



ASPIRATION THROMBECTOMY FOR ACUTE CEREBROVASCULAR DISEASES

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Thrombus Aspiration during ST-Segment Elevation Myocardial Infarction

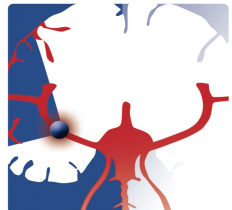
Ole Fröbert, M.D., Ph.D., Bo Lagerqvist, M.D., Ph.D., Göran K. Olivecrona, M.D., Ph.D., Elmir Omerovic, M.D., Ph.D., Thorarinn Gudnason, M.D., Ph.D., Michael Maeng, M.D., Ph.D., Mikael Aasa, M.D., Ph.D., Oskar Angerås, M.D., Fredrik Calais, M.D., Mikael Danielewicz, M.D., David Erlinge, M.D., Ph.D., Lars Hellsten, M.D., Ulf Jensen, M.D., Ph.D., Agneta C. Johansson, M.D., Amra Kåregren, M.D., Johan Nilsson, M.D., Ph.D., Lotta Robertson, M.D., Lennart Sandhall, M.D., Iwar Sjögren, M.D., Ollie Östlund, Ph.D., Jan Harnek, M.D., Ph.D., and Stefan K. James, M.D., Ph.D.

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EDITORIAL



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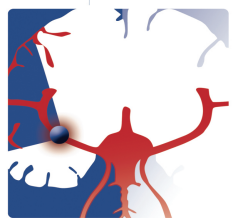
Unmet Aspirations — Where To Now for Catheter Thrombectomy?

Robert A. Byrne, M.B., B.Ch., Ph.D., and Adnan Kastrati, M.D.

Aspiration in acute coronary syndrome

Differences between ACS and AIS

- Acute coronary syndrome largely homogeneous condition
- Occlusive lesion usually plaque with thrombus (ruptured plaque)
- Need to deal with plaque in addition to thrombus



UPMC MAT FOR STROKE- EARLY EXPERIENCE

Endovascular treatment of basilar artery occlusion by manual aspiration thrombectomy

Brian T Jankowitz,¹ Aitziber Aleu,² Ridwan Lin,² Mouhammad Jumaa,² Hilal Kanaan,¹ Dean Kostov,¹ Maxim Hammer,² Ken Uchino,² Larry R Wechsler,² Michael Horowitz,¹ Tudor G Jovin²

ABSTRACT

Background and purpose Basilar artery occlusion remains one of the most devastating subtypes of stroke. Intravenous and intra-arterial therapy have altered the natural history of this disease; however, clinical results remain poor. Therefore, exploring more aggressive and innovative management is warranted.

Methods Six consecutive patients presenting with a basilar artery occlusion were treated with the same general algorithm of intra-arterial tissue plasminogen activator and mechanical thrombectomy with the Merci retrieval system. If complete recanalization was not achieved after two passes, manual syringe aspiration through a 4.3F catheter was employed.

Results All interventions utilizing aspiration thrombectomy resulted in recanalization, with five out of six cases displaying TIMI3/TICI3 flow and one patient resulting in complete recanalization of the basilar artery with persistent thrombus in one P2 segment (TIMI2/TICI2B). All patients survived, with five out of six independent in activities of daily living at 3 months (mRS 0–2).

recanalize and have sufficient penumbral brain to allow a good recovery. In selected cases, this has been shown to be possible as far out in time as 50 h.⁶ Considering the higher rates of recanalization with intra-arterial therapy and the short time window required for administration of intravenous thrombolytics, intra-arterial therapy with or without intravenous therapy is considered the standard form of therapy used in many centers.^{3 7–9}

The current armamentarium for intra-arterial therapy includes thrombolytics and a variety of devices intended to disrupt, stent or aspirate thrombus. The latter has been described with the Penumbra System (Penumbra Inc., Alameda, California, USA), which uses continuous aspiration through a pump connected to a catheter.¹⁰ A recently introduced 4.3F catheter provides another method to remove clot via intermittent, manual aspiration. We describe six consecutive cases of BAO treated with aspiration thrombectomy and short-term follow-up.

