The Royal Children's Hospital

Melbourne, Australia

Victorian Paediatric Cardiac Surgical Unit

Perfusion Unit:

CPB Protocol

Version: October. 2004

CONTENTS

All information supplied herein relates to current practice at the Royal Children's Hospital, Melbourne. No guarantee can be made with reference to flows, primes, and cannulae and all details should be considered and verified for suitability prior to use in any other institution.

PERFUSION UNIT PERSONNEL

Director of Unit

Stephen B. Horton PhD, CCP, CCP (USA)

Cardiovascular perfusion
Haemodynamic monitoring
ECLS management
Computer systems management
Administration of Unit

Clarke A. Thuys B. App.Sc., Grad. Dip. App. Sc., CCP

Cardiovascular perfusion
Haemodynamic monitoring
ECLS management
Equipment maintenance

Martin Bennett B. App.Sc., CCP

Cardiovascular perfusion
Haemodynamic monitoring
ECLS management
Homograft bank

Simon Augustin B. App.Sc., CCP

Cardiovascular perfusion
Haemodynamic monitoring
ECLS management

Monica Rosenberg B.App.Sc., CCP

Cardiovascular perfusion
Haemodynamic monitoring
ECLS management

CARDIOPULMONARY BYPASS - BLOOD FLOW CIRCUIT & PRIME DETAILS

1. SURFACE AREA (Uses the formula of DuBois)

HEIGHT (cm.)
WEIGHT (kg.) > SURFACE AREA (Sq.M)

2. FLOW

a) Patients under 10 kg: Flow = weight x 150 ml/min/kg

Eg. 3.5 kg
55 cm > Surface area = 0.23 Sq.M.

Flow = 3.5 kg x 150 ml/min/kg = 525 ml/min

b) Patients over 10 kg: Flow = 2400 ml/Sq.M./min

Eg. 20 kg
110 cm > Surface area = 0.80 Sq.M.

Flow = 2400 ml/Sq.M/min x 0.80 Sq.M. = 1920 ml/min

3. PATIENT BLOOD VOLUME

This parameter is age dependent and is only approximate.

a)	0	-	6 months	=	100 ml/kg
b)	6 months	-	18 months	=	90 ml/kg
c)	18 months	-	and older	=	80 ml/kg

4. CHOICE OF CIRCUIT (at October 2004)

Once the patient flow has been calculated, the circuit is selected.

Blood Flow (ml/min)	Venous Line	Arterial Line	Pump Boot	Oxygenator	Arterial Line Filter	Prime Volume
< 1500	_"	_"	_"	Terumo RX-05	Terumo CX-AF02	~ 350 ml
1500 to 2000	3/8"	1/4"	3/8"	Terumo SX-10	Terumo CX-AF02	~ 750 ml
2000 to 3000	3/8"	3/8"	3/8"	Terumo SX-10	Terumo CX-AF125X	~ 1000 ml
> 3000	1/2"	3/8"	1/2"	Terumo SX-18	Terumo CX-AF125X	~ 1250 ml

5. PRIMES

The prime for cardiopulmonary bypass (CPB) is calculated such that the combined haemoglobin (ie. patient and bypass pump blood) is approximately 80-90 g/L as a minimum.

The prime volume is kept to an absolute minimum in order to use as little donor blood as possible.

For patients less than 6.6 kg (flow < 1000 ml/min) fresh heparinised donor blood is used in the prime if it is available (3000 units of heparin in 30 ml of saline to 1 unit of whole blood instead of CPD on collection). This unit must be used within 24 hours of procurement. For patients less than 4.0 kg, using the Terumo RX-05, only half of this unit (235 ml) is required if cardioplegia is not required. If fresh heparinised blood is unavailable CPD whole blood or CPD packed cells are used for the prime.

For older patients between 6 and 10 kg one unit of donor blood, less than 3 days old is used. This blood contains citrate (CPD or ACD) as an anti coagulant.

Patients greater than 8 kg have a bloodless prime so long as the haemoglobin is > 120 g/L.

To calculate the total amount of diluent and volume of donor blood required, the following formula is used:

$$\left[\frac{\textit{Patient Hb - 90}}{\textit{Patient Hb}} \times \textit{Patient Blood Volume}\right] + \left[\frac{\textit{Volume of Donor Blood in Prime}}{4}\right]$$

= the volume of diluent, which should be added to the donor blood to achieve a combined Hb of approximately 90 g/L. The Hb of blood is estimated to be 120 g/L.

All the above calculations are done by a computer which has been programmed to calculate a prime based on the patient's Hb, age and weight. The program automatically takes into account the different size tubing and oxygenator required for the various patient sizes.

6. DILUENT

Our aim is to have a biochemically and physiologically "balanced" CPB pump prime. The following primes are used, and some flexibility is advised with regard to the individual nature of patient presentation and patient pathology.

The composition of the diluent which is added to the donor blood varies with the type of blood used.

I. "HEPARINISED" BLOOD

*	Blood	440 ml
*	Heparin	30 mg/L diluent
*	Sodium Bicarbonate	10 mmol
*	Calcium Chloride	0.5 mmol.
*	5 % Glucose	5 ml
*	PlasmaLyte 148	remainder of diluent volume

II. "CPD" WHOLE BLOOD

*	Blood	407 ml
*	Heparin	25mg/unit of blood + 30 mg/L diluent
*	Sodium Bicarbonate	12 mmol
*	Calcium Chloride	5 mmol
*	PlasmaLyte 148	remainder of diluent volume

III. "CPD" BLOOD: PACKED CELLS

*	Blood	273 ml
*	Heparin	25mg/unit of blood + 30 mg/L diluent
*	Calcium Chloride	1.5 mmol.
*	Sodium Bicarbonate	12 mmol
*	20% Albumin	amount needed to bring the level to 40 g/L in the diluent.
*	PlasmaLyte 148	remainder of diluent volume

IV. BLOODLESS PRIME

A clear prime is used for all patients above 10 kg. assuming that the patients haemoglobin is > 120 - 140 g/L. Clear primes may be used in smaller patients if the patient's haemoglobin is abnormally high. Total prime dilution should not exceed 40 ml/kg. Therefore if the patients weight is 25 kg., a 1100 ml prime is used. If the weight is 40 kg., a 1300 ml is used, etc. Maximum prime volume is 1600 ml. For low weight patients with high Hb, the RX-05 can be used up to 1.5 lpm flow. It should be primed as follows and the excess priming fluid removed from the circuit prior to bypass.

