Microsurgical Clipping of Distal Basilar Trunk Aneurysm during Adenosine-Induced Profound Hypotension

Abstract

A 46-year-old male presented with a history of sudden severe headache 1 week back, altered sensorium and right hemiparesis for 2 days. On examination, Glasgow Coma Scale (GCS) was E4V4M6 and the patient had right hemiparesis (power – 4/5). Computed tomography (CT) revealed diffuse subarachnoid hemorrhage (Fisher's Grade III). CT angiogram revealed distal basilar trunk aneurysm arising between the origin of the left posterior cerebral artery and superior cerebellar artery, ectatic dilatation of distal basilar trunk, and a left middle cerebral artery (MCA) bifurcation aneurysm. Basilar trunk aneurysm was approached through subtemporal route and aneurysm was clipped during adenosine-induced profound hypotension (AIPH) without application of temporary clip. Single bolus 6 mg of adenosine was given, and aneurysm was successfully clipped during AIPH (systolic <60 mmHg). There were no complications related to adenosine. Ectatic part of distal basilar trunk was wrapped with Teflon. The left MCA bifurcation aneurysm was clipped in the same session. At 3-month follow-up, the patient's sensorium was normal (GCS-E4V5M6) and the right hemiparesis improved (4+/5). Adenosine enhances the safety of clipping these aneurysms by providing transient cardiac arrest or profound hypotension. In developing countries, microsurgical clipping is a cost-effective treatment option for basilar artery aneurysms.

Keywords: *Adenosine-induced asystole, adenosine-induced profound hypotension, basilar artery aneurysm, basilar trunk aneurysm, clipping, middle cerebral artery bifurcation aneurysm, multiple intracranial aneurysms*

Narayanam Anantha Sai Kiran, Veldurti Ananta Kiran Kumar, Valluri Anil Kumar[1], Amit Agrawal

Departments of Neurosurgery and [1]Neuroanaesthesia, Narayana Medical College Hospital, Nellore, Andhra Pradesh, India

Introduction

Microsurgical clipping of basilar artery aneurysms is technically challenging as the surgical corridors for temporary clip application are narrow and deep. Adenosine enhances the safety of clipping these aneurysms by providing transient asystole or profound hypotension during clipping.[1] We describe successful clipping of a distal basilar trunk aneurysm during adenosine-induced profound hypotension (AIPH).

Case Report

History and examination

A 46-year-old male presented with a history of sudden severe headache 1 week back, one episode of seizures followed by altered sensorium and right hemiparesis for 2 days. The patient was drowsy and Glasgow Coma Scale (GCS) was E4V4M6. The patient had right hemiparesis (Medical Research Council grade – 4/5).

Imaging features

Computed tomography (CT) revealed diffuse subarachnoid hemorrhage (SAH) (Fisher's Grade III) with blood predominantly in interpeduncular fossa. CT angiogram revealed wide-necked distal basilar trunk aneurysm arising from the basilar trunk between the origin of the left superior cerebellar artery (SCA) and posterior cerebral artery (PCA) and pointing to the left [Figure 1]. There was ectatic dilatation of distal basilar trunk between the origins of SCAs and PCAs. Small bilobed left middle cerebral artery (MCA) bifurcation aneurysm was also noted. Ruptured aneurysm was probably distal basilar trunk aneurysm as blood was predominantly in interpeduncular fossa close to basilar artery aneurysm.

Operation and postoperative course

Both the aneurysms were planned for clipping in one session. Cardiac workup and clearance for adenosine-induced transient asystole (AITA) was taken. Approach to distal basilar trunk aneurysm was left

How to cite this article: Sai Kiran NA, Kiran Kumar VA, Kumar VA, Agrawal A. Microsurgical clipping of distal basilar trunk aneurysm during adenosine-induced profound hypotension. Asian J Neurosurg 2019;14:1214-7.

