NEUROVASCULAR RESCUE

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STROKE IN CARDIAC CATHERIZATION

- Overall incidence is low:
  - Diagnostic procedure: 0.03-0.3%
  - PCI: 0.3-0.4%
- High morbidity and mortality
- Patient risk factors: female gender, diabetes mellitus, hypertension, prior CVA or renal failure
- Advanced CAD, prior CABG, extensive plaques on TEE, decreased LVEF

Circulation 2008;118:678-683

OTHER RISK FACTORS

- Long catheterization procedures, urgent procedures, use of intraaortic balloon counterpulsation
- Large caliber catheters: Judkins left and Multipurpose guiding catheters
- Vascular access: transradial vs transfemoral approach

ETIOLOGY

- Air embolism
- Thrombus formation in catheter or on its surface
- Disruption of atheroma in the aortic arch during catheter manipulation
- Microemboli frequently detected by TCD
- Cerebral hemorrhage

PRESENTATION

- Often occurs during or immediately after the procedure but can be delayed up to 36 hrs
- Visual disturbance, motor weakness, aphasia, altered mental status
- Vertebrobasilar involvement in ~1/2 cases
- Asymptomatic in 15%
- Embolus most frequently lodged in MCA or ICA bifurcation

DIAGNOSTIC TESTING

- CT
- MRI: DWI/PWI
- Cerebral angiography

TREATMENT

- Many ischemic strokes are due to emboli from thrombi formed in an extracranial artery or the heart
- These older and harder clots are less responsive to thrombolytics
- Larger clot burden and tortuous cerebrovascular anatomy render treatment more difficult
- There is no defined standard of acute treatment
- Only approved treatment: IV t-PA 0.9 mg/kg up to 3 hrs (NINDS trial) *NEJM 1995;333:1581-1587*

PROBLEMS WITH IV t-PA

- Neurologist has to see the patient
- NIHSS score at least 4
- PT<15
- SBP must be <185, DBP must be <110
- CT brain must be “normal”
- Does not work well for large vessel occlusions
- 6% risk of symptomatic ICH
- Risk of groin or retroperitoneal hematoma, systemic bleeding

CONTRAINDICATIONS FOR IV t-PA

- Seizure at symptom onset
- Any history of ICH
- GI or any serious hemorrhage within 3 weeks
- Major surgery or trauma within 2 weeks
- Stroke or head trauma within 3 months
- Clinical history suggesting SAH

IV t-PA FOR PROXIMAL VASCULAR OCCLUSION

- Both baseline and 3 month F/U NIHSS scores significantly worse with “hyperdense MCA sign”
- Recanalization with IV t-PA: partial 30%, complete 4.3%
- Recanalization with IA t-PA: ~70%

NINDS Trial

PROACT II

PROLYSE IN ACUTE CEREBRAL THROMBOEMBOLISM

- Open label trial
- 180 pts with proximal MCA occlusion <6 hrs
- NIHSS 4-30
- Randomized 2:1 - 9 mg IA r-proUK over 2 hrs + IV heparin vs IV heparin alone

JAMA 1999;282:2003-2011

PROACT II

	IA r-ProUK	Control	p value
Recanalization	67%	18%	<.001
mRS <2	40%	25%	.04
Mortality	24%	27%	NS
Symptomatic ICH	10%	1.8%	

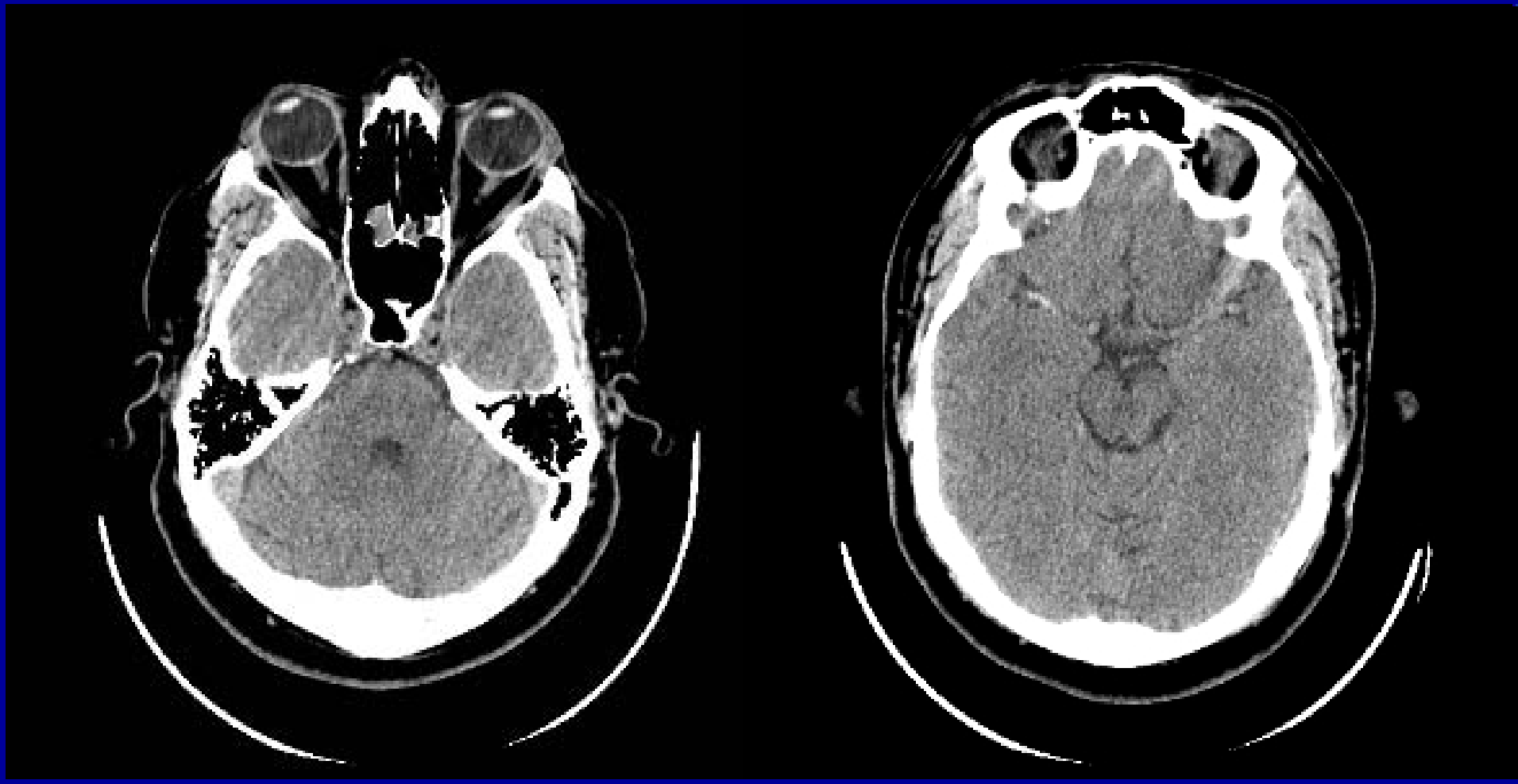
Absolute benefit 15%
Relative benefit 58%
Number needed to treat 7

AbESTT II

ABCIXIMAB IN EMERGENT STROKE TREATMENT

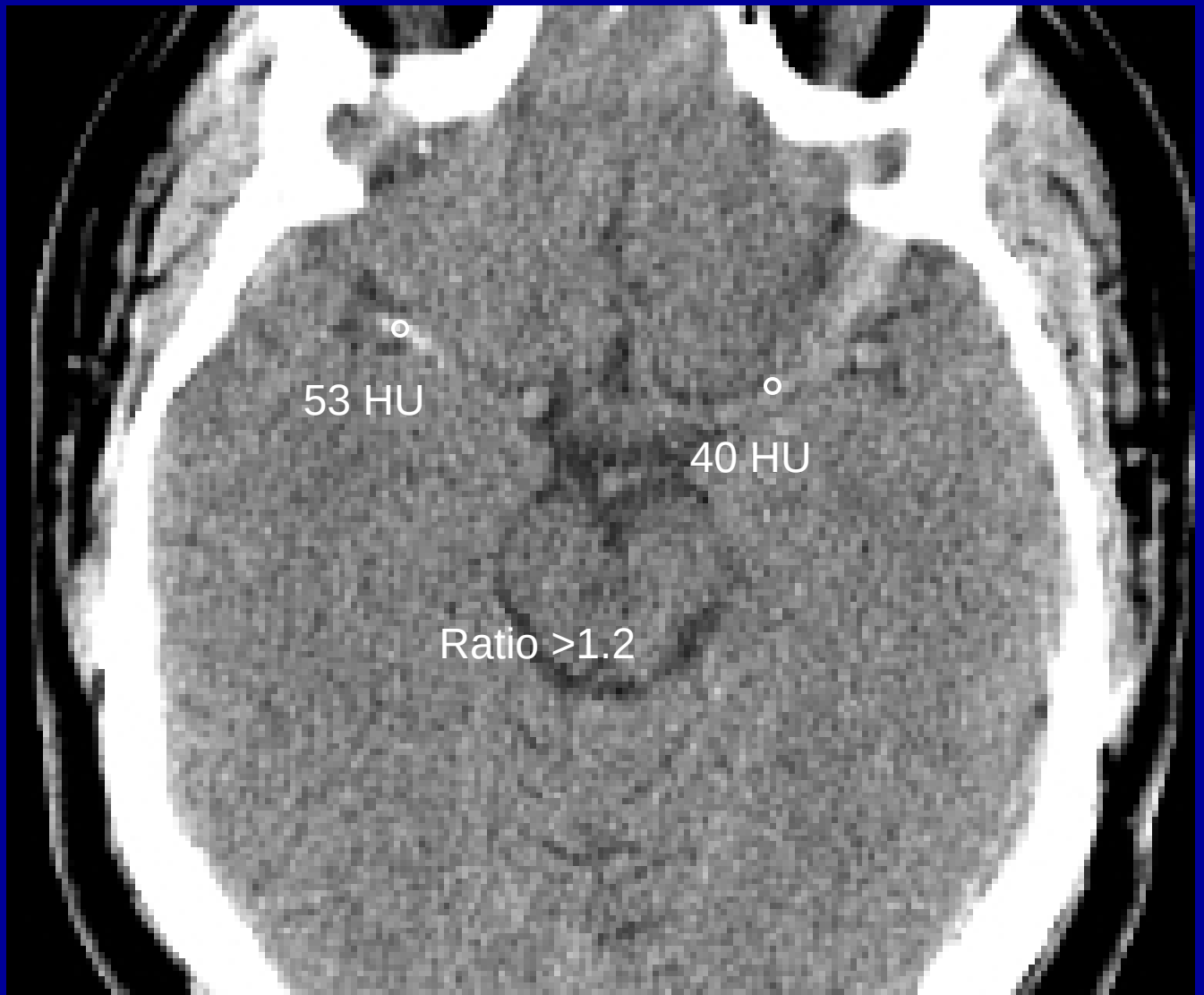
- Stroke onset <5 hrs
- Abciximab 0.25 mg/kg IV bolus followed by 0.125 mcg/kg/min infusion for 12 hrs vs placebo
- No difference in outcome at 3 months
- Within 5 days, 5.5% of abciximab treated and 0.5% placebo treated patients had symptomatic or fatal ICH (p=0.002)
- Trial terminated due to unfavorable benefit risk profile