The prime is made up in the following ratio:

*	PlasmaLyte 148	1000 ml
*	20% albumin	200 ml
*	Heparin	25 mg
*	Sodium Bicarbonate	30 mmol
*	5 % Glucose	10 ml

The biochemical and acid-base balance for the the prime is tested by blood gas analysis and matched closely to the patient status prior to the initiation of bypass. Sterile water for injection should be used to dilute the prime if the Na+ level is too high. If the K+ is too high sterile water or 0.9% saline should be used to dilute the prime depending on the Na+ level. If Na+ and K+ are high the prime may have to be haemofiltered to reduce these levels to match the patient.

CARDIOPULMONARY BYPASS - CANNULA SIZES

Once the flow rate is calculated the choice of arterial and venous cannula size is made. In the case of venous cannulation, the choice as to single (right atrial) or double (SVC and IVC) cannulation is made. The overall choice of cannula size is done by the computer, using the charts below.

1. AORTIC CANNULA SIZES (within recommended rates, JECT 13(4):224-231, 1981)

FLOW	FR SIZE
<380	6
380 - 560	8
560 - 700	10
700 - 1000	12
100 -1400	14
1400 -1800	16
1800 -3000	18
> 3000	20

2. FEMORAL CANNULA SIZES *

FLOW			SIZE (mm) Metal	SIZE FR Art	SIZE FR Ven
0	-	400	2.0	8	8-10
400	-	700	2.5	10	10-12
700	-	1000	2.8	12	12-14
1000	-	1500	3.0	14	14-18
1500	-	2000	3.5	16	18
2000	-	2700	4.0	18	20
2700	-	3500	4.5	20	24
3500	-	>	5.0	24	28

* Femoral cannulation is used on occasion, in re-operations.

- CURRENTLY USED:
- **6 & 8 FR** - STOCKERT PEDIATRIC AORTIC CANNULA;STOCKERT INSTRUMENTE, MUNICH, GERMANY
  10 – 18 FR "ARGYLE" AORTIC CANNULA, 135^{0}ANGLED TIP; SHERWOOD MEDICAL, ST. LOUIS, MO., USA .
  20 FR – "DLP" ARTERIAL CANNULA ULTRAFLEX; MEDTRONIC CARDIAC SURGICAL PRODUCTS, GRAND RAPIDS ,MI., USA

  * FOR FEMORAL CANNULATION A NON-DISPOSABLE METAL CANNULA OR A "FEM-FLEX" PERCUTANEOUS CANNULA, RESEARCH MEDICAL INC, MIDVALE, UTAH, USA IS USED.

3. VENOUS CANNULA SIZES

a) Bi-caval cannulation

FLOW ml/min.			DOUBLE "DLP/RMI" SVC mm/FR	IVC mm/FR
0	-	400	3.9/12	3.9/12
400	-	600	3.9/12	5.3/16
600	-	800	4.7/14	5.3/16
800	-	1000	4.7/14	6.0/18
1000	-	1400	5.3/16	6.0/18
1400	-	1800	6.0/18	6.0/18
1800	-	2000	6.0/18	6.5/20
2000	-	2250	6.5/20	6.5/20
2250	-	2500	6.5/20	7.3/22
2500	-	2750	6.5/20	7.3/22
2750	-	3000	7.3/22	8.7/24
3000	-	3600	8.7/24	8.7/24
3600	-	3900	8.7/24	9.5/28
3900 ->			9.5/28	9.5/28

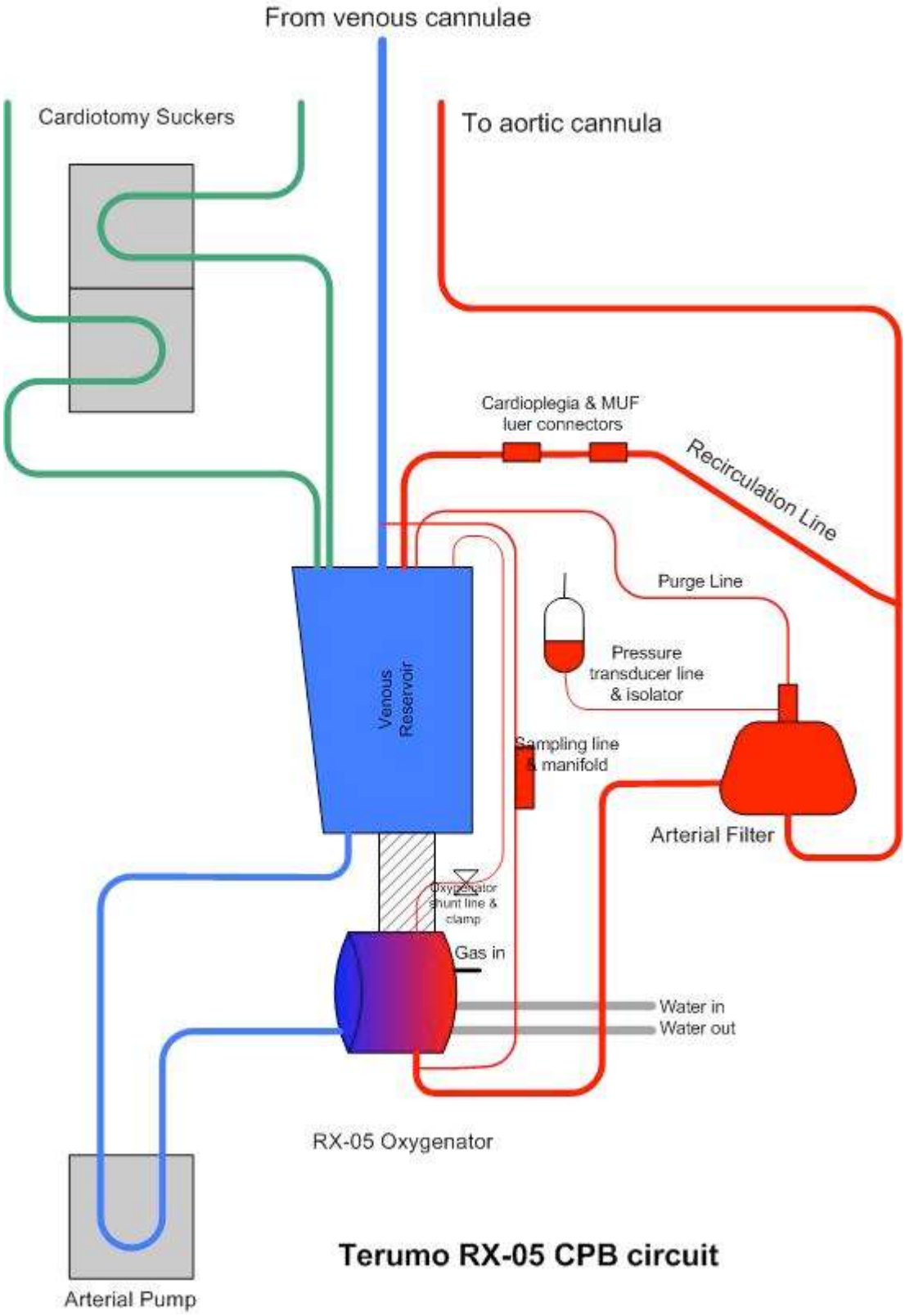
CURRENTLY USED: *DLP:* "67xxx" AND "69xxx" SERIES. DLP INC GRAND RAPIDS MICHIGAN, USA.
RMI: "TF-xxx-090" SERIES RESEARCH MEDICAL INC MIDVALE, UTAH, USA.

