

Adenosine induced cardiac standstill

Several flow-arrest techniques have been introduced for the treatment of [complex aneurysms](#) that cannot be treated with conventional [clipping](#) or endovascular [coil embolization](#). Adenosine-induced transient asystole is an alternative method of flow arrest.

[Adenosine](#)-induced flow arrest briefly reduces [cerebral perfusion pressure](#) and reduces the turgor of the aneurysm, thereby facilitating the clip ligation in [complex aneurysms](#). Periods of flow arrest have to be carefully coordinated with the surgeon such that necessary working time is available for aneurysm dissection and clip placement. Adenosine-induced transient asystole is safe and efficacious when administered at an average of 0.3 to 0.4 mg/kg IBW in combination with [remifentanyl](#)/low-dose volatile anesthetic with propofol. The adenosine dose will achieve approximately 45 seconds of controlled systemic [hypotension](#) and a bloodless surgical field. Adenosine offers the advantage of easy applicability in different situations without advanced preparation or complex logistical coordination with anesthesiology and cardiovascular surgery. This technique also allows the surgeon to have the maximum amount of space available to manipulate the aneurysm and place the clips, as no temporary clips are in the field of view. Also, temporary clips only decrease flow from the clipped inflow, whereas adenosine produces a more global hypotension and therefore often a better collapse of the aneurysm ¹⁾.

Adenosine-induced asystole for cerebral aneurysms surgery was first described by Groff et al. ²⁾ in [1999](#) in [posterior circulation aneurysms](#).

It is an easily applied technique in a variety of clinical situations. Its use requires minimal advanced preparation and no complex logistical coordination with other subspecialties. However, patient-specific dose-response relationships must be determined by exposure, so the relationship may not be known in an emergent situation. Persistent hypotension is a potentially major complication. [Rapid ventricular pacing](#) (RVP) has recently been reintroduced into cerebrovascular surgery. It is more predictable than adenosine in response time and, thus, can be used during unanticipated complications, such as aneurysmal rupture. It also induces a shorter period of hypotension compared with adenosine. However, RVP is more invasive and more complex from an anesthesia standpoint. Vascular neurosurgeons should be familiar with these techniques and know their applications and limitations ³⁾.

Case series

2017

The aim of a study is to report the experience in the use of adenosine in aneurysm [clipping](#) and arteriovenous malformation (AVM) resection and review the literature. The records of all patients who had adenosine-assisted clipping of intracranial aneurysms and AVM resections between November 2015 and December 2016 were extracted from prospectively maintained database. The following data were collected: patient demographics, comorbidities, size and location of the aneurysms or AVM, number of boluses and total dose of adenosine administered, duration of cardiac standstill and hypotension (systolic blood pressure < 60 mmHg), intraoperative and postoperative complications and outcome scores at discharge. Literature search on Embase and PubMed for the terms "adenosine and clipping", "adenosine and aneurysm" and "adenosine and AVM" was performed. Eight aneurysms

and two AVMs were identified. While both AVMs were elective procedures, half of the aneurysm clippings were on urgent basis.

Al-Mousa et al. used adenosine safely with spontaneous return of rhythm in all cases. Temporary clips to the parent artery were applied for brief periods in 2 patients who had pre-adenosine intraoperative rupture. They did not observe any immediate or late adverse events related to administration of adenosine.

In a review, a total of ten case series and four case reports were identified. There were no reports on the use of adenosine in AVM resection. Transient adenosine-induced asystole is a safe and effective technique in facilitating surgical treatment of complex aneurysms and AVMs. In addition, adenosine use reduces the need, duration, and associated complications of temporary clip applications to parent arteries ⁴.

2015

A total of 22 aneurysms in 22 different patients that underwent adenosine-induced transient asystole during aneurismal neck clipping within the past 4 years were retrospectively reviewed. Adenosine was administered intravenously in a test-incremental manner (starting with 6-12 mg and then giving additional doses as needed) in 11 patients and in an estimated manner (pre-calculated as 0.3-0.4 mg/kg) in 11 patients.

Overall, the study consisted of 18 unruptured saccular aneurysms, three ruptured saccular aneurysms, and a ruptured pseudoaneurysm. Adenosine-induced transient asystole was used in cases of temporary clipping inability, wide necked aneurysm, deep-seated aneurysm, or a thin aneurysm wall. The number of administrations, dose (mg/kg in ideal body weight) and duration of asystole were 1-4 (mean, 2.3) times, 0.08-1.27 (mean, 0.36) mg/kg and 0-30 (mean 13) seconds in the test-incremental manner and 1-2 (mean, 1.09) times, 0.24-0.42 (mean, 0.34) mg/kg and 13-41 (mean, 24) seconds in the estimated manner, respectively. There was a linear relationship between the dose and the duration of asystole. Twenty out of 22 aneurysms were clipped successfully with adenosine-induced transient asystole. However, in the other two cases, additional suction decompression was required for the final clipping. Adenosine-related cardiologic complications occurred in two cases of self-limited atrial fibrillation during restoration of the cardiac rhythm.

In our experience, adenosine-induced transient asystole was safe and helpful for satisfactory clipping of a complicated aneurysm. An estimated dose injection of adenosine was more convenient than the test-incremental method and did not result in serious cardiologic problems ⁵.

2009

A report describes three children, aged eight to 11 years, with high-flow cerebral arteriovenous malformations who underwent interventional neuroradiological procedures involving glue (N-butyl cyanoacrylate) embolisation under general anaesthesia. The procedure was facilitated by relative hypotension induced by esmolol infusion and intravenous adenosine boluses. To allow controlled deposition of N-butyl cyanoacrylate into the arteriovenous malformations, glue injection was synchronised with the onset of adenosine-induced brief cardiac standstill. This resulted in satisfactory obliteration of the arteriovenous malformations nidus in all cases. The haemodynamic modulations, including the adenosine-induced brief cardiac standstill, was noted to not affect the BIS values in our

patients. All patients had satisfactory obliteration of their arteriovenous malformations and had good neurological outcomes at one-year follow-up ⁶⁾.

1)

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2)

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3)

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5)

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6)

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