ARROWHEAD REGIONAL MEDICAL CENTER
Operative Services Policies and Procedures

SECTION: **PATIENT CARE** **SUB SECTION:** **CARDIOVASCULAR SURGERY**

SUBJECT: **CARDIOVASCULAR SURGERY SERVICE EQUIPMENT AND SUPPLIES**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Cardiovascular Operating Room Equipment and Supplies shall include but not limited to items listed below.

PROCEDURES

I. Monitoring and Recording Equipment
   A. Electrocardiograms
   B. Pressure Monitoring System
   C. Coronary Blood Flow Monitoring System
   D. Cardiac Monitoring System
   E. Patient Temperature Monitoring System
II. Blood Gas Analyzer
III. Cardiopulmonary (Heart Lung) Machine with Oxygenator
IV. Equipment for Rapid Cooling and Heating of the patient
V. Defibrillator (Internal and External paddles-adult)
VI. TEE
VII. Suction Outlets with piped air and oxygen, tanks of gas including mixtures of oxygen and carbon dioxide
VIII. Resuscitation Equipment
IX. Motorized Cardiac Operative Table
X. Internal Cardiac Pacer
XI. Intra-aortic Balloon Pump (IABP)
XII. All other necessary equipment and supplies routinely found in an operating room suite

REFERENCES: **Title 22 Requirements**

DEFINITIONS:

ATTACHMENTS: **N/A**

APPROVAL DATE:

N/A	**Policy, Procedures and Standards Committee**
06/22/2021	**Nursing Standards Committee** Applicable Administrator, Hospital or Medical Committee
06/08/2021	**Operative and Other Invasive Committee** Applicable Administrator, Hospital or Medical Committee
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06/17/2021	**Medical Executive Committee** Applicable Administrator, Hospital or Medical Committee
	Board of Supervisors Approved by the Governing Body

REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE** **SUB SECTION:** **CARDIOVASCULAR SURGERY**

SUBJECT: **CARDIOVASCULAR SURGERY TEAM & ON-CALL CVOR TEAM**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Cardiovascular Surgery Staffing remains consistent with Title 22 Requirements. The Surgical Services Department shall assure prompt activation of the Surgery Department's On Call team in Response to a Patient's need for emergency Cardiovascular Surgery.

PROCEDURES

I. The Cardiovascular Surgical Team consists of the following members for the performance of all Cardiac Operative Procedures
   A. 2 Registered Nurses
   B. 1 Surgical Scrub Tech or Registered Nurse Scrub
   C. Anesthesiologist
      1. Certified or eligible for certification by the Board of Anesthesiology
   D. Perfusionist
      1. The Perfusionist functions under the immediate supervision of the Cardiovascular Surgeon

II. Medical personnel will consist of 3 Surgeons for procedures requiring extracorporeal bypass
   A. One surgeon will have Certification by the American Board of Thoracic Surgery or be eligible for Certification by the American Board of Thoracic Surgery
   B. One Surgeon can be replaced with a Nurse Practitioner (NP) , Physician's Assistant (PA), or Senior Surgical Resident
   C. The physician will have responsibility for
      1. Implementing established policies and procedures
      2. Training and supervising the nurses and technicians in special techniques
      3. Supervising the clinical Perfusionists

III. On Call Cardiovascular Surgical Team will consist of the following personnel
   a. One Circulating Registered Nurse
   b. One CVOR Scrub Tech or Scrub RN
   c. Cardiac Anesthesia
   d. Perfusionist
   e. Cardiovascular Surgeon

IV. The On Call team will have a 30 Minute Maximum response time.

V. The CVOR On Call Team will be contacted by OR Charge Nurse or OR Manager.

VI. Prior to calling in the CVOR On-Call Team, the following information shall be obtained from the requesting physician.
   a. The Desired start time of the procedure
   b. Verify the surgeon has been made aware of the patient
   c. Verify NPO status of the patient
   d. Obtain information relative to procedure being scheduled and any needed equipment.
   e. Inquire whether or not second Scrub is needed.
   f. Inquire if patient will be admitted or if there is a change in bed status

VII. Failure to reach On-Call staff:
   a. If a member of the CVOR crew is not available the Director of Surgical Services shall be notified for assistance.

REFERENCES: **Title 22 Requirements**

DEFINITIONS:

ATTACHMENTS: **N/A**

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EFFECTIVE: _____

REVISED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **ACCIDENTAL HYPOTHERMIA GUIDELINES**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To warm accidental or deliberately induced hypothermia patients. Accidental hypothermia is defined as a core temperature below 35° C. At this temperature the body becomes progressively unable to generate sufficient heat to function efficiently.

Severe freshwater drowning causes profound hypo-osmotic plasma volume as free water is absorbed across the alveolar membrane. This can result in pulmonary edema, hemolysis, and congestive heart failure. Saltwater drowning because of its iso-osmotic nature can result in fewer physiologic changes. Prolonged exposure with gradual cooling, such as land exposure or submersion wearing a survival suit, will result in hypovolemia due to the loss of fluids from the long physical exertion.

A certified cardiovascular perfusionist or a board eligible perfusionist under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. DEFINITION OF HYPOTHERMIA

mild	32 - 35° C	90 - 95° F
moderate	28 - 32° C	82 - 90 ° F
severe	25-28° C	77 - 82° F
extreme	< 25° C	< 77° F

Cardiac arrest can result due to a drop in the body's core temperature. Severe hypothermia is associated with marked depression of cerebral blood flow and oxygen requirement, reduced cardiac output, and decreased blood pressure. The victim's pulses and respiratory efforts may be difficult to detect. Definitive management of severely hypothermic patients requires emergent medical care.

II. INDICATIONS FOR PASSIVE CORE REWARMING (NO Cardiopulmonary Bypass [CPB])

A. Moderate hypothermia, (28 - 32° C) with any perfusing cardiac rhythm
B. Severe hypothermia, (25 - 28° C) with stable cardiac rhythm

Passive rewarming is usually successful when the core temperature does not fall below 30°C. This involves the use of hyperthermia blankets, warm IV fluids, and insulation.

III. INDICATIONS FOR ACTIVE REWARMING (CPB)

A. Moderate hypothermia, 28 - 32°C (82 - 90° F) with cardiac arrest (or non-perfusion despite electric cardiac activity)

B. Severe hypothermia, 25 - 28°C (77 - 82° F) with cardiac arrest or unstable cardiac rhythm*
C. Extreme hypothermia < 25° C (<77° F) with or without cardiac arrest
D. Moderate or severe hypothermia, managed with active rewarming, for patient who develops cardiac arrest
E. Moderate hypothermia managed with active rewarming for patient who remains hypothermic and fails to regain stable cardiac rhythm and adequate perfusion after 30 minutes of passive rewarming

Active rewarming indicated when temperature falls below 30°C. This allows for a more precise control over temperature, plasma volume, electrolyte, acid base status, ventricular fibrillation and systemic perfusion. If available, the "portable" CPB circuits will expedite the treatment of the patient direct transfer to the operating room without a visit to the Emergency Room and employing femoral artery to femoral vein bypass using percutaneous cannula is also a mode of treatment.

* *Bradycardia alone does not constitute unstable cardiac rhythm in the hypothermic patient.*

IV. TYPES OF CARDIOPULMONARY BYPASS

A. Femoral-femoral bypass in all patients

B. Atrial-aortic bypass (median sternotomy) if:

1. Cardiac arrest
2. Inadequate flow rates/slow rewarming (< 0.5° C/min)
3. Small children (< 20 kg)
4. Circuit design and cannula selection may need to be selected at the time of the procedure due to surgeon's preferences.

V. PROTOCOL

A. Determination of hypothermia

Moderate, severe or extreme hypothermia (< 32° C, or 90° F) rectal (thermistor bladder catheter) and confirmed esophageally (core temperature); or any hypothermia with cardiac arrest.

B. Cardiopulmonary bypass

Prime: The purpose of this priming solution is to provide a hyper-oncotic prime with the intent of removing fluid from the interstitium. The electrolytes will be corrected during the rewarming process. 1/2 of total priming volume = Isolyte 7.4 The other 1/2 of total priming volume = 25% Albumin (e.g. 800mls isolyte 7.4 + 800mls Albumin = 1600mls).

1. Full cardiopulmonary bypass circuit set-up by the perfusion team without the cardioplegia setup or CPS machine.
2. Full systemic anticoagulation to maintain activated clotting time at 450-480 seconds.

The surgeon may elect to give the heparin directly into the heart due to cardiac arrest.

3. Intravenous antibiotics: e.g., Cefazolin
4. Patient < 20 kg: consider immediate median sternotomy and central (atrial-aortic) bypass
5. Patient > 20 kg: Cannulation of femoral artery and vein - cannulas appropriate for patient size

6. Median sternotomy and atrial-aortic bypass if inadequate rewarming or flow, cardiac arrest, or at discretion of bypass team.
7. Set the sweep and FI02gas flows higher than normal to compensate for low venous saturation and high PC02's. As these parameters come into normal range adjust gas flows accordingly.
8. ***Go on pump matching the temperature of the prime to the patient core temperature. Stay at this temperature for a minimum of 15 minutes.***
9. Add fluid as needed, try to minimize the Isolyte and Potassium load. Patients who are rewarmed from deep or profound hypothermia frequently have an increased vascular permeability and require large volumes of fluid. On the other hand, use of a hemoconcentrator is recommended to remove excess volume.
   ***** Increased urine output is not unusual.***
10. Perform frequent blood gasses. At 30ºC when the sodium pump begins to function, draw blood samples after rewarming every few degrees; wait for the results, and treat any electrolyte imbalance before rewarming any further.
11. Have anesthesia add Positive end expiratory pressure throughout the case. 14mm Hg is suggested to curtail pulmonary edema.
12. Re-warm slowly; a suggested guideline is 1-2 degrees every 5 minutes, or 15 degrees per hour, and/or not more than 5-degree difference in temperature between the heater cooler and the patient blood temperature (arterial side).
13. Remember that drug reactions are difficult to predict under a core patient temperature of 30 degrees and may cause toxicity.
14. Steroid, if used, dose is 25mg/kg of Solu-Medrol in children.
15. The surgeon will decide how far to warm the patient. It is not uncommon to only rewarm to between 32°C and 35°C due to the real possibility of cerebral edema.
    ***** Maintaining the patient at 35°C will afford some cerebral protection.***

C. Bypass termination

1. Consider ultrafiltration or hemodialysis using a hemoconcentrater before decannulation
2. Bypass termination when:

   a. Core temp = 37° C and spontaneous-stable cardiac rhythm and weanable to mechanical respirator
   b. Severe injury incompatible with life (pronounce dead)
   c. Failure to wean from bypass (pronounce dead)

REFERENCES:

Fister M, Knafelj R, Radsel P, et al. Cardiopulmonary Resuscitation with Extracorporeal Membrane Oxygenation in a Patient with Profound Accidental Hypothermia and Refractory Ventricular Fibrillation. Ther Hypothermia Temp Manag 2019; 9:86.

Pasquier M, Hugli O, Paal P, et al. Hypothermia outcome prediction after extracorporeal life support for hypothermic cardiac arrest patients: The HOPE score. Resuscitation 2018; 126:58.

Pasquier M, Rousson V, Darocha T, et al. Hypothermia outcome prediction after extracorporeal life support for hypothermic cardiac arrest patients: An external validation of the HOPE score. Resuscitation 2019; 139:321.

DEFINITIONS:

ATTACHMENTS: **N/A**

APPROVAL DATE:

N/A	**Policy, Procedures and Standards Committee**
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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **ADULT PUMP PRIME**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To prime the cardiopulmonary bypass circuit with the minimum amount of volume to maintain the patient's hematocrit in an acceptable range. To add medications, prescribed by the physician, in order to have a priming solution that will meet the patient's physiological needs on cardiopulmonary bypass.

A certified cardiovascular perfusionist or a board eligible perfusionist should perform this procedure under the direct supervision of a certified cardiovascular perfusionist.

PROCEDURES

I. Adult Pump Prime without Blood

1600 ml	Isolyte® S pH 7.4 (or enough to adequately prime the system)
10 g	Aminocaproic Acid (Amicar)
25 g	Mannitol
25 mEq	Sodium Bicarbonate (NaHCO3)

II. Adult Pump Blood Prime

A. Subtract equal amount of crystalloid as amount of RBCs or FFP added

B. Use same medications as bloodless prime

C. Consider adding an additional 25mEq NaHCO3

D. Add an additional 5 - 10K units of Heparin

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

ATTACHMENTS: **N/A**

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **ALBUMIN ADMINISTRATION**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Albumin administration during Cardiopulmonary Bypass (CPB)

A certified cardiovascular perfusionist, a board eligible perfusionist under the direct supervision of a certified cardiovascular perfusionist should perform this procedure

PROCEDURES

I. General Information:

A. The use of 1.25 gram Albumin /100 ml crystalloid will be the standard for administration of colloid during CPB.

B. Do not prime with Albumin.

C. Only after 1000 mL of crystalloid has been used, this includes the pump prime as well as an additional 1000 mL of crystalloid. 12.5 gram Albumin can be administered per 1000mL.

REFERENCES: **Fluids and Organ Dysfunction: A Narrative Review of the Literature and Discussion of 5 Controversial Topics. Kingeter AJ, Kingeter MA, Shaw AD. Cardiothorac Vasc Anesth. 2018;32(5):2054. Epub 2018 Mar 13.**

DEFINITIONS:

ATTACHMENTS: **N/A**

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REPLACES:

EFFECTIVE:

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **GENERAL PRINCIPLES OF ASEPTIC TECHNIQUES AND STANDARDS PROTOCOL FOR PERFUSION CIRCUIT**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To provide a consistently germ-free perfusion circuit for patients undergoing extracorporeal circulation.

It is the responsibility of the perfusionist of record to ensure the complete, appropriate, aseptic assembly and priming of the extracorporeal circuit prior to placing the patient on cardiopulmonary bypass.

PROCEDURES

A. All components used in an extracorporeal bypass circuit are guaranteed sterile and pathogen free by the manufacturer or vendor on the product. The perfusionist checks the expiration date on all the components. Any component that has reached its expiration date will not be used.

B. Any component with questionable sterility will not be used in a patient circuit.

C. Each component will be inspected for physical damage or abnormality. Components found to be damaged or to be missing pieces will be returned to the vendor for replacement or credit.

D. The process of opening or removing components from packaging will be done using aseptic technique.

E. The non-sterile perfusionist, in assembling the perfusion circuit will use aseptic technique.

F. Each component in a circuit with a high probability of harboring very small or microscopic amounts of air will be subject to a carbon dioxide purge.

G. All high-pressure connections will be tie banded.

H. To verify the integrity of the heat exchanger, the heat exchanger will be pressure tested prior to the addition of any fluid into the perfusion circuit.

I. The perfusion circuit will be primed with a crystalloid solution. This will be allowed to recirculate for at least five minutes through a prebypass filter.

J. The entire circuit will be debubbled by rapping the tubing and components with a line clamp or percussion hammer. Particular attention will be paid to the oxygenator, heat exchanger, arterial filter, arterial line segments and connectors.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

ATTACHMENTS: **N/A**

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06/08/2021	**Operative and Other Invasive Committee** Applicable Administrator, Hospital or Medical Committee
06/08/2021	**Pharmacy and Therapeutic Committee** Applicable Administrator, Hospital or Medical Committee
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06/17/2021	**Medical Executive Committee** Applicable Administrator, Hospital or Medical Committee
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REPLACES:

EFFECTIVE: _____

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **AUTOLOGOUS PRIME (RAP)**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Retrograde Autologous Priming (RAP) is a technique in which, after heparin is administered and the aorta is cannulated, blood is allowed to flow, in a retrograde manner, down the aortic line and displace the prime in the circuit. The prime is removed from the circuit and either discarded or placed in a sterile bag for later infusion into the patient if needed. The venous line's prime is also shunted and discarded or placed in a sterile bag. The goal is to remove as much of the crystalloid component of the prime as possible without jeopardizing the patient's hemodynamics or safety. Removing crystalloid will reduce hemodilution, help preserve oncotic pressure, reduce patient's exposure to blood products, reduce need for blood transfusions and thereby reduce burden on blood bank, and reduce the cost by reducing need for blood transfusion

A certified cardiovascular perfusionist, a board eligible perfusionist under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Technique

A. Patient is heparinized
B. Patient's aorta is cannulated
C. Manifold tubing from oxygenator is clamped
D. Clamp is placed on tubing between Centrifugal pump and Oxygenator
E. Manifold tubing from oxygenator is connected to a sterile Isolyte bag
F. Clamp is removed from manifold tubing and the prime is slowly bled back into the Isolyte bag. If patient is stable, once blood starts to be removed from the RAP line, exsanguinate the blood into a transfusion bag for later re-infusion.
G. Before going on bypass, the venous line can be RAP'd by draining the venous line prime into an Isolyte bag through a veno-set.
H. Once the Venous line is full of blood, you are ready to initiate cardiopulmonary bypass.
I. Prime that is taken off into a sterile Isolyte bag can be hung back up for re-infusion if needed.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **AUTOTRANSFUSION**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Perioperative autotransfusion refers to the recovery, washing and reinfusion of blood lost during emergent or elective surgical procedures. With regard to these Standards, autotransfusion is defined as a cell centrifugation and washing device. Blood is collected in a filtered cardiotomy and is then subjected to a process of separation, concentration, and washing by the Continuous Autotransfusion System (Autolog, Medtronic) for subsequent re-infusion to the same patient.

Perioperative autotransfusion will be performed by a certified clinical perfusionist or a board eligible perfusionist.

PROCEDURES

I. Indications for Use

Intra-operative autotransfusion is the ideal transfusion method in the following surgical specializations:

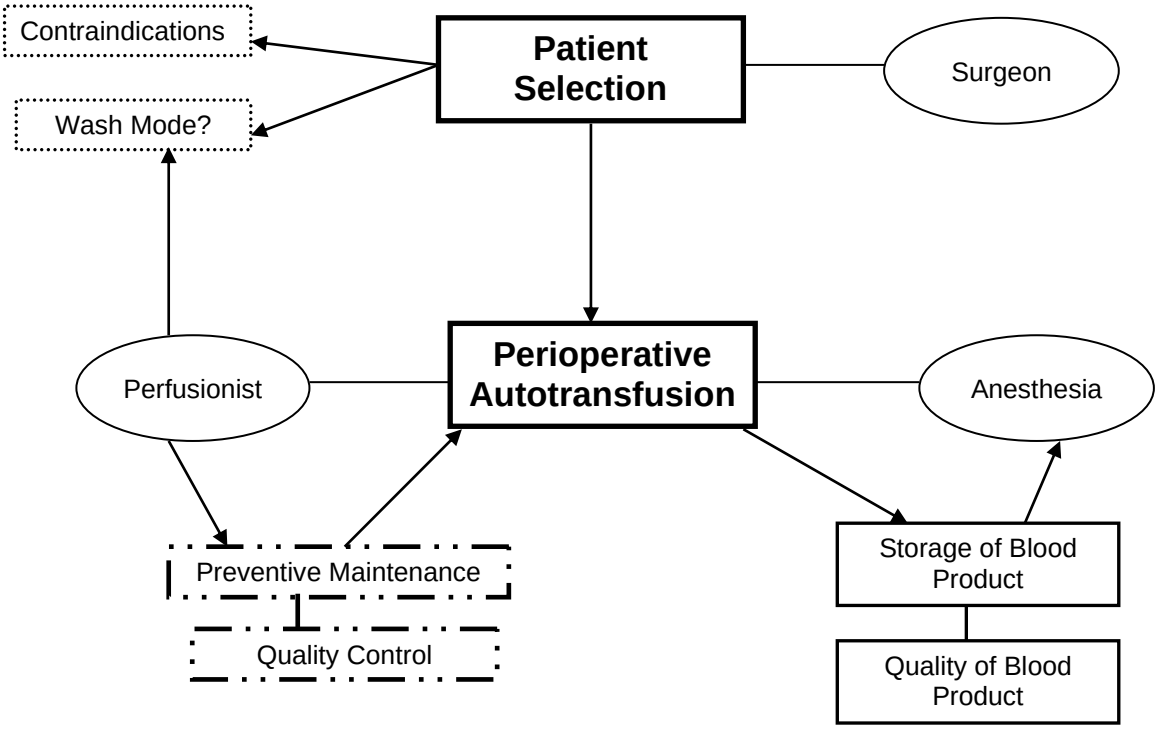
A. Cardiovascular surgery
B. Orthopedic surgery
C. Thoracic surgery
D. Emergencies
E. Transplantation
F. Neurosurgery
G. Urological surgery
H. Obstetrical-gynecological surgery

II. Contraindications for Use

Intra-operative recovery of blood together with the following substances is contraindicated:

A. Topical hemostatic agents
B. Fibrin glue thrombin
C. BioGlue
D. Avitene
E. Amniotic fluid
F. Betadine-based solutions
G. Intestinal contents
H. Bile
I. Pancreatic juice
J. Gastric fluids
K. Antibiotics not licensed for parenteral use
L. Methylmethacrylate
M. Urine

PROCESS:



III. Perfusion Coverage

A. The Perfusion Department will provide 24-hour personnel coverage for all cardiothoracic procedures requiring cell savers.

B. The perfusionist on call will be assigned to the cardiothoracic case requiring autotransfusion and should be notified by the OR desk/ Charge Nurse. Generally, the perfusionist pager number and phone number are written on the call board of the OR.

C. The Perfusionist will be available within 30 mins of being called.

IV. Autotransfusion:

A. The red blood cells obtained through autotransfusion will be administered to the patient within four hours from the end of processing.

B. Red blood cells obtained through the process of autotransfusion will be administered at the discretion of the surgeon, anesthesiologist, and perfusionist with respect to the clinical scenario.

C. The Medtronic autoLogTM will not be used for direct patient reinfusion (i.e. from the machine directly to the patient). Reinfusion of washed red cells should be carried out by gravity after transferring the processed blood to a blood transfer bag. Do not directly reinfuse processed blood from the holding bag to the patient. Directly reinfusing the blood from the holding bag exposes the patient to the risk of air embolism.

D. Pressure bags will ***not*** be used to infuse any blood products.

E. Blood warmers may be used at the discretion of the Anesthesiologist.

F. With the exception of 0.9% sodium chloride, USP, drugs or medications shall not be added to perioperative products intended for transfusion unless one of the following applies:

1. They have been approved for this use by the FDA.
2. There is documentation available to show that the addition is safe and that it does not adversely affect the perioperative product.

V. Equipment and Supplies

A. Medtronic Autolog console
B. Medtronic wash kit (reservoir, process kit, and aspiration line)
C. Wall vacuum with regulatory device
D. (1) 18-inch suction line
E. (1) One liter bag of 0.9% Sodium Chloride
F. (1) Two liter bottle of 0.9% Sodium Chloride
G. 30,000 units of Heparin
H. 600ml transfer bags
I. Autotransfusion record and charge sheet

VI. Equipment Set-Up

A. Hang 2L saline wash solution on the lower IV pole hanger.

B. Open the wash kit, remove the holding bag and hang it on the upper IV pole hanger. Close the clamps.

C. Remove the waste bag from the wash kit, verify that the drain valve is closed and install the waste bag on the posts provided at the side of the autoLog (volume markers facing away from the machine).

D. Make sure no dust, dirt or other foreign material is in the centrifuge chamber or in the air detector tubing guide.

E. Place the bowl into the chamber with the side tubing facing the waste bag. Align the centrifuge notches with the openings on the wings of the centrifuge bowl. Press down and turn clockwise to lock the bowl in place.

Make sure that the bowl is completely inserted. Remove, clean, and reinsert if necessary.

F. Connect the side (waste) tubing to the waste bag. **Confirm that there are no kinks in the tubing.**

G. Place your thumb into the pump lever groove and open the pump lever in the direction of the arrow while holding the machine firmly. Place the pump header tubing into the space between the pump head and the pump lever. Stretch the tubing over the pump outlet tubing guide and into the groove to engage the pump header positioner in the socket. Once the tubing is correctly inserted, release the pump lever to complete installation.

H. Insert the pump header tubing into the air detector guide. It is important to fully insert the tubing into the guide.

I. Open the valve lever while holding the machine firmly. Place the manifold into the opening between the lever and the valve head with the three tubes towards the back of the machine and the bevel on top. Once the manifold is correctly inserted, release the valve lever to complete the installation. Each of the three tubes should be in its own guide and the manifold should be partially covered by the valve lever.

Confirm that there are no kinks in the tubing. Correct if necessary.

J. Press the Go key. The machine will perform a complete rotation of the valve head. The machine will display “CONNECT SAL, HOLDING, RESERVOIR AND WASTE”.

K. Verify connection of kit to holding bag.

L. Spike the middle manifold tubing into the saline bag. Release the saline clamp.

M. Connect the bottom manifold tubing to the remaining port on top of the reservoir cover.

N. Set-up of the disposable components is now complete.

O. Press GO to confirm completion. The machine will prime the system with a small amount of saline and place the machine into standby. The display will read: “Stop 0 ml 0 ml”. In the standby mode the machine will not start automatically.

P. To move the machine out of the standby mode and into automatic mode, press the Go key. The display will read: “MACHINE READY 0 ml 0 ml”.

VII. Anticoagulation Guidelines

A. Add 30,000 units of heparin to one liter bag of 0.9% Sodium Chloride.

B. As a general guideline, the flow of heparinized saline is regulated so that approximately 15mL are added to each 100mL of collected blood (1:7 ratio of heparin solution to blood).