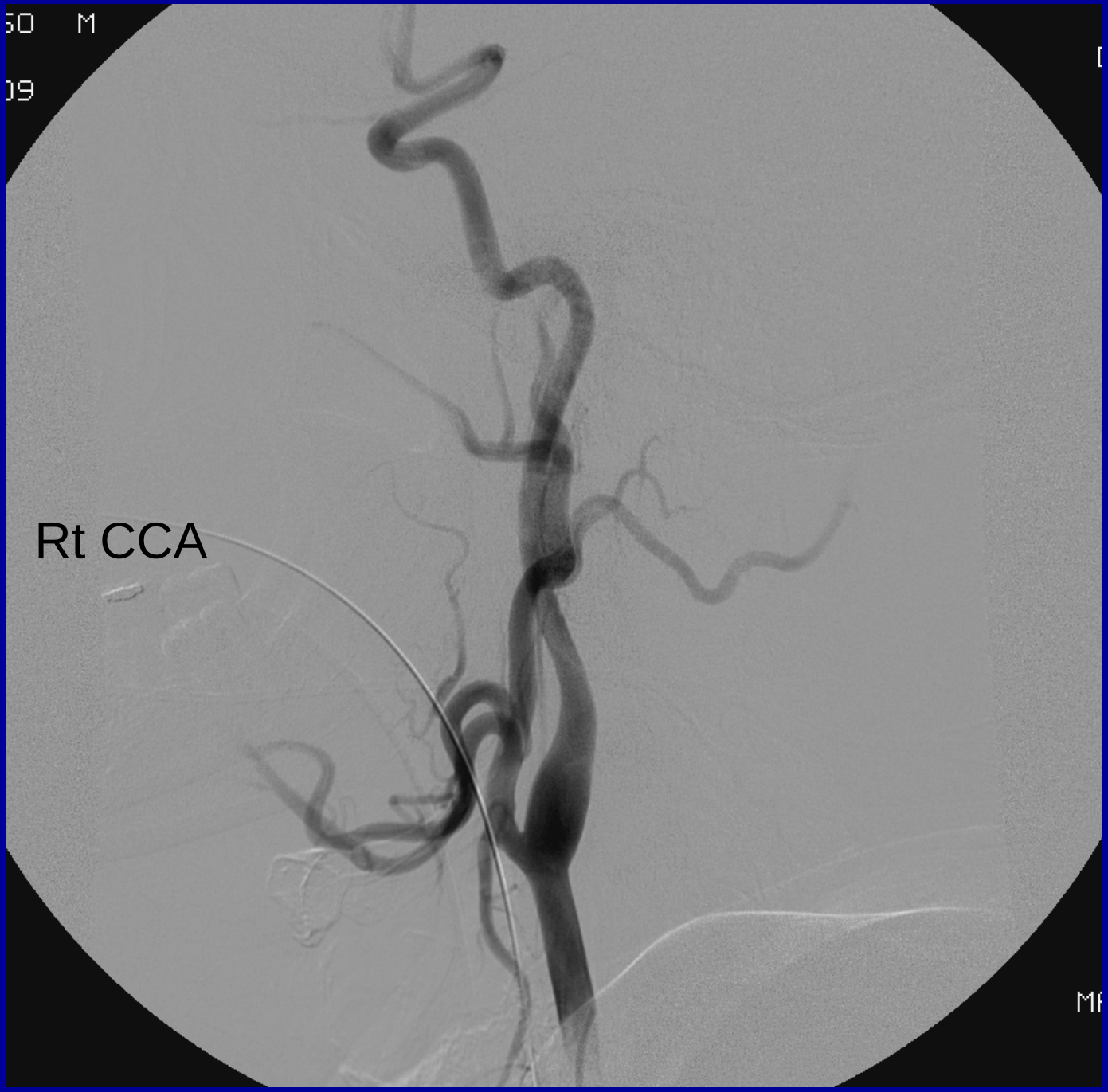
Stroke 2008 Jan;39(1):87-99



CT without contrast

HYPERDENSE MCA SIGN

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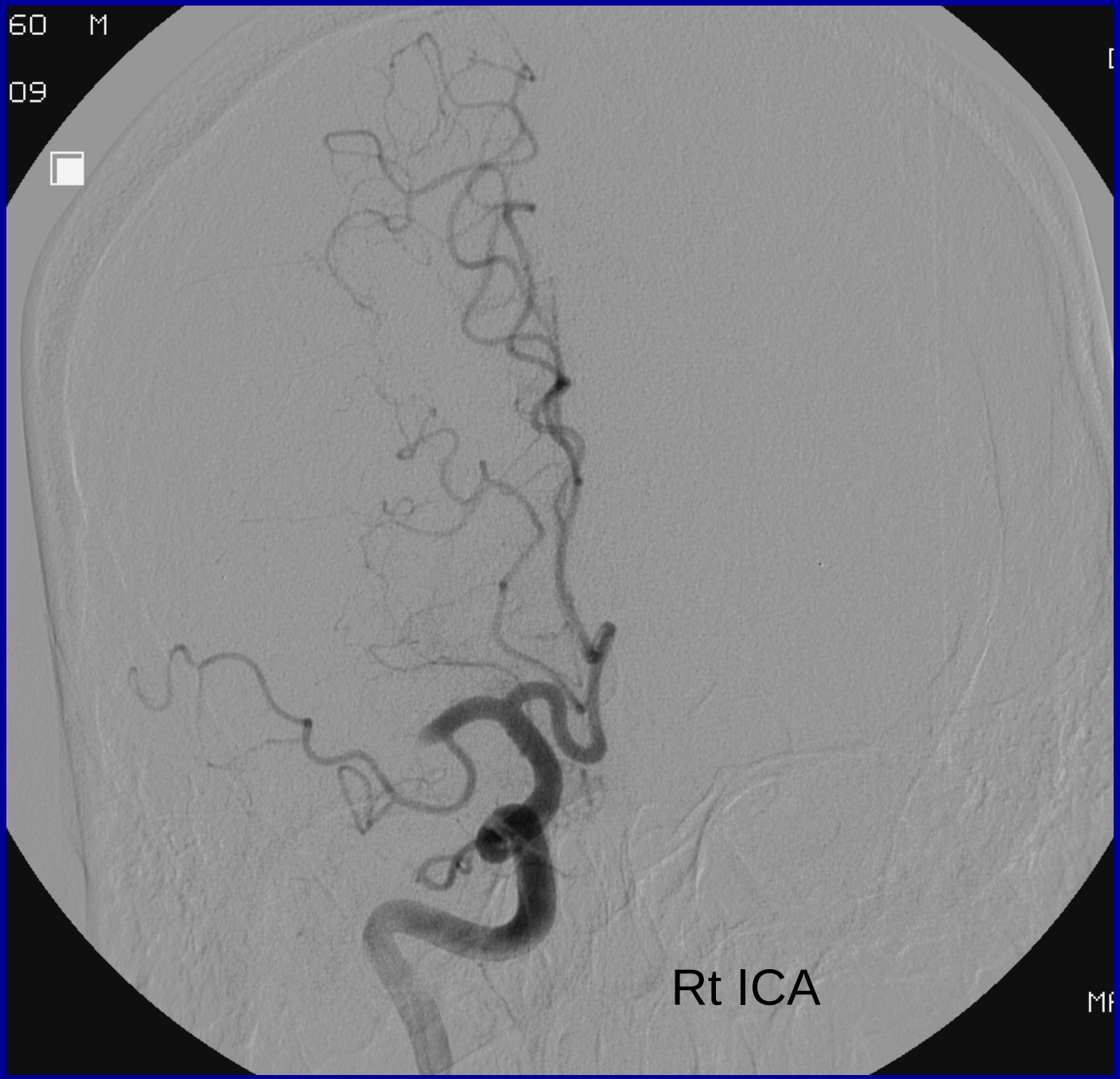
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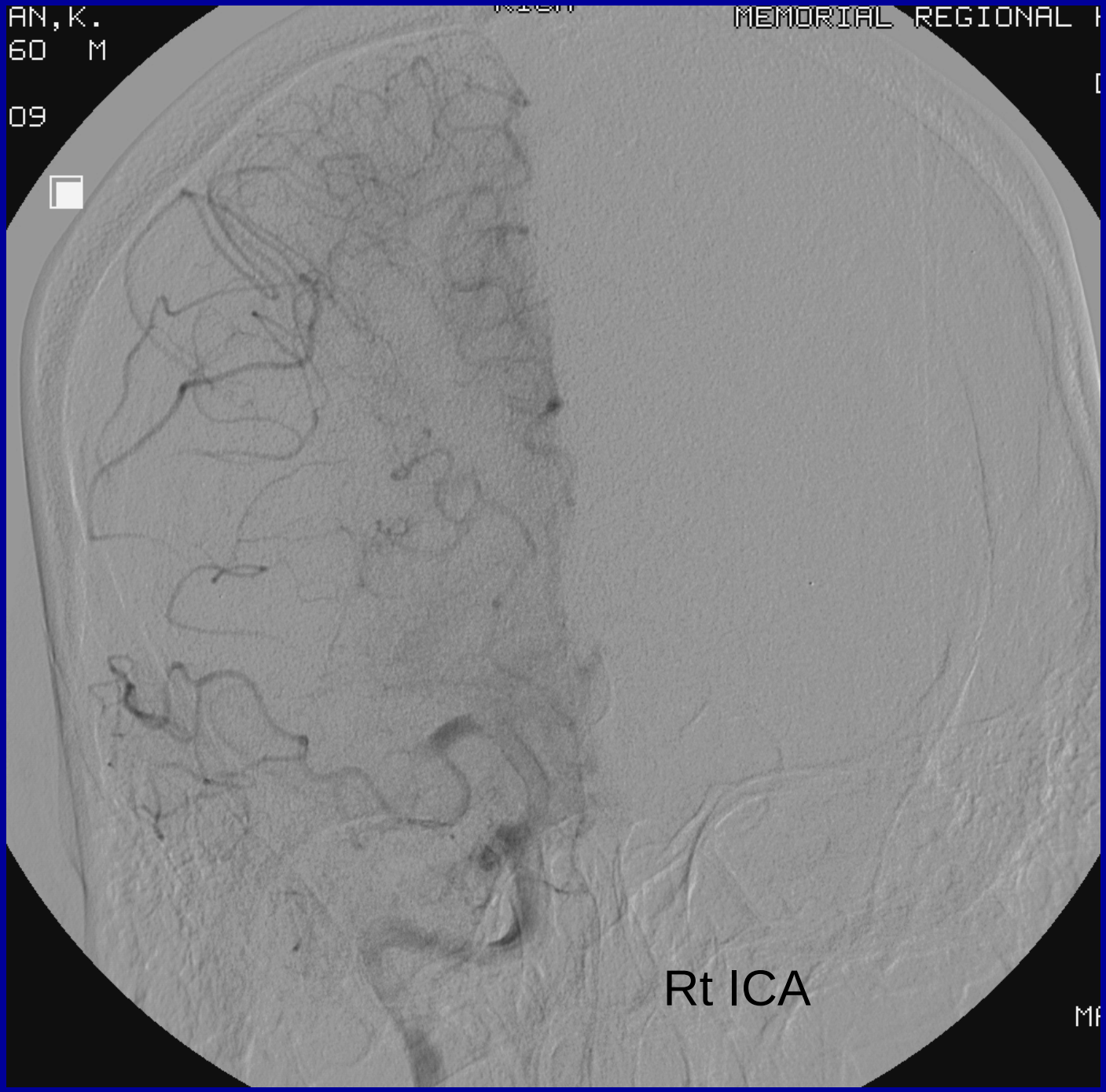