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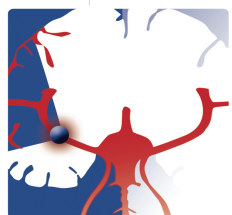
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Manual Aspiration Thrombectomy (MAT), A Novel Approach To Endovascular Therapy For Acute Stroke

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UPMC, Pittsburgh, PA; *Univ Hosp Germans Trias I Pujol, Barcelona, Spain

Background

Manual aspiration thrombectomy (MAT) is an endovascular recanalization modality that is frequently used in acute coronary artery syndromes. In intracranial vessels however, there is little experience to date with this method. We aimed to evaluate recanalization rates, clinical outcomes and safety with this method in a consecutive case series treated at our center.

Methods

Retrospective review of a prospectively acquired acute endovascular stroke database, from which patients treated with MAT were identified. MAT was carried out with the Distal Access Catheter (DAC) 0.57 and 0.44 French and Penumbra Reperfusion Catheter 0.54 and 0.41 French placed in the thrombus and attached to a syringe. Collected data include baseline demographics, risk factors, clinical and imaging characteristics. Successfully recanalization was defined as TIMI 2 and 3. Outcome (available in all patients analyzed) was considered favorable if mRS at 90 days was ≤ 2 .

Results

DEMOGRAPHIC	N 161
Median age	66
Median ASPECT score	9
Median NIHSS	16
Oclusion site	
M1 MCA	56%
M2 MCA	8%
ICA terminus	26%
Tandem extracranial-intracranial carotid	23%
Vertebrobasilar	13%
Additional treatment modality	
MERC1 device	90
Median 1 pass MERC1 device	Mean 1.4 pass
Penumbra device	40%
IA tPA	47%
IV tPA	32%

RESULT	
TIMI 2 and 3 recanalization	91%
TIMI 3 recanalization	24.5%
Parenchymal hematoma (PH1, PH2)	15.5%
Perforation rate	3%
Favorable outcome	52% (78 out of 150)
Median time to start procedure	Mean 370 minutes
Median treatment duration	Mean 90 minutes

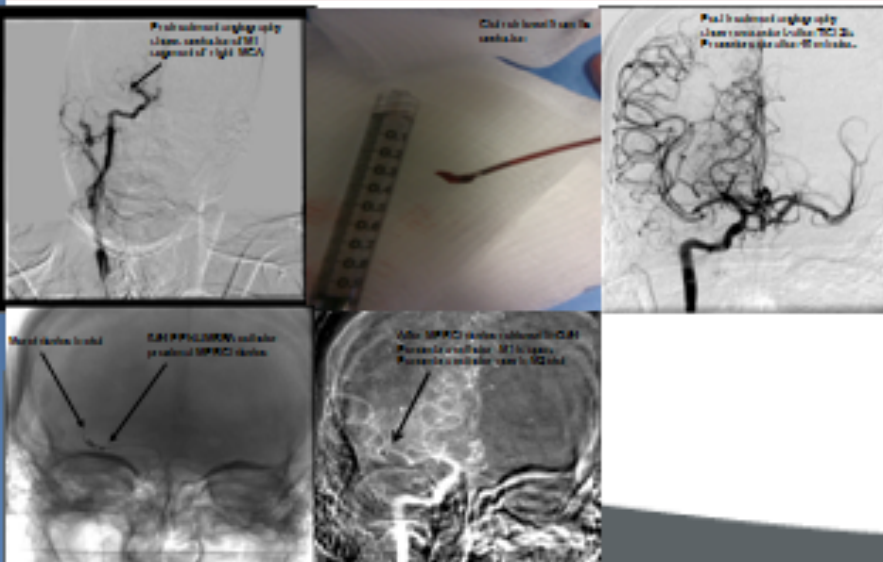
Significant predictors of outcome

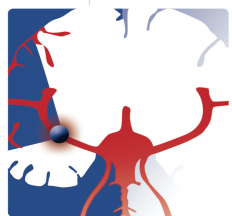
Variable	OR	95% CI	P
Admission NIHSS	0.85	0.77-0.94	0.001
Age	0.93	0.88-0.97	0.004
Intubation	0.17	0.50-0.64	0.008
ASPECT score	1.90	1.17-3.09	0.009
Treatment duration	0.98	0.97-0.99	0.046
Admission glucose	0.99	0.98-0.99	0.044
Recanalization	16.9	0.82-346.5	0.066

