Limited Prime Pediatric Perfusion

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Introduction

Perfusion of Jehovah's Witness patients entails a total ban on blood or it's components. In the pediatric patient, this restriction is more severe than in an adult. Dilution on the order of 200% occurs if you perfuse a 6 Kg. child with one liter of non-haemic prime. Oxygen transport, electrolytes, and hemostasis all are compromised.

At the Children's Hospital of Buffalo, we have developed a mini-prime non-haemic perfusion technique reducing both the loss of the patient's natural blood components and the dilution requirements of the system. In both steps, perfusion adequacy must be understood and maintained.[1] To illustrate this approach, we will use two 18Kg. patients operated on during the clinical trials of two new pediatric oxygenators, the Shiley* S-070 and the Bentley** BOS-5 (Table 1).

Methods

In order to reduce blood component destruction, perfusion time is shortened with the use of profound deep hypothermia and circulatory arrest.[2] An additional saving may be seen in the patient who was surface cooled to 23°C. using ice packs and then core cooled to 17°C. on perfusion (Figure 1). In the patient using core cooling, only part of the surgery was performed during perfusion as well as during circulatory arrest, entailing a longer perfusion time (Figure 2). Myocardial cardioplegic solution was used in both cases.

The dilution requirements were reduced with either of the new oxygenators, the total system prime being 500 ml. of Ringer's lactate/D5 (Figure 3). Direct arterial and venous lines are trimmed to minimum length during cannulation. One-quarter inch I.D. tubing was used wherever possible. A line clamp was used to control venous return, eliminating tubing slack required for raising or lowering an oxygenator.

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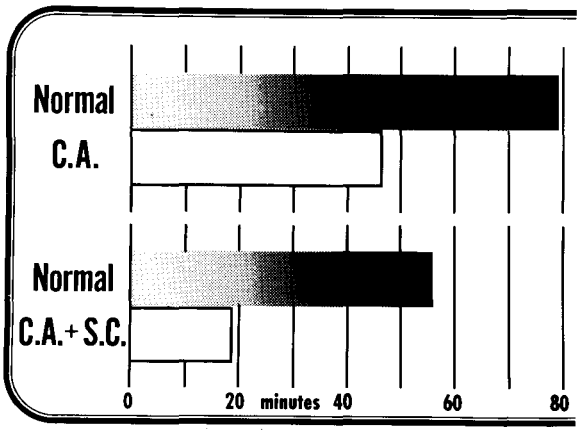
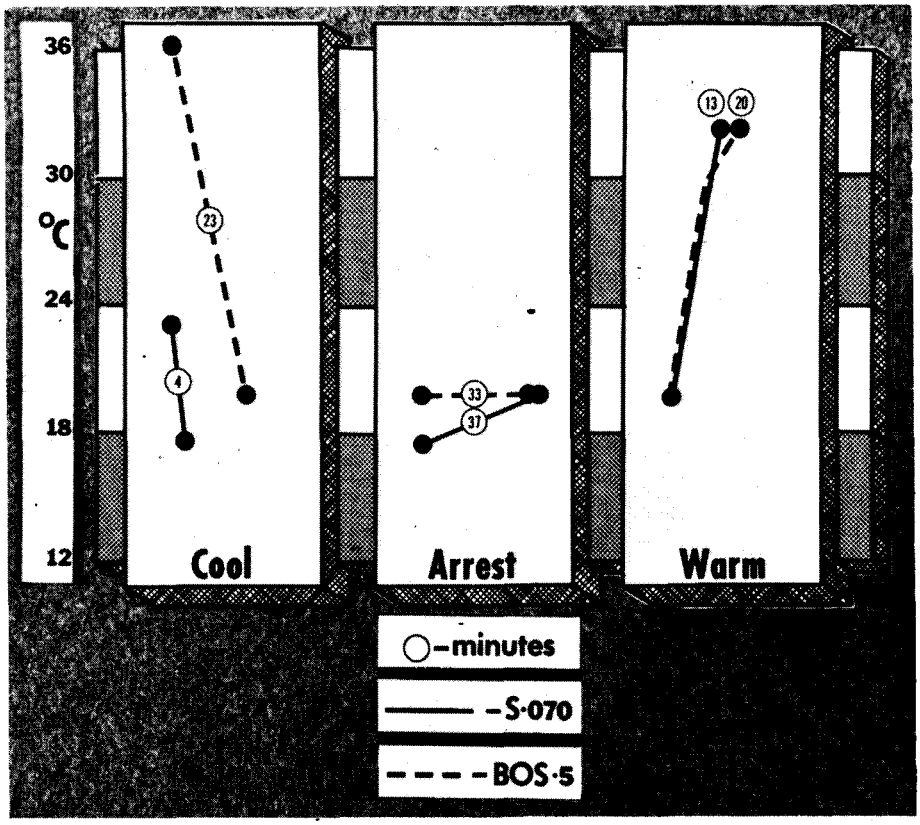
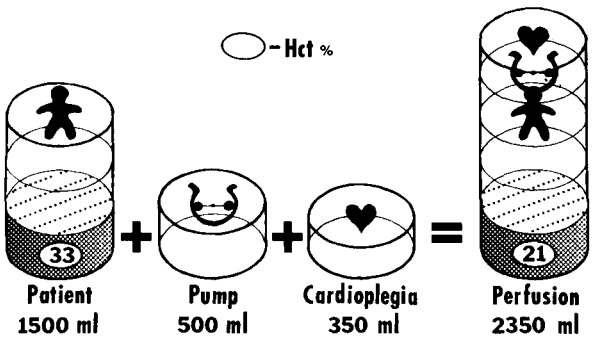
Defect	Age	Weight	Preop Hct.	Pump Hct.	Post	48 Hours
Ventricular septal defect	5 yrs.	18 Kg.	37.4%	22%	39%	36%-S-070
Ventricular septal defect/ debanding	9 yrs.	18 Kg.	39.5%	27%	33%	45%-BOS-5