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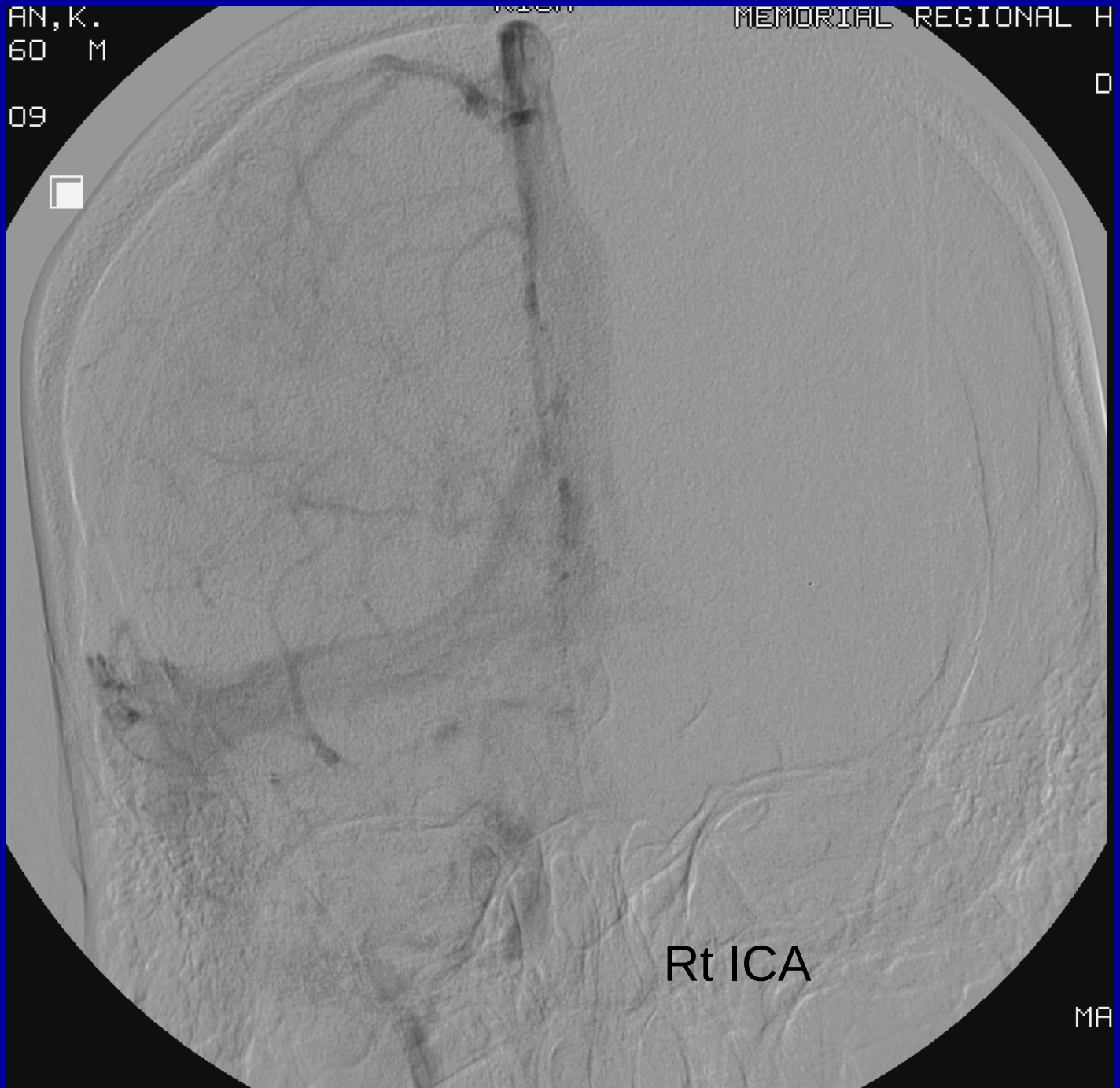
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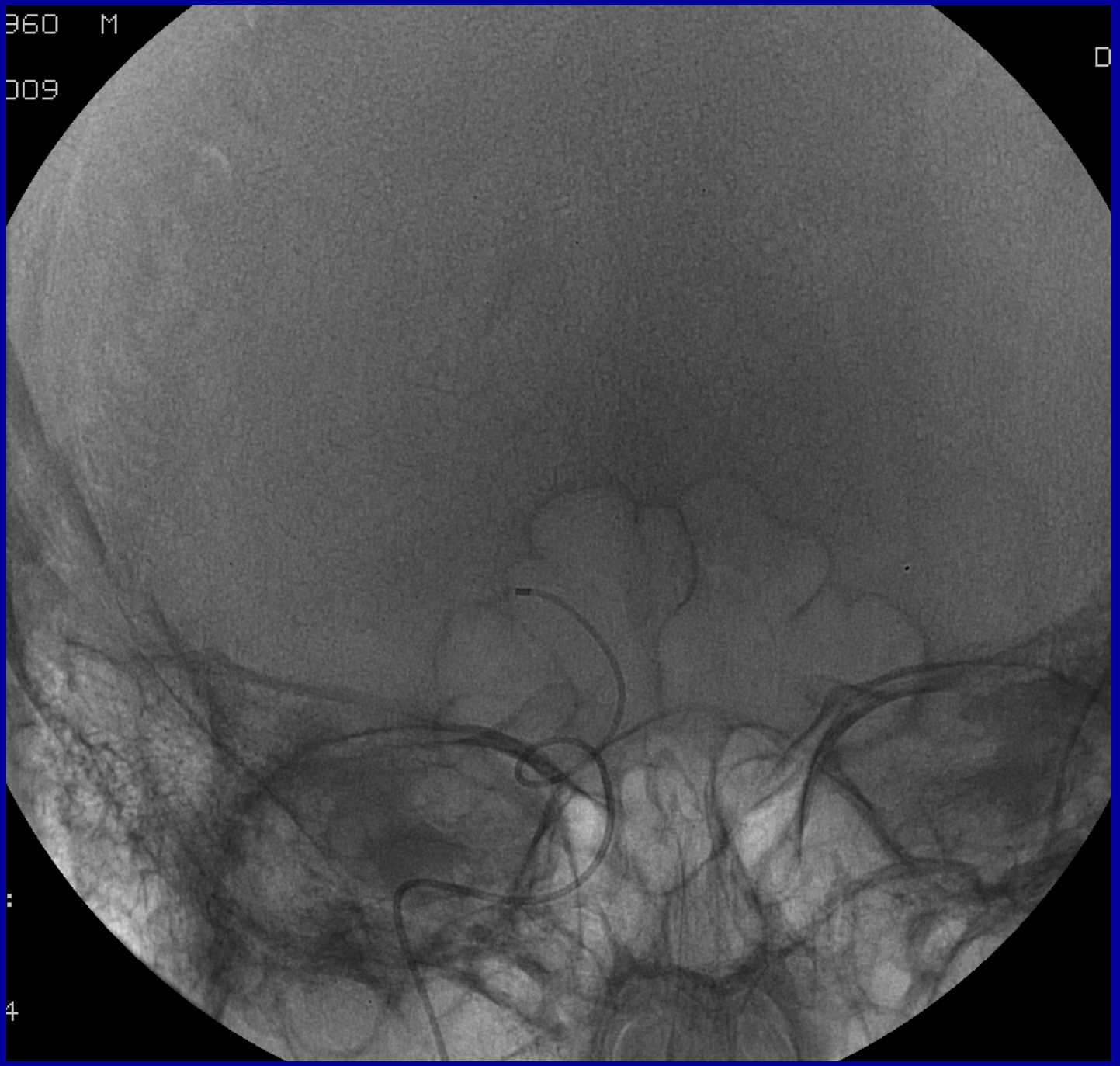
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