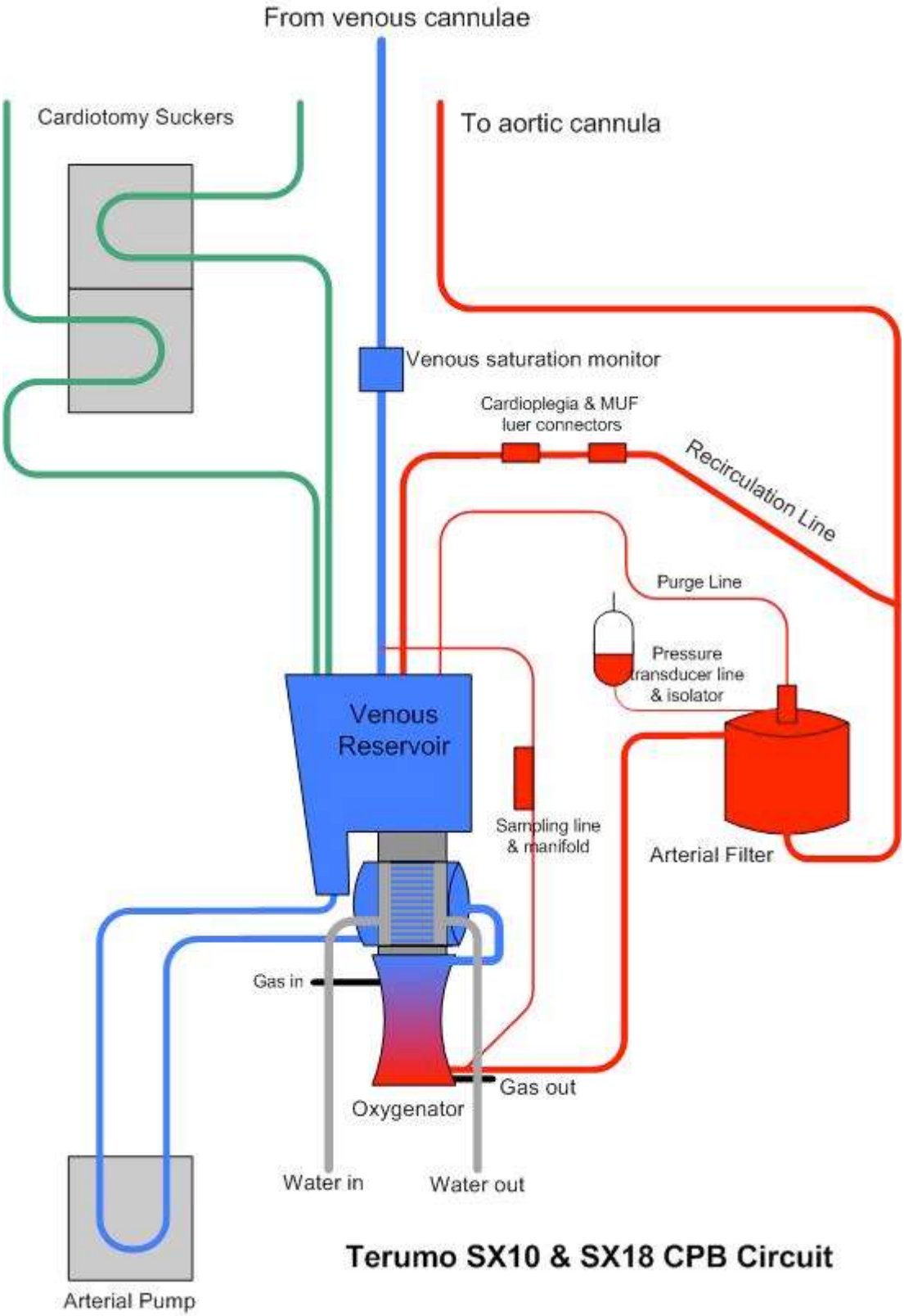
b) Right atrial cannulation

FLOW (ml/min)			SINGLE DLP/RMI (FR)
0	to	300	12
300	to	450	14
450	to	600	16
600	to	1000	18
1000	to	1300	20
1300	to	1500	22
1500	to	2000	24
2000	to	3000	28
3000 ->			28

For flows greater than 3000 ml/min a two stage venous cannula may be used.

Cardiopulmonary Bypass Circuit Diagrams





Terumo SX10 & SX18 CPB Circuit

Perfusion Procedure

Anaesthetic **(anaesthetic protocol can vary between anaesthetists)**

Fentanyl 15 – 150 mcg/kg +/- Morphine 0.2 – 0.5mg/kg (small loading dose to the CPB circuit)
Isoflurane (if required)
Ketamine 2mg/kg/hr
Midazolam 0.04 mg/kg/hr

Pre bypass

Heparin 3mg/kg
Aprotinin 50,000 units/kg load, 10,000/kg/hr 10,000/100ml prime to pump
Amicar (if used) 100mg/kg load 30 mg/kg/hr

Perfusion Procedure: On Pump*.*

Once the priming procedure has been completed, the checklist finalised, and the patient heparinised, cardiopulmonary bypass can be commenced. The aortic cannulation is done first to allow rapid infusion, or bypass with cardiotomy sucker return if required.

Bypass may be instituted with only one of the venous cannulae. If this is the case flow is increased to the point where the blood level in the venous reservoir is steady even if it is not the calculated full flow. Once the second venous cannula is connected flow can be increased to the calculated full flow. There is usually a drop in perfusion pressure at the start of CBP. It is usually transient and the pressure will increase after 2-3 minutes. Flow should be increased to compensate for this pressure drop if possible. If the pressure has not increased after 3-4 minutes a small dose (0.5-1.0mg) of metaraminol can be given. Cooling can commence, once full flow has been established, at the request of the surgeon. The surgeon will snare the caval tapes. If the perfusion pressure becomes too high during CPB, Sodium Nitro Prusside (titrate), Phentolamine (1/2-1 mg, then as required), Phenoxybenzamine (0.5-1.0mg/kg) or Isoflurane (titrate) can be used to manage the hypertension. Reducing flow should only be used as a last resort.

As the patient is cooled the FiO_2 can be reduced. The flow remains at the calculated flow or greater unless specifically requested. If the aorta is to be cross-clamped the cardioplegia will be ready and the tubing flushed. The cardioplegia pump needs to be turned on very slowly as the line is connected to the cardioplegia cannula to ensure that there is no air in the line.