Catheter use for MAT	
DAC 0.44	51%
DAC 0.57	40%
Penumbra 0.41	21%
Penumbra 0.54	26%
Small catheter only	40%
Large catheter only	41%

Conclusion

MAT is a useful addition to the armamentarium of endovascular treatment modalities for acute stroke. When used as part of multimodal recanalization strategies it appears to enhance the recanalization rate and possibly to improve outcome. In addition, when used in substitution to other treatment modalities it may significantly reduce procedural cost.

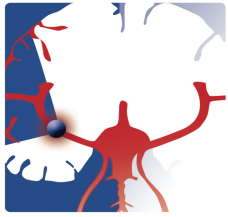




MAT + MERCI

UPMC EXPERIENCE

- Median procedure time - 90 min
- Successful Recanalization (TIMI 2/3) - 93% (177/191)
 - TIC1 2a/2b/3 91%, TIC1 2b/3 71%, TIC1 3 25%
- Recanalization (TIC1 2b/TIC1 3) by vessel– BA 100%, M1 69%, ICAT 61%, M2 75%
- Favorable outcome (90 day mRS ≤ 2) - 55%
- Mortality at 90 days - 25%
- Parenchymal hematoma (PH1/PH2) - 13.6% (26/191)
- Perforation - 2.3% (4/191)



Manual Aspiration Thrombectomy

Adjunctive Endovascular Recanalization Technique in Acute Stroke Interventions

Brian Jankowitz, MD; Amin Aghaebrahim, MD; Alexandra Zirra; Oana Spataru, MD; Syed Zaidi, MD; Mouhammad Jumaa, MD; Gerardo Ruiz-Ares, MD; Michael Horowitz, MD; Tudor G. Jovin, MD

Background and Purpose—We evaluated recanalization rates, clinical outcomes, and safety when manual aspiration thrombectomy is used in conjunction with other thrombolytic modalities in a consecutive case series of patients with large vessel intracranial occlusion.

Methods—We conducted a retrospective review of a prospectively acquired acute endovascular stroke database. Manual aspiration thrombectomy was carried out with Distal Access and Penumbra reperfusion catheters of different sizes placed in the thrombus and aspirated with a syringe.

Results—We identified 191 patients: Occlusion locations were as follows: M1% to 50%, M2% to 10%, internal carotid artery terminus 25%, and vertebrobasilar 15%. Median treatment duration was 90 minutes. Recanalization results were Thrombolysis in Myocardial Ischemia 2/3 93%, Thrombolysis in Myocardial Ischemia 3 27%, Thrombolysis In Cerebral Infarction 2a/2b/3 91%, Thrombolysis In Cerebral Infarction 2b/3 71%, and Thrombolysis In Cerebral Infarction 3 25%. Larger catheters were associated with higher recanalization rates. Parenchymal hematoma rate was 13.6%. The favorable outcome (90-day modified Rankin Scale ≤ 2) rate was 54%. Mortality at 90 days was 25%.

Conclusions—Manual aspiration thrombectomy is a useful addition to the armamentarium of endovascular treatment modalities for acute stroke. (*Stroke*. 2012;43:1408-1411.)

Key Words: aspiration ■ endovascular ■ intra-arterial ■ stroke ■ thrombectomy

OTHER ASPIRATION TECHNIQUES

ADAPT

ORIGINAL RESEARCH

Initial clinical experience with the ADAPT technique: A direct aspiration first pass technique for stroke thrombectomy

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ABSTRACT

Background The development of new revascularization devices has improved recanalization rates and time but not clinical outcomes. We report our initial results with a new technique utilizing a direct aspiration first pass technique with a large bore aspiration catheter as the primary method for vessel recanalization.