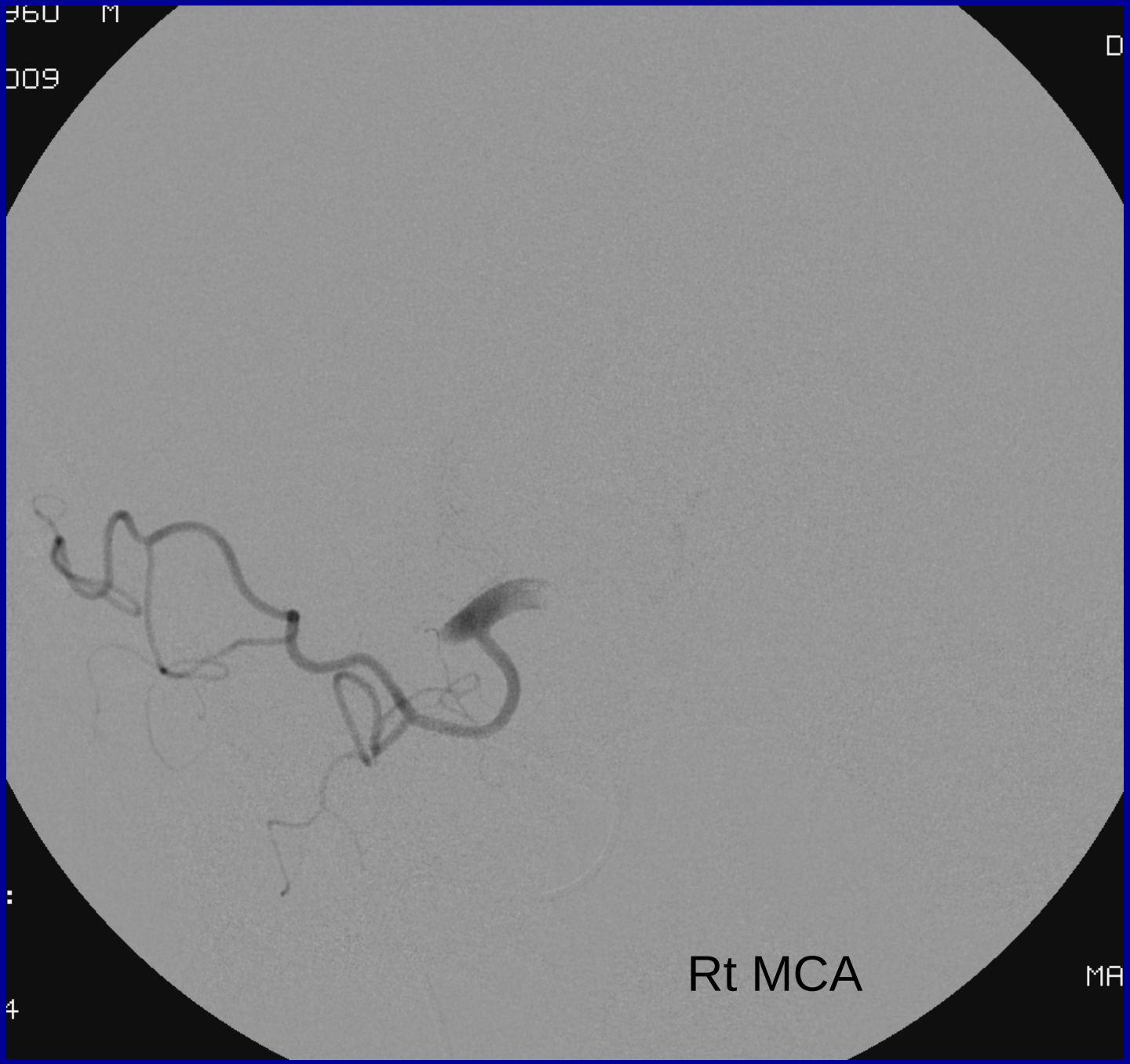
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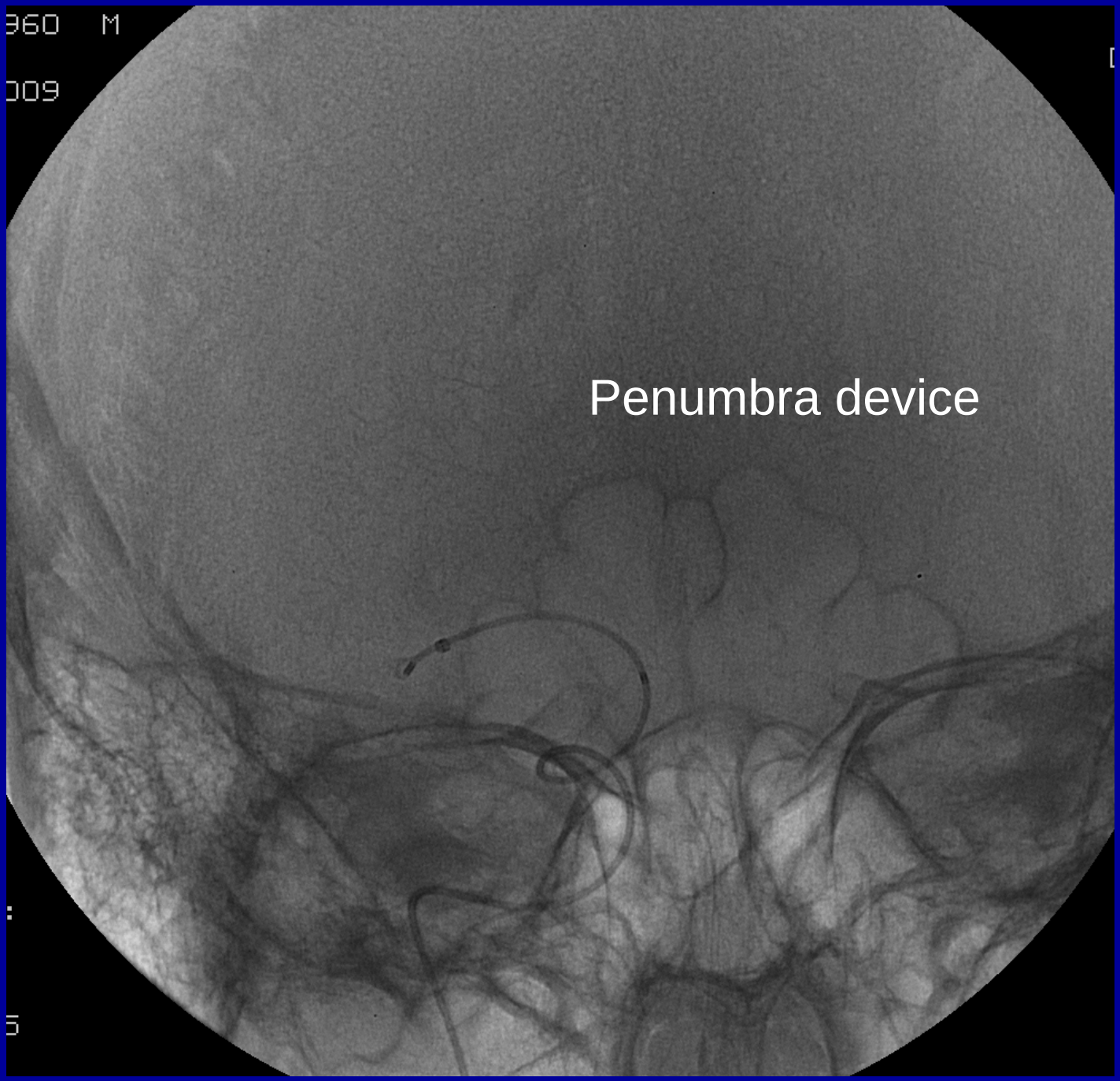
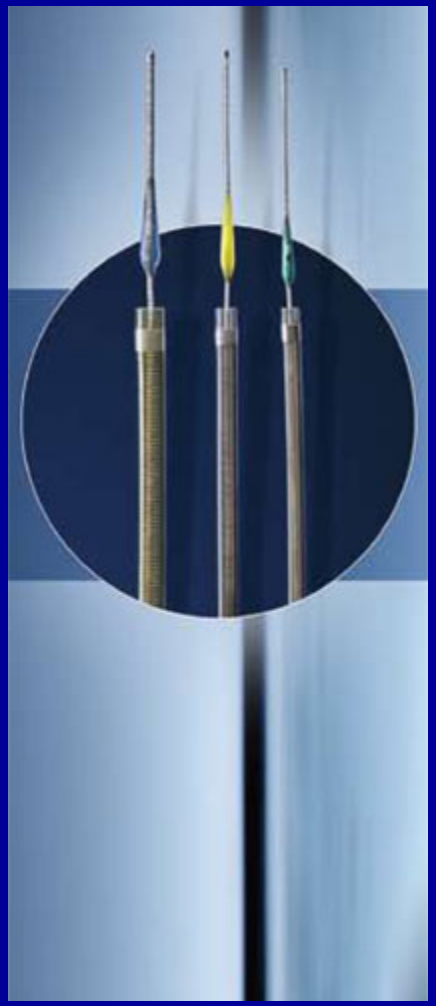
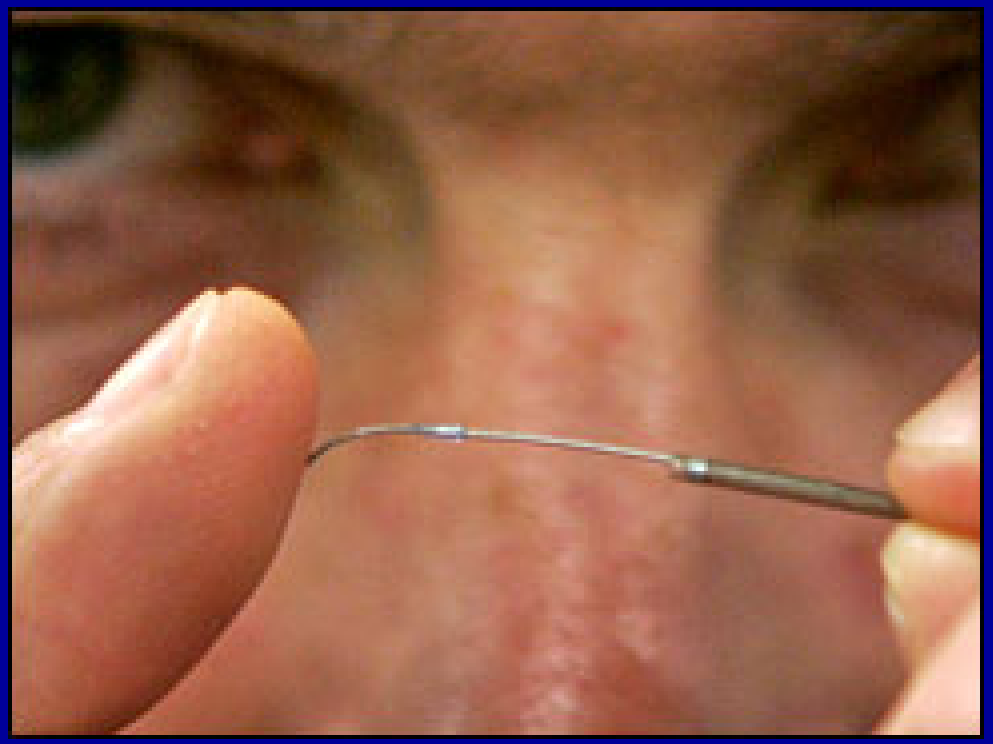
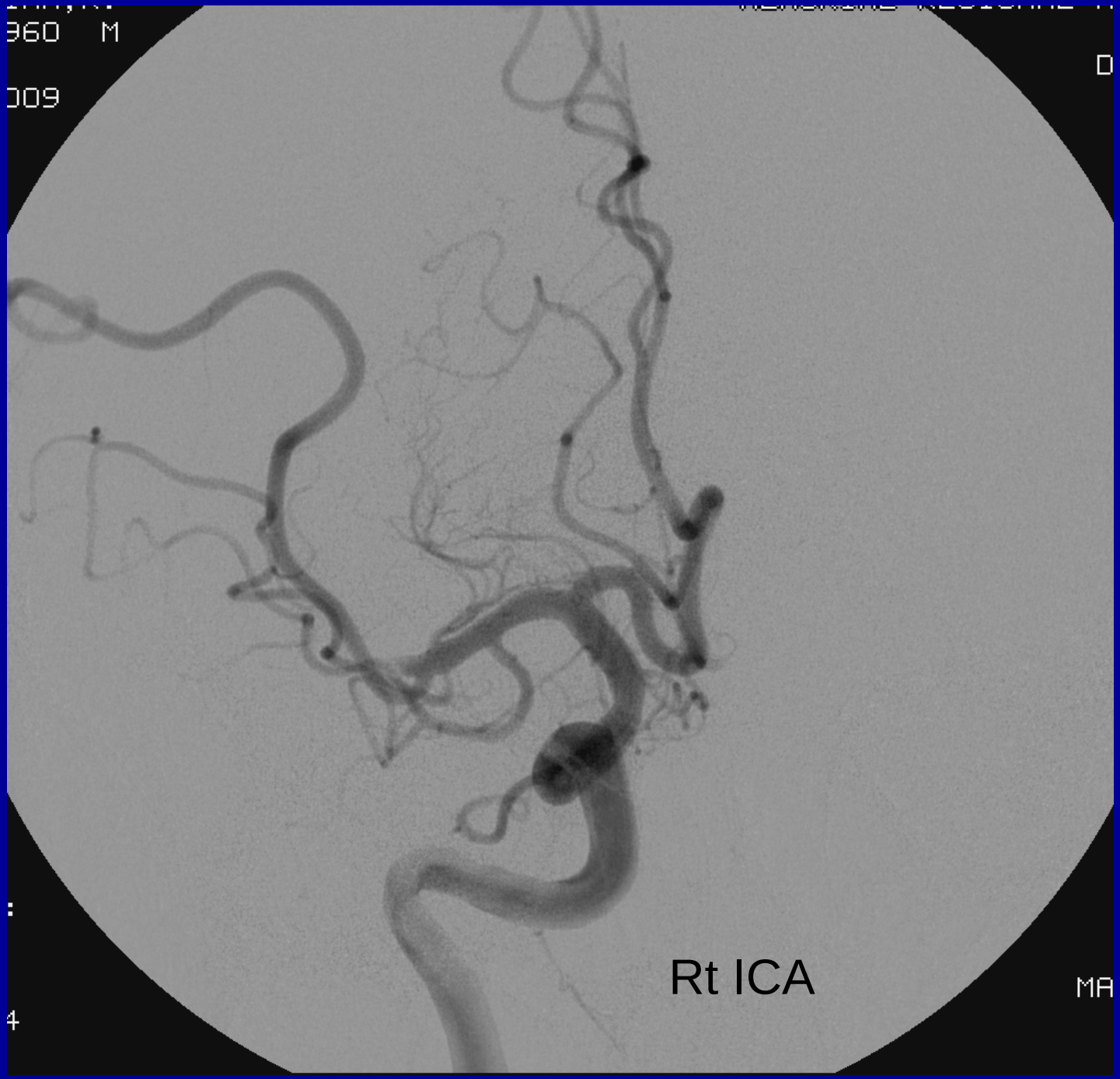

