

Adenosine Induced Cardiac Arrest for Intracranial Aneurysm Clipping

Purported Benefits

- Collapse the aneurysm down in a limited space allowing dissection of inflow vessels by decreasing inflow (volume & pressure)
1. Provides alternative to temporary clipping:
 - Temporary clips may allow dissection with less risk of intra-op rupture
 2. Adenosine induced cardiac arrest temporarily reduces pressure in the aneurysm during application of clip
 - May allow nearly bloodless field for clip application if rupture occurs

What does the Literature say?

1. What is the supported Adenosine dosage range?
2. What is the optimal asystolic event timing?
3. What is the optimal blood pressure?
4. How should the patient be monitored?
5. What is the required IV access?
6. What are the contraindications?

Adenosine Dose Ranges

- Literature reports an exceedingly large dose range for Adenosine induced cardiac arrest
- Studies have numerous end points for “appropriate” response
- Initial Adenosine dose 0.3 – 0.5 mg/kg ideal body weight

- *Heppner et al*: Basilar tip aneurysm - Adenosine induced asystole for the treatment of a basilar tip aneurysm following failure of temporary clipping. *Acta Neurochir (Wien)*. 2007;149(5):517-20
 - Single patient report
 - 6, 12, 36, 36, 36 mg doses given in sequence (total dose 126 mg)
 - Induced asystole up to 52 seconds with hypotension for slightly less additional time after return of cardiac rhythm

- *Luostarinen et al*: Adenosine-induced cardiac arrest during intraoperative cerebral aneurysm rupture. *World Neurosurg.* 2010 Feb;73(2):79-83
- Retrospective review of 16 patients who had intraoperative aneurysm rupture
- 6 to 87 mg Adenosine given

- *Bebawy et al*: Adenosine-induced flow arrest to facilitate intracranial aneurysm clip ligation: dose-response data and safety profile. *Anesth Analg*. 2010 May 1;110(5):1406-11
 - Retrospective review of 24 aneurysm clippings
 - All but one developed asystole after Adenosine administration
 - Median dose 0.34 mg/kg (range 0.29 – 0.44 mg/kg) ideal body weight
 - SBP < 60 for median 57 seconds (range 26 – 105 sec)

- *Powers et al*: Transient Adenosine-induced asystole during the surgical treatment of anterior circulation cerebral aneurysms: technical note. Neurosurgery. 2010 Dec; 67(2 Suppl Operative):461-70
 - Report of 6 cases
 - Escalating Adenosine dosing: 6, 12, 18, 24, 36 mg
 - Maximum dose per patient ranged from 12 to 60 mg (cumulative)
 - Total doses per patient ranged from 18 to 112 mg

- *Bendok et al*: Adenosine for temporary flow arrest during intracranial aneurysm surgery: a single-center retrospective review. *Neurosurgery*. 2011 Oct;69(4):815-20
 - Retrospective review of 40 cases over 2 year period (10 intra-op ruptures)
 - Number of doses needed:
 - 1 dose (n = 19)
 - 2 doses (n = 16)
 - 3 doses (n = 5)
 - Starting dose 0.3 to 0.4 mg/kg ideal body weight
 - Median dose 24 mg
 - Flow arrest median time: 57 sec (26 – 102 sec)
 - “Failed to facilitate clip placement” in 5 patients

- *Golshani et al*: A review of the management of posterior communicating artery aneurysms in the modern era. Surg Neurol Int. 2010 Dec 22;1:88.
 - Reviews considerations for aneurysm clipping
 - Discusses role of Adenosine induced cardiac arrest
 - No mention of Adenosine dosing

- *Guinn et al*: Adenosine-induced transient asystole for intracranial aneurysm surgery: a retrospective review. J Neurosurg Anesthesiol. 2011 Jan;23(1):35-40
 - Retrospective review of 27 patients
 - Escalating doses: 6, 12, 18, 24 mg
 - Median dose to induce asystole > 30 seconds was 30 mg
 - Median dose to induce BP < 60 mmHg for more than 30 seconds was 15 mg
 - Median dose to induce BP < 60 mmHg for > 60 seconds was 30 mg

Pertinent Point

Develop an individualized Adenosine dose curve based on the asystolic response of the patient.

Contraindications

1. CAD
2. Decompensated heart failure
3. Pulmonary disease
4. Asthma
5. Severe bradycardia arrhythmias (2nd or 3rd degree heart block without a pacemaker and Sick sinus syndrome without a pacemaker)
6. Long QT syndrome
7. Wolff-Parkinson-White syndrome
8. Severe hypotension
9. Poison / drug-induced tachycardia

Monitoring / Access

- Standard 5-lead EKG
- R-2 pads + 3 lead pacing EKG (for pacing / defib unit)
- Central venous access
 1. Internal jugular
 2. Subclavian
 3. Long arm CVP
- Adenosine must arrive at the coronary ostia in aorta in a bolus / non-diluted fashion (challenging with peripheral IV's especially from distal locations)