Address for correspondence:
Dr. Narayanam Anantha Sai Kiran, Department of Neurosurgery, Narayana Medical College Hospital, Chintharedy Palem, Nellore - 524 003, Andhra Pradesh, India.
E-mail: saikiransssihms@gmail.com

Video Available on: www.asianjns.org

Access this article online

Website: www.asianjns.org

DOI: 10.4103/ajns.AJNS_157_19

Quick Response Code:

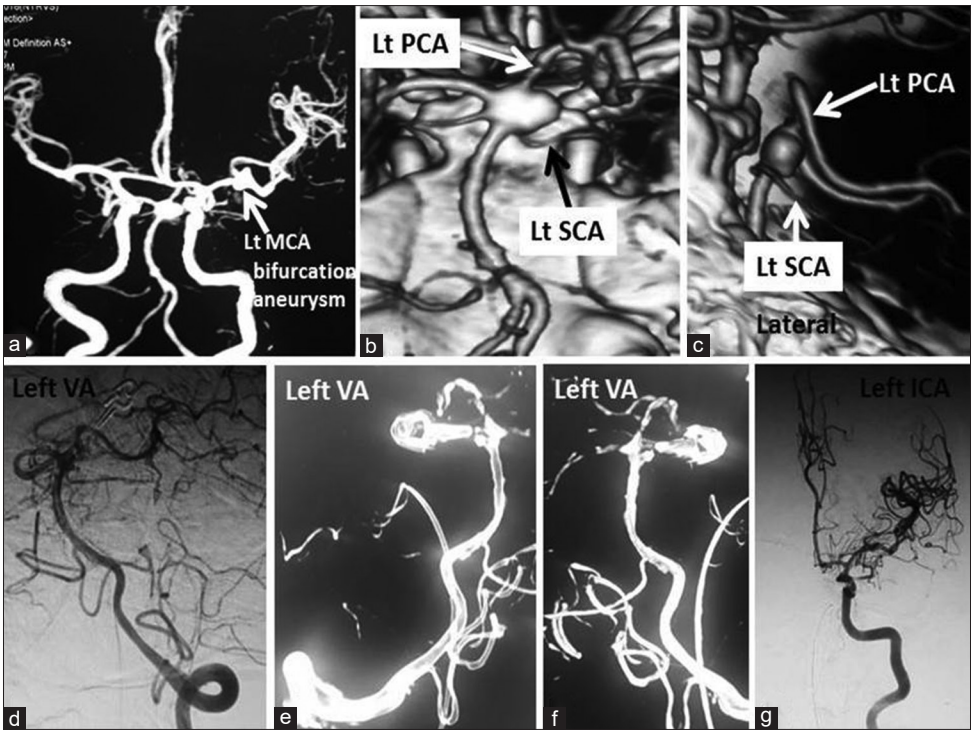

Figure 1: (a-c) Preoperative computed tomography angiogram showing distal basilar trunk aneurysm arising between the origin of the left posterior cerebral and the left superior cerebellar arteries, ectatic dilatation of distal basilar trunk between the origin of superior cerebellar arteries and posterior cerebral arteries, bilobed left middle cerebral artery bifurcation aneurysm (arrow in A). (d-g) Postoperative digital subtraction angiography (DSA) showing successful clip ligation of distal basilar trunk and middle cerebral artery bifurcation aneurysms

subtemporal and for the left MCA bifurcation aneurysm was left pterional [Video 1]. Total intravenous anesthesia with propofol and fentanyl infusion was used for better brain relaxation. Large frontotemporal craniotomy suitable for both the approaches was performed. It was decided to clip the ruptured distal basilar artery aneurysm first. Surgery was performed in supine position. Head was fixed in Sugita clamp and turned 90° to the right for the left subtemporal approach for basilar trunk aneurysm. Transcutaneous pacemakers were placed. Basilar trunk proximal to the aneurysm was exposed for managing inadvertent rupture of aneurysm during dissection. Basilar trunk aneurysm was wide necked with a thin wall and was projecting laterally. The distal basilar trunk between the origins of SCAs and PCAs was ectatic. Both options of clip application parallel to basilar trunk with curved/angled clip and perpendicular to basilar trunk with straight/slightly curved clips were considered [Video 1]. Perpendicular clipping with slightly curved clip (FE-752K-Aesculap, Yasargil, 8.3 mm standard curved clip) was considered to be the safe clipping technique for this aneurysm [Video 1]. Thiopentone (150 mg) was given just before AITA for cerebral protection. Single bolus 6 mg of adenosine was given and aneurysm was successfully clipped during AIPF (systolic <60 mmHg) without application of temporary clip. Another booster clip of same size was applied. There was no asystole and only transient profound hypotension for around 20 s was recorded with 6 mg adenosine. There were no complications related to AIPF. Ectatic dilatation of the distal basilar trunk was wrapped with Teflon fluff and covered with fibrin glue. Later, the left MCA bifurcation aneurysm was clipped in the same session. Optimal position for clipping of MCA bifurcation aneurysm (head rotation to the right by 30°) without changing the drapes could be achieved by rotating the Sugita head frame and table. Two clips (FE740K-7 mm std. straight clip and FE710K-5 mm mini straight; Aesculap, Yasargil) were used to clip the bilobed MCA bifurcation aneurysm [Video 1]. Postoperatively, the patient remained drowsy for a few days. The patient's sensorium and right hemiparesis gradually improved over the next 2 weeks. Check angiogram (digital subtraction angiography (DSA)) done before discharge revealed successful clip ligation of both the aneurysms [Figure 1]. At a follow-up of 3 months, the patient's sensorium was normal (GCS-E4V5M6) and the right hemiparesis improved significantly (4+/5).

Discussion

AITA or AIPH facilitates safe clipping of aneurysms when temporary clip placement is difficult.[2-8] It is a much simple and safe technique of providing temporary flow arrest or profound hypotension during aneurysm surgery compared to deep hypothermic cardiac arrest or rapid ventricular pacing.[2,7] Adenosine binds to cardiac A1 receptors and prolongs the conduction through atrioventricular node by decreasing the activity of adenylate cyclase.[7] The major disadvantage of AITA/AIPH is the very short duration

of asystole or profound hypotension as the half-life of adenosine is only 10 s and is rapidly cleared from circulation.[2-7] The duration of AITA/AIPH is difficult to predict.[2-8] Considering these limitations, AITA/AIPH should be used only when temporary clip placement is difficult.[5,7] AITA/AIPH facilitates clipping of basilar artery aneurysms as narrow and deep surgical corridors make application and removal of temporary clip relatively difficult, and temporary clip may obscure the operating view of these aneurysms.[1,7] Other indications for AITA/AIPH include early intraoperative rupture before proximal and distal control, insufficient control with temporary clip, synergistic to temporary clip application in achieving complete flow arrest, giant/complex aneurysms with difficult anatomy for temporary clip placement, and atherosclerotic proximal vessel.[2-8] AITA is a safe technique, and complications are extremely uncommon.[2-8] Various complications reported include atrial fibrillation, prolonged bradycardia/asystole, and ventricular tachycardia. AITA should be avoided in patients with coronary artery disease, cardiac dysrhythmias, bronchial asthma, and gout.

After the first description of the use of adenosine for clipping a basilar apex aneurysm in 1999 by Groff *et al*., safety and efficacy of adenosine during microsurgery for intracranial aneurysms has been reported in various reports.[1-9] Wang *et al*., in their literature review of AITA for intracranial aneurysms, found that there was a wide variation in the dose of adenosine given (initial dose of adenosine given ranged between 6 and 12 mg/0.2 and 0.4 mg/kg and median dose of adenosine between 12 and 78 mg) for inducing AITA and in the median duration of AITA (8–57 s).[7] Both test incremental method (starting with 6 or 12 mg adenosine and additional doses based on the response) and estimated dose injection method (0.3–0.4 mg/kg given in precalculated manner) have been described.[8] Powers *et al*. reported escalating doses of adenosine (6, 12, 18, 24, and 36 mg) to determine the dose of adenosine that would cause 30 s of asystole.[6] Predetermining the dose of adenosine that causes considerable duration of AITA by escalating doses and using that dose during clipping will expose the patient to multiple episodes of transient asystole and can cause complications secondary to brain ischemia, especially in patients with acute SAH similar to the present case.[4,8] In the present report, we decided to give an initial dose of 6 mg of adenosine after keeping the clip ready for clipping at the neck of the aneurysm. We decided to apply the clip once there is profound hypotension or asystole with 6 mg of adenosine and use higher doses if there is no AITA/AIPH with this dose. Profound hypotension was achieved with 6 mg of adenosine in this patient and aneurysm was successfully clipped during this period.

Endovascular treatment for both distal basilar trunk and MCA bifurcation aneurysms in this patient will be far more expensive than surgical treatment in a developing country like India due to very high device cost of material (hardware, microcatheter, guidewires, coils, stents, flow diverters, etc.) required for endovascular treatment.[9] The patient's family opted for surgical clipping as they could not afford expensive endovascular treatment. Clipping of both the aneurysms in a single session was performed in this patients as multiple intracranial aneurysms is a high-risk condition requiring prompt and early treatment of both ruptured and unruptured (silent) aneurysms, and poor outcome due to subsequent fatal bleeding from silent aneurysms following clipping of only ruptured aneurysms was reported.[10] Clipping of both the aneurysms was done for free of cost under the state government health scheme in this patient. Although endovascular treatment is preferred to clipping for basilar artery aneurysms at many centers, clipping is a reasonably safe and cost-effective treatment option for these aneurysms in developing countries.

Conclusion

AITA or AIPH enhances the safety of clipping basilar artery aneurysms in narrow and deep surgical corridors as temporary clip placement is difficult in these cases.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Groff MW, Adams DC, Kahn RA, Kumbar UM, Yang BY, Bederson JB, *et al.* Adenosine-induced transient asystole for management of a basilar artery aneurysm. Case report. J Neurosurg 1999;91:687-90.
2. Rangel-Castilla L, Russin JJ, Britz GW, Spetzler RF. Update on transient cardiac standstill in cerebrovascular surgery. Neurosurg Rev 2015;38:595-602.
3. Al-Mousa A, Bose G, Hunt K, Toma AK. Adenosine-assisted neurovascular surgery: Initial case series and review of literature. Neurosurg Rev 2019;42:15-22.
4. Bebawy JF, Gupta DK, Bendok BR, Hemmer LB, Zeeni C, Avram MJ, *et al.* Adenosine-induced flow arrest to facilitate intracranial aneurysm clip ligation: Dose-response data and safety profile. Anesth Analg 2010;110:1406-11.
5. Bendok BR, Gupta DK, Rahme RJ, Eddleman CS, Adel JG, Sherma AK, *et al.* Adenosine for temporary flow arrest during

intracranial aneurysm surgery: A single-center retrospective review. Neurosurgery 2011;69:815-20.

6. Powers CJ, Wright DR, McDonagh DL, Borel CO, Zomorodi AR, Britz GW, *et al.* Transient adenosine-induced asystole during the surgical treatment of anterior circulation cerebral aneurysms: Technical note. Neurosurgery 2010;67:461-70.
7. Wang X, Feletti A, Tanaka R, Yamada Y, Suyama D, Kawase T, *et al.* Adenosine-induced flow arrest to facilitate intracranial complex aneurysm clip ligation: Review of the literature. Asian J Neurosurg 2018;13:539-45.
8. Lee SH, Kwun BD, Kim JU, Choi JH, Ahn JS, Park W, *et al.* Adenosine-induced transient asystole during intracranial aneurysm surgery: Indications, dosing, efficacy, and risks. Acta Neurochir (Wien) 2015;157:1879-86.
9. Tahir MZ, Enam SA, Ali RP, Bhatti A, ul Haq T. Cost-effectiveness of clipping vs. coiling of intracranial aneurysms after subarachnoid hemorrhage in a developing country a prospective study. Surg Neurol 2009;72:355-60.
10. Heiskanen O. Risk of bleeding from unruptured aneurysm in cases with multiple intracranial aneurysms. J Neurosurg 1981;55:524-6.