Penumbra device

PENUMBRA DEVICE



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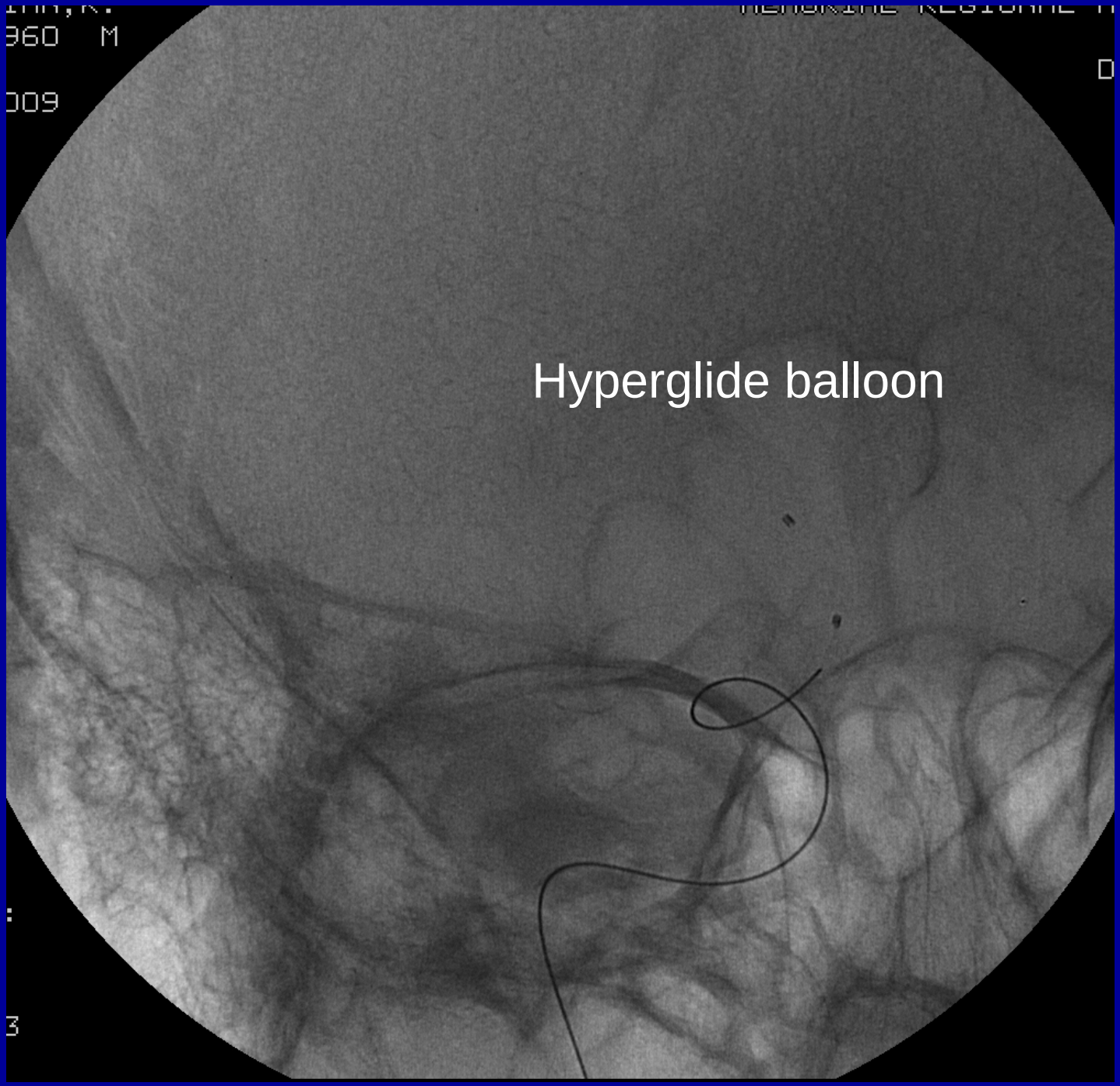
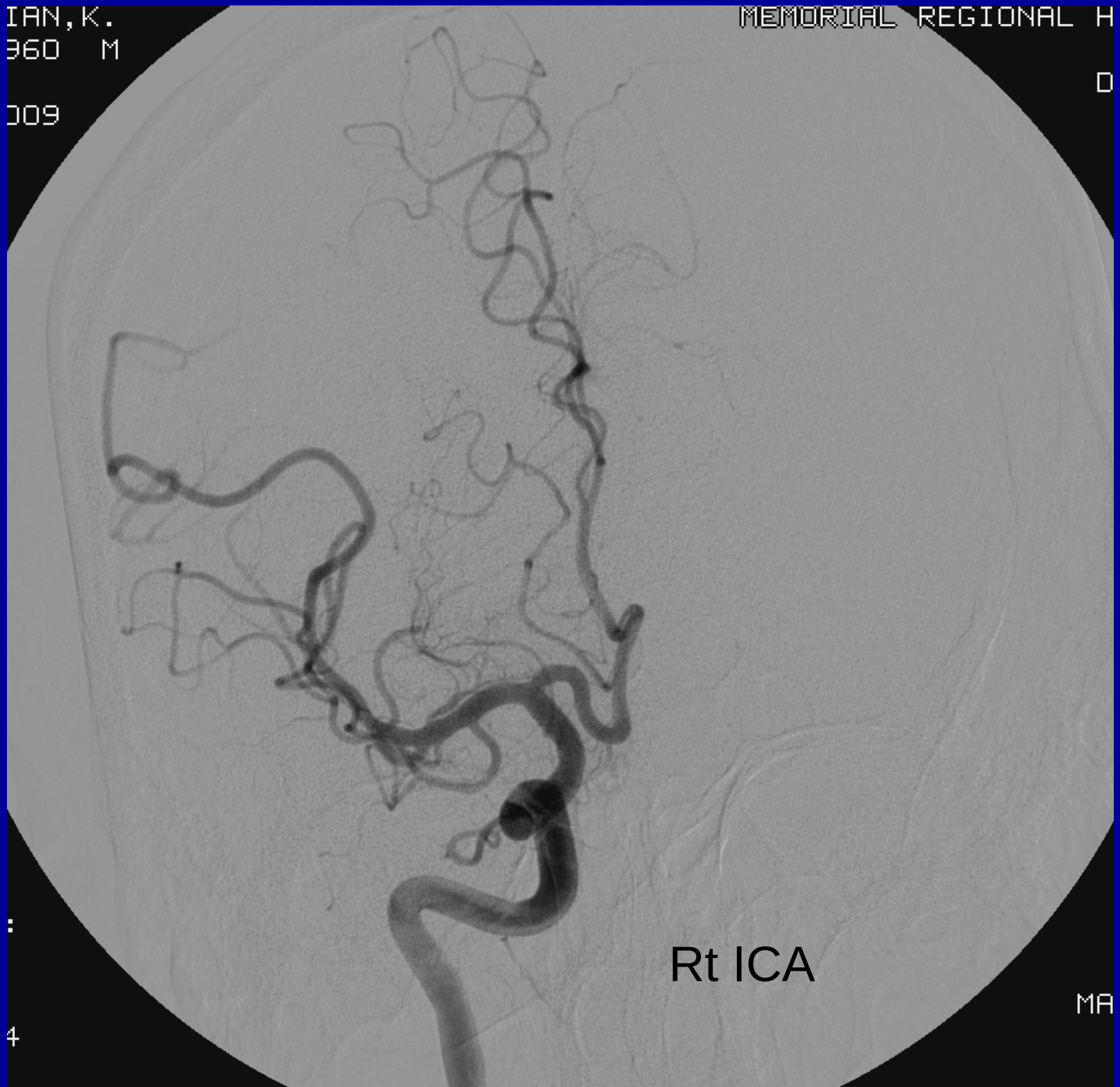