* Shiley Scientific, Inc., Irvine, California.
** Bentley Laboratories, Inc., Irvine, California.


Normal
C.A.
Normal
C.A.+S.C.
0
20
minutes
40
60
80


36
30
°C
24
18
12
Cool
Arrest
Warm
23
4
33
37
13
20
○-minutes
——— -S-070
- - - -BOS-5


○-Hct %
33
21
Patient
1500 ml
Pump
500 ml
Cardioplegia
350 ml
Perfusion
2350 ml

Reluctantly, the arterial line filter and it's bypass was eliminated, saving 250ml and reducing blood damage. The circuit was pre-rinsed through a micro-filter to remove particulate contamination. Both of the new oxygenators have little prime hold-up and excellent heat-exchanger performance. We use 100% O_2 with the S-070 and 98% O_2/2% CO_2 with the BOS-5 according to the PCO_2. At a gas flow rate giving the desired A.P.O.2, VPO_2 is monitored using the Critikon*** in-line O_2 analyzer and blood flow adjusted accordingly. Blood volume is controlled with reference to the central venous pressure. Diuresis is aided with mannitol in the prime and lasix during re-warm, when required, with attention to the K^+ level. An activated coagulation time (ACT) of 500-700 sec. is maintained during perfusion using a Hemochron**** 400. Allowance is made for temperature particularly during rewarming.[3] Arterial pressure is controlled with drugs. To save blood, only one sample (during the rewarm perfusion) is taken for blood gases, electrolytes, and ACT.

Metaraminol bitartrate (Aramine) is used in the initial prime to avoid additional volume needed to overcome any vasodilation during perfusion. Following bypass, the remaining prime, including that in the venous line, is transfused and, without interruption, an additional 100 ml. of Ringer's lactate is added through the cardiotomy side and transfused to the patient. Thus, all possible blood components are returned to the patient before disconnecting any lines. Warming of the patient continues using surface thermal blankets.

Comments

A twofold approach to the problem of the Pediatric Jehovah Witness patient has been presented. Perfusion time and blood component loss has been minimized with the use of profound hypothermia and circulatory arrest. The dilution of the patient's natural blood components has been minimized by judicious reduction of the perfusion circuit, the use of two new pediatric oxygenators, and the uninterrupted re-transfusion of all prime and circuit rinse solution to the patient following bypass. The methods outlined provided the two patients presented with a successful limited prime perfusion followed by a rapid, uncomplicated postoperative recovery.

*** Critikon Division, McNeil Labs, Inc. Irvine, CA.

**** International Technidyne Corp., Edison, New Jersey.

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References

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2. Vidne, B. A., Subramanian, S. Surface induced profound hypothermia in infant cardiac operations: A New System. *Ann. Thorac. Surg.* 22:572, Dec. 1976.
3. Hattersley, P.: Activated coagulation time of whole blood. *JAMA* 136:1966.