When the surgeon is ready to cross-clamp the aorta the flow is reduced to half and the clamp applied. Cardioplegia is delivered at 110ml/m^2/min for 4 minutes and pressure limited at an appropriate level (40-100mmHg). More cardioplegia flow may be needed to obtain a reasonable pressure in the aortic root. Once the heart has been arrested and the atrium, ventricle or vessel opened the flow is increased to normal.

When the cardioplegia has been delivered the blood gases, electrolytes and ACT (MaxACT) are measured. ACT must be kept at more than 400 seconds. Pressure, temperature, flow, sweep gas characteristics and venous saturation are constantly monitored and recorded on paper every 10

minutes or when a change is made. Cardioplegia is delivered for another 2 minutes at approximately 20-minute intervals or at the request of the surgeon.

During the procedure the surgeon may require a dedicated vent sucker that needs to be managed appropriately.

If the patient is very haemodiluted and there is a large volume in the cardiotomy reservoir a haemofilter is used to concentrate the circulating volume, Lasix may also be given. In general blood is not given at this time, as it is more effective if given post CPB as there is a much smaller circulating volume. Blood gases (alpha stat) and electrolytes need to be checked more frequently (usually every 30-40 minutes) when haemofiltering because of the loss of electrolytes in the filtrate. Modified ultrafiltration (MUF) may be used post CPB to haemoconcentrate the patient if there is sufficient volume in the circuit.

Prior to removal of the cross-clamp warming the patient should commence. The blood temperature should never be more than 8° C higher than the nasopharyngeal temperature, and not exceed 37.9° C. The FiO_2 should remain unchanged until after the clamp is removed. The flow is reduced to half when the clamp is removed and then slowly (over a period of about 1-minute) returned to full flow. A few minutes after removal of the clamp blood gases and electrolytes are measured.

It is normal for the patient perfusion pressure to drop during warming. If possible increase flow to increase the pressure, otherwise a small dose (0.5-1.0mg) of metaraminol may be given. Hypotension may be due to arrhythmia and increased flow rather than pharmacological agents should be used if this is the case.

The FiO_2 should be increased to keep the venous saturation above 65% if possible. In infants this is not always possible, increasing the flow can help in this situation if there is sufficient reserve in aortic line pressure limits and perfusion pressure limits. This usually resolves once the patient is ventilated.

Prior to coming off CBP the patient must be: at the required temperature, the blood gases and electrolytes within acceptable parameters, ventilated, and in an acceptable cardiac rhythm.

The SVC cannula may be clamped first to allow ejection to occur. It may be necessary to reduce flow when the heart stars to eject to prevent emptying the venous reservoir. To separate the patient from CPB the venous clamp is slowly closed while the flow is reduced, transferring flow to the patient. Care must be taken not to overfill the heart and optimal filling pressures need to be set and all shunts n the circuit must be closed.

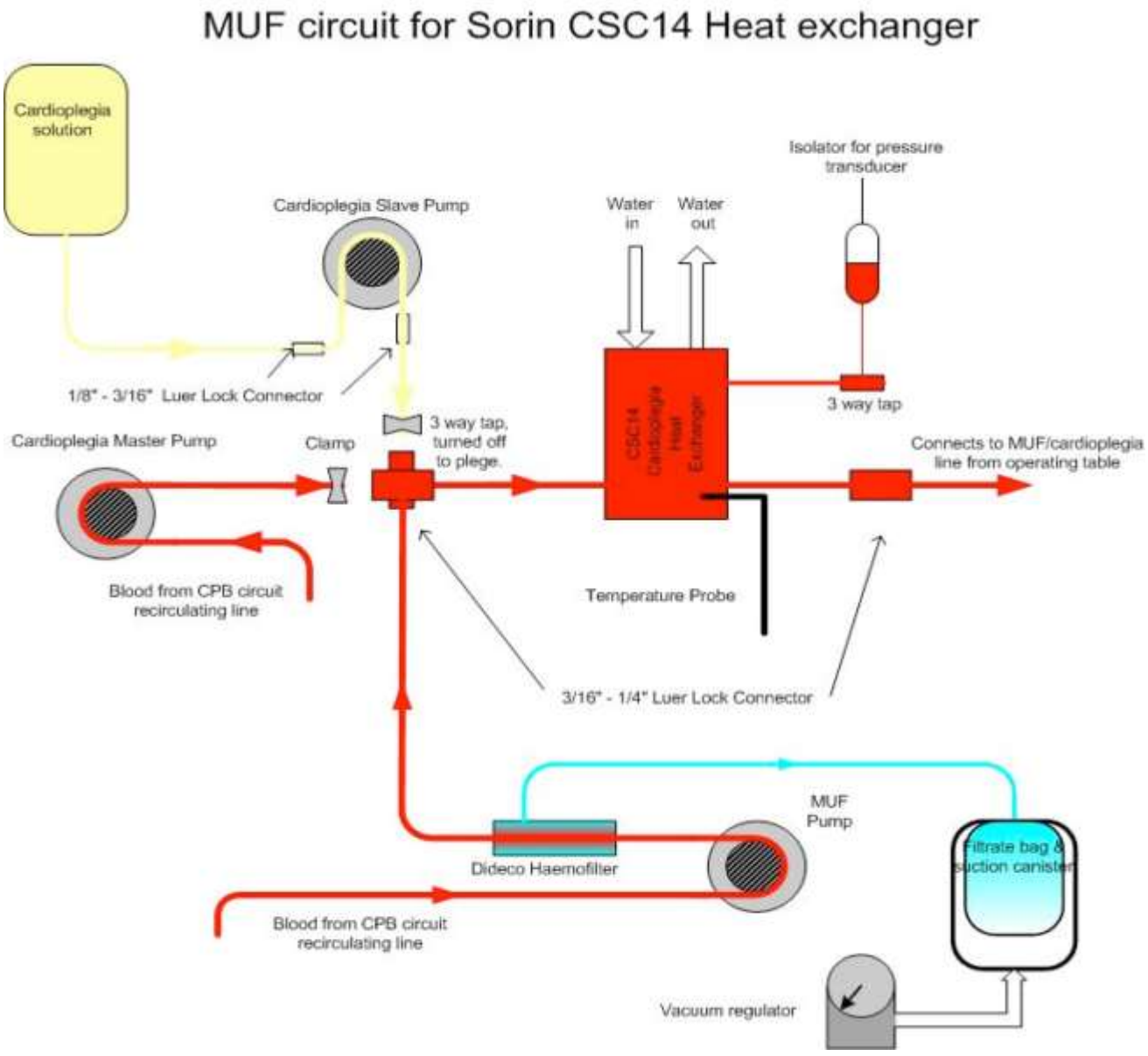
Once the venous clamp is closed and the flow reduced to zero, the blood in the venous line can then be flushed through to the venous reservoir for re-infusion or MUF. MUF can be started if required (see MUF guidelines), otherwise the IVC is clamped and the venous cannulae removed. Until the aortic cannula is removed blood can be re-infused through it.