Hyperglide balloon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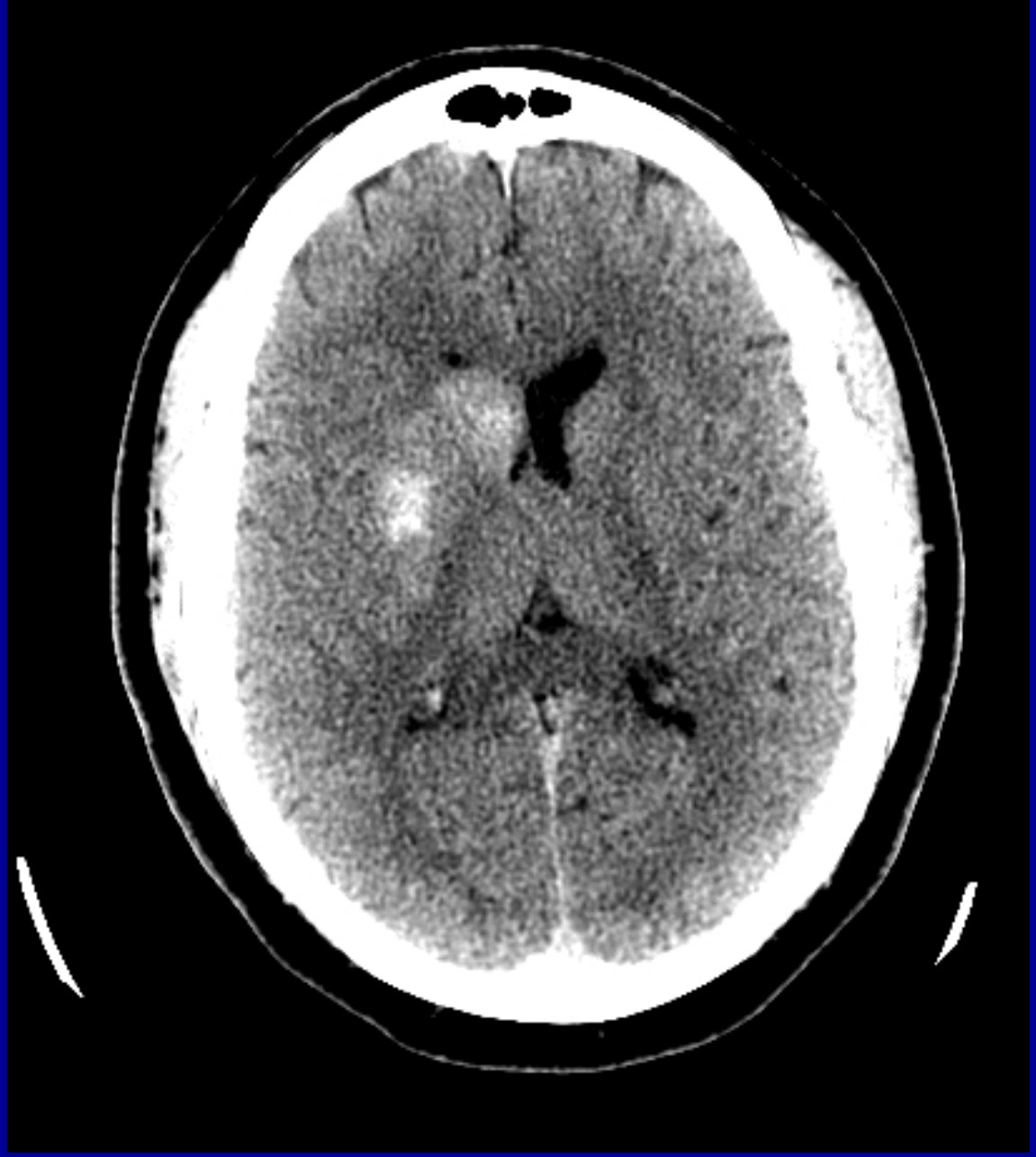
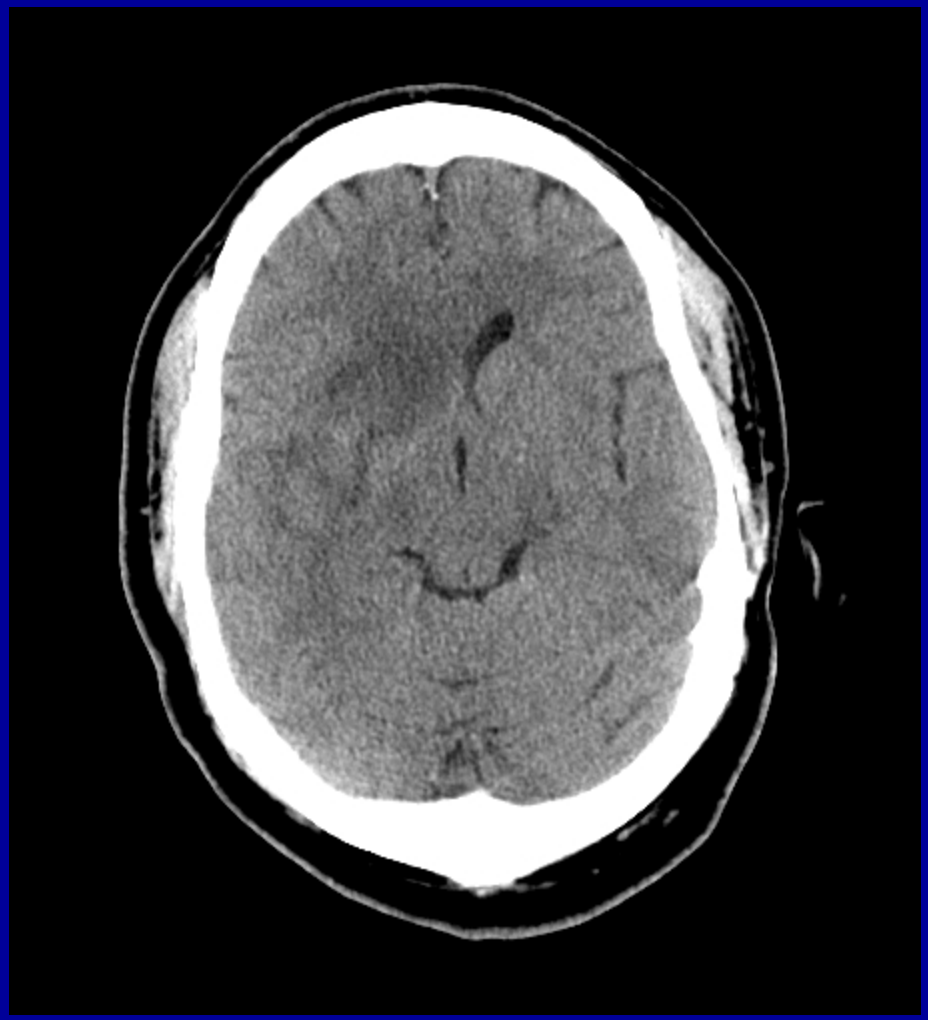
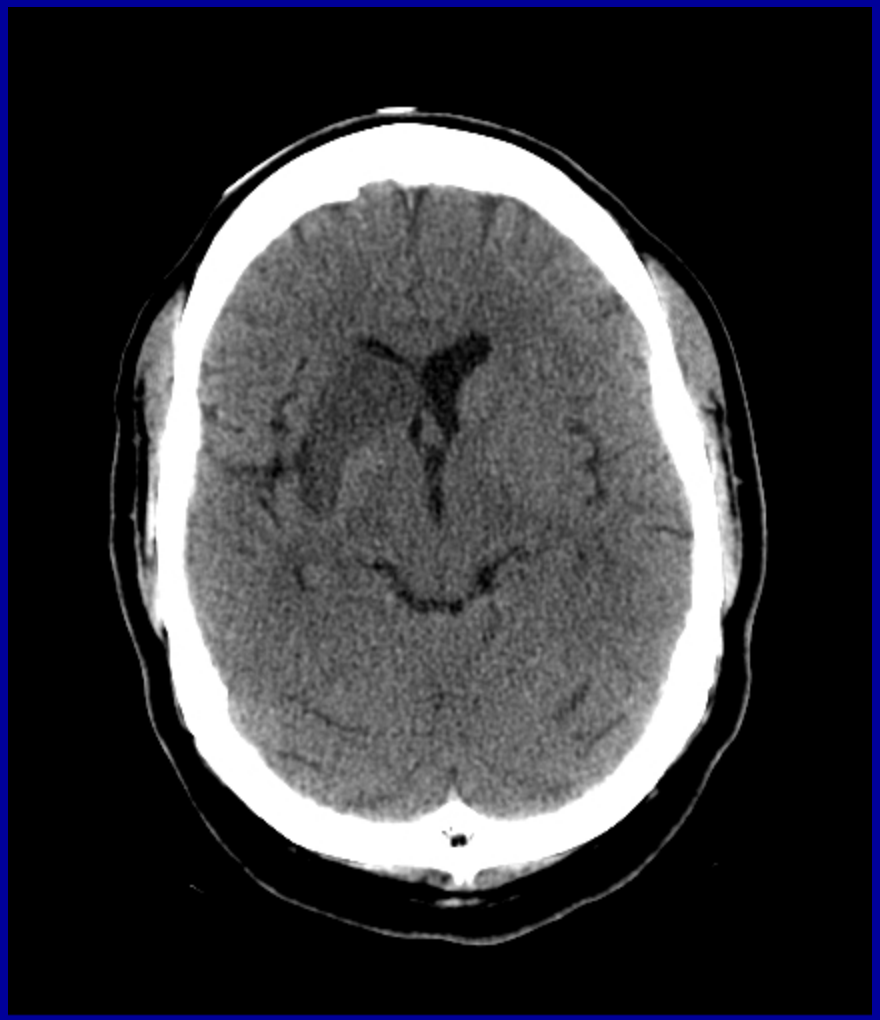


CT without contrast post intervention



6 hours later



2 weeks later

PENUMBRA STROKE TRIAL

- Single arm multicenter trial
- 125 patients. 24 international centers
- Stroke within 8 hours of onset
- NIHSS score >8
- Complete occlusion of a large intracranial vessel