Methods A retrospective evaluation of a prospectively captured database of 37 patients at six institutions was performed on patients where the ADAPT technique was utilized. The data represent the initial experience with this technique.

Results The ADAPT technique alone was successful in 28 of 37 (75%) cases although six cases had large downstream emboli that required additional aspiration. Nine cases required the additional use of a stent retriever and one case required the addition of a

Penumbra aspiration separator to achieve recanalization. The average time from groin puncture to at least Thrombolysis in Cerebral Ischemia (TICI) 2b recanalization was 28.1 min, and all cases were successfully revascularized. TICI 3 recanalization was

achieved 65% of the time. On average, patients presented with an admitting National Institutes of Health Stroke Scale (NIHSS) score of 16.3 and improved to an NIHSS score of 4.2 by the time of hospital discharge. There was one procedural complication.

Discussion This initial experience highlights the fact that the importance of the technique with which new stroke thrombectomy devices are used may be as crucial

generation of devices needs to focus on quality of thrombectomy rather than ability to recanalize. We report our initial results with a new technique utilizing a direct aspiration first pass technique with a large bore aspiration catheter as the primary method for vessel recanalization.

METHODS

Retrospective analysis from a prospectively captured database was gathered on the first patients undergoing stroke thrombectomy with the ADAPT technique at the Medical University of South Carolina, Swedish Medical Centre, Vanderbilt University, Erlanger Medical Centre, Stony Brook University, and University at Buffalo using an institutional review board approved protocol.

ADAPT technique

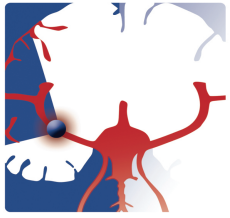
All operators selected patients for thrombectomy according to their usual protocol (figure 1). Access to the cerebral vasculature required a 6 French Neurosheath, usually a Neuron 088 Max (Penumbra, Oakland, California, USA). This was advanced as far distally into the internal carotid artery as was safely possible, usually to the skull base or petrous segment of the internal carotid artery. For posterior circulation thrombi, the Neuron 088 was navigated into the largest caliber vertebral artery and positioned into the distal V2

- Single catheter type (Penumbra)
- Pump aspiration
- Non-consecutive case series

Primary MAT – UPMC EXPERIENCE

- 10/2012- 6/2013 Manual Aspiration performed as first line treatment in all patients treated (consecutive series)
- Other modalities (stentriever mainly) used as rescue only
- 112 patients treated





UPMC Primary MAT Experience

Catheters and sizes used

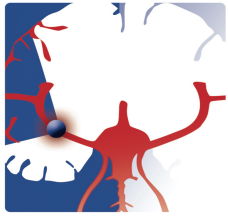
- Navien (Covidien Inc.) 0.072 and 0.058 (84%)
- Penumbra (Penumbra Inc. 0.054 and 0.041 (23%)
- DAC (Stryker Inc.) 0.070, 0.054 and 0.44 (4%)
- >0.070 in 27%
- 0.054 -0.058 in 75%

Primary MAT – UPMC EXPERIENCE

Variable	N (%)	Median(IQR)	mRS ≤ 2*		
			OR	P value	95% CI
Age (yrs)		66 (29-93)	0.97	0.041	0.94-0.99
NIHSS		17(4-36)	0.78	0	0.70-0.88
Baseline ASPECT		9 (4-10)	1.5	0.008	1.11-2.04
Time to Procedure (hrs)*		4.45(1.16-34.3)	0.99	0.113	0.99-1.00
Treatment Time (Minutes)**		70(15-289)	0.99	0.047	0.980-0.99
Male	61 (54.4)		1.63	0.215	0.75-3.5
Left MCA	54(54)		0.79	0.056	0.34-1.79
HTN	81 (72.3)		0.88	0.766	0.37-2.04
DM	22 (19.8)		0.43	0.124	0.153-1.252
Afib	40 (36)		0.88	0.77	0.39-1.88

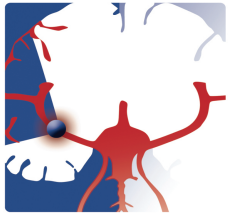
TICI ≥ 2b	97 (86.6)		2.07	0.01	1.18-3.62
Intubation	13 (12.4)		0.45	0.2	0.13-1.59
IV TPA	46 (41)		1.6	0.2	0.75-3.63
M1	70 (62)		1.2	0.53	0.57-2.89
M2	9 (8)		1.18	0.8	0.27-5.00
ICA terminus	21 (18.7)		0.81	0.69	0.29-2.23
Tandem	21 (18.7)		2.08	0.16	0.73-5.88
Any ICA	38 (33.9)				
Basilar	12 (10.7)				
Number of passes		2(1-8)	0.88	0.35	0.68-1.14

ENT	4 (3.5)				
MRS < 3 at 90 days	52 (46.1)				
MRS 6	35 (31)				
Pure MAT	66 (59)		1.14	0.73	0.522-2.50
Favorable outcome	48 (46.1)				
HT	31 (27)				
Aspiration catheter			0.75	0.45	0.36-1.55
0.4/0.5/0.6					
Asp catheter brand	Navien (84)		1.2	0.46	0.73-1.97
	DAC (4)				
	Penumbra (2)				



UPMC Primary MAT Experience RESULTS (n=112)

- TIC1 2b/3- 86%
- Of TIC1 2b-3: 61% MAT only; 41% MAT + adjunctive
- TIC1 3 -30%
- PH1/PH2: 9.9%
- mRS ≤ 2 : 46%
- 90 d mortality: 31%
- Median time: puncture to reperfusion 70 min
- Median number of passes: 2
- Distal embolization: 3.7%
- Mean time puncture to reperfusion: MAT only vs MAT plus adjunctive 63 min vs 97 min ($p < 0.0001$)
- Neither catheter make nor size were associated with higher or faster recanalization rates



UPMC Primary MAT Experience

Conclusion

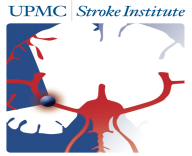
- Results (clinical, procedural) comparable to Stentriever data
- Potential for substantially lower cost
- Obviates need for BGC
- Benefit compared to Stentriever beyond cost needs to be assessed in randomized trials



