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Extracranial to Intracranial Bypass for the Treatment of Cerebral Aneurysms in the Pediatric Population; a Case Report and Review of the Literature

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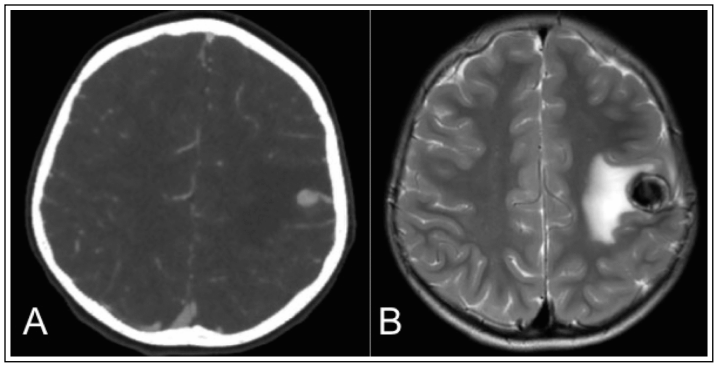
Introduction

- Pediatric cerebral aneurysms are rare and differ in morphology and location
- Higher incidence of being fusiform and presenting as giant
- Numerous studies of microsurgical clipping have been published, but few regarding Extracranial to intracranial bypass
- The authors present obliteration of an unruptured large, partially thrombosed, distal, eloquent territory MCA aneurysm with a superficial temporal artery (STA) to MCA bypass and trapping in a child

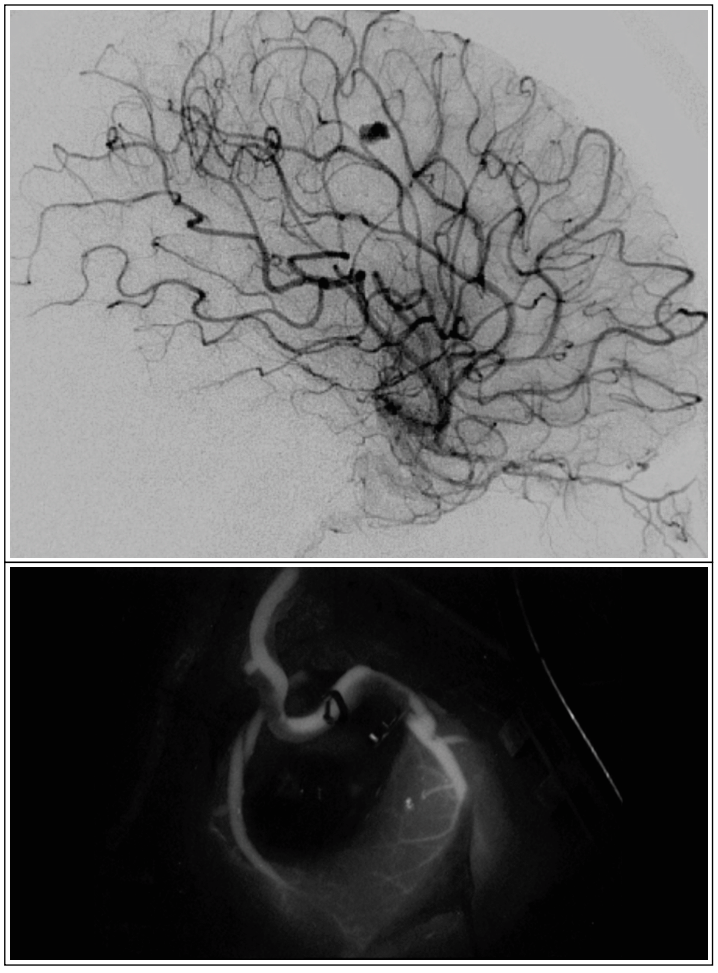
Clinical Course

- Three year-old male presented after a ground level fall without loss of consciousness
- Developed right facial twitching, lasting ten seconds, over the course of a week
- Initially treated with broad-spectrum antibiotics, but infectious work-up proved negative
- Vessel sacrifice was not ideal as lesion was in eloquent cortex; open and endovascular approaches were complicated by the large size of the aneurysm compared to the size of the parent artery
- Proceeded with surgical trapping with STA-MCA bypass
- Postoperatively, the patient remained neurologically intact; MR angiography demonstrated a patent bypass and MR of the brain demonstrated stable edema in the left frontal lobe with no abnormalities on diffusion weighting imaging.