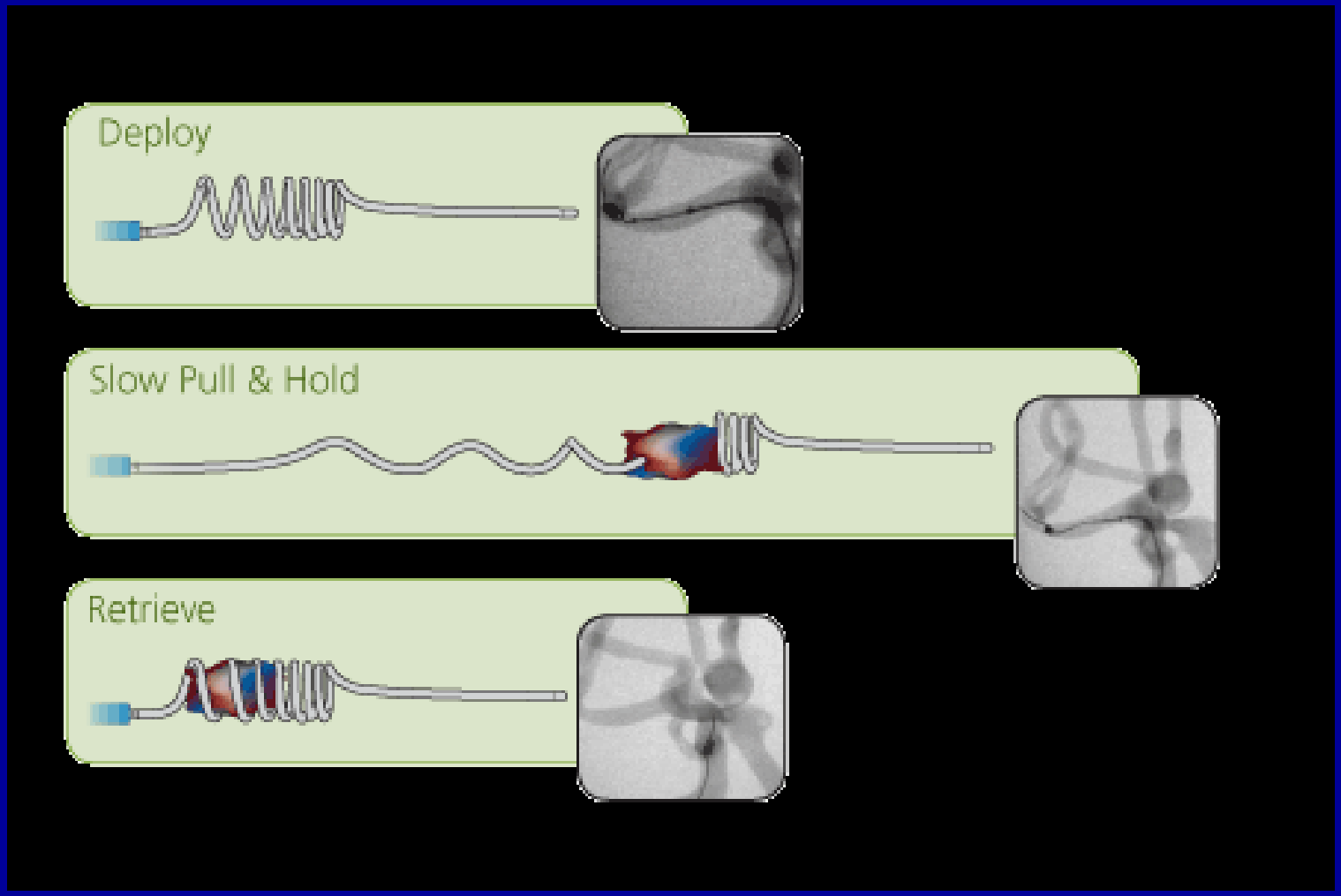
PENUMBRA RESULTS

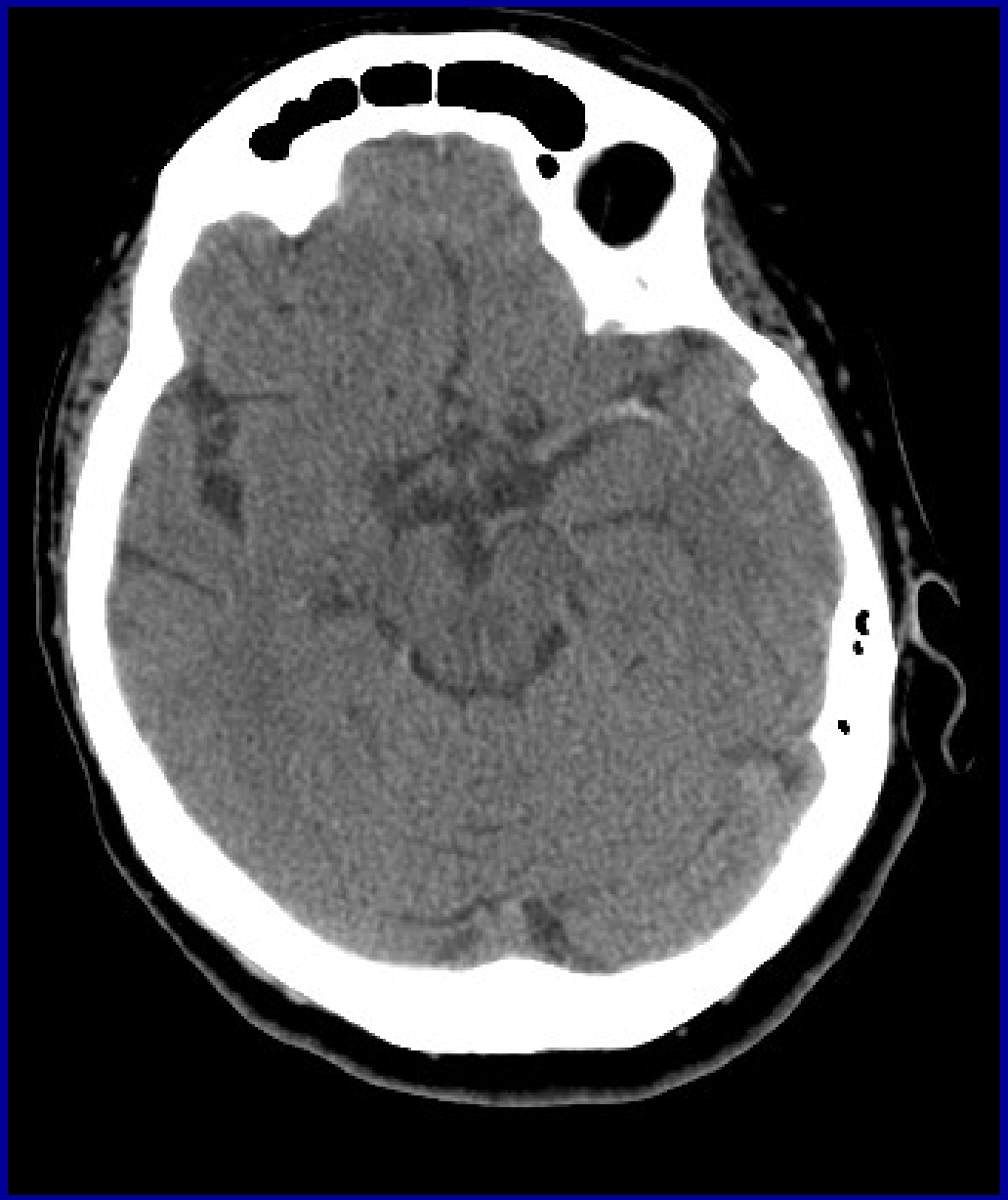
- 81.6% rate of revascularization vs 48.2% historical control *(p<0.0001)*
- 3.2% serious adverse events
- 11.2% symptomatic ICH
- >4 point improvement NIHSS score at discharge: 57.8%
- mRS <2 at 90 days: 25%