VIII. Perioperative Conduct

A. The Perfusionist shall perform perioperative autotransfusion services at the request of the physician/surgeon.

B. The Perfusionist performing perioperative autotransfusion shall complete their checklist prior to the procedure.

C. Obtain one end of the aspiration line from the operating field and connect it to a filtered port on the cardiotomy reservoir.

D. Attach the spike of the suction set to the heparinized 0.9% Sodium Chloride flush.

E. Turn on the vacuum and adjust the suction to a level of -100 to -150mmHg. Do not go beyond -150mmHg as this can damage red blood cells.

F. Flush the suction line with 100-150mL of the heparinized saline. Adjust the heparinized saline to drip at a rate of 15mL saline for each 100mL of blood collected in the cardiotomy.

G. The continuous blood processing procedure can be started by pressing the Start key (Green Button).

H. Utilize the Autotransfusion Record and record the time, and volume of RBC's.

I. The washed cells are given to the anesthesia for re-infusion.

J. Label the autologous blood product with the following information:

1. Patient name
2. Patient hospital identification number
3. Date and time collected
4. Expiration time (four hours from the end of processing)
5. Volume collected
6. Type of product
7. Perfusionist's initials

K. When the procedure is completed, make sure the Autotransfusion Record and Charge Sheet are properly completed and signed by the perfusionist(s) involved.

IX. Storage of Blood Product

Blood can be stored at room temperature and should be re-infused within four hours from the end of processing. Blood salvaged in the operating room or intensive care unit should not be sent to the blood bank.

X. Post-Operative Conduct

Disposal of Contaminated Supplies

A. Follow guidelines set forth by hospital policy.

B. Practice universal precautions while disposing of cell saver disposables at the end of the case.

C. Obtain Red bin with double bags from OR; dispose of all disposables in the red bin.

XI. Cleaning and Disinfecting

To ensure the proper and safe operation of the Autolog device, the system must be kept clean at all times. In order to be cleaned and disinfected, the device must be turned off and disconnected from

the external power supply. In general, a mild cleaning agent should be used to clean the device. In order to be disinfected, the Autolog device must be wiped using a cloth soaked with disinfectant.

Caution: Only disinfectants on an alcoholic base must be used.

XII. General Warnings and Precautions

A. Inadequate washing can result in a blood product containing significant free hemoglobin and reinfusing such a blood product can result in renal damage.

B. Infusion of blood salvaged from a contaminated wound can lead to sepsis.

C. Dissemination of malignant cells is a theoretical complication if tumor cells are salvaged and re-infused.

D. It is strongly recommended not to exceed -150 mmHg negative pressure during blood aspiration from the operating area. An excessive negative pressure causes hemolysis in the recovered blood.

E. The manufacturers recommend use of a micropore filter for re-infusion of washed cells to the patient

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

ATTACHMENTS: **N/A**

APPROVAL DATE:

N/A	**Policy, Procedures and Standards Committee**
06/22/2021	**Nursing Standards Committee** Applicable Administrator, Hospital or Medical Committee
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06/17/2021	**Medical Executive Committee** Applicable Administrator, Hospital or Medical Committee
	Board of Supervisors Approved by the Governing Body

REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **BREAKDOWN AND DISPOSAL OF PERFUSION CIRCUIT**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To establish procedures to prevent unnecessary exposure of personnel to infectious materials and to prevent contamination of the environment.

Every disposable piece of the extracorporeal circuit must be disposed of at the end of every surgery. Any piece of equipment that has been attached to the circuit, but not used i.e. hemoconcentrator, is deemed contaminated and cannot be used on another patient. Arrowhead Regional Medical Center will follow waste handling procedures, which comply with accepted medical practice and standards and all government regulations.

PROCEDURES

I. Break Down of Circuit

A. Perfusionist or assistant must wait until the surgeon has placed wires in the patient's chest.
B. Perfusionist must analyze the patient's status to confirm that it is safe to dispose of circuit.
C. The cooler/heater must be turned off and the water lines should be emptied and removed.
D. All clamps and monitoring equipment, that is not a disposal, must be removed.
E. The sucker and vent lines should be removed from raceways.
F. The cardioplegia system should be removed.
G. Entire circuit must be thrown away into a proper designated receptacle that is labeled for hazardous waste.
H. The lines must be taken from the table and thrown away with the rest of the circuit.
I. Because the circuit is now contaminated and thrown away, the perfusionist must be ready to set up a new circuit at a moment notice in case of an emergency.
J. If an autotransfusion circuit was used, it cannot be disposed of until all the processable blood has been washed and put in a transfer bag. The collection cardiotomy cannot be disposed of until the surgeon is done using the suction. After this, the components can be disposed in a proper designated receptacle labeled for hazardous material.
K. If the autotransfusion circuit was not used and has had no contact with any other part of the circuit or exposure to the patient's blood or fluids, then it can be covered up and saved for another patient.
L. If only a collection cardiotomy was used without being attached to an autotransfusion circuit, then the cardiotomy cannot be disposed of until the surgeon is done using the suction.

II. Disposing of Perfusion Circuit

A. Solid waste materials are placed in waste receptacles lined with disposable plastic liners.

B. Infectious waste is double bagged in distinctive red plastic bags as directed by the Infection Control Manual. This material is destroyed by sterilization.

C. Disposable syringes with needles, scalpel blades and other sharp items are placed into puncture resistant containers and destroyed by sterilization.

D. Personnel involved in handling and disposal of infectious materials are informed of the potential health and safety hazards and trained in appropriate handling and disposal methods.

E. Waste disposal bags are securely closed and transported in carts specifically designated for that purpose. Prior to sterilization, bagged waste is held in the red containers.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **CARDIOPLEGIA ADMINISTRATION USING MPS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To deliver cardioplegia solution according to the surgeon's protocol during Cardiopulmonary bypass.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. PRESSURE vs. FLOWRATE ADMINISTRATION

It is extremely important to regulate pressure and flow rate, however, more important is the pressure. Do not exceed a MPS pressure of 200 mmHg antegrade or coronary sinus pressure of 60 mmHg retrograde. Higher pressures may rupture the coronary sinus, thus requiring immediate surgical repair. Flow rates range between 150-400 ml. depending on the administration route if it is antegrade vs. retrograde.

Low coronary sinus pressures with higher flow rates are usually indicative of a misplaced retrograde coronary sinus cannula.

II. INITIAL DELIVERY OF CARDIOPLEGIA AND SUBSEQUENT ADMINISTRATION

A. Deliver approximately 500 ml. of cold blood cardioplegia antegrade not to exceed a line pressure of 200 and K+ of 25 Meq/l. (Upon surgeon request a warm antegrade and retrograde cardioplegia induction may delivered for patient with recent MI).
B. Retrograde delivery of 1,000 ml of cold cardioplegia with coronary sinus pressure that may not exceed 60mmHg.
C. Subsequent doses are administered antegrade and/ or retrograde (see surgeon preference) every 10-20 minutes.
D. Subsequent doses of 400-800 ml. antegrade or retrograde taking into consideration K+ concentration and adjusting it as needed.

III. MYOCARDIAL ELECTRICAL ARREST

A. Myocardial electrical arrest should be achieved within 300-500 ml. of antegrade cardioplegia. However, there are four possibilities may exist for not achieving cessation of myocardial activity within the prescribed time frame:

1. Significant antegrade coronary stenosis, thus requiring retrograde administration to achieve arrest.

2. Aortic valve insufficiency
3. normothermic cardioplegia delivery temperature
4. Improperly prepared mixtures

B. Upon completion of the vein grafts, antegrade Cardioplegia is given through the graft at a pressure no greater than 150 mmHg.
C. Initial flow through a graft should not exceed 15 ml/MIN until surgeon is prepared measure the graft flow. When volume is requested to size the vein, the aortic root vent is shut off.
D. Retrograde Cardioplegia delivery is initiated with the vent off to allow the aortic root to fill with blood. Upon proximal hole punch completion, the aortic root vent will be requested to be turned back on again.
E. Remind surgeon that the vent is off when beginning retrograde Cardioplegia delivery and again every 150 ml until requested to resume venting the aortic root to prevent LV distention.

IV. HOT SHOT

A. Cardioplegia temperature mode should be changed to warm (37°C).
B. Arrest agent is set to zero.
C. The delivery of warm blood retrograde or antegrade is initiated right before cross-clamp is taken off.
D. Warm blood dose could be 500ml or more, keep delivering the warm blood until the cross clamp is off the aorta.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS: **MPS = Myocardial Protection System**

ATTACHMENTS: **N/A**

APPROVAL DATE:

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **CARDIOPLEGIA SETUP AND PRIMING**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To Setup and Prime Quest Myocardial Protection System (MPS) following standard protocol as outlined in the Instructions for Use of the MPS.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. In general, each perfusion procedure will have the MPS set-up with the following cartridges:

A. Main Delivery Set
B. Arrest Agent Pouch
C. Additive Pouch
D. Single Delivery Line

1. Prime
   a) Crystalloid Source
   b) Prime the MPS with the prime solution.

2. Blood Source
   a) The blood source line from the MPS is connected aseptically to the cardioplegia port of the membrane oxygenator.

3. Arrest Agent
   b) Fill arrest agent pouch with 40 ml of potassium chloride (2 mEq/ml).

4. Additive Agent
   c) Fill additive pouch with 44 ml of Dextrose 5%, 2g of Magnesium Sulfate, and 20mg of Dexamethasone.

II. Initiate priming protocol on the MPS by setting the following initial parameters:

Parameter	Set To
1. Antegrade Pressure Source	System
2. Blood Crystalloid Ratio	blood only
4. High Arrest Delivery Content	25 mEq
5. Low Arrest Delivery Concentration	5 mEq
6. Additive Delivery Concentration	6 mL/L

7. Warm Delivery Temperature 37°C
8. Antegrade Upper Pressure Limit 300 mmHg
9. Antegrade Lower Pressure Limit 10 mmHg
10. Retrograde Upper Pressure Limit 200 mmHg
11. Retrograde Lower Pressure Limit 10 mmHg

Continue with prime sequence by using Autopurge to evacuate air from water lines and prime circuit.

III. Priming of the Cardioplegia Delivery Line

During prime circulation, keep MPS running at 200 ml/min, to able to prime MPS with patient's blood, once you initiate bypass. After priming the MPS with patient's blood, prime the delivery line to the field once surgeon asked for it. It is usually done after bypass initiation and right before X-clamping of the Aorta.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **CARDIOPULMONARY SUPPORT (CPS)**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To provide immediate cardiopulmonary support (CPS) as an effective means of resuscitating patients in need of urgent cardiac support. Emergent use of CPS can be effective in the following clinical situations: accidental hypothermia, drug overdose, failed PTCA, cardiogenic shock and/or cardiac arrest.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a perfusion student both of whom under the direct supervision of a certified perfusionist should perform this procedure.

PROCEDURES

I. Equipment

A. A dry CPS circuit without an oxygenator or heat exchanger will be setup, draped, and stored in the sub-sterile room between OR 4 & 5 at all times in preparation for its emergent use. The machine will remain plugged in to provide maximal battery power during transport. The CPS cart will be stocked with all necessary equipment including, but not limited to, the following:

1. Sterile Maquet Quadrox D oxygenator with integral heat exchanger
2. Femoral arterial and femoral venous cannulas
3. Isolyte Ph 7.4 solution for priming
4. Clamps

II. Procedure

A. Circuit: Upon notification for the need of CPS, the perfusionist will modify the CPS circuit for the intended procedure (oxygenator insertion, blood gas monitoring, etc.). If time allows, the circuit will be flushed with CO2 to assist in deairing. The circuit will be primed in a sterile fashion utilizing the Isolyte PH 7.4 solution provided on the CPS cart. Depending on the emergent nature of the situation the prime solution may be less than physiologic upon initiation. If this is the case, all attempts will be made to correct physiologic variables once CPS has been initiated and the patient is hemodynamically stable.

B. Temperature: The temperature of the prime solution will be dependent on the clinical scenario, although normothermia is most common.

C. Cannulation: Femoral cannulation is most common although atrial-aortic cannulation may be necessary for the smaller patient (<20kg).

D. Heparinization: Heparinization will be performed according to the clinical situation and at the discretion of the perfusionist and physician. ACT monitoring will be performed to assure adequate anticoagulation.

E. Flow: Pump flow will be determined based on the clinical scenario, patient size, patient hemodynamic variables, and oxygenation status in conjunction with arterial and venous blood gases sent to lab.

F. Ultrafiltration: An ultrafiltration device can be added to the CPS circuit in an effort to manage volume and/or metabolic imbalances as determined by the perfusionist and physician.