A. A axial CT angiogram illustrates a vascular lesion, most likely an aneurysm, of the distal middle cerebral artery. B. A T-2 weighted MRI sequence shows a hypointense region, larger than the aneurysm appreciated on CTA. This is most consistent with a large, partially thrombosed aneurysm in the peri-rolandic region.

Catheter angiogram shows a left internal carotid artery injection. This image confirms the CTA and MRI findings. A distal MCA aneurysm is demonstrated without any associated arteriovenous malformation and no other aneurysms identified.



Indocyanine Green (ICG) fluorescence angiography postbypass and aneurysm occlusion.

Results

- Pediatric EC-IC bypasses pose a unique set of challenges, including small vessel diameter, graft considerations such as size and long-term impact of graft harvest, future growth of the patient, longer expected lifetimes
- Kim et al. reported MCA distribution infarcts in 2 out of 10 (20%) patients, both of which were giant MCA aneurysms, and both recovered to their neurologic baseline. All grafts were patent at last follow up and the aneurysm obliteration rate was 90%.
- Kalani et al. reported postoperative complications in 4 of 28 (14%) bypass procedures and at last follow up 3 out of the 4 were independent. Another patient experienced unilateral blindness as a result of graft failure leaving 2 of 28 (7%) procedures with long-term complications

Study	Patients	Aneurysm Location	Size	Ruptured	EC IC Bypass	Radiographic Follow Up (Months)	Graft Patency Rate	Aneurysm Obliteration Rate at Last Follow Up	Clinical Outcomes
Lansen (1989)	n=1	MCA	Giant	-No	STA-MCA and parent vessel occlusion using Drake tourniquet	5	100%	100%	Neurologically intact at 2 years
Zhang (2002)	n=2	Cavernous ICA; MCA	Giant (n=2)	Yes =1 No=1	ECA - MCA with SVG (n=2)	<1 and 48	100%	50%	Neurologically intact at 2yrs and 4yrs follow up
Goedee (2009)	n=1	MCA	Giant	No	Double Barrel STA-MCA bypass	<1	Not reported	100%	Neurologically intact postop
Alamanda (2012)	n=1	M2	Giant	No	ECA - MCA with SVG	5	100%	100%	Neurologically intact at 5 month follow up
Kim (2013)	n=10	MCA (n=6); Basilar (n=2); PCA (n=1); ACoA (n=1)	Giant (n=4), Large (n=3), Small (n=3),	Yes=3 No=7	End-to-side SVGs(n=4); interposition bypass grafts (n=2 RAGs); side-to-side (n=1); lingual artery graft (n=1); intracranial reimplants (n=2)	Mean = 40 Median = 15	100%	90%	mRS 0-2 in 9 of 9 patients available for follow up at mean 40.5 months
Kalani (2014)	n=27	MCA (n=14); ICA (n=7); PCA (n=2); ACA (n=2); Basilar (n=2), Vertebral (n=1), Vertebrobasilar junction (n=1)	Giant (n=14), Large (n=5), Small (n=10)	Yes=5 No=24	STA -MCA (n=6); ECA-ICA with SVG (n=7); in situ bypass (n=6); ECA-ICA with RAG (n=3); STA onlay (n=3); STA-PCA (n=1); OA-PCA (n=1); end-to-end anastamosis (n=1);	Mean = 49.6 Median = 14	80% (20 of 25 available for follow up)	92.3% (24 of 26 available for follow up)	GOS 4-5 in 96.3% at mean 46 month follow up
Abla (2014)	n=1	Supraclinoid ICA	Giant	No	Double barrel STA-MCA with frontal branch directly anastamosed and parietal branch anastamosed using RAG	<1	100%	100%	Neurologically intact; improved visual fields at 5 months
Presented Case	n=1	MCA	Large	No	STA-MCA	<1	100%	100%	Neurologically intact postop

- A conservative assessment of the best available literature dictates that EC-IC bypass for aneurysms in the pediatric population can achieve aneurysm obliteration in 90% or greater of the cases with a long-term complication rate of less than 10%.
- When considering that a greater proportion of these aneurysms are giant or fusiform these outcomes are equal to or superior to those achieved in the adult population

Conclusions

- Though the majority of reported EC-IC bypasses for aneurysms in the pediatric population have demonstrated to be safe and effective, there still remains a relatively small number of cases performed overall, and most of these cases have relatively short-term follow up data
- Further analysis with longer follow up periods is warranted
- EC-IC bypass can provide a therapeutic benefit for a select pediatric aneurysm population