PENUMBRA

- Available in Europe since June 2007
- FDA approval in US in December 2007

MERCI DEVICE
Mechanical Embolus Removal in Cerebral Ischemia





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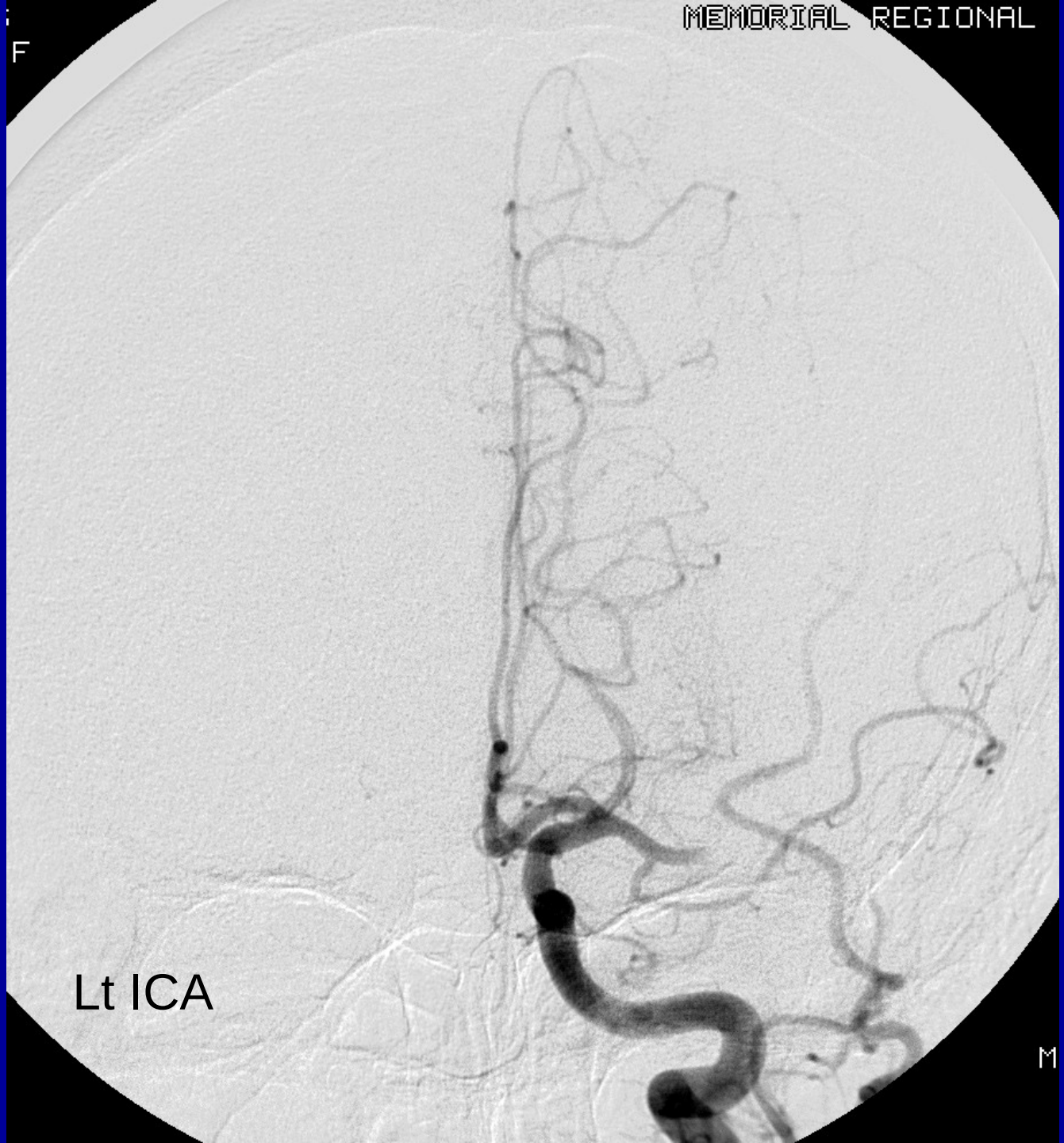
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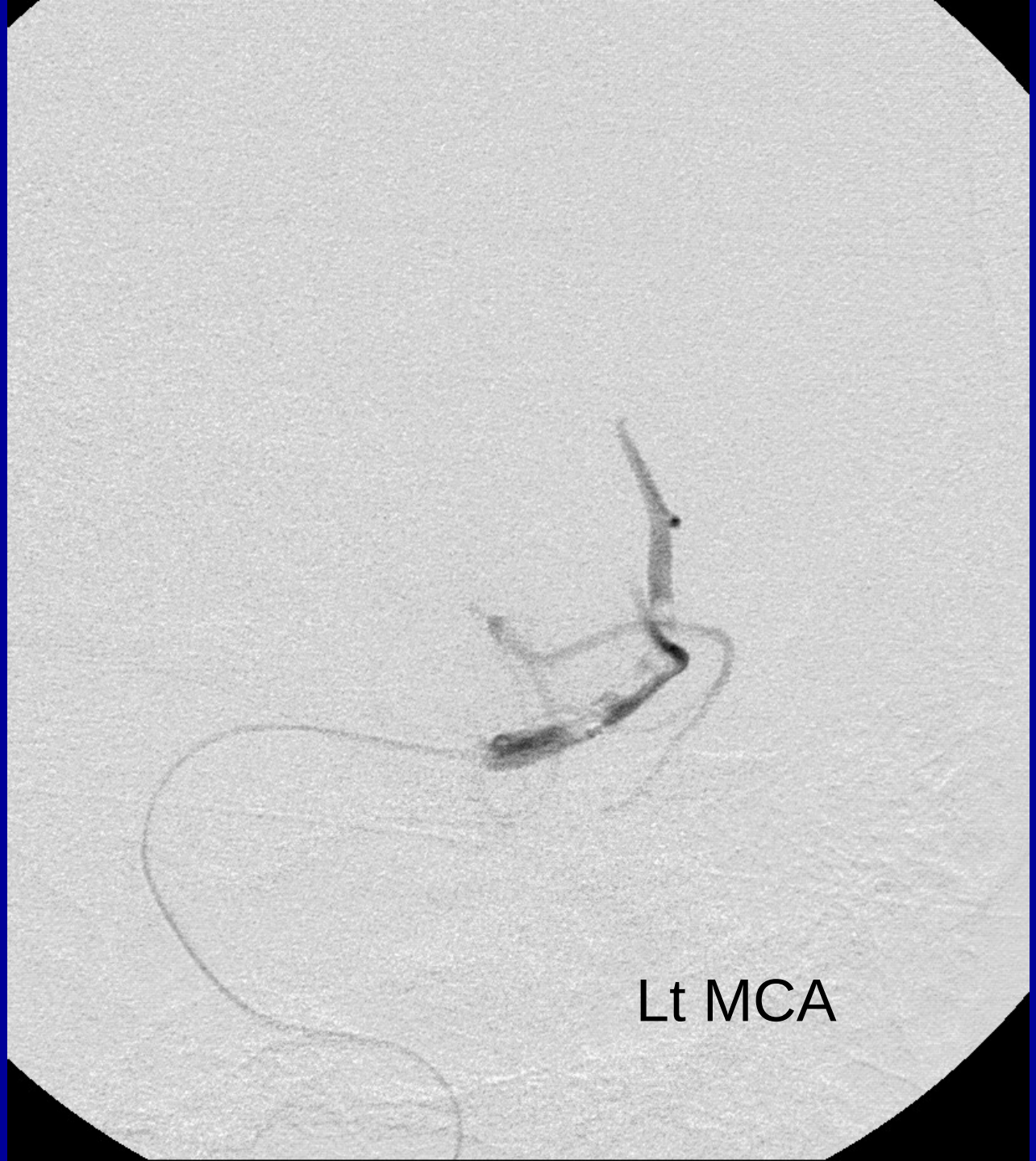
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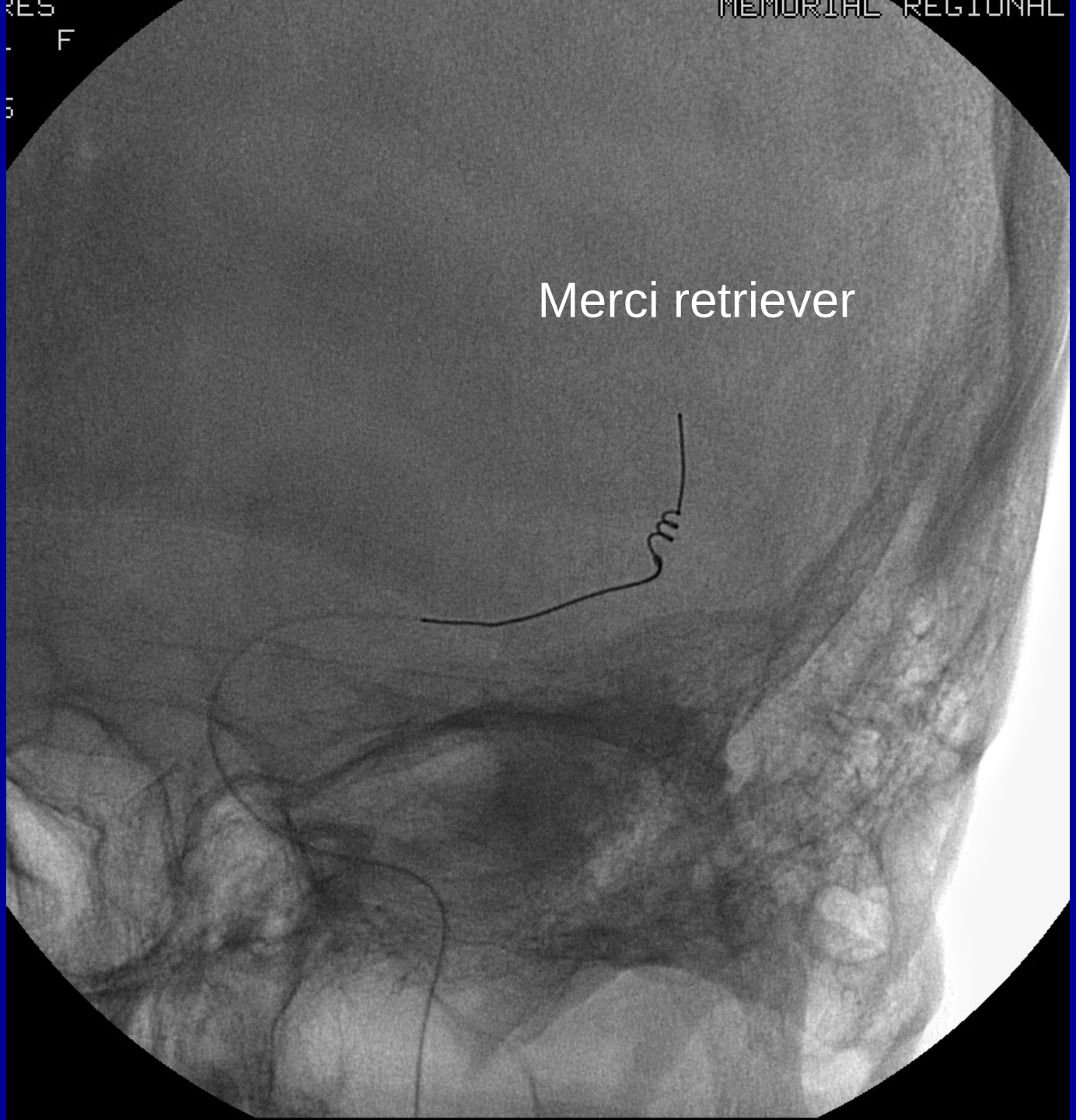
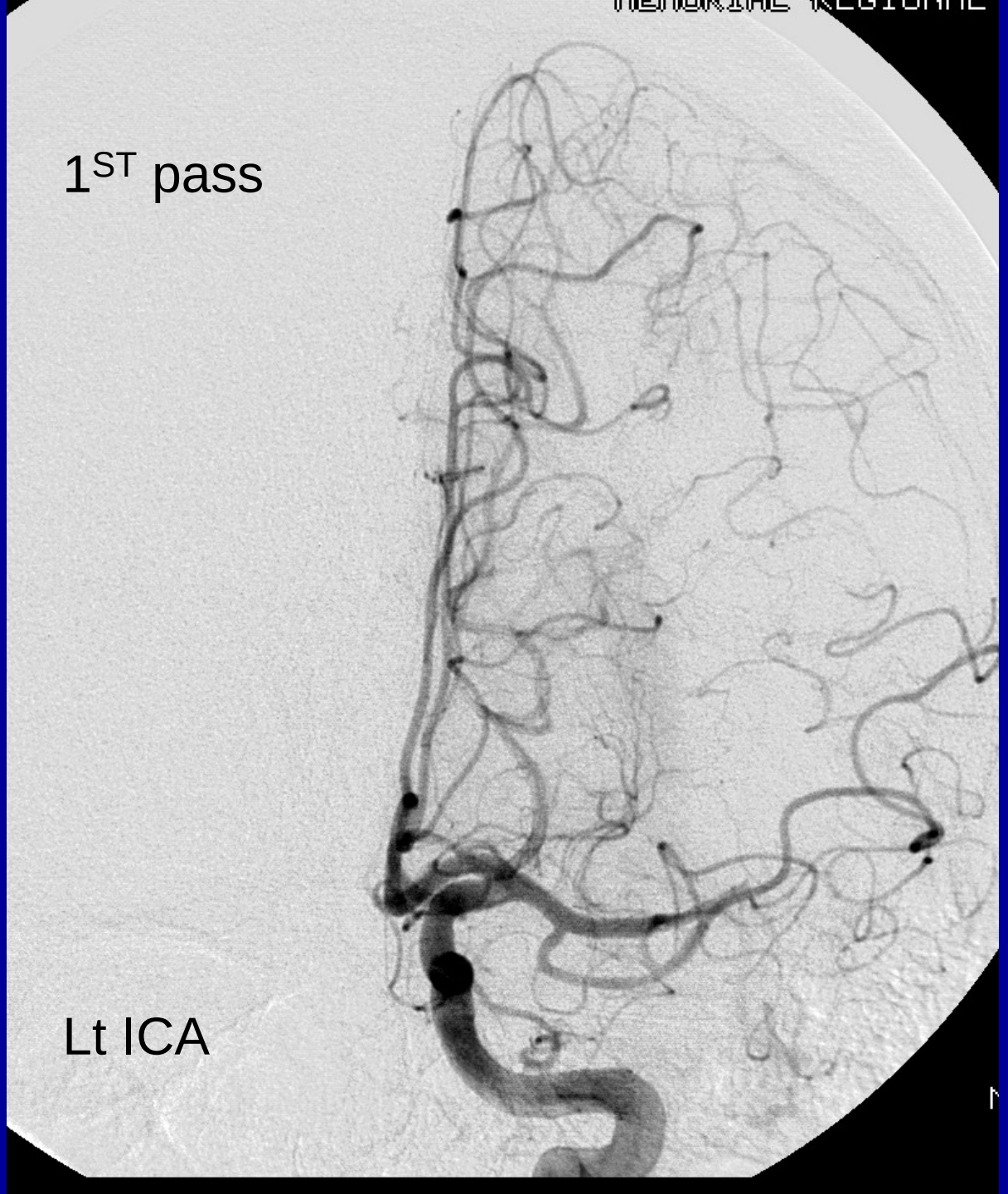
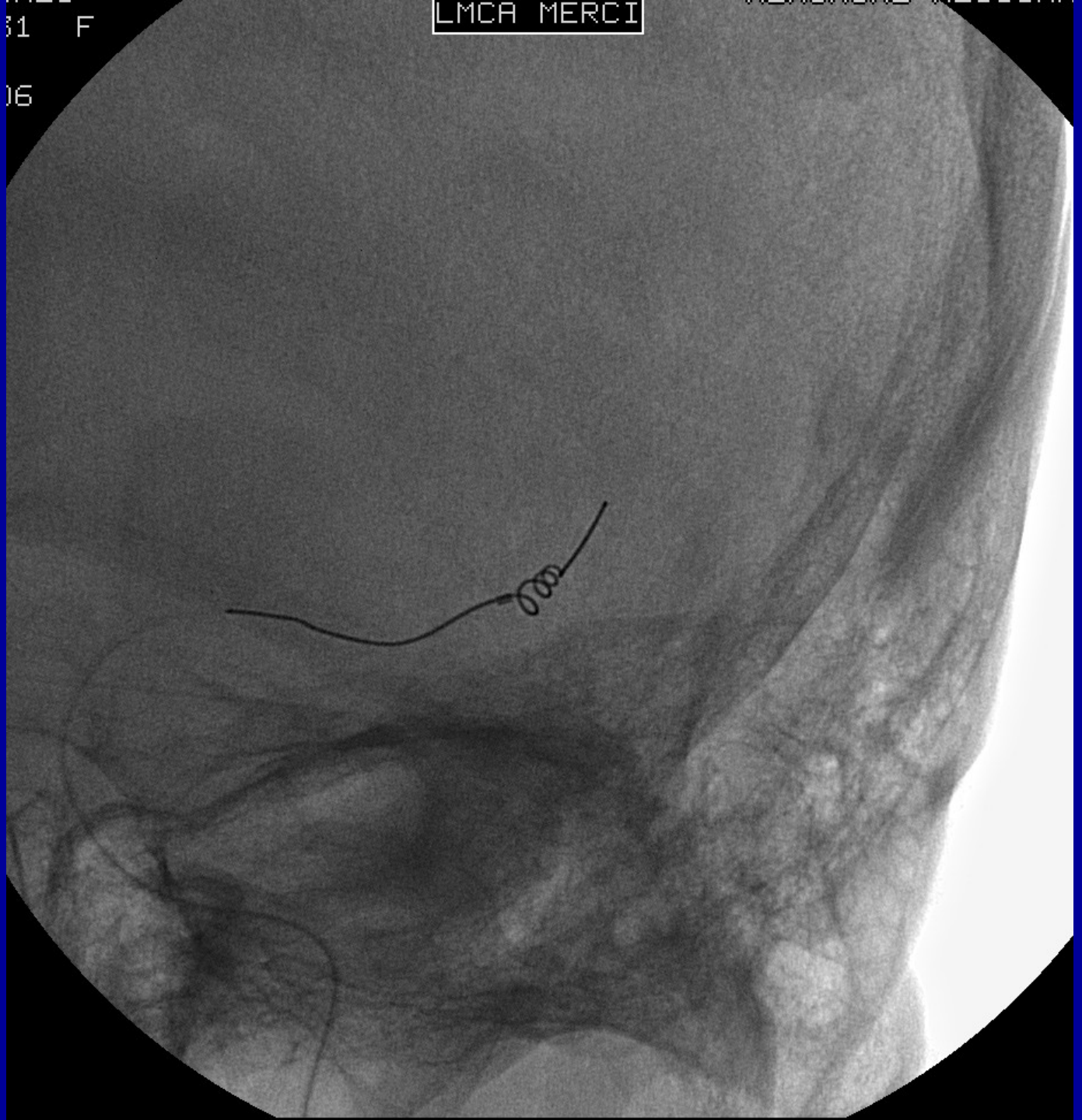