G. Safety Devices: Pressure alarms and temperature sensors will be used on all cases.

H. Coagulation monitoring: All coagulation and patient hemostasis will be guided by ACT monitoring and labs.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **EMERGENCY CARDIOPULMONARY BYPASS PREPARATION**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The necessity to initiate cardiopulmonary bypass or extracorporeal support in an emergency situation is an ever-present element of cardiovascular surgery. In an emergency situation, the clinical picture will dictate the response of the cardiopulmonary perfusionist staff. While the situation may be chaotic, the perfusionist will utilize as many safeguards as possible and employ a heightened level of vigilance, as patient safety is the paramount concern.

This procedure should be performed by a certified cardiovascular perfusionist, a board eligible perfusionist, or a perfusion student, both of whom are under the direct supervision of a certified cardiovascular perfusionist.

PROCEDURES

I. Procedure

A. In an emergency situation, it may be necessary to deviate from the normal initiation procedure. For example:

1. The perfusion arterial filter may be flushed with CO2 or not.
2. The prime solution may be less than physiologic.
3. The initiation procedure may be abbreviated and/or a very rapid increase of extracorporeal support may be required.

Attempts will be made to correct the situation once bypass has been established and the patient is in a stable state.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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DEFINITIONS:

ATTACHMENTS: **N/A**

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **EMERGENCY INITIATION OF CARDIOPULMONARY BYPASS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The perfusionist must always be prepared for an emergency. In case of an emergency due to patient status, the perfusionist might be in a situation where he/she would have to "crash on." Depending on whether a set and/or primed pump availability will decide the steps that should be taken to crash on if need at the discretion of the primary perfusionist assigned to the case. The safety of the patient will always be the number one priority.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. For all cases the optimal Activated Clotting Time (ACT) is a minimum of 480 seconds before bypass can commence. In the situation of an emergency the ACT can be a minimum of 300 seconds before bypass can begin if the patient status is too severe to wait. ****TO BEGIN BYPASS AT ANY ACT LOWER THAN 300 SECONDS, AFTER THE FULL HEPARIN DOSE HAS BEEN ADMINISTERED, WILL BE AT THE COMPLETE FULL DISCRETION OF THE SURGEON.**

II. If there is a pump that is already set up and primed (ready for bypass), then the perfusionist will make sure that the anesthesiologist gives the appropriate heparin dose for initiating bypass. Meanwhile heparin is being administered, the perfusionist will check off on the steps on the emergency checklist. If every item on the list can be checked off, then the perfusionist should be ready to initiate bypass.

III. If there is a pump set up but the perfusionist has not had the opportunity to prime the circuit, they will do so as quick as possible. The prime should be dropped as the perfusionist confirms with anesthesia that the full initial heparin dose is given. The amount of crystalloid that will be dropped and the drugs that are administered to the prime will depend on the severity of the situation, therefore the amount of time the perfusionist has to prepare and what they feel is best for the patient. Once the circuit is fully primed with at least crystalloid, then the perfusionist should check off on the items on the emergency bypass list. Once all the items on the list have been checked off, the perfusionist should be ready to initiate bypass.

IV. If there is no pump set up at all then the perfusionist will set up the circuit with the components that time allows. There should be a minimum of the venous reservoir, oxygenator, centrifugal pump or tubing in roller head, arterial line filter, arterial line pressure reading, and A-V loop. Any other components set up will depend on time allowed and is at the discretion of the perfusionist. All other components of the ECC can be added on later while on bypass or if the opportunity presents itself. Once the circuit is set up the perfusionist will prime with at least crystalloid. The perfusionist will confirm with anesthesia that the full initial heparin dose is administered. Once the perfusionist is able

to check off all the items on the emergency bypass checklist, then they should be ready to initiate bypass.

V. Every “stand-by” case or “off pump” case will have at least an un-primed circuit set up ready to prime in case of an emergency. The surgeon may request to have a primed pump ready for stand-by as well. If the circuit has not been used and has stayed sterile, it may be covered up and used on another patient.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **EXCESS VOLUME IN PERFUSION CIRCUIT**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Excessive volume in the perfusion circuit may be caused by a patient in congestive heart failure, unintentional administration of a large fluid volume by intravenous administration, return to the perfusion circuit of slush solution from the surgical field, or by the addition of too much crystalloid by the perfusionist. Other possible causes are a heat exchanger leak whereby water enters the perfusion circuit, or excessive use of vasoconstrictive agents. The source of the excess volume must be identified before the problem can be solved.

A certified cardiovascular perfusionist, a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Guidelines

A. If the volume is so large that the cardiotomy/venous reservoir is full, it will be necessary to either splice in a second cardiotomy reservoir or pump volume from the recirculation line to an empty prime bag.
B. If the excessive fluid is a result of the addition of crystalloid solution to the circuit, it should be removed by means of a hemoconcentrator.
C. If the fluid is due to excessive patient's blood volume, it should be sequestered until the end of bypass when it may be needed. If it is not needed, then it too should be hemoconcentrated.
D. If the fluid is due to water to blood leak from the heat exchanger, the oxygenator must be changed out. See the specific protocol for treatment of a leaking heat exchanger.
E. Monitor and correct the hematocrit as indicated.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **FEMORAL VEIN TO FEMORAL ARTERY BYPASS GUIDELINES**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Distal perfusion with an extracorporeal circuit is one of the techniques available for surgery on the descending and thoracoabdominal aorta. During the period of aorta cross clamping, distal perfusion provides blood flow to the lower intercostals and lumbar arteries and may reduce spinal cord ischemia that results when the segments of the thoracic aorta are excluded by clamping. Distal aortic perfusion will also provide protection to the kidneys, liver and gastrointestinal tract as long as the aortic disease does not extend below the celiac or superior mesenteric artery. This technique also provides support to the patient who has had a circulatory collapse and is unable to maintain his own perfusion.

A certified cardiovascular perfusionist or a board eligible perfusionist should perform this procedure, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist.

PROCEDURES

I. Requisites:

A. Total cardiopulmonary bypass circuit:
- 1 Femoral venous cannula – surgeon preferences.
- 1 Femoral artery cannula – surgeon preferences.
- 1 3/8” LL connector and sterile lock units
- 1 3/8” x 3/8’:x ½” Y connector
- 1 3/8” x 3/32” x 2’ sterile tubing

B. Set up cardiopulmonary bypass circuit according to department policy.

II. Perfusion for Surgery on the Descending Aorta

A. Two arterial lines are necessary in order to monitor the proper parameters.
One should be placed in the radial artery monitor the pressures above the aortic clamp and one should be placed in the femoral artery opposite from the arterial line from the Cardiopulmonary Bypass (CPB) circuit. This line will monitor pressures below the aortic clamp.

B. Initiate bypass slowly watching the arterial line pressure for a sudden rise that could indicate a femoral artery dissection.

C. Flow as high as the venous return will allow. The projected flow rate is between 20 – 40 ml/kg to provide adequate flow to the lower body. Adjust the flow to regulate the blood flow to the upper body. Maintain upper body systolic blood pressures above 80mm/Hg.

****Regulating the upper body pressure takes communication between the perfusionist and the anesthesiologist.**

D. Full heparinization is required. Follow routine perfusion standards of practice established ARMC for monitoring blood gases and anticoagulation protocols.

E. Shed blood can be returned to the circuit or an autotransfusion reservoir by suction.

F. Once the patient is heparinized and cannulated initiate CPB slowly, closely monitoring the arterial line pressure for any sudden rise, an indication of femoral artery dissection.

G. Adjust the flow rate according to the rate of venous return. Adjust for any hypovolemia that may have occurred.
**** Flow rates lower than usual on full CPB are normal if the patient is partially supporting himself.**

H. Monitor the patient parameters as one would on full CPB.

I. At the appropriate time, the patient will be converted to full CPB

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

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REPLACES:

EFFECTIVE: _____ **REVISED**: _____

REVIEWED: _____

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **GENERAL STANDARDS FOR PERFUSION SERVICES**

POLICY

The perfusionist responsibility to assure that patient safety is guaranteed at all times. Patients who undergo open-heart surgery are at increased risk for hemodynamic instability. The heart-lung machine provides vascular support in the event of cardiovascular collapse or shock.

A certified cardiovascular perfusionist or a board eligible perfusionist under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. A functional heart-lung machine is readily available at all times

A. Assure that a standard adult perfusion circuit is assembled on one or two heart-lung machines, located either in the Work Room, or in designated operating room 4 at ARMC. The circuit must be available at all times during normal work hours, assembled circuits utilized for scheduled cases in the aforementioned room will meet this requirement.

B. Assure that appropriate perfusionist staffing is maintained during normal work hours. Emergent conditions will preempt scheduling made the day prior, and always take precedence.

C. During the work week (Monday through Friday), on call perfusionist will cover all surgical procedures that require perfusionist intervention from 5PM until 06:30 AM and be available to respond within 30 minutes of notification.

DEFINITIONS: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **GUIDELINES DEEP HYPOTHERMIC CIRCULATORY ARREST (DHCA)**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Deep Hypothermic Circulatory Arrest (DHCA) will be utilized during procedures where flow to the upper extremities, including the head vessels needs to be terminated. This is usually during repairs of the ascending aorta if the head vessels are involved in the repair. DHCA is a means of preserving the cerebral function by reducing the metabolism to very low levels. At the discretion of the surgeon, reduce the patient's body temperature and discontinue cardiopulmonary bypass for a period of circulatory arrest, so that the surgeon may operate in a bloodless field. The length of the arrest period is debatable, but at a temperature of 18 – 22°C, 40 – 60 minutes is considered safe before any organ damage occurs.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Equipment

Typical cardiopulmonary bypass circuit set-up and assembly.

II. Procedure

A. Heparin is administered and adequate Activated Clotting Time (ACT) (> 480 seconds) is obtained.
B. Femoral arterial cannulation and femoral venous cannulation. The venous line may be "y'd" so that another cannula can be put into the right atrium to increase venous return.
C. Initiate cardiopulmonary bypass and begin cooling to 18-20°C prompted by the surgeon.
D. The patient's hematocrit should be lowered along with the temperature. Usually for adults – a hematocrit of 18 – 20ºC is sufficient.
E. Ensure that anesthesia has placed ice on the patient's head.
F. Maintain typical Cardiopulmonary Bypass (CPB) management while patient is being cooled to prepare for DHCA.
G. While patient is being cooled, the surgeon is preparing the graft by sewing on a sidearm that will be used for cannulation once the patient is off of DHCA and re-warming.
H. Once the graft has been prepared and the patient is cool, the cross-clamp is applied and retrograde cardioplegia is administered.
I. When the desired temperature is reached, upon the surgeon requests the Heart-Lung Machine is turned off, the patient is exsanguinated, and the venous line is clamped.
J. The Surgeon prepares the patient for delivery of Retrograde Cerebral Perfusion. **See Retrograde Cerebral Perfusion Policy 328.00.**

III. Conduct of Perfusion

A. During the period of DHCA
   1. ACT's are monitored at 20-minute intervals
   2. Blood flow through the oxygenator by flowing through the recirculation line. This is maintained to avoid stagnation.
   3. Documentation is continued at 15-minute intervals and any event is recorded.
   4. Surgeon is notified of arrest time at 15-minute intervals.

IV. Pharmacology

A. Consult with the surgeon and/or anesthesiologist about the administration of steroids before going on bypass.
B. 50 Meq of NaHCO3 upon resumption of CPB or as indicated by blood gas results.

V. Cardioplegia

A. Inform the surgeon at 15-minute intervals of myocardial ischemia.
B. Give additional Cardioplegia when ordered by the surgeon and always be aware of the mode of delivery of cardioplegia (antegrade, retrograde, or ostial).

VI. Re-initiation of Cardiopulmonary Bypass

A. The aortic cannula may be returned to the original, a repositioned cannula or removed from the femoral artery and re-inserted into the sidearm of the woven graft. This will allow the restoration of blood flow through the head vessels while the distal aorta is still clamped.
B. At the discretion of the surgeon flow is re-instituted, probably without the venous line. Once the venous line is open and full flow can be achieved, re-warming begins.

VII. Re-warming

A. Re-warm while maintaining no more than a 6°C gradient between the venous blood and water bath temperatures. Do not exceed a warming rate greater than 0.5 °C per minute. Never let arterial blood temperatures exceed 37.5 °C.
B. Increase the hematocrit as the patient's temperature increases; try keeping the hematocrit and temperature the same until a hematocrit of 24% is reached.
C. Hemoconcentration and the use of diuretics indicated to elevate the hematocrit.

REFERENCES:

Davies LR. Hypothermia: Physiology and Clinical Use. Cardiopulmonary Bypass Principles and Practice, Gravlee GP, 'Davies RF, Utley JR, (eds). Baltimore: Williams & Wilkins, 1993 pp149 – 152.