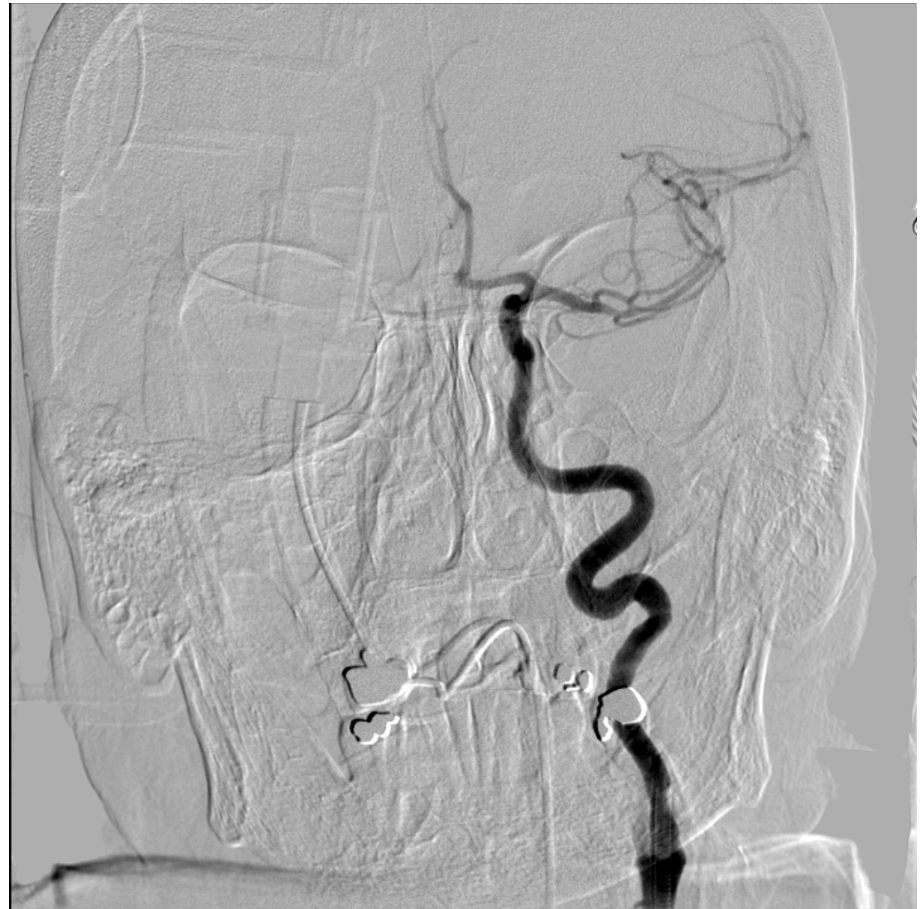
MAT VIA TRANSCERVICAL APPROACH

- 87 year old with NIHSS 17 ; ASPECTS 9

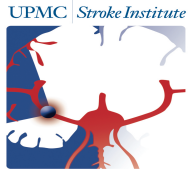




MAT VIA TRANSCERVICAL APPROACH – UPMC EXPERIENCE



Puncture to reperfusion - 20 min



MAT VIA TRANSCERVICAL APPROACH AT UPMC

Date	Age	Side	Reason	Attempted Access to Sheath Placement	Sheath to Recan	Passes	TICI	Catheter
4-19-13	87	Left	Arch (30)	20	27	3	TICI 2A	0.058 Navien
4-21-13	87	Left	Arch (20)	13	7	1	TICI 3	0.072 Navien
6-15-13	63	Left	Arch (60)	20	43	2	TICI 2B	0.058 Navien
7-15-13	81	Left	Arch (30)	20	15	1	TICI 2B	0.072 Navien
9-23-13	61	Left	Femoral (22)	17	10	1	TICI 3	0.072 Navien
10-7-13	87	Left	Age	10	10	1	TICI 3	0.072 Navien

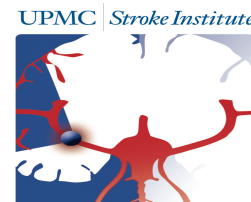
Jadahav et. al, JNIS 2013 (in press)

Manual aspiration thrombectomy for cerebral venous sinus thrombosis

Brian Thomas Jankowitz,¹ Lance Matukas Bodily,² Mouhammad Jumaa,³
Zaidi F Syed,³ Tudor G Jovin³

Table 1 Patient demographics and presentation

Patient No	Sex	Age (years)	Sinus thrombosed	Suspected etiology	Hemorrhage, edema, and mass effect/sulcal effacement on imaging?
1	F	1–5	Superior sagittal sinus Bilateral transverse sinuses	Extreme dehydration Possible hypercoagulable state	Yes
2	F	55–60	Right transverse sinus Straight sinus	Hypercoagulable state (malignancy)	No, edema only
3	M	55–60	Straight sinus	Secondary to AV fistula	No, edema only
4	F	55–60	Distal left sigmoid sinus Proximal internal jugular	Hypercoagulable state/idiopathic	Yes
5	F	65–70	Posterior 2/3 of superior sagittal sinus Right transverse sinus	Trauma	Yes
6	F	20–25	Superior sagittal sinus	Hypercoagulable state/NuvaRing	Yes

