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# A Simplified Method for Cold Blood Cardioplegia

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**Ian M. Ross, C.P., C.C.P.**

Discipline of Surgery, Faculty of Medicine  
Memorial University of Newfoundland  
St. John's, Newfoundland

## Introduction

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There are currently several methods described for the administration of a cardioplegic solution.<sup>(1-4)</sup> In our institution we have chosen to follow the method advocated by Dyson and associates.<sup>(5)</sup> In the description of their technique Dyson, et al, use a two-pump system which adds extra equipment to an already complicated system. A simple and safe one-pump system was devised and has been in use in our institution for over a year.

## Materials

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The perfusion tubing is  $3/16$ " I.D. polyvinyl chloride which is included in the tubing packs for convenience and ease of set-up. The system is completely disposable\* thereby minimizing any extra work for the pump team (Fig. 1). The pump header is  $1/4$ " I.D. Tygon\*\* tubing and the heat exchanger is a disposable Travenol Pediatric Miniprime unit\*\*\*. The bubble trap\*\*\*\* is a disposable unit with a priming volume of about 20ml. A second cardiotomy reservoir is used as a cardioplegia reservoir.

## Method

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After the tubing has been set up, clamps are placed on the cardioplegia reservoir outflow (2) and the line to the bubble trap (4). At this point 26mEq of potassium chloride, 20ml of CPD (citrate phosphate dex-

trose) solution and 50ml of sodium bicarbonate are added to the cardioplegia reservoir, to which 1,000ml of blood will later be added from the pump. An extra 1,000ml of Lactated Ringers is added to the prime so that when the blood is drawn off at the beginning of the pump run there will not be a shortage of blood available to conduct the perfusion. Even with the addition of this extra fluid the patient's hematocrit has never dropped below 18%.

The patient limb of the cardioplegia perfusion line is passed off the table and connected to the outflow of the bubble trap. Water from a Blanketrol† unit is cooled to 10°C and is then opened to the heat exchanger. As soon as blood begins to leave the arterial side of the oxygenator the cardioplegia pump†† is started at full flow (500ml/min). At this rate it only takes 2 minutes to obtain 1,000ml of blood in the cardioplegia reservoir. At this point the pump is stopped, a clamp is applied to the coronary perfusion outflow line at (1), and the clamp at (2) is removed. The pump is then restarted and continues to run in a recirculation mode to both mix the solution and cool it to 10°C until it is required.

When the blood cardioplegia solution needs to be administered a clamp is applied at (3), the clamp at (4) is removed and the bubble trap is  $3/4$  filled by bleeding the air via the stopcock on the pressure line. The line is then filled to the level of the table and perfusion is begun through the aortic root using a 12Fr. DeBakey coronary perfusion catheter†††.

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\* Cobe Laboratories Inc., Lakewood, Colorado.

\*\* Norton Company, Akron, Ohio.

\*\*\* TMO337, Artificial Organs Division, Travenol Laboratories Inc., Deerfield, Illinois.

\*\*\*\* Cobe Laboratories Inc., Lakewood, Colorado.

† Cincinnati Sub-Zero Products Inc., Cincinnati, Ohio.

†† 5M6050, Sarns Low Flow Pump, Sarns Inc., Ann Arbor, Michigan.

††† 007721, U.S.C.I., Billerica, Massachusetts.

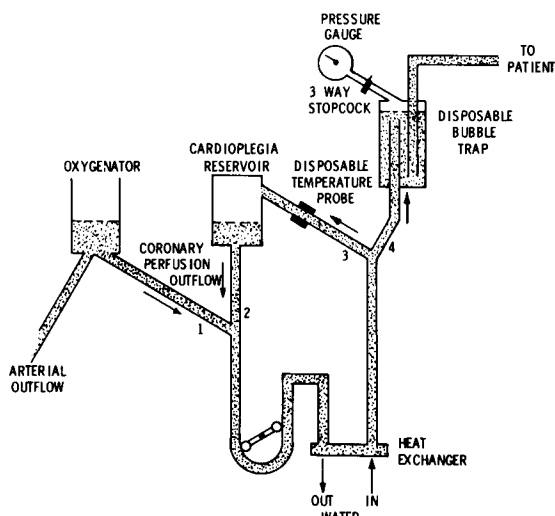


Figure 1.

The initial 500ml infusion of the cardioplegia solution is infused into the aortic root at an intra-aortic pressure of 100 torr. This pressure is obtained by subtracting the resistance in the cardioplegia line at a given flow rate from the pressure on the pressure gauge. Thereafter, we perfuse 300ml of solution for every 20 minutes of cross-clamp time. During the interval when the solution is not being infused the pump is put into the recirculation mode with clamps at (1) and (4) to keep the solution cold. The temperature of the cardioplegia solution is measured by the disposable temperature probe<sup>§</sup> in the recirculation line. This period of recirculation also allows time for the addition of drugs and the drawing off of more blood as needed during the case.

A final infusion of 500ml of the cardioplegia solution is given just before the aortic clamp is taken off. Any residual solution is salvaged by being pumped from the cardioplegia reservoir into the cardiotomy sucker which is placed in the open end of the patient cardioplegia line and thereby returned to the oxygenator.

<sup>§</sup> 13406, Sarns, Inc., Ann Arbor, Michigan

## Discussion

We have used this system for delivering cold blood cardioplegia for over one year, and have been satisfied that it is a safe and efficient method of providing myocardial protection during aortic cross-clamping.

Since cold blood cardioplegia has been introduced, we have performed 143 open-heart procedures, including 27 emergency procedures and several complex cardiac repairs. The overall mortality rate has been 5.6%, with the great majority of the deaths occurring in the emergency cases. In all patients myocardial protection was judged to be satisfactory, as assessed by septal temperature measurements and disappearance of cardiac electrical activity. Indeed, the use of inotropic drug support and mechanical balloon-pump assistance in the perioperative period has been required in only 5% of all patients, a considerable reduction from the preceding year (12%).

We are convinced that the use of cold blood cardioplegia has enhanced myocardial protection, and that the method described in this article is a safe and practical means for administering the cardioplegic solution.

## Acknowledgments

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