When the Heparin is reversed with Protamine (3-5 mg/kg) the cardiotomy suckers must be turned off. Once the chest is closed the blood in the CPB circuit can be bagged for reinfusion.

Post Bypass

Dopamine 2.5-10mcg/kg/min

MODIFIED ULTRAFILTRATION - PROTOCOL & CIRCUIT



The modification to conventional ultrafiltration in use at RCH is based on the technique described by Elliott et al, Great Ormond Street, London.

Why Filter?

The increase in extravascular fluid which tends to accompany cardiopulmonary bypass (CPB), is in part due to increased capillary permeability, as a result of the inflammatory response initiated by CPB.

The effects of oedema have been described by various authors in relation to lungs, heart, brain, kidneys and abdomen.

Perioperative ultrafiltration and more specifically post CPB modified ultrafiltration (MUF), can be used to decrease total body water thereby minimising these deleterious effects.

We have found that A-V MUF can be implemented effectively and easily immediately post CPB, and generally result in notable improvements in patient haemodynamic and pulmonary status.

Our aim is to remove 100ml/kg of filtrate and this usually requires a period of 12 to 20 minutes in the neonatal population. Time taken and amount of filtrate removed will vary in larger children.

MUF the RCH way:

Equipment: Haemofilter – Dideco DHF 0,2
Circuit – 3/16" tubing.
Return line – cardioplegia circuit.
Suction - > - 150mmHg
Pump – Jostra Roller pump 100

Method: (A-V MUF)

The inlet to the haemofilter is attached via a luer connector to the re-circulation line. The filter outlet is connected to the venous reservoir for initial priming. This configuration allows the option of perioperative ultrafiltration should this be necessary.

The temperature of the water circulating through the cardioplegia heat exchanger should be set at approx. 38C . The MUF circuit is primed if possible using the contents of the venous reservoir / oxygenator during bypass, returning the blood to the venous reservoir, and used as a conventional haemofilter. Otherwise, at completion of CPB the arterial line is clamped off to the patient and the MUF circuit is primed using the contents of the venous reservoir / oxygenator. It may be necessary in small patients to drain the venous line to facilitate this. When adequately deaired the filter inlet line is placed in the raceway of the MUF pump. The filter outlet line is connected to the three way tap at the crystalloid component inlet of the cardioplegia circuit. The tap is turned off to the cardioplegia solution, the cardioplegia blood line is clamped . Flush the return line to remove the 30 ml of cardioplegia that remain in it, and attach to the silicon tubing on the venous cannula,

which remains in the RA. During MUF priming and prior to commencing MUF itself adequate patient filling must be maintained via the arterial line.

Removal all claps from the MUF circuit and commenced MUF slowly ensuring that a positive pressure is maintain in the arterial line at all times. We find no problem with this providing the aortic cannula remains will positioned, the MUF pump flow does not exceed **10% of calculated full flow** and that suction is not applied to the filter unless the MUF pump is running.

Once flow from the patient arterial line to the MUF circuit is established, turn the suction on to maximise the transmembrane pressure differential across the filter. Maintain adequate patient filling by adding volume from the oxygenator / venous reservoir but ensure that this is done at a rate that always ensures the top up flow rate is less than the MUF flow rate. This will ensure that flow is directed via the filter rather then back up the arterial line.

Continue to MUF until the desired amount of filtrate has been removed and an adequate haemoglobin has been achieved.

It may be necessary to "chase" the oxygenator contents through with crystalloid to provide adequate patient filling. Bear in mind that this could be a problem if a return to bypass is requited, and in any case the "chaser" volume must stop short of the haemofilter itself or dilution will negate the progress achieved. If necessary, blood rather then crystalloid can be used as the top up volume.

MYOCARDIAL & PULMONARY PRESERVATION - SOLUTIONS, PROTOCOL & CIRCUIT

1. CARDIOPLEGIA SOLUTION

The blood cardioplegia is based upon that used at the Royal Melbourne Hospital.

Blood Cardioplegia Base Solution (500 ml) (BaxterHealthcare Pty Ltd. Toongabbie NSW Australia)

Sodium – 77 mmol
Potassium – 40 mmol
Magnesium – 15 mmol
Chloride – 149 mmol
Glucose – 11 mmol
Lidocaine – 1 mmol
Water for injections BP QS
Approximate pH 3.5 – 4.0, approximate osmolality 586 mOsm.

To this is added 25 ml of 8.4% Sodium Bicarbonate and 28 mmol of Monosodium L-Aspartate. The induction dose is mixed in a ratio of 1:4, Base solution:blood. The maintenance dose is delivered at 1:6, Base solution:blood.

Patients below 10 kg:
This is usually delivered at a pressure of 40 - 70 mmHg.

Patients above 10 kg:
This is usually delivered at a pressure of 60 - 90 mmHg, and up to a maximum of 100 mmHg in adult patients.

As a guide, note the end diastolic pressure of each individual patient prior to cardiopulmonary bypass. This will indicate the normal filling pressure of the coronary arteries. When aortic incompetence is present, the CPS flow is increased.

Administration

For ALL Patients:	Temperature: 8 - 12°C
Initial Delivery Rate:	110 ml/m_/min for 4 minutes
Subsequent Delivery Rate:	110 ml/m_/min for 2 minutes

2. DONOR HEART CARDIOPLEGIA

Solution :	1000 ml	Cardioplegia Solution A
	28 mmol	Monosodium L-Aspartate
	10 ml	Sodium Bicarbonate 8.4%

The solution is oxygenated.
Solution must be filtered through a five micron filter

Administration

For ALL Patients:	Temperature: 8°C
Delivery Rate:	Approximately 110 ml/m_/min for 4 min.

3. DONOR LUNG PRESERVATION SOLUTIONS

Solution:	1 L	Modified Euro-Collins Solution
	14 mmol	Monosodium L-Aspartate

The solution is oxygenated.

If modified Euro Collins solution is not available:

1 L	Collins Solution
65 ml	50% Glucose
6 mmol	Magnesium Sulphate (3 ml)
14 mmol	Monosodium L-Aspartate

This solution is oxygenated.
Solution must be filtered through a five micron filter.