Engelman R, Baker RA, Likosky DS, et al. The Society of Thoracic Surgeons, The Society of Cardiovascular Anesthesiologists, and The American Society of ExtraCorporeal Technology: Clinical Practice Guidelines for Cardiopulmonary Bypass--Temperature Management during Cardiopulmonary Bypass. J Extra Corpor Technol 2015; 47:145.

Saad H, Aladawy M. Temperature management in cardiac surgery. Glob Cardiol Sci Pract 2013; 2013:44.

Engelman R, Baker RA, Likosky DS, et al. The Society of Thoracic Surgeons, The Society of Cardiovascular Anesthesiologists, and The American Society of ExtraCorporeal Technology: Clinical Practice Guidelines for Cardiopulmonary Bypass--Temperature Management During Cardiopulmonary Bypass. J Cardiothorac Vasc Anesth 2015; 29:1104.

DEFINITIONS:

ATTACHMENTS: **N/A**

APPROVAL DATE:

N/A	**Policy, Procedures and Standards Committee**
06/22/2021	**Nursing Standards Committee** Applicable Administrator, Hospital or Medical Committee
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06/17/2021	**Medical Executive Committee** Applicable Administrator, Hospital or Medical Committee
	Board of Supervisors Approved by the Governing Body

REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: PATIENT CARE / PERFUSION **SUB SECTION:**

SUBJECT: GUIDELINES FOR PHARMACOLOGICAL SUPPORT

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Maintaining the patient's arterial pressure within normal limits is one part of the perfusionist's Scope of Practice. The patient's arterial pressure can be changed by altering the blood flow rate. However, there are safe limits as to how much the blood flow rate can be altered without adversely affecting the patient. Once the safe limits have been reached, then the addition of vasoactive drugs or volume replacement may be necessary to maintain patient's physiological function. All medications are given under the authority and guidance of an attending physician, who oversees the actions of the perfusionist.

A certified cardiovascular perfusionist or a board eligible perfusionist should perform this procedure under the direct supervision of a certified cardiovascular perfusionist. The primary perfusionist may administer the drugs found in the list of Physician Standing Orders. Medications not found in the Standing Orders may be given upon direct verbal order from the surgeon or anesthesiologist. At the conclusion of the procedure, the surgeon must sign the perfusion record indicating that he/she verbally ordered those drugs not found in the Standing Orders.

PROCEDURES

I. The following list contains medications that can be administered safely through the heart-lung machine.

Medication List	Common Volume
Albumin 5%	500 ml
Albumin 25%	100 ml
Aminocaproic Acid 250 mg/ml	40 ml
$CaCL_2$ 10%	10 ml
Dextrose 50% (50 g)	10 ml
Furosemide 10 mg/ml	2 ml
Heparin 1,000 units/ml	10 ml
Isoflurane	100 ml
Lidocaine 2% Syringe (100 mg)	5 ml
Magnesium Sulfate 50% (1 g)	2 ml
Mannitol 25% (12.5 g)	50 ml
MethylPREDNISolone	1 g
Milrinone 1 mg/ml	20 ml
Methylene Blue 1%	2 ml
Nitroglycerine 5 mg/ ml (50 mg)	10 ml
KCL 2 mEq/ml (20 Meq)	10 ml
Phenylephrine 1% (20 mg)	2 ml
Sodium Bicarbonate 7.5% (45 Meq)	50 ml
Thrombate III 500-650 units/vial (1,000 units)	2 vials

REFERENCES: **Guidelines for Conduct of Cardiopulmonary Bypass. Journal of Cardiothoracic and Vascular Anesthesia 2021, 5 (1-17)**

DEFINITIONS:

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: PATIENT CARE / PERFUSION **SUB SECTION:**

SUBJECT: HIGH SERUM POTASSIUM LEVELS GUIDELINES DURING CARDIOPLEGIA ADMINISTRATION

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

High serum potassium levels can be caused by an excessive administration of cardioplegia solution, administration of older units of red blood cells, patients in renal failure or uncontrolled diabetes. This procedure will provide some guidelines in the treatment of high serum potassium levels.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a perfusion student both of whom are under the direct supervision of a certified perfusionist should perform this procedure.

PROCEDURES

I. Guidelines:
   A. Be alert for any concomitant diseases that could predispose the patient to high serum potassium levels on cardiopulmonary bypass.

   B. If the administration of blood becomes necessary, administer the freshest blood available. If hyperkalemia is evident or expected, use washed red cells, if possible.

   C. Use of a hemoconcentrator will reduce the serum potassium level.

   D. Maintain renal function if possible, with the use of diuretics.

   E. Be attentive during the administration of cardioplegia especially on long procedures. Monitor the serum potassium level as clinically indicated.

   F. The following regimen can be given if the patient's temperature is above 30 degrees

      1. Dextrose or Glucose. This replaces the glucose that will be driven intracellular upon administration of insulin.

      2. NaHCO3 provides intracellular binding sites for the potassium in the form of potassium carbonate, to buffer the dextrose and to correct the acidosis resulting from the shift of hydrogen ions from intracellular to extracellular as electrical equilibrium is maintained.

      3. Insulin – Drives the potassium intracellular, resulting in insulating the myocardium from high potassium levels.

**** Be aware that this regimen may take up to 20 minutes to be effective.**

REFERENCES:

McCullough PA, Beaver TM, Bennett-Guerrero E, Emmett M, Fonarow GC, Goyal A, Herzog CA, Kosiborod M, Palmer BF. Acute and chronic cardiovascular effects of hyperkalemia: new insights into prevention and clinical management. Cardiovasc Med. 2014;15(1):11-23.

Mullane R, Fristoe L, Markin NW, Brakke TR, Merritt-Genore HM, Siddique A, Miles CD, Plumb TJ.J. Zero balance ultrafiltration using dialysate during nationwide bicarbonate shortage: a retrospective analysis. Cardiothorac Surg. 2019 Sep 10;14(1):163

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **INITIATION OF CARDIOPULMONARY BYPASS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The perfusionist will ensure that bypass is instituted in a gradual, safe manner with a circuit and priming solution that minimizes the physiologic disturbance of the patient.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure. Cardiopulmonary bypass will be initiated only on the order of the attending cardiac surgeon.

PROCEDURES

I. Procedure:

A. Slowly open the venous drainage line after ensuring that any clamps have been removed from the venous cannulae.

B. Simultaneously and gradually initiate forward flow from the oxygenator through the arterial cannula.

****Observation of the flow direction is critical.**

C. Gradually increase the flow rate to the targeted number as venous drainage and reservoir volumes allow.

D. Observe the pressure in the arterial line, with the pressure gauge. Look for any problems (high pressure, no pressure) possibly created by a mal-positioned cannula, kinked or a clamped arterial line.

E. Once the flow rate has been established, communicate with the surgeon and anesthesiologist that bypass has been safely established.

F. Perform appropriate laboratory tests once bypass has been established to confirm that adequate perfusion is being provided.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

ATTACHMENTS: **N/A**

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	Board of Supervisors Approved by the Governing Body

REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **JEHOVAH WITNESS PATIENT ON CARDIOPULMONARY BYPASS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To recognize, understand and respect the restrictions for blood use for patients who practice the religious practice of Jehovah's Witness (JW). Followers of this faith believe that blood removed from the body should be disposed of and they do not accept autotransfusion of pre-deposited blood. Techniques for intraoperative collection or hemodilution that involve blood storage are objectionable to them. However, many JW permit the use of dialysis and heart –lung equipment (non-blood prime) as well as intraoperative salvage where the extracorporeal circulation is uninterrupted; the physician should consult with the individual patient as to what his conscience dictates. The religious tenets of Jehovah Witnesses will be respected. The attending surgeon and anesthesiologist shall determine each patient's specific interpretation of their religious convictions to select the proper treatment.

A certified cardiovascular perfusionist or a board eligible perfusionist or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Cardiopulmonary Bypass (CPB) Consideration

A. Minimize CPB prime. A physiologic saline prime should be used (e.g. Isolyte) and the volume used should be minimized to prevent excessive dilution.

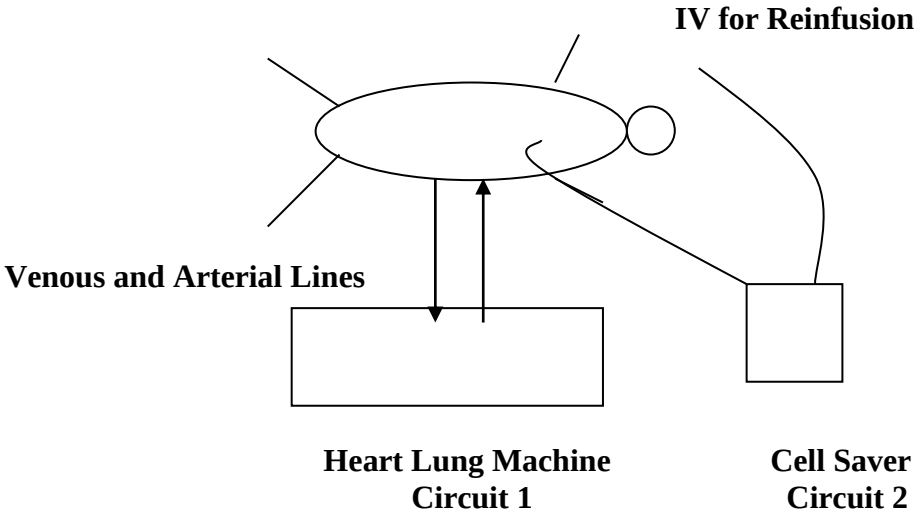
B. Employ diuretics if appropriate

C. If acceptable to patient, a unit of blood can be removed before commencement of CPB to be re-infused after bypass. Maintain an attachment to the patient via a continuous circuit. Volume can be re-infused during or at the termination of CPB.

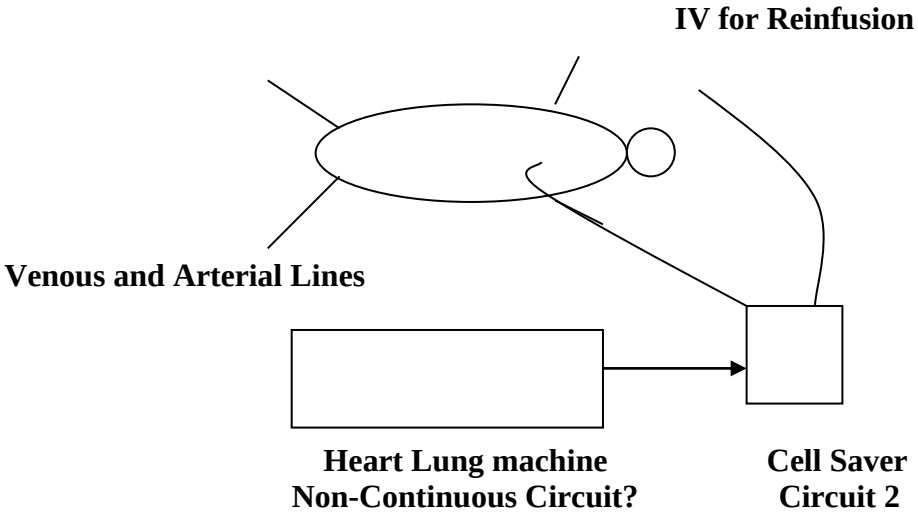
D. If washed autotransfusion blood is acceptable to the patient, connect the cell saver blood bag to the patient upon setting up the system to ensure the continuity of the circuit. This can be used to salvage as much blood as possible from the circuit and any blood loss that can be gathered pre and post bypass.

E. Adjuncts to lower prime, consider the use of ultrafiltration during the case to remove excess plasma water, and consider following the case to concentrate the pump prime to return to the patient postoperatively.

On CPB – Patient is Cannulated



Post CPB – Patient is Decannulated



REFERENCES:

Prasad SJ, Nair P, Gadhvi K, Barai I, Danish HS, Philip AB. Cultural humility: treating the patient, not the illness. Med Educ Online. 2016;21(1):30908.

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **LEFT HEART BYPASS GUIDELINES**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The incidence of paraplegia following surgical repair on the descending aorta is well documented in the literature. Shunting the blood to maintain a pressured in the distal aorta is one treatment in an attempt to prevent spinal cord ischemia. Left heart bypass diverts the blood from the patient's circulation after it has passed through the lungs by cannulating the left atrium and returning it to the arterial system via the femoral artery. The use of heparin bonded circuits alleviates or minimizes the use of heparin during the procedure. This is thought to help in reducing the amount of postoperative bleeding.

This procedure is usually performed with the use of a centrifugal pump. See previous section titled Thoracic Aneurysms for the set-up procedure.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a perfusion student both of whom under the direct supervision of a certified perfusionist should perform this procedure.

PROCEDURES

I. Requisites
   A. The patient needs 2 arterial lines, one in the radial artery and one in the femoral artery. These lines provide information as to how well the patient is perfusing on his own and how much assistance is needed from the perfusion circuit.

II. Procedures
   A. Cannulation: Surgeon Preference

      1. The patient may receive at least 5000 units of heparin with the use of non-heparin bonded circuits, however, check with the surgeon's protocol.

      2. Draw a baseline Activated Clotting Time (ACT). Maintain ACT between 250- 300 sec and titrate heparin to maintain this level throughout the case.

      3. At the discretion of the surgeon, commence bypass turning on the centrifugal pump to establish enough RPMs to generate a forward flow when the clamp is removed from the "to patient" line.

      4. Adjust the flow in order to maintain a pressure of 80 – 100mm/Hg in the radial line and a pressure greater than 50 – 60mm/Hg in the femoral line. If it is not possible to maintain the pressures, consult with the anesthesiologist so that appropriate measures can be taken; i.e., volume replacement or pharmacologic support.

5. Flow rates of 20 – 40 ml/Kg, or a CI of 1.3 L/MIN/m2 is acceptable for perfusing the lower portion of the body.

6. Monitor ACTs and maintain the perfusion record according to departmental protocols.

7. At the discretion of the surgeon, discontinue bypass by clamping the outflow then the inflow lines.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **MANAGEMENT OF ADULTS ON CARDIOPULMONARY BYPASS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The basic principle of cardiopulmonary bypass is to maintain the patient in a normal physiologic state while undergoing cardiopulmonary bypass.
When situations arise outside of normal parameters, the perfusionist should use judgment obtained from education and experience to make decisions.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Guidelines
   A. These guidelines are established for the patient with no concomitant diseases. Exceptions to these guidelines are discussed with each parameter. Maintain the following parameters in the following ranges:

      1. Cardiac Index between 1.6 – 3.2 L/min/m $^{2..1}$

      2. Arterial Pressure: 40 – 90 mean[2]
         a. Patients with peripheral vascular disease, carotid artery disease, or renal artery stenosis will require pressures on the high end of the normal range. Avoid hypotension if at all possible.

         b. Pressures that do not respond to an increase or decrease in the blood flow rate may require the use of pharmacological agents to bring the pressures back to a normal range.

      3. Arterial Blood Gases and Venous PO2:
         pH 7.35—7.45
         pC02 35—45 mmHg
         p02> 100 mmHg
         HC03 22—28 mEq/L
         vP02 40—45 mm/Hg

      4. Venous Oxygen Saturation > 60%

      5. Hematocrit > 20%

a. Certain disease states will require a higher hematocrit so that there will be a higher
oxygen carrying capacity in the blood. An example would be the coronary bypass patient with severely impaired ventricular function.

b. Hematocrits less than less than 20% can be tolerated during profound hypothermia.

6. Potassium 3.5 – 5.5 mg/dl
   a. Potassium must be monitored very closely in patients with renal dysfunction. *Refer to High Serum Potassium Level Guideline.*

7. Urine output greater than greater than 1 ml/Kg/hr
   a. Patients with oliguria will require high doses of diuretics. Monitor the urine output very closely.

8. Activated Clotting Time (ACT)
   a. Patients require ACT's greater than 480 seconds using either kaolin or celite as the activator.

9. Temperature
   a. Determined by the type of procedure and the surgeon's protocol.

   b. Maintain a 10˚ or less gradient between the water temperature and the patient's venous blood temperature during the cooling and re-warming periods.[6]

10. Glucose less than 300 mg/dl
    a. Diabetic patients require frequent monitoring of glucose levels. Avoid administering fluids containing glucose. The surgeon or Anesthesiologist may order administration of insulin.

11. CVP less than 5 – 10 mm/Hg2
    a. Sudden elevation of the CVP can be caused by several factors:
       i. an airlock
       ii. kinked venous return line
       iii. tumor or thrombus
       iv. sudden lifting of the heart causing the venous cannula to become obstructed. [7]

12. Mean PA 0 – 10 mm/Hg3

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

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EFFECTIVE: _____

REVISED: **N/A**

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **OFF PUMP STERILITY**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To ensure that the sterility, integrity, and quality of care to the patient are uncompromised.

The sterility and integrity of the Extra-corporeal Circuit for off pump procedures is maintained during the operative procedure.

PROCEDURES

I. Procedure

The perfusionist will properly assemble the extra-corporeal circuit using aseptic technique. After completion of the set-up, the perfusionist will then drape the unprimed set up (prime upon physician orders), using clean linen sheets. This is done prior to the patient entering the operating room. The perfusionist will closely monitor that the sterility and integrity of the extra-corporeal circuit is maintained during the operative procedure. If the perfusionist feels that these criteria have been met, the perfusionist may use the extra-corporeal set up for additional operative procedures if not used. If the perfusionist feels that the sterility and integrity of the extra-corporeal set up has been compromised, he or she will disassemble the extra-corporeal set up and reassemble another one using the same aseptic technique. The dry circuit can be covered with a clear fluid barrier and used up to 10 days after first set up.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **OXYGENATOR CHANGE OUT**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To replace a failed or damaged oxygenator prior, during or after cardiopulmonary bypass.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.
The assistance of another qualified perfusionist would be helpful.

PROCEDURES

I. Requisites:
   1 Oxygenator
   2 Clamps
   1 Sterile scissors/ blade
   2 Alcohol swaps

Make sure there is enough volume in the reservoir to prime the new oxygenator.

II. Mechanical considerations need to be evaluated before oxygenator change out.
   A. Oxygen being delivered to the oxygenator?
   B. Is the gas path obstructed?
   C. Is the gas connected to the correct port?
   D. Are FiO2 and gas flow appropriate?

III. Patient considerations need to be evaluated.
   A. Is the hematocrit adequate?
   B. What is the temperature?
   C. Is blood flow adequate?
   D. Are anesthesia and relaxant levels adequate?

IV. Calculate O2 transfer of your oxygenator

(Arterial O2 content- venous O2 content) X (10) X (flow in LPM)

Art. Content = [(art. Sat. %) x (1.34ml O2) x (Hgb mg%)] + [(PaO2) (.003)]
Ven. Content = [(ven. Sat. %)x (1.34ml O2)x (Hgb mg%)] + [(PvO2) (.003)]

Maximum Value = 360ml/min @

Blood Flow 6L/min
Gas flow 15L/min
Blood temp 37ºC
Hemoglobin 12g/dl

If O2 transfer is inadequate, oxygenator must be changed

V. Prepare Oxygenator to be added
   A. Open and inspect a new oxygenator for defects.
   B. Mount the new oxygenator on a holder for stabilization.
   C. Cardioplegia delivery should be off at the time of exchange.
   D. Attach one end of recirculation line to new oxygenator, the 2nd end must be attached to the venous reservoir, the 3rd end to the Cardioplegia line.
   E. Open the recirculation line.
   F. Place a 2nd clamp on the right side of the oxygenator bypass line.
   G. Clean the oxygenator bypass line between the 2 clamps with alcohol.

Make sure you have enough volume in the venous reservoir to permit adequate priming.

Make sure that the oxygenator recirculation from the new oxygenator is open and connected to the venous reservoir.

VI. Priming the new oxygenator

   A. There is no need to come off bypass.
   B. Using the sterile scissors cut between the two clamps on the oxygenator bypass line.
   C. Attach the right side of the oxygenator bypass line to the inlet of the oxygenator.
   D. Attach the left side of the oxygenator bypass line to the outlet of the new oxygenator.
   E. Take the clamp on the right side of the oxygenator bypass line off to permit the priming of the new oxygenator.
   F. As the prime fill the new oxygenator, tilt it back and forth and tap tubing between port and clamp to remove any air in the oxygenator.
   G. Once the new oxygenator is air free, remove the clamp at the outlet end of the oxygenator.
   H. Move oxygen line to the new unit.
   I. Clamp out the old oxygenator or use in parallel with the new oxygenator depending on the situation.
   J. Reattach the cooler-heater, arterial temperature probe and gas scavenging line.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

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REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **PERFUSION CONSIDERATIONS FOR A PATIENT WITH RENAL DISEASE**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Hemodilution and fluids containing potassium are contraindications in the patient with renal disease; however, they are necessary tools for cardiopulmonary bypass. This procedure provides guidelines for the management of the renal patient undergoing cardiopulmonary bypass.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist, should perform this procedure.

PROCEDURES

I. Guidelines

A. Determine the extent of renal failure. Does the patient have oliguria or anuresis? If the patient is anuretic, consider the following:
   1. When did the patient have his last dialysis treatment? It is best if the patient was dialyzed a few hours prior to surgery.

B. Use the pump prime found in the procedure manual.
   1. The use of oncotic agents will help in reducing the fluid from “third spacing.”

C. If the patient has oliguria, high doses of diuretics will be required. Monitor the urine output very closely.

D. Optional technique: The patient will not be able to excrete the potassium administered via the cardioplegia system.
   1. Hemoconcentrator should be considered to remove Potassium.
   2. If there is insufficient volume in the perfusion circuit, add Normal Saline 0.9% to begin hemoconcentrating.
   3. Replace hemoconcentrated volume with Normal Saline.
   4. Monitor the serum potassium level frequently.
   5. Continue this procedure until the desired serum potassium level is achieved.

E. The patient’s mean arterial pressure should be maintained at a higher than usual level, particularly in the patient with oliguria.

F. The patient on dialysis may be anemic due to the dialysis treatments.

1. Use of a hemoconcentrator and/or the addition of RBCs will help in maintaining or in elevating the hematocrit.
2. When bypass is to be discontinued, the hematocrit should be on the high side of the normal range accepted on bypass.

G. Refer to the procedure “High Serum Potassium levels”

REFERENCES:

Hori D, Yamaguchi A, and Adachi H. Coronary Artery Bypass Surgery in End-Stage Renal Disease Patients. Ann Vasc Dis. 2017 Jun 25; 10(2): 79–87

Yotsueda R, Taniguchi M, Tanaka S, et al. Cardiothoracic ratio and all-cause mortality and cardiovascular disease events in hemodialysis patients: the Q-Cohort study. Am J Kidney Dis. Epub Feb 10, 2017.

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EFFECTIVE: _____

REVISED: **N/A**

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **PUMP STANDBY GUIDELINES**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Under certain circumstances, the decision of whether or not the patient will require cardiopulmonary bypass (CPB) cannot be made until the procedure is underway. This requires a perfusionist to be committed to that patient until it has been determined if CPB is indicated. It is the surgeon's decision as to whether or not to set up and prime the perfusion circuit. If at all possible, the circuit is not usually primed unless it will be used that day, in order to save costs. The surgeon will inform the perfusionist as well as the rest of the OR team when and if this operation will require CPB at the earliest possible moment.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Guidelines

A. The perfusionist will review the patient's record to familiarize him/herself with the patient's condition.
B. The perfusionist will set up the CPB equipment as per pump protocol.
C. After consultation with the surgeon, the perfusionist will organize the supplies to be used if necessary.
D. The Arterial Blood Filter should be CO2 flushed, clamped out and ready for immediate use.
E. The circuit is to be maintained dry and sterile (ie. drape left covering the circuit).
F. The perfusionist will have all medications, primes and cardioplegia solutions available for immediate use.
G. Do not open any additional supplies or prime the pump, unless requested by the surgeon.
H. Perform the necessary calculations to be used on cardiopulmonary bypass.
I. Stay in or near, the operating room until the surgeon makes a decision if cardiopulmonary bypass is indicated.
J. Should the circuit NOT BE USED:
    1. All clamps should be removed from the circuit.
    2. The chart should be completed and filed as per departmental protocol.
    3. All drugs, IV solutions and syringes should be restocked.
K. A Cell Saver will be made available upon the surgeon's request.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **RE-ESTABLISHMENT OF BYPASS FOLLOWING INITIAL TERMINATION**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Cardiopulmonary bypass may need to be re-established due to hemorrhage, hypotension, cardiac arrhythmias or cardiac arrest. The need to return to cardiopulmonary bypass will be urgent and needs to be performed in a systematic manner. It is helpful to delay contaminating the circuit until reasonably certain that the patient is stable.

A certified cardiovascular perfusionist, a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Requisites

A. A complete perfusion circuit
B. Blood available
C. Heparin
D. Priming solutions

II. Guidelines

A. Re-heparinize the patient if the heparin has been neutralized or sufficient anticoagulation is questionable.

B. If the lines are still filled and bubble free, use the same pump to reestablish bypass, after ACT is checked and adequate.

C. If the cannulae have been removed, re-cannulate the patient and initiate cardiopulmonary bypass (CPB) in the normal fashion.

D. If the lines have been passed off the sterile field:
1. A new setup circuit must replace the drained unsterile circuit.
2. If the circuit is not already primed, prime the system with the usual prime.
3. Verify that the gas lines have been connected.
4. Connect water lines
5. Initiate CPB

E. Consider the "crutch" **H-BOAT** before initiating CPB.

H - Heparin Has the proper dose of heparin been given? In the event of a cardiac arrest, consider administering it via the right atrium.
B - Blood Is blood still available for use in the perfusion circuit if needed to elevate the patient's hematocrit?

O – Oxygen Is the gas source connected and set properly?
A – Air Is the perfusion circuit free of air bubbles?
T – Tubing Is the tubing in the pump heads in the proper direction?

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

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EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **RETROGRADE CARDIOPLEGIA**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Retrograde cardioplegia administration to protect the heart during the X-clamp duration of cardiopulmonary bypass.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Equipment

A. Retrograde Cardioplegia Catheter
B. Anesthesia Pressure Monitor (for coronary sinus pressure monitoring)
C. Blood Cardioplegia

II. Technique

A. The Surgeon will place the retrograde cardioplegia catheter into the coronary sinus. This can be done before going on bypass or while on bypass. Heparin must be given before the retrograde cardioplegia catheter can be place into the coronary sinus.
B. If the catheter is place into the sinus while on bypass, the Surgeon will ask the Perfusionist to hold up volume into the right side of the heart while he inserts the catheter. You will see air come down the venous line while the catheter is being inserted.
C. Once the catheter is inserted, a pressure line will be passed off from the surgeon to anesthesia. Anesthesia will flush the line and zero the monitor for accurate pressure measurements of the coronary sinus pressure.
D. The Perfusionist will be asked to flush the cardioplegia line while the surgeon connects the cardioplegia line to the retrograde cardioplegia catheter.
E. Once the Cross-clamp has been applied, the cardioplegia can be administered. *Make sure that you know the mode of delivery of the cardioplegia (Antegrade or Retrograde).*

III. If the cardioplegia is being delivered in a retrograde manner

A. Keep an eye on the cardioplegia line pressure.
B. Keep the Coronary Sinus Pressure under 50-mm Hg.
C. Keep the Coronary Sinus Pressure above 30-mm Hg.
D. Turn the LV vent on (under Surgeon's order) to decompress the left ventricle.
E. Make sure that the heater-cooler for the cardioplegia is set on cold.
F. If the aorta is open, have the Surgeon verify that cardioplegia is coming out of the coronary ostia.

IV. Consideration as cardioplegia is delivered

A. Note how much cardioplegia it takes to cause the heart to arrest. Inform the Surgeon if it takes more cardioplegia than usual to arrest the heart. The Surgeon may prescribe more cardioplegia if necessary.
B. Give the prescribed dose of cardioplegia and inform the Surgeon when the dose is in.
C. Start the timers for the ischemic period between doses of cardioplegia.
D. Give subsequent doses according to protocol.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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SECTION: PATIENT CARE / PERFUSION **SUB SECTION:**

SUBJECT: SET UP AND PRIMING OF CENTRIFUGAL PUMP FOR THORACIC ANEURYSMS

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Surgery on the descending aorta requires clamping the aorta interrupting perfusion distal to the aortic clamp. This causes distention of the arterial system above the clamp and ischemia to the spinal cord and vital organs distal to the clamp. One of the methods of treating this condition is to divert the blood from the left atrium to a centrifugal or a roller pump and then to the artery distal to aortic clamp. This provides perfusion to the lower intercostals and lumbar arteries as well as to the liver, kidneys acid gastrointestinal tract, diverting some of the blood flow aids in controlling the blood pressure in the upper body by relieving the distention in the arterial system in the upper body.
This procedure is performed for Type III DeBakey dissection. This type of dissection is located in the descending thoracic aorta that starts distal of the left subclavian artery and ending above the diaphragm. It is possible for the dissection to propagate below the diaphragm.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a perfusion student both of whom under the direct supervision of a certified perfusionist should perform this procedure.

PROCEDURES

I. Perfusion & Anesthesia Considerations

A. Arterial blood pressure lines, one for the right radial and one for the femoral artery. The femoral line will go into the leg that is not cannulated.
B. Use of the INVOS Somanetics monitoring device.

II. Requisites

A. Centrifugal Pump Console
B. Thoracic Aneurysm tubing set which may be heparin or “X” coated
C. Centrifugal pump head and Flow sensor
D. Dispensing pin
E. 1-liter Normal Saline
F. 2 line clamps

III. Procedure

A. Pass the sterile 3/8” in diameter tubing set, centrifugal pump head and flow sensor to the sterile field.
B. The scrub nurse or “sterile” person will attach the tubing to the outlet and inlet of the pump head.
C. Attach the flow sensor to the outlet tubing.
D. “Sterile” person will prime the tubing and pump use a pulp syringe.

E. To remove the air from the tubing and pump, submerge the open end of the tubing under normal saline.
F. Pass the centrifugal head to the perfusionist.
G. Connect the centrifugal head to the centrifugal pump console.
H. Turn the console on slowly and flow until no more air left in the tubing or the pump head.
I. Turn the pump off and clamp both end of tubing while still under normal saline.
J. The surgeon will connect both ends of the tubing to the flow outlet and inlet cannulae ensuring no air in the tubing.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **SICKLE CELL ANEMIA PATIENT MANAGEMENT ON CARDIOPULMONARY BYPASS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

To conduct cardiopulmonary bypass on patients with known Sickle Cell traits with particular attention to preventing the sickling of erythrocytes due to abnormal hemoglobin molecular shape and its sequelae. The homozygous form of Sickle Cell anemia causes the predominance of Hemoglobin S red blood cells and will develop sickling more quickly on alteration of their basic parameters. The heterozygous individuals have a lower percentage of Hemoglobin S and usually do not have symptoms unless exposed to certain stimuli.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist should perform this procedure.

PROCEDURES

I. Modifications of Conduct of Perfusion to Prevent Sickling

Open-heart surgery using hypothermic CPB creates conditions that precipitate sickling. Deoxygenated HbS can resulting in vaso-occlusion, intravascular thrombi, infarction and tissue necrosis, ending in permanent tissue or organ damage. Endothelial reaction can develop and leads to a vicious circle of further sickling. Anemia may result from the shortened survival time of the red blood cells due to hemolysis.

Stimulus for Sickling	**Modification**
1. Hypoxemia	Maintain high paO2 around 300 mmHg while on CPB, pre-oxygenate prior to induction.
2. Acidosis	Keep pH about 7.50, blood flow rate high, and add NaHCO3 if necessary.
3. Decreased 2,3 DPG levels	Partial exchange transfusions on the pre- operative day will allow the level of 2,3 DPG to increase. Plasma can be saved by sequestration.
4. Infection	Careful sterile technique.
5. Hypothermia	Avoid topical cooling, the patient should not be cooled below 30° to prevent capillary stasis and vasoconstriction.
6. Stagnation injury	Maintain arterial pressure 65-90 mmHg to avoid hypoperfusion leading to acidosis, stasis and sickling. Use of crystalloid cardioplegia or high hemoglobin A (HbA) fraction blood to prevent stagnation and desaturation

	between doses also to reduce introduction of RBCs that have potential to sickle into the coronary circulation. Increased frequency of cardioplegia delivery. Hemodilution of the patient to decrease the blood viscosity.
7. Hemolysis	Avoid use of mechanical valves.
8. Presence of HbS Erythrocytes	Partial exchange transfusion with blood 3 days old or less. This can be done 1-day pre-op or just prior to going on bypass.
9. Drugs that induce hemolysis	No use of Salicylates, Quinidine, Vitamin K, Choloromycitin.

II. Additional Prophylaxis

A. Prophylactic folic acid administration preoperatively
B. Avoid Cross Clamping
C. Use Postoperative oxygen therapy until recovery is complete with at least 30% oxygen.
D. Exchange Transfusion Procedure
E. If the patient is to be exchange transfused just prior to bypass, this can be accomplished by draining venous return just prior to going on bypass while simultaneously replacing the volume through the arterial cannula from a blood primed circuit. The removed blood is processed into red cells and plasma through the cell saver. The red cells are discarded. The goal should be to have a hemoglobin A (HbA) concentration of 60-70% of the total cells of the patient.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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EFFECTIVE: _____

REVISED: **N/A**

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SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **SUCKER CARDIOPULMONARY BYPASS GUIDELINES**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

Sucker bypass is an emergency procedure and usually performed when normal cannulation sites are inaccessible or have not been prepared.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a perfusion student both of whom under the direct supervision of a certified perfusionist should perform this procedure.

PROCEDURES

I. Guidelines
   A. In its simplest form, sucker bypass may be viewed as a rapid infusion device, where excessive bleeding is managed until the patient can be placed on full cardiopulmonary bypass. It is most commonly seen with redo procedures and chest trauma. As the surgeon attempts to open the sternum, a large blood vessel is severed or the ventricle cut, resulting in life threatening hemorrhage.
   B. The arterial cannula is usually placed via cut down in the femoral artery. This cannula may be a percutaneous type intended for fem-fem bypass or it may be a short-tipped aortic cannula.
   C. What differentiates sucker bypass from fem-fem bypass is the route of venous return. In sucker bypass, venous blood enters the extracorporeal circuit from the sucker lines rather than the venous line.
   D. Sucker bypass is a normothermic procedure. There is no cross clamp and no vent.
   E. The highest priority is getting the AV loop and the sucker lines on the field and connected. Cardioplegia lines are not a priority.

II. Procedure

   A. Initiation of Sucker Bypass
      1. Usually excessive bleeding from a large vessel initiates the sequence of events.
      2. Be aware of venous reservoir volume as it can be extremely volatile! Constant vigilance of flow and venous reservoir volume is necessary.
      3. Temporary circulatory arrest is a possibility to control hemorrhage. Be sure to start a clock and keep surgeon informed of circulatory arrest time as patient will be normothermic.
      4. Remember, the patient is usually not heparinized at time of incident. Decisions made in the first few minutes of events will determine the long-term well-being of the patient. Add extra 30,000 USP of heparin to pump if necessary.
      5. The first response the physician may have is to heparinize the patient and ask the perfusionist to turn on pump suckers. These orders are frequently given at the same time.
      6. The surgeon will begin to cannulate the femoral artery or another access site.

7. If the patient is not heparinized or only partially heparinized, blood will collect in the venous reservoir, and will clot off in a few minutes. A clotted off pump circuit disrupts emergent institution of bypass. If blood is being collected via the pump suckers, add several hundred mL of crystalloid and extra heparin as suggested in #4 to venous reservoir. Agitate to mix using the recirculation line.
8. Draw up the patient's loading dose of heparin and add it directly to the venous reservoir. This may result in the patient becoming over heparinized. However, heparin is easily reversible (clot is not) and has a short half-life.
9. Complete the emergency pre-bypass checklist and mentally prepare for a rocky bypass run.
10. As soon as the femoral artery has been cannulated, the surgeon may choose to go on sucker bypass.
11. In most cases, there has not been adequate time to allow the heparin loading dose to circulate in the patient and a post heparin ACT has not been drawn.
12. The perfusionist must be absolutely meticulous in communication with the surgeon. There is a perfusion protocol that dictates what the minimally accepted ACT is for initiation of bypass. Direct physician orders will replace perfusion protocols.
13. Perfusionist must state, "We do not have an ACT. There is extra heparin in the pump. It is your call if we go on." The perfusionist follows whatever orders the surgeon gives, taking every precaution to assure the patient is as safe as the situation allows. Document the order in the perfusion record.
14. As soon as possible, an ACT and other labs should be drawn.

B. Management of Sucker Bypass

1. **Hypovolemia** is frequently encountered as a result of hemorrhage. A large amount of the patient's blood volume may be on the floor or in the surgical drapes. Treat with crystalloid, blood products, and colloids.
2. **Hypotension** may occur secondarily to hypovolemia, low cardiac output, massive hemodilution, and shock. In many cases, treatment of hypovolemia will improve the patient's blood pressure.
3. **Poor venous return** is a common problem. Venous drainage via the pump suckers is limited to the number of suckers present and the maximum sucker rate per unit of time. To minimize hemolysis, pump suckers should be employed at rates less than 2 liters per minute, but at the discretion of the surgeon. Hemolysis is time dependent—the longer high flow suction, the more damaging the short-term suction.
4. **Metabolic disturbances** should be anticipated. Red cell damage from the pump suckers will lead to elevated potassium levels and plasma free hemoglobin. Anaerobic metabolism may occur, leading to metabolic acidosis and loss of bicarbonate. Administration of blood products, crystalloid and colloid may further alter the patient's acid base and electrolyte balance.
5. **No vent is present** to decompress the heart.
6. **Keep the patient above the fibrillatory temperature of 30°C unless directed by surgeon.** Normothermia is a highly metabolic state, which may require higher cardiovascular support than sucker bypass is capable of providing and may result in acidosis and shock. Patient temperatures between 30-34 degrees Celsius may have cerebral protective effects. After resolution of the hemorrhage, check for the patient's target temperature with the surgeon.
7. **The patient is only partially supported** by the extracorporeal circuit. Arterial blood gases will only partially reflect the arterial blood content. **All blood gases obtained during sucker bypass should be drawn directly from the patient.** Venous blood returning from the suckers may be grossly contaminated with arterial blood or ambient

room air and cannot be used to determine the patient's mixed venous saturation. Have anesthesia draw a venous blood sample from the central venous line if available.
8. Monitor urine output frequently. Minimum acceptable urine output should be 1 ml/kg/hour. Treat low urine output with a diuretic.
9. Monitor central venous pressure and pulmonary artery pressures closely. Elevation in these pressures may indicate the heart is starting to fail.
10. Be prepared to switch from sucker bypass to traditional and alternative sources of venous drainage such as jugular, femoral, or right atrium
11. Sucker bypass terminates when a traditional venous cannulation site is established.

REFERENCES: **Guidelines for Conduct of Cardiopulmonary Bypass. Journal of Cardiothoracic and Vascular Anesthesia 2021, 5 (1-17)**

DEFINITIONS:

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EFFECTIVE: _____

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REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **TERMINATION OF CARDIOPULMONARY BYPASS**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The return of the heart and lungs to normal circulation following cardiopulmonary bypass (CPB) is a potential period of stress for the heart if proper planning and preparation have not occurred. The insults on the body from cardiac arrest, hypothermia, electrolyte imbalance, anticoagulation, and others must be thoroughly evaluated before bypass can be terminated. Communication between the surgeons, anesthesiologist and perfusionist is essential for successful termination of cardiopulmonary bypass.

Extracorporeal circulation will be terminated on the order of the attending cardiovascular surgeon.

PROCEDURES

I. The following conditions should be met before, the patient is weaned from cardiopulmonary bypass

   A. The patient's temperature, measured via tympanic, rectal or venous blood sites, is greater than 35°C.

   B. The patient's acid base balance, hematocrit, and whole blood electrolytes are within physiologically acceptable limits.

   C. The patient has a life supporting cardiac rhythm.

   D. The anesthesia team is able and ready to assume responsibility to support the patient on the ventilator.

   E. Items C and D may be waived if the attending surgeon feels that the patient cannot be weaned from CPB and may benefit from extended support, such as ECMO or VAD.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

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REVISED: **N/A**

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SECTION: PATIENT CARE / PERFUSION **SUB SECTION:**

SUBJECT: TRANSFUSION GUIDELINES AND DETERMINATION OF AMOUNT OF BLOOD NEEDED IN CARDIOPULMONARY BYPASS PRIME

POLICY

To assist the perfusionist in the selection of the blood constituents during cardiopulmonary bypass .To aid the perfusionist in predicting the hematocrit on bypass and provide guidance in determining how much blood is necessary to add to the prime or during bypass to reach a desired hematocrit.

A certified cardiovascular perfusionist or a board eligible perfusionist should perform this procedure, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist.

PROCEDURES

I. GENERAL INFORMATION

A. At the time a blood sample is obtained for cross-matching for blood transfusion, the patient must have a name band with medical record number on.
B. In all areas of the Medical Center only registered nurses, who have completed nursing department orientation, Allied Health Professionals who are appropriately credentialed (perfusionist), and physicians may hang the following blood components:
    1. Whole blood or red cells.
    2. Fresh frozen plasma, plasma-SD thawed (solvent-detergent treated plasma, PLAS+SD).
    3. Platelet concentrates.
    4. Cryoprecipitate.
    5. Albumin.
C. Compatibility is established by Blood Bank personnel.
D. Verify physician's signature and patient's signature on consent for blood transfusion.
E. The nurse **must** contact the appropriate physician when the crossmatch on the transfusion tag states that the unit is not compatible.
F. When checking blood, there needs to be two employees. One must be the individual who is hanging the blood; the other can be an RN or a Physician.
G. When blood is ordered, a blood request form is filled out and blood bank is notified.
H. NEVER ADD MEDICATIONS TO THE BLOOD. The perfusionist may add heparin based upon a physician's order.
I. If a reaction occurs, return blood pack to Blood Bank with appropriate documentation. Complete hospital report of transfusion reaction. Complete this form on all cases of suspected or known transfusion reaction.
    * Refrigerate unused blood in blood refrigerator in the room.
J. Blood transfusion should be completed in 4 hours. Notify physician if the transfusion is not completed in 4 hours.
K. Return unused blood pack to Blood Bank.

II. ESSENTIAL STEPS IN BLOOD PRODUCT TRANSUFION

A. Verify Transfusion Order doctor's order
B. Verify physician's signature and patient's signature on consent for blood transfusion.
C. Ascertain if blood is available in Blood Bank.
D. Obtain blood from Blood Bank.
E. When blood arrives, it needs to be checked by two employees. One must be an individual who is hanging the blood; the other can be an RN, physician, or perfusionist.

Remember: Each of the two employees who sign the transfusion record is individually responsible for checking the identity of the patient. Patient's name and patient ID (medical record #) number on the identity band must match Blood Bank tag. Blood/component number, unit number on bag must be verified with donor number on tag and type before signing slip.

III. DETERMINING THE AMONUT OF BLOOD NEEDED

A. The optimal hematocrit on bypass is at least 24%.

B. If the hematocrit on bypass is estimated to be 20% or lower, consider using blood in the prime after consultation with the surgeon.

C. Patients who have been in congestive failure for some time often have higher blood volumes, therefore, the nomogram for determining the blood volume may not be accurate.

Estimation of Hematocrit on Bypass =

$$\frac{\text{Red cell mass (patient. Hct x patient. blood volume*)}}{\text{Total circulating volume (pump prime + Pt. blood volume + pre-pump IV's)}}$$

*** Use a nomogram for adult blood volume or the 70 mls/kg**

D. To Determine Amount of Blood for Pump Prime Using RBCs

1. (BV) (Pt Hct) = Pt RCV

2. (BV + Prime + IV's) (Des Hct) = Req RCV

3. Req RCV – Pt RCV = Needed RCV

4. Needed RCV = cc's of RBC's needed

Legend:

Des Hct =	Desired Hematocrit
Pt RCV =	Patient Red Cell Volume
Req RCV =	Required Red Cell Volume
Pt Hct =	Patient Hematocrit
BV =	Blood Volume

E. To Determine Amount of Blood for Pump Prime Using Whole Blood

1. $$\frac{\text{Des Hct} \times [(.08 \times \text{BWkg} \times 1000) + \text{PrV}] - (.08 \times \text{BWkg} \times 1000 \times \text{Pt Hct})}{.38}$$

Legend:

PrV=	Pump Prime
BWkg=	Body Weight in Kilograms
Des Hct=	Desired Hematocrit on bypass

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

Cheung, A. T., Stafford-Smith, M., & Heath, F. M. Management of cardiopulmonary bypass.

DEFINITIONS:

APPROVAL DATE:

N/A	**Policy, Procedures and Standards Committee**
06/22/2021	**Nursing Standards Committee** Applicable Administrator, Hospital or Medical Committee
06/08/2021	**Operative and Other Invasive Committee** Applicable Administrator, Hospital or Medical Committee
06/09/2021	**Quality Management Committee** Applicable Administrator, Hospital or Medical Committee
06/17/2021	**Medical Executive Committee** Applicable Administrator, Hospital or Medical Committee
	Board of Supervisors Approved by the Governing Body

REPLACES:

EFFECTIVE: _____

REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **TREATMENT OF WATER-BLOOD LEAK FROM THE HEAT EXCHANGER**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

An increase in the venous reservoir level either slowly or rapidly, severe hemolysis if on Cardiopulmonary Bypass (CPB), severe hyperkalemia, and hyponatremia are indicators of a leaking heat exchanger. This situation can be identified pre bypass by checking the heat exchanger before any priming fluids have been administered.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a perfusion student both of whom are under the direct supervision of a certified perfusionist, should perform this procedure.

PROCEDURES

I. Change out the oxygenator according to the GMC Perfusion Department's Oxygenator Change-Out protocol.
II. Correct the hematocrit by means of hemoconcentration and/or the addition of packed red blood cells.
III. Monitor the electrolytes and blood gases carefully. Make appropriate corrections.
IV. Consider the use of antibiotics.

REFERENCES:

Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients

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REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **VOLUME SELECTION**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

The conduct of cardiopulmonary bypass often requires volume replacement as a necessity to maintain patient's physiological function. All required volumes are given under the authority and guidance of an attending physician, who oversees the actions of the perfusionist.

A certified cardiovascular perfusionist or a board eligible perfusionist should perform this procedure, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist.

PROCEDURES

I. The choice of priming fluid for the perfusion circuit is based on the following factors:

A. Patient's estimated hematocrit on bypass. The formula is as follows:

$$\text{Pt's Hct} \times \text{Blood Volume (BV)} = \text{Red Cell Volume (RCV)}$$

$$\text{Pump prime} + \text{Pt. BV} + \text{pre pump IV's} = \frac{\text{RCV}}{\text{estimated Hct on CPB}}$$

B. If the estimated hematocrit on CPB is < 20%, a blood prime may be indicated. Select a crystalloid prime for estimated hematocrits > 20%.

C. The Patient's preoperative condition should be taken into consideration when determining the priming solutions of the perfusion circuit, i.e. hemodynamically unstable patient, patient's size, age, religious convictions, and concomitant diseases.

D. Surgeon's protocol should be considered.

E. It may be necessary to discontinue bypass with a hematocrit > 22% in elderly, or hemodynamically unstable patients.[2]

F. Blood replacement is usually not indicated unless the Hematocrit is less than 20%.

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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REVISED: **N/A**

REVIEWED: **N/A**

SECTION: **PATIENT CARE / PERFUSION** **SUB SECTION:**

SUBJECT: **MANAGEMENT OF AIR EMBOLISM**

APPROVED BY: _____
OPERATIVE SERVICES, NURSE MANAGER

POLICY

In the event of a patient being exposed to gross embolism event the following procedure will serve as a guide for the cardiac team to eliminate and minimize detrimental effects of a massive air embolus delivered during cardiopulmonary bypass. Massive air embolism can result from the following: interruption of flow in the venous return line, perfusionist inattention, reversal of the pump tubing in roller head, interruption of the arterial line, unexpected contraction of the LV, defective oxygenator, oxygenator falling off its holder, pressurized cardiotomy reservoir, run away pump head, perforation in the tubing on the negative side of the arterial pump head, improper priming of the perfusion circuit, surgical personnel kicking, standing or falling on the arterial or venous line causing air to enter the system.

A certified cardiovascular perfusionist or a board eligible perfusionist, or a student perfusionist both of whom are under the direct supervision of a certified cardiovascular perfusionist, should perform this procedure.

PROCEDURES

I. Perfusionist

A. Clamp arterial and venous lines immediately
B. Close arterial filter purge line
C. Alert surgical team
D. Search and correct cause
E. Refill all lines with fluid
F. Assure there is adequate volume in reservoir

II. Anesthesiologist/Anesthetist

A. Manually apply bilateral carotid arteries compression
B. Place patient in deep Trendelenburg
C. Ventilate lungs with 100% O2 to facilitate the removal of N2.

III. Surgeon

A. Fill the pericardium with cold irrigation to submerge the aortic cannula.
B. Decannulate and purge the arterial line of air.
C. Place arterial cannula into SVC, ***this provides an exit route for the air.***
D. Remove air through the submerged aortic cannulation site, right atrial appendage and needle stabs into PA and RV.

E. Air can be removed from the coronaries with small needle stabs.
F. When the right heart is purged of air the surgeon can allow the perfusionist to initiate retrograde hypothermic perfusion of the head as the carotids are gradually released.
G. Retrograde through the SVC with flow of 1-2 L/Min
H. Continue retrograde flow for 3-5 minutes
I. Recannulate the aorta

IV. Perfusionist

A. Resume CPB and cool to at least 20 degrees Celsius at the surgeon requests.
B. Maintain the mean arterial pressure to 65 mmHg or greater.
C. Set the F102 to 100%.
***** This decreases the nitrogen content between the lungs and the blood.***
D. Maintain the PCO2's in the low 30's to help to minimize cerebral edema.
E. Maintain high blood flow rates, even during hypothermia.
F. Come off bypass with the systolic pressure over 100 mmHg and low filing pressures.

V. Anesthesiologist/Anesthetist

A. Administer 1 g of Dexamethasone to aid in cell membrane stabilization.

B. Induce deep anesthesia with a 10 mg/kg dose of sodium pentobarbital, and then at a drip rate of 1-3 mg/kg/hr. The drip should be maintained for 24-48hrs or until the intracranial pressure returns within normal limits.

VI. Surgeon

A. Complete the surgical procedure

REFERENCES: **Society of Cardiovascular Anesthesiologists (SCA): Clinical practice improvement advisory for management of perioperative bleeding and hemostasis in cardiac surgery patients**

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REVISED: **N/A**

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