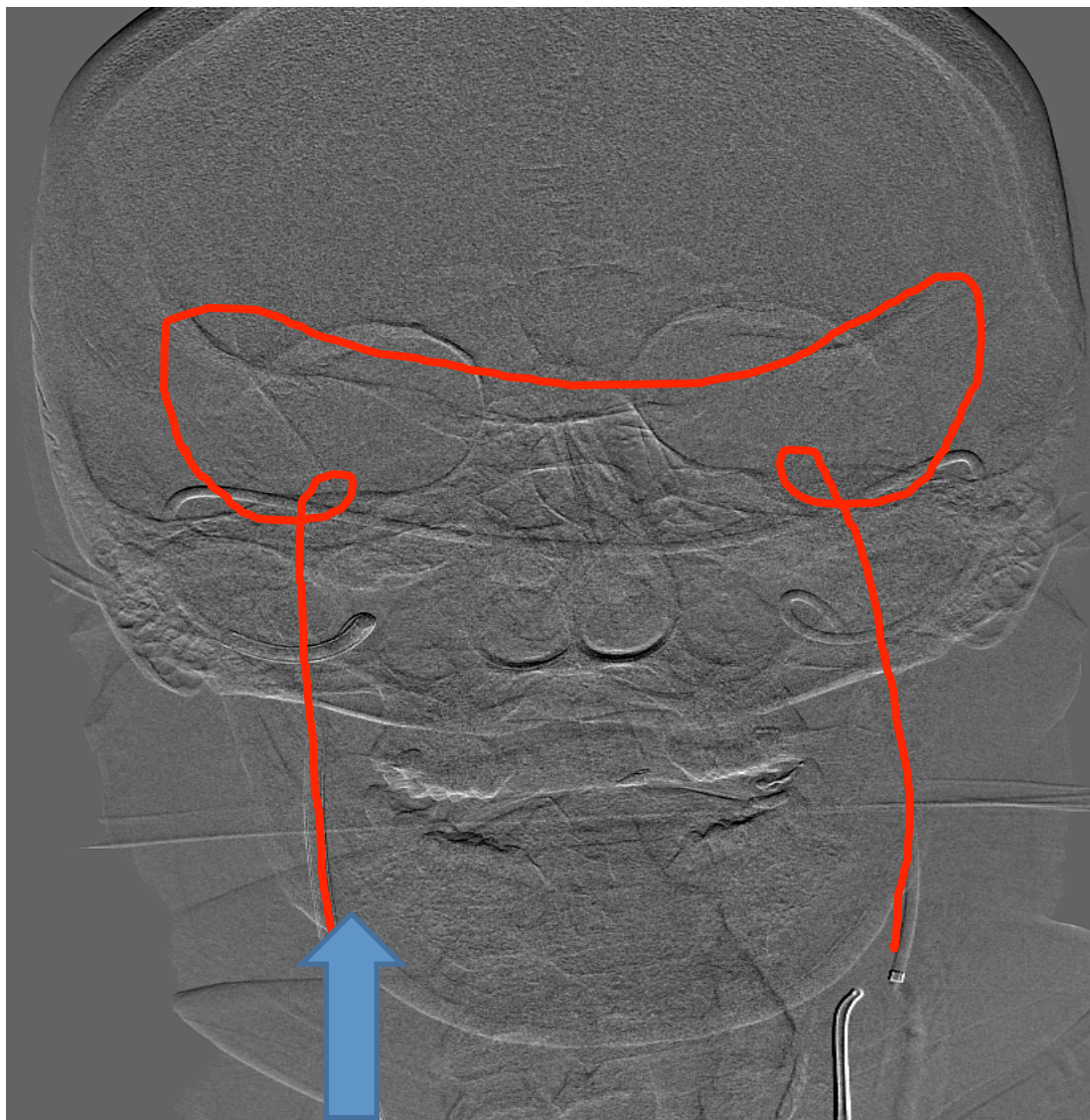


MAT FOR SINUS THROMBOSIS

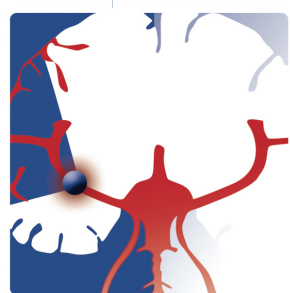
- 25 year old post partum woman with HA and L occipital hemorrhage



MAT FOR SINUS THROMBOSIS



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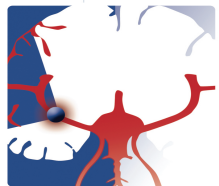
MAT FOR SINUS THROMBOSIS

- PRE MAT



POST MAT





CONCLUSION

- MAT - additional tool in armamentarium of endovascular arterial and venous reperfusion therapy
- Feasible as stand-alone treatment in majority of patients
- Feasibility likely to improve with advances in catheter technology
- Benefit over stentriever beyond cost needs to be demonstrated in randomized trials