Administration

For ALL Patients:	Temperature: 8°C
Delivery Rate:	150 - 250 ml/ min.
Delivery pressure:	15 - 20 mmHg

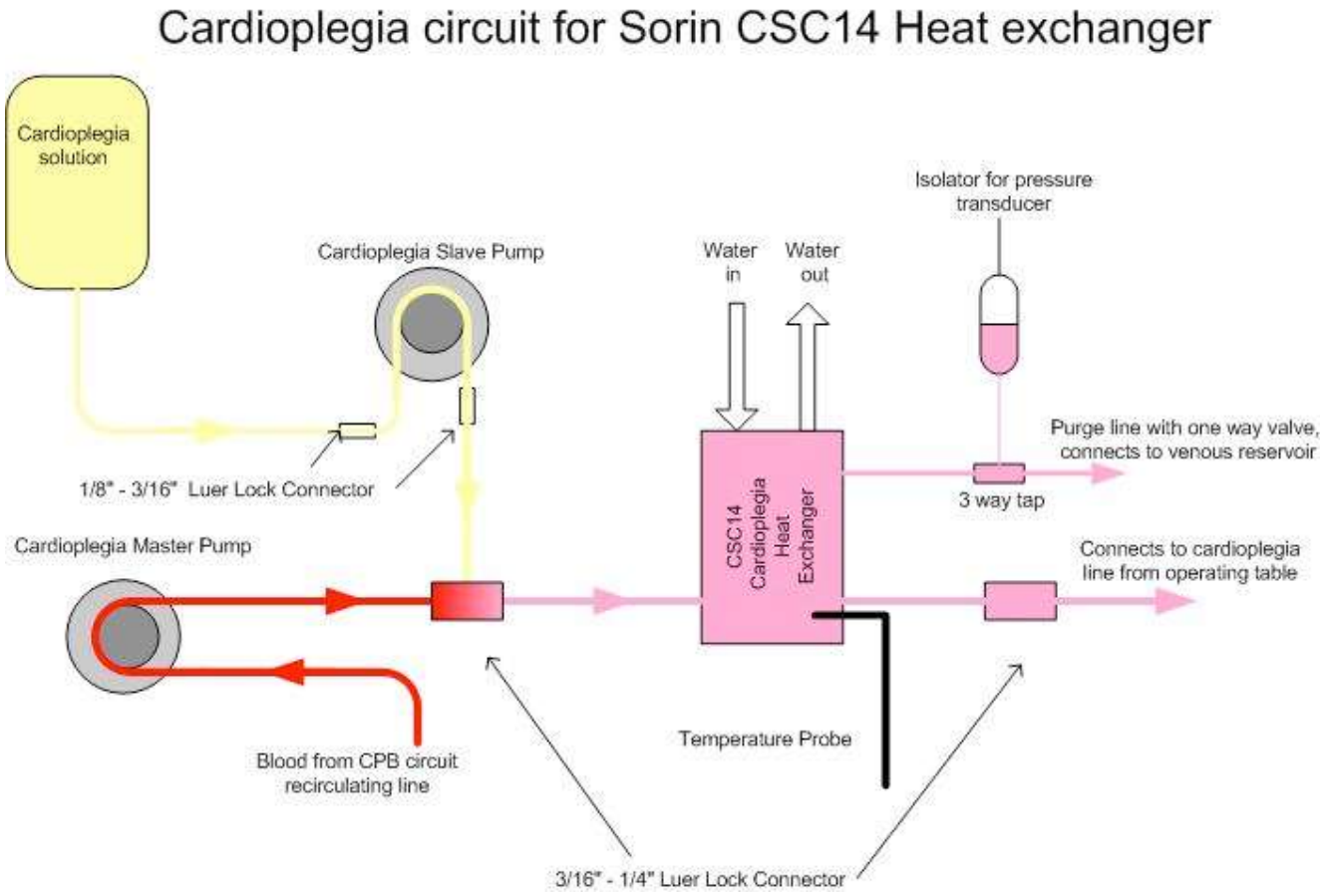
4. DONOR HEART STORAGE SOLUTION

Solution:	1 L	Modified Euro-Collins Solution
	14 mmol	Monosodium L-Aspartate

This solution is oxygenated.
Solution must be filtered through a five micron filter.

Temperature: 6 - 8 °C.

Heart or heart/lungs are wrapped in 3 sterile bags all containing some of the procurement solution to cushion the heart from direct contact with the ice packed around it for transportation.



EXAMPLE ONLY

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ROYAL CHILDREN'S HOSPITAL
PERFUSION DATA
Case Number 206
DATE - Tuseday 6 July 2004

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NAME - RX-05, Heparin Prime
U.R. - 9999999 BLD.GRP - A POSITIVE
DOB - 04/07/2004 AGE- 2 DAYS

HEIGHT - 50 cm.
WEIGHT - 3.50 kg.
SURFACE AREA - 0.208 sq.m
HAEMOGLOBIN - 12.0 gm/dl.
BLOOD VOL. - 350 mls.

Previous surgery :
DIAGNOSIS : Transposition

HEPARIN	- 5 mgs.	Hct. On bypass	- 34.7
BICARBINATE	- 10 mM.	Hb on bypass	- 10.5
CALCIUM	- 0.5 mM.	Femoral size	- 2.5
HEP. SALINE	- 30 mls.	DILUENT VOLUME	- 91 mls.
PLASMALYTE 148	- 45 mls.	VOLUME OF BLOOD	- 440 mls.
5% DEXTROSE	- 5 mls.		----------
		TOTAL PRIME >>>>>	531 mls.
Jostra plege 1:4	3 rpm		----------
Jostra plege 1:6	3 rpm		

OXYGENATOR : Terumo RX 05
ARTERIAL CANNULA : 8 FR.
92.86 % of max. flow
136.84 % > max. flow
For downsized cannula
VENOUS CANNULAE :
3.9 mm tip 12 FR
3.9 mm tip 12 FR

OPTIMUM FLOW : 520 mls/min.
C.P.S. FLOW : 23 mls/min.
C.P.S. SPEED : 6 rpm
Blood Plege 1:4, 1:6
4 5
COOLING : 32 degrees N/P

86.67% of max. flow – indicated cannulae
130.0% > max. flow – downsized cannulae

PERFUSIONIST - MR.C.THUYS

SURGEON - MR.D'UDEKEM

ANAESTHETIST - DR.R.EYRES

INSTRUMENT NURSE - SR.

Min. Pulm.Valve Ring Diam.>>	Min.ring size Diameter (mm)	Area (mm^2)	Half Sizes.
	7	39	5

Mean Normal Valve Diam.>>	Mitral	Tricuspid	Aortic	Pulm.
	11.2	13.4	7.2	8.4

EXAMPLE ONLY

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ROYAL CHILDREN'S HOSPITAL
PERFUSION DATA
Case Number 206
DATE - Tuseday 6 July 2004

****

NAME - RX-05, Whole Blood
U.R. - 9999999 BLD.GRP - AB POSITIVE
DOB - 24/08/2003 AGE- 10 MONTHS

HEIGHT - 71 cm.
WEIGHT - 7.78 kg.
SURFACE AREA - 0.376 sq.m
HAEMOGLOBIN - 12.2 gm/dl.
BLOOD VOL. - 700 mls.

