immediately post bypass showed mean values of PO₂ 235 mm. Hg, PCO₂ 29 mm. Hg, pH 7.48, plasma bicarbonate 26 meq./l. and base excess +2 meq./l. No additional electrolytes were used in the prime solution and this resulted in a mild postbypass hypokalemia (3.1-3.6 meq./l.).

Occasionally, slight increases in blood pH were noted. This increase in blood pH levels was attributed both to the slight hypokalemia, and as a result of the sodium bicarbonate addition. A potassium drip was instituted at the end of bypass at the rate of 40 meq./l./hr, until normal plasma levels were reached.

Urine output on bypass averaged approximately 70 mg./hr. If the urine output was less than 40 ml./hr., 12-25 grams of Mannitol were added to the oxygenator reservoir to improve renal function. If further diuresis was desired, Furosamide, 15-35 mg. was used. Lower urine outputs, however, were noticed to be more prevalent with lower arterial pressures.

Blood pressures immediately post bypass returned rapidly to normal limits, approximately 120/80 mm. Hg. Blood from the oxygenator reservoir was added during the first five minutes after bypass to maintain a mean central venous pressure of 12-17 cm. H₂O. Cannulae and lines were then disconnected and all further blood losses were replaced with fresh or bank blood.

Bypass times varied from 58 minutes to 226 minutes. They averaged approximately 60 minutes per vein graft. Patients were usually awake before leaving the operating room and did not develop neurological or serious psychological problems during their recovery.

BIBLIOGRAPHY

1. Kalke, B. R., Casteneda, A., and Lillehei, C. W.: "A Clinical evaluation of the new Temptrol (Bentley) disposable blood oxygenator". J. Thorac. Cardiovasc. Surg.: 57: 679, 1969
2. Galletti, P. M. and Brewer, G. A.: *Heart-Lung Bypass*: Grune and Stratton, New York and London, 1962.

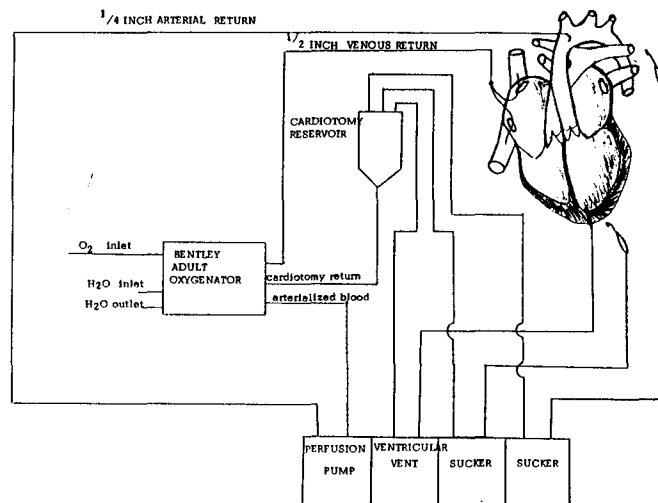


FIGURE 1