\*The intent of this product is to be a resource; not a replacement for institutional protocols. Standard 1 of AmSECT’s Standards and Guidelines for Perfusion Practice.1 These Standards and Guidelines may also be superseded by the judgement of the healthcare professional taking into account the facts and circumstances of the individual case.

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| **SUBJECT/TITLE** | **ANH - Acute Normovolemic Hemodilution** |
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| **PURPOSE:** | This policy describes preparing intraoperative whole blood collection for acute normovolemic hemodilution. This technique may be useful for patients with objections to blood transfusion e.g Jehovah's Witnesses, or patients with rare blood types for whom it is difficult to find compatible RBC units. |
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| **TARGET POPULATION:** | Patient population that the surgeon and anesthesiologist determine will benefit from this procedure. |
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| **DEFINITIONS:** | Due to the well-known risks and complications of blood transfusion, blood conservation efforts are critical.(1-5)  ANH is a blood conservation technique that sequesters a patient’s whole blood during the intraoperative setting.  Hemodilution from ANH reduces the patient hemoglobin concentration therefore fewer RBC’s are lost during any blood loss events.(6) |
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**POLICY:**

1. The surgical team will determine the amount of blood to be removed, as well as the replacement amount of crystalloid or colloid.
2. Patient selection is also an important consideration. Everyone may not be eligible for ANH. (6)
   1. The surgeon will determine which patients are deemed stable enough for ANH
   2. Patients with unstable angina, tight coronary lesions, low ejection fraction, or hemodynamic instability are not suitable candidates for volume removal.(7)
3. If possible, it is preferable to remove the ANH before the sternotomy and heparinization, which may initiate the coagulation cascade, defeating a key purpose of removing unactivated blood. ANH protects RBC’s, platelets and clotting factors from activation during surgery and from the cardiopulmonary bypass circuit (CPB).

**PERFUSION PUMP CONSIDERATIONS: n/a**

**PROCEDURE:**

The surgeon, along with the surgical team, will determine:

1. The amount of volume to be taken from the patient:
   1. Options for determining how much to take off may be volume based
   2. A written protocol or algorithm will be helpful to achieve notable results and avoid observational bias.(8)
   3. Consider also type/length of surgery, degree of cooling, and any comorbidities
   4. An equal volume of fluid is given to replace the amount of blood lost.
      1. Consider utilizing colloids (5% Albumin) instead of crystalloids for this hemodilution.(9)
2. How and where the blood should be stored after volume is removed.
3. What type of anticoagulation used; citrate-phosphate-dextrose (CPD) or heparin.
4. The plan of action in a low volume clinical situation.
5. Whether to give back the sequestered blood or transfuse with donor blood.

**Calculating volume of blood to be collected:**

1. The patient's ideal body weight in kilograms (kg) is needed in order to calculate the estimated blood volume (EBV). This reflects the total circulating blood volume in the vascular tree. This is approximately 70 cc/kg for adult females and 75 cc/kg in adult males. For example, a 90 kg male patient might be expected to have an EBV of 90 X 75 cc = 6750 cc
2. The baseline, initial or starting hemoglobin (Hb) concentration.
3. The target Hb for ANH. This is typically a value that reflects a level of Hb that is safe and tolerated by the patient without adverse effects.
4. Average Hb = the baseline and target Hb summed and divided by a factor of 2.
5. **Standard ANH equation: Volume of Blood that may be sequestered using ANH =**

***Baseline Hb - target Hb/ Average Hb X EBV***

Example, take a male patient weighing 90 kg with a starting Hb of 14 g/dl. We elect that a Hb of 10 g/dl is a safe end-point for ANH. The volume of blood that may be collected = 14-10/12 X 6750 = 2,250 cc.

**Reinfusion of ANH Blood:**

1. There must be positive identification of the patient with the blood bag using the last name and medical record number.
2. Blood is re-infused by connecting the bag via a standard blood administration set with a clot screening filter (pore size of 170-260 microns) to the infusion port.
3. Do not reinfuse through the collection tubing because it does not have a clot screening filter and hence increases the risk of introducing clots into circulation.
4. Timing of whole blood reinfusion is an important aspect in the blood management and conservation approach.
   1. Blood should be reinfused as surgical conditions dictate.
   2. During rapid uncontrolled surgical hemorrhage whole blood might be needed to restore blood volume.
   3. If surgical hemorrhage is slow and protracted, whole blood would be needed to restore Hb levels to normal and correct surgical anemia
5. During cardiac surgery, whole blood reinfusion might occur after protamine administration, so that the procoagulant effect of the whole blood would be maximized.
6. Any blood removed should should be reinfused while in the OR
   1. AABB guidelines state ANH blood expires after 8 hours at room temperature
7. If hypervolemia is likely to occur from blood reinfusion, the use of a diuretic may be indicated
8. When blood is reinfused, it is recommended that the last collected unit be infused first. This is due to when whole blood is collected with ANH, each subsequent unit becomes progressively more dilute.

# CLINICAL ASSESSMENT/SCREENING:

1. Contraindications: Unstable patients, to be determined by the surgeon

**RELATED DOCUMENTS:**

n/a

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# DISCLAIMER:

In emergency situations, immediate life support measures of whatever appropriate nature come first with attention turning to measures described in this protocol/process as soon as possible and practical.

This is a minimal protocol/process that may be exceeded at any time based on the judgment of the involved patient care personnel.

This protocol/process encourages high quality patient care but observing it cannot guarantee any specific patient outcome.

This protocol/process is subject to revision from time to time, as warranted by the evolution of technology and practice.

Review period: Review as changes occur or per institutional protocol.

Original hard copies and computer copies of this protocol are stored under the supervision of the Chief Perfusionist, Department of Cardiovascular Perfusion.

Documents relating to patient care standards are developed according to the accepted hospital standards.

# APPROVED BY: *(signature of CMO and CNE only required)*

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