Previous surgery :
DIAGNOSIS : Tetralogy of Fallot

HEPARIN	- 30 mg.	Hct. On bypass	- 34.7
BICARBONATE	- 12 mM.	Hb on bypass	- 10.5
CALCIUM	- 5.0 mM.	Femoral size	- 2.5
PLASMALYTE 148	- 100 mls.	DILUENT VOLUME	- 183 mls.
C.P.D.	- 63 mls.	VOLUME OF BLOOD	- 425 mls.
5% DEXTROSE	- 0 mls.		----------
		TOTAL PRIME >>>>>	608 mls.
Jostra plege 1:4	6 rpm		----------
Jostra plege 1:6	7 rpm		

OXYGENATOR : Terumo RX 05
ARTERIAL CANNULA : 14 FR.
82.86 % of max. flow
116.00 % > max. flow
For downsized cannula
VENOUS CANNULAE :
3.9 mm tip 18 FR
3.9 mm tip 16 FR

OPTIMUM FLOW : 1160 mls/min.
C.P.S. FLOW : 42 mls/min.
C.P.S. SPEED : 11 rpm
Blood Plege 1:4, 1:6
8 9

COOLING : 32 degrees N/P

82.86% of max. flow – indicated cannulae
116.0% > max. flow – downsized cannulae

PERFUSIONIST - MR.C.THUYS

SURGEON - MR.D'UDEKEM

ANAESTHETIST - DR.R.EYRES

INSTRUMENT NURSE - SR.

Min. Pulm.Valve Ring Diam.>>	Min.ring size Diameter (mm)	Area (mm^2)	Half Sizes.
	9.5	72	6.5

Mean Normal Valve Diam.>>	Mitral	Tricuspid	Aortic	Pulm.
	14.4	17.3	9.5	10.7

EXAMPLE ONLY

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ROYAL CHILDREN'S HOSPITAL
PERFUSION DATA
Case Number 206
DATE - Tuseday 6 July 2004

****

NAME - RX-05, PC Prime
U.R. - 9999999 BLD.GRP - B NEGATIVE
DOB - 04/07/2004 AGE - 2 DAYS

HEIGHT - 50 cm.
WEIGHT - 3.50 kg.
SURFACE AREA - 0.208 sq.m
HAEMOGLOBIN - 11.2 gm/dl.
BLOOD VOL. - 350 mls.

Previous surgery :
DIAGNOSIS : Transposition

HEPARIN	- 14 mg.	Hct. On bypass	- 34.7
BICARBONATE	- 12 mM.	Hb on bypass	- 10.5
CALCIUM	- 1.5 mM.	Femoral size	- 2.5
PLASMALYTE 148	- 120 mls.		
C.P.D.	- 63 mls.	DILUENT VOLUME	- 261 mls.
ALBUMIN 20%	- 42.9 mls.	VOLUME OF BLOOD	- 273 mls.

		TOTAL PRIME >>>>>	534 mls.

Jostra plege 1:4 3 rpm
Jostra plege 1:6 3 rpm

OXYGENATOR : Terumo RX 05
ARTERIAL CANNULA : 8 FR.
92.86 % of max. flow
136.84 % > max. flow
For downsized cannula

OPTIMUM FLOW : 520 mls/min.
C.P.S. FLOW : 23 mls/min.
C.P.S. SPEED : 6 rpm
Blood Plege 1:4, 1:6
4 5

VENOUS CANNULAE :
3.9 mm tip 12 FR
3.9 mm tip 12 FR

COOLING : 32 degrees N/P

86.67% of max. flow – indicated cannulae
130.0% > max. flow – downsized cannulae

PERFUSIONIST - MR.C.THUYS

SURGEON - MR.D'UDEKEM

ANAESTHETIST - DR.R.EYRES

INSTRUMENT NURSE - SR.

Min. Pulm.Valve Ring Diam.>>	Min.ring size Diameter (mm)	Area (mm^2)	Half Sizes.
	7	39	5.0

Mean Normal Valve Diam.>>	Mitral	Tricuspid	Aortic	Pulm.
	11.2	13.4	7.2	8.4

EXAMPLE ONLY

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ROYAL CHILDREN'S HOSPITAL
PERFUSION DATA
Case Number 206
DATE - Tuseday 6 July 2004

****

NAME - RX-05, Clear Prime
U.R. - 9999999 BLD.GRP - A NEGATIVE
DOB - 04/07/2002 AGE - 24 MONTHS

HEIGHT - 88 cm.
WEIGHT - 11.75 kg.
SURFACE AREA - 0.523 sq.m
HAEMOGLOBIN - 15.5 gm/dl.
BLOOD VOL. - 940 mls.

Previous surgery :
DIAGNOSIS : VSD

HEPARIN	- 15 mg.	Hct. On bypass	- 33.8
BICARBONATE	- 12 mM.	Hb on bypass	- 11.2
CALCIUM	- 2.0 mM.	Femoral size	- 2.5
PLASMALYTE 148	- 350 mls.		
5% DEXTROSE	- 10 mls.	DILUENT VOLUME	- 475 mls.
ALBUMIN 20%	- 100 mls.	VOLUME OF BLOOD	- 0 mls.

		TOTAL PRIME >>>>>	475 mls.

Jostra plege 1:4 9 rpm
Jostra plege 1:6 9 rpm

OXYGENATOR : Terumo RX 05
ARTERIAL CANNULA : 14 FR.
89.29 % of max. flow
125.00 % > max. flow
For downsized cannula

OPTIMUM FLOW : 1250 mls/min.
C.P.S. FLOW : 58 mls/min.
C.P.S. SPEED : 15 rpm
Blood Plege 1:4, 1:6
11 13

VENOUS CANNULAE :
3.9 mm tip 16 FR
3.9 mm tip 16 FR

COOLING : 32 degrees N/P

89.29% of max. flow – indicated cannulae
125.0% > max. flow – downsized cannulae

PERFUSIONIST - MR.C.THUYS

SURGEON - MR.D'UDEKEM

ANAESTHETIST - DR.R.EYRES

INSTRUMENT NURSE - SR.

Min. Pulm.Valve Ring Diam.>>	Min.ring size Diameter (mm)	Area (mm^2)	Half Sizes.
	12	113	8.5

Mean Normal Valve Diam.>>	Mitral	Tricuspid	Aortic	Pulm.
	15.8	19	11	12

EXAMPLE ONLY

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ROYAL CHILDREN'S HOSPITAL
PERFUSION DATA
Case Number 206
DATE - Tuseday 6 July 2004

****

NAME - SX-10, Clear Prime
U.R. - 9999999 BLD.GRP - A NEGATIVE
DOB - 02/11/1995 AGE - 8.7 YEARS

HEIGHT - 142 cm.
WEIGHT - 28.60 kg.
SURFACE AREA - 1.080 sq.m
HAEMOGLOBIN - 15.0 gm/dl.
BLOOD VOL. - 2288 mls.

