**Clinical Protocol†**

*Intraoperative Cardiopulmonary Bypass Heparin Administration‡*

Department of Anesthesiology and Perioperative Medicine

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**CPB related procedure?**

- **No**
  - **Do not use this protocol¹**

- **Yes**
  - **Has the patient been treated with a heparin drip in past 12 hours?²**
    - **No**
    - **Determine a baseline ACT value**
    - **Bolus the patient based upon measured body weight with 300 Units/kg of unfractionated heparin via a central venous line (the line should be aspirated for blood both before and after heparin bolus administration to insure the heparin dose is intravascular)³**
    - **Initiate a heparin drip⁴ at a dose of 100 Unit/kg/hour based upon measured body weight (e.g., a 107 kg patient would receive 10.7 mL/hr of 1000 Units/mL) using a syringe pump run in mL/hour mode. Terminate the heparin infusion upon rewarming.**
    - **Verify that the perfusionist has added 10,000 Units of heparin to the CPB priming fluid⁵**

  **Initiate CPB**

  - **Yes, ACT ≥ 400 sec**
    - **Verify therapeutic anticoagulation for CPB (ACT ≥ 400 sec)⁶ after the drug has had a full 2+ minutes to circulate**

  - **No, ACT < 400 sec**
    - **Administer an additional 200 Units/kg of heparin & have Anithrombin III concentrate available**

  - **Failure to achieve an ACT ≥ 400 secs following administration of 500 U/kg heparin should prompt the administration of one vial (~500 IU) of IV Antithrombin III concentrate (may repeat as needed to up to 4 vials total⁷)**

- **Yes**
  - **Verify therapeutic anticoagulation for CPB (ACT ≥ 400 sec)⁶ after the drug has had a full 2+ minutes to circulate**

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¹ **Do not use this protocol**: This protocol is not to be used if the patient has been treated with a heparin drip within the past 12 hours.

² **Has the patient been treated with a heparin drip in past 12 hours?**: Check if the patient has received a heparin drip within the last 12 hours.

³ **Bolus the patient based upon measured body weight with 300 Units/kg of unfractionated heparin via a central venous line**: Administer a bolus dose of 300 Units/kg of heparin via a central venous line.

⁴ **Initiate a heparin drip at a dose of 100 Unit/kg/hour based upon measured body weight**: Start a heparin drip at a rate of 100 Unit/kg/hour.

⁵ **Verify that the perfusionist has added 10,000 Units of heparin to the CPB priming fluid**: Ensure the perfusionist has added the required amount of heparin to the priming fluid.

⁶ **Verify therapeutic anticoagulation for CPB**: Confirm the therapeutic anticoagulation for CPB.

⁷ **Failure to achieve an ACT ≥ 400 secs following administration of 500 U/kg heparin should prompt the administration of one vial (~500 IU) of IV Antithrombin III concentrate (may repeat as needed to up to 4 vials total)**: If the ACT does not reach the required level, administer additional Antithrombin III concentrate as needed.
†Clinical protocols are based on the best and most recent available data and are expected to be followed by all CASECAG staff unless there is a compelling clinical reason not to, or new data becomes available that suggests an alternate treatment protocol. Standardizing our approach to some of our practices is expected to reduce drug errors in the clinical environment and improve ease of work flow for the trainees.

‡Heparin administration protocols vary by institution. This protocol is based upon established practice patterns at UHCMC as well as a review of the peer reviewed literature related to this topic.

1: This protocol is intended for use in patients undergoing procedures requiring the use of cardiopulmonary bypass (CPB). Employing this protocol in other patient populations may result in life threatening hemorrhagic complications.

2: There are several clinical scenarios where heparin resistance (or insensitivity) has been observed to be more common. (Avery EG, et al.). The following list of clinical scenarios should prompt one to be ready to treat heparin resistance:

- Treatment with heparin infusion in the preceding 12 hours
- Treatment with an intra-aortic balloon pump (IABP) ± heparin infusion
- Treatment with a nitroglycerin infusion
- Known antithrombin III deficiency
- Disseminated intravascular coagulation (DIC)
- Active endocarditis or sepsis

3: Failure to aspirate the central line both prior to and following IV heparin administration could result in a failure to adequately heparinize the patient as central line migration cannot be ruled out. Any question about the functional status of the central line and administration of the heparin can be verified with the activated clotting time (ACT). If the central line has migrated then the heparin should be administered directly into the right atrium by the surgeon followed by ACT verification. (Mashour G, Avery EG)

4: Use of heparin infusions have been demonstrated in prospective studies to be associated with achievement of more consistent blood heparin levels as well as less postoperative hemorrhage. (Despotis GJ, et al.) Further, use of heparin infusions in the setting of cardiac surgery has been associated with biochemical evidence of better coagulation cascade suppression. (Despotis GJ, et al.)

5: The perfusionists are all careful not to add the heparin (and amicar when applicable) to the CPB pump prime until after they have completed the retrograde autologous priming procedure so that the drugs are not lost in the discarded prime fluids.

6: The established threshold of an ACT \( \geq 400 \) sec with the Hemochron Jr. Elite is equivalent to an ACT of 480 sec obtained with the Hemochron 801 per an internal validation/comparison study. The ACT value of \( \geq 400 \) sec will continue to be acceptable at our institution until prospective study of this value in our unique clinical setting demonstrates either biochemical or transfusion outcome evidence of a detrimental outcome associated with employing this threshold. Peak heparin effect has been shown to occur at 2 minutes after IV bolus injection in cardiac surgical patients. Waiting longer to check an ACT in patient with low cardiac output syndrome is only a theoretical concern that has never been validated.

7: Doses as high as 50 IU/kg (e.g., approximately 7 vials in a 70 kg patient) of antithrombin III concentrate have been tested in cardiac surgical patients and found to be safe and effective. It has not been shown that there is any clear benefit in using such high doses so it appears to be both medically safe and pharmacoeconomically prudent not to use any more than is necessary to achieve our desired ACT threshold of \( \geq 400 \) sec. (Koster A, et al.)
References:


