



Case Report

Double-barrel STA-MCA bypass for a giant thrombosed supraclinoid ICA aneurysm with gangliocapsular infarct – A case report

S. Venkatesan¹, S. Balaji^{1,*}

¹Dept. of Neurosurgery, Meenakshi Mission Hospital, Madurai, Tamil Nadu, India



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ABSTRACT

Extracranial-intracranial (EC-IC) bypass is an essential tool for cerebral revascularization procedure. Superficial temporal artery–middle cerebral artery (STA-MCA) bypass was usually performed using one stem of the STA only. In an attempt to augment the flow and to direct the flow to different ischemic areas of the brain, a “double-barrel” technique is used, in which both branches of the STA are used to revascularize distinct MCA territories. Though there are many advancements in endovascular procedures, still STA MCA bypass plays a role in selected cases. We report a 50 years old female with giant thrombosed supraclinoid segment internal carotid artery (ICA) aneurysm with gangliocapsular infarct presented with vision loss, and limb weakness. Patient underwent double barrel STA-MCA bypass, post operatively patient improved of symptoms and patient was discharged in a stable condition. Though endovascular techniques have evolved exponentially over the last few years, and most of these complex aneurysms can be treated using flow-diverting techniques. Though the need for microsurgical intervention is diminished in this endovascular era, still the surgeons should think about these revascularization procedures as it gives life-long durable solution.

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1. Introduction

Crowell and Yasargil published the first reported case of superficial temporal artery-middle cerebral artery (STA-MCA) bypass in 1969, in a patient with complete MCA occlusion.¹ STA-MCA bypass has been used successfully in the treatment of patients with giant aneurysms, cranial base tumours, moyamoya disease and steno-occlusive disease. Most surgeons have described this using the parietal branch of the STA to anastomose in an end-to-side fashion to a distal branch of the MCA.^{2–7} This technique is referred to as a “low-flow” bypass.^{8,9} In an attempt to augment the flow and to redirect flow to different ischemic areas of the brain, a “double-barrel” technique is used in which both branches of the STA are used to revascularize different MCA

territories. It has also been shown to provide “high flow,” as measured by intraoperative quantitative flow measurement. The standard imaging evaluation for bypass candidates with steno-occlusive disease included Magnetic resonance imaging (MRI), 6-vessel Digital subtraction angiography (DSA), and CT perfusion (CTP) with acetazolamide challenge to assess for areas of ischemia, vascular occlusion, and collateralization, and regions of hypoperfusion with impaired cerebrovascular reserve.

Surgery was recommended for symptomatic patients with evidence of ischemia and impaired cerebrovascular reserve despite their receiving best medical management, in accordance with proposed clinical recommendations.^{10,11} The patient selection criteria was similar to that used for STA-MCA single barrel flow augmentation bypass. Surgical technique includes using a linear incision following the parietal branch of the STA with a small frontal

* Corresponding author.

E-mail address: narayanasmrithi@gmail.com (S. Balaji).

satellite incision, the two branches of the STA are harvested as donor vessels. These are anastomosed to recipient distal MCA vessel in temporal and proximal branches of frontal MCA. So this technique is used for augmentation of flow and to directly perfuse the hypoperfused regions of different areas of MCA territories.

2. Case Report

A 50 years old female presented to emergency department with history of progressive loss of vision on right side, head ache, not able to speak, difficulty in using left upper and lower limb and difficulty in walking for 10 days duration. She was apparently normal before 10 days then she noticed gradually decreased vision on her right eye in the form of blurring to complete loss of vision now. Head ache was right sided with constant dull aching in nature, not associated with vomiting. She was not able to use her left upper limb for her routine work and the weakness is progressively increasing. She was not able to walk due to the weakness of her left lower limb and able to walk only with support. She was not able to speak along with the onset of weakness. On examination patient was conscious, oriented, aphasic, no perception of light on right side with RAPD, left side vision was normal. On motor system examination on left side, upper limb power was grade 2/5 and lower limb was grade 3/5 with normal power on right side. MRI brain with MRA and MRV showed acute infarct seen in right basal ganglia, corona radiata and insular cortex (MCA territory). Contrast MRI shows decreased flow seen in cervical ICA, a giant thrombosed aneurysm measuring about 2.6*2.4 cm, arising from the supraclinoid segment of right ICA, the aneurysm shows mass effect over the right optic nerve and optic chiasma with no flow seen in aneurysm segment, minimal flow in right MCA and its cortical branches. DSA was done showed decreased filling of right ICA with no filling seen beyond clinoid segment with giant aneurysm in supraclinoid segment. Also shows no adequate flow across the A-com. In view of rapid progression of infarct, no flow beyond clinoid segment and no adequate flow across A-com, various treatment modality was discussed like aneurysm clipping with ICA reconstruction or double-barrel STA-MCA bypass surgery with parent vessel occlusion. Pros and cons of each surgical procedure was discussed in detail with the patient attenders and finally they were agreed to proceed with double-barrel STA-MCA bypass procedure. patient underwent double-barrel STA-MCA bypass surgery in which both branches of Right STA dissected to adequate length, right fronto temporal craniotomy was done, right frontal branch STA anastomosed with temporal cortical branch of MCA (M4 segment) and parietal branch of STA anastomosed with M3 branches of MCA using 10-0 ethilon under microscope. Flow across the anastomosis checked using Intra op ICG. Surgery was uneventful and patient was shifted to ICU. On post operative day (POD) 1, patient

was started on tablet aspirin and clopidogrel. From POD 3 onwards patient showed improvement in left limb power. Two weeks after the surgery patient started verbalising the words and power in the left upper limb improved to 3/5 and in lower limb 4/5. By the end of one month after the surgery patient's speech was improved and able to verbalize normally. Power in left upper and lower limb became 4+/5 and started to walk without support. On follow-up CT perfusion scan showed good perfusion seen in right ganglio capsular region, right peri sylvian region and good flow across the STA to MCA anastomosis with complete occlusion of ICA proximal to thrombosed aneurysm, on follow-up MRI brain, the size of aneurysm was regressed in size to 2.2*2.0 cm.

3. Discussion

STA-MCA bypass technique was first described by Woringer and Kunlin,¹² Donaghy and Yasargil,¹³ performed the first STA-MCA bypass surgery. Usually surgeons performs a single-anastomosis STA-MCA bypass with the parietal branch and it is considered as a low-flow bypass which is inadequate for flow replacement. The single barrel -bypass can only irrigate either the frontal or the temporal MCA territory, but a double-barrel bypass can provide a significant amount of flow immediately and directly to different recipient territories. The quantitative flow measurements demonstrated that double-barrel bypass has significantly higher overall flow compared with single-anastomosis bypass (69 mL/min vs 39 mL/min). These flows are dynamic, and donor vessels can enlarge or regress based on demand. Bypass flows can be monitored by angiography, quantitative MRA,¹⁴ and, transcranial Doppler ultrasound.^{15,16} When equal flow deficiencies are in both the superior and inferior MCA divisions, and the double-barrel technique augments the flow better than the single barrel technique. Outcomes of double barrel bypass surgery can be assessed by CT perfusion. Double-barrel bypass was helpful in secondary stroke prevention.

The complication rates are similar to that of single-barrel bypass. In aneurysm management, bypass surgery has its role in challenging and failed endovascular treatment cases.¹⁷ Moreover, it is a rescue treatment for symptomatic flow diverter thrombosis.¹⁸ Perioperative antiplatelet therapy and eptifibatide administration reduce the risk of graft thrombosis.¹⁹ Indocyanine green angiography (ICGA) and microvascular doppler sonography (mDS) are used for intraoperative flow assesment.²⁰

4. Conclusion

Double barrel STA-MCA bypass surgery might be a better option of treatment for selected cases, particularly giant complex thrombosed aneurysms with cerebral ischemia where endovascular techniques not feasible. The high

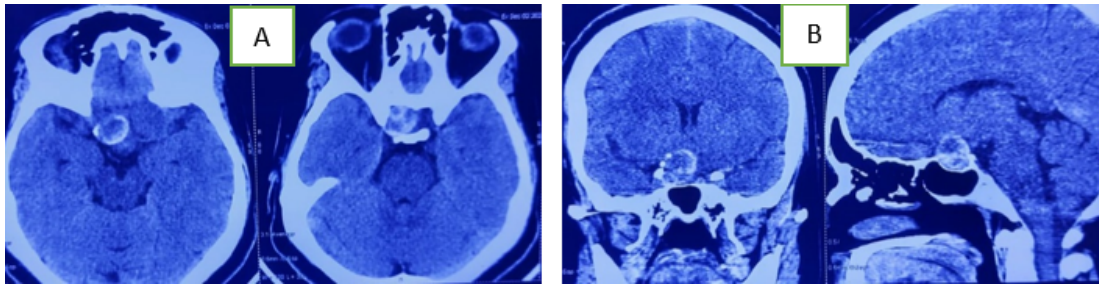


Fig. 1: A,B: CT brain showing giant thrombosed supraclinoid aneurysm in right side.

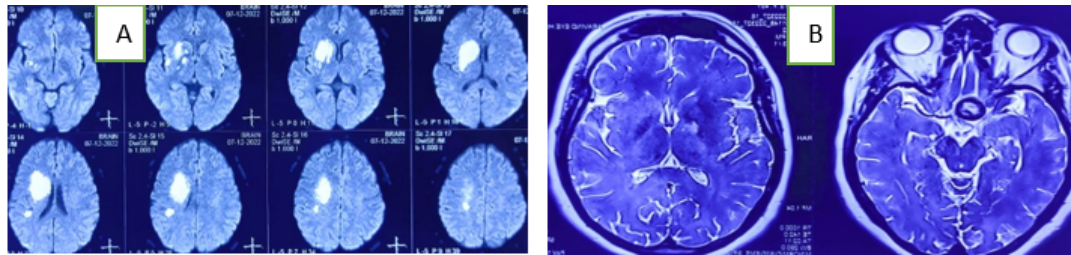


Fig. 2: A: MRI brain DWI images showing right side gangliocapsular infarct; **B:** MRI brain T2WI axial showing Right giant thrombosed supraclinoid aneurysm with gangliocapsular infarct and the aneurysm shows mass effect over the right optic nerve and optic chiasma.



Fig. 3: A: DSA contrast injection in right CCA showing good flow in ECA with and reduced flow till clinoid with no flow beyond clinoidal segment; **B:** DSA contrast injection in right ICA showing reduced filling till clinoid segment of ICA with giant aneurysm in supraclinoid segment; **C:** DSA contrast injection in right ECA showing good filling in frontal and parietal branches of STA.

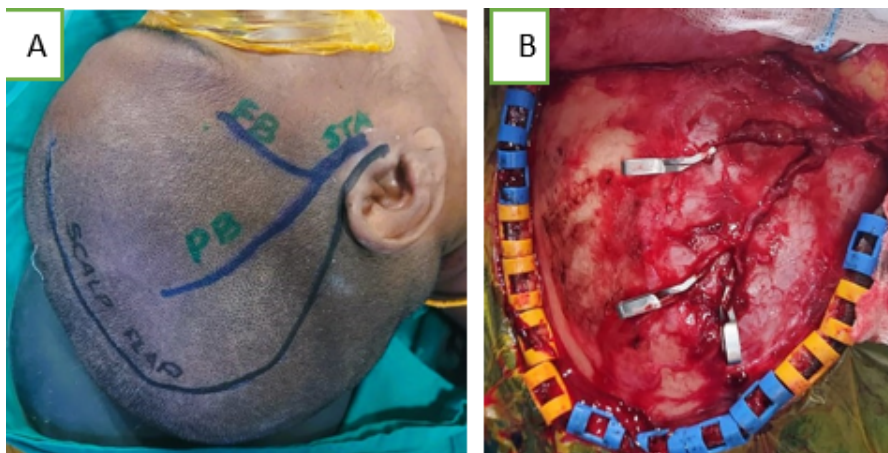


Fig. 4: A: Showing frontal and parietal branches of STA marked using Doppler; **B:** Showing adequate dissection of frontal and parietal branches of STA.

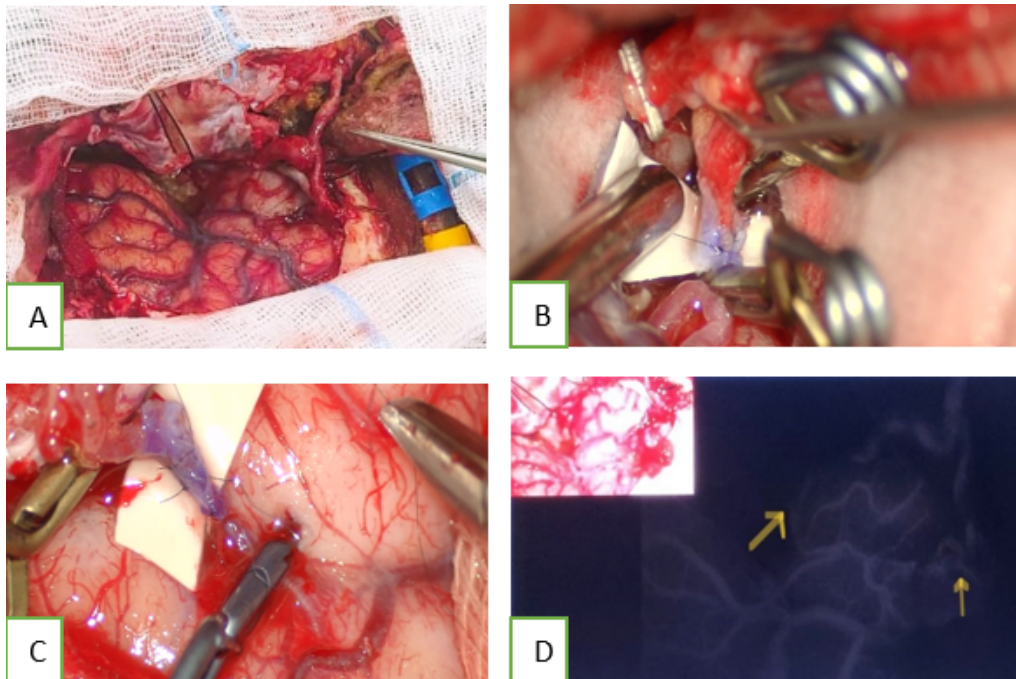


Fig. 5: **A:** Intra op picture showing double barrel STA-MCA anastomosis; **B:** intra op picture showing M3-parietal branch of STA anastomosis; **C:** Intra op picture showing temporal cortical-frontal branch of STA anastomosis; **D:** Intra op ICG showing double barrel STA-MCA anastomosis

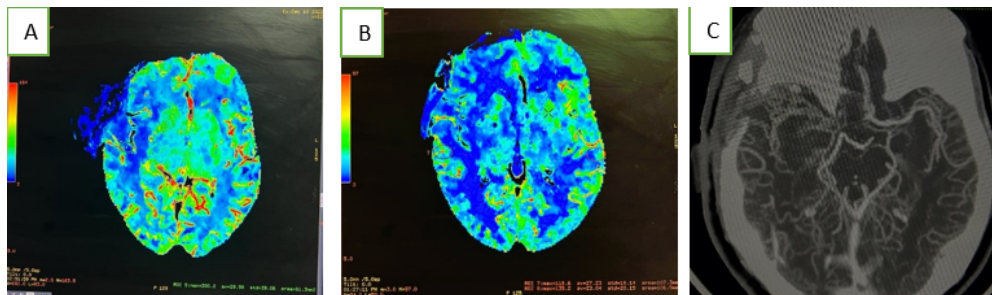


Fig. 6: **A:** CT perfusion study showing good perfusion in right perisylvian region; **B:** CT perfusion study showing good perfusion in right ganglio capsular region; **C:** CT perfusion study showing adequate cross flow across the STA to MCA on right side.

rates of intraoperative and postoperative patency support the feasibility of dual-anastomosis STA-MCA bypass for revascularization. The perioperative complications are same of that of single barrel technique. The functional outcomes at follow-up and perfusion improvement postoperatively support the efficacy of this technique.

5. Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient have given their consent for 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.

6. Source of Funding

None.

7. Conflicts of Interest

There are no conflicts of interest.

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Author biography

S. Venkatesan, Senior Consultant

S. Balaji, Senior Resident  <https://orcid.org/0000-0001-9098-1372>

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