Previous surgery :
DIAGNOSIS : ASD

HEPARIN	- 38 mg.	Hct. On bypass	- 34.8
BICARBONATE	- 35 mM.	Hb on bypass	- 10.4
CALCIUM	- 3.0 mM.	Femoral size	- 4.0
PLASMALYTE 148	- 750 mls.		
5% DEXTROSE	- 10 mls.	DILUENT VOLUME	- 902 mls.
ALBUMIN 20%	- 100 mls.	VOLUME OF BLOOD	- 0 mls.

		TOTAL PRIME >>>>>	902 mls.

Jostra plege 1:4 19 rpm
Jostra plege 1:6 20 rpm

OXYGENATOR : Terumo SX 10
ARTERIAL CANNULA : 18 FR.
86.33 % of max. flow
143.89 % > max. flow
For downsized cannula

VENOUS CANNULAE :
3.9 mm tip 22 FR
3.9 mm tip 20 FR

OPTIMUM FLOW : 2590 mls/min.
C.P.S. FLOW : 121 mls/min.
C.P.S. SPEED : 32 rpm
Blood Plege 1:4, 1:6
24 28

COOLING : 34 degrees N/P

94.18 % of max. flow – indicated cannulae
103.6 % > max. flow – downsized cannulae

PERFUSIONIST - MR.C.THUYS

SURGEON - MR.D'UDEKEM

ANAESTHETIST - DR.R.EYRES

INSTRUMENT NURSE - SR.

Min. Pulm.Valve Ring Diam.>>	Min.ring size Diameter (mm)	Area (mm^2)	Half Sizes.
	18.5	270	13

Mean Normal Valve Diam.>>	Mitral	Tricuspid	Aortic	Pulm.
	20.2	24.9	14.0	15.3

EXAMPLE ONLY

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ROYAL CHILDREN'S HOSPITAL
PERFUSION DATA
Case Number 206
DATE - Tuseday 6 July 2004

****

NAME - SX-18, Clear Prime
U.R. - 9999999 BLD.GRP - A NEGATIVE
DOB - 25/04/1989 AGE - 15.2 YEARS

HEIGHT - 176 cm.
WEIGHT - 65.40 kg.
SURFACE AREA - 1.794 sq.m
HAEMOGLOBIN - 13.6 gm/dl.
BLOOD VOL. - 5232 mls.

Previous surgery :
DIAGNOSIS : ASD

HEPARIN	- 38 mg.	Hct. On bypass	- 36.2
BICARBONATE	- 45 mM.	Hb on bypass	- 11.0
CALCIUM	- 4.0 mM.	Femoral size	- 5.0
PLASMALYTE 148	- 1000 mls.		
5% DEXTROSE	- 10 mls.	DILUENT VOLUME	- 1259 mls.
ALBUMIN 20%	- 200 mls.	VOLUME OF BLOOD	- 0 mls.

		TOTAL PRIME >>>>>	1259 mls.

Jostra plege 1:4 32 rpm
Jostra plege 1:6 34 rpm

OXYGENATOR : Terumo SX 18
ARTERIAL CANNULA : 20 FR.
61.43 % of max. flow
143.33 % > max. flow
For downsized cannula

OPTIMUM FLOW : 4300 mls/min.
C.P.S. FLOW : 201 mls/min.
C.P.S. SPEED : 54 rpm
Blood Plege 1:4, 1:6
41 47

VENOUS CANNULAE : 3.9 mm tip 28 FR
3.9 mm tip 28 FR

COOLING : 34 degrees N/P

86.00 % of max. flow – indicated cannulae
110.3 % > max. flow – downsized cannulae

PERFUSIONIST - MR.C.THUYS

SURGEON - MR.D'UDEKEM

ANAESTHETIST - DR.R.EYRES

INSTRUMENT NURSE - SR.

Min. Pulm.Valve Ring Diam.>>	Min.ring size Diameter (mm)	Area (mm^2)	Half Sizes.
	20.0	314	14

Mean Normal Valve Diam.>>	Mitral	Tricuspid	Aortic	Pulm.
	23.8	29.1	16.5	18.2

CBP CHECKLIST

Royal Children's Hospital

CARDIOPULMONARY BYPASS RECORD

AFFIX PATIENT IDENTIFICATION LABEL

CARDIOPULMONARY BYPASS CHECKLIST

- ☐ Connect all power cords, cables, gas lines and temp. probes
- ☐ Connect Heater/Cooler lines and flush
- ☐ Note Oxygenator, pump set and cardioplegia serial numbers
- ☐ CO_2 flush circuit
- ☐ Check sucker occlusions
- ☐ Read and check patient history
- ☐ Prepare drugs **Counter signature:**_____
- ☐ Prepare cardioplegia solution and occlusion **Counter signature:**_____
- ☐ Check blood **Counter signature:**_____
- ☐ Connect gas line to oxygenator
- ☐ Prime and debubble arterial filter and circuit
- ☐ Check and add drugs
- ☐ Set venous clamp tubing size
- ☐ Set arterial tubing size and calibrate _____LPM @ 100 RPM
- ☐ Activate bubble detector and air emboli detector
- ☐ Set and enable arterial pump alarms
- ☐ Set and enable cardioplegia pump alarms
- ☐ Prime temperature _____°C
- ☐ Set arterial pump occlusion
- ☐ Attach venous saturation monitor
- ☐ Take pre bypass gas sample

SIGNATURE _____ DATE_____

CARDIOPULMONARY BYPASS CHECKLIST

MR 82B

StockNo 013127

CBP RECORD

	PRESSURE			TEMPERATURE				FLOW				COMMENTS
TIME	ART	SVC	LINE	OES	N/P	ART	H_2O	PUMP	SWEEP	FiO_2	SvO_2	
				ON BYPASS								

COMMENTS: _____

ON BYPASS _____ AORTIC CLAMP ON _____

OFF BYPASS _____ AORTIC CLAMP OFF _____

TOTAL BYPASS _____ TOTAL X CLAMP TIME _____

CIRC. ARREST _____ ACTUAL TEMP. _____

HEPARIN IN _____ PROTAMINE IN _____ URINE OUTPUT _____ ml

SAMPLE No.	TIME	TEMP	SWEEP	FiO_2	Hb	pH	pCO_2	pO_2	BIC.	B.E.	GLUC.	Na^{++}	K^{+}	Ca^{++}
PRIME														
1														
2														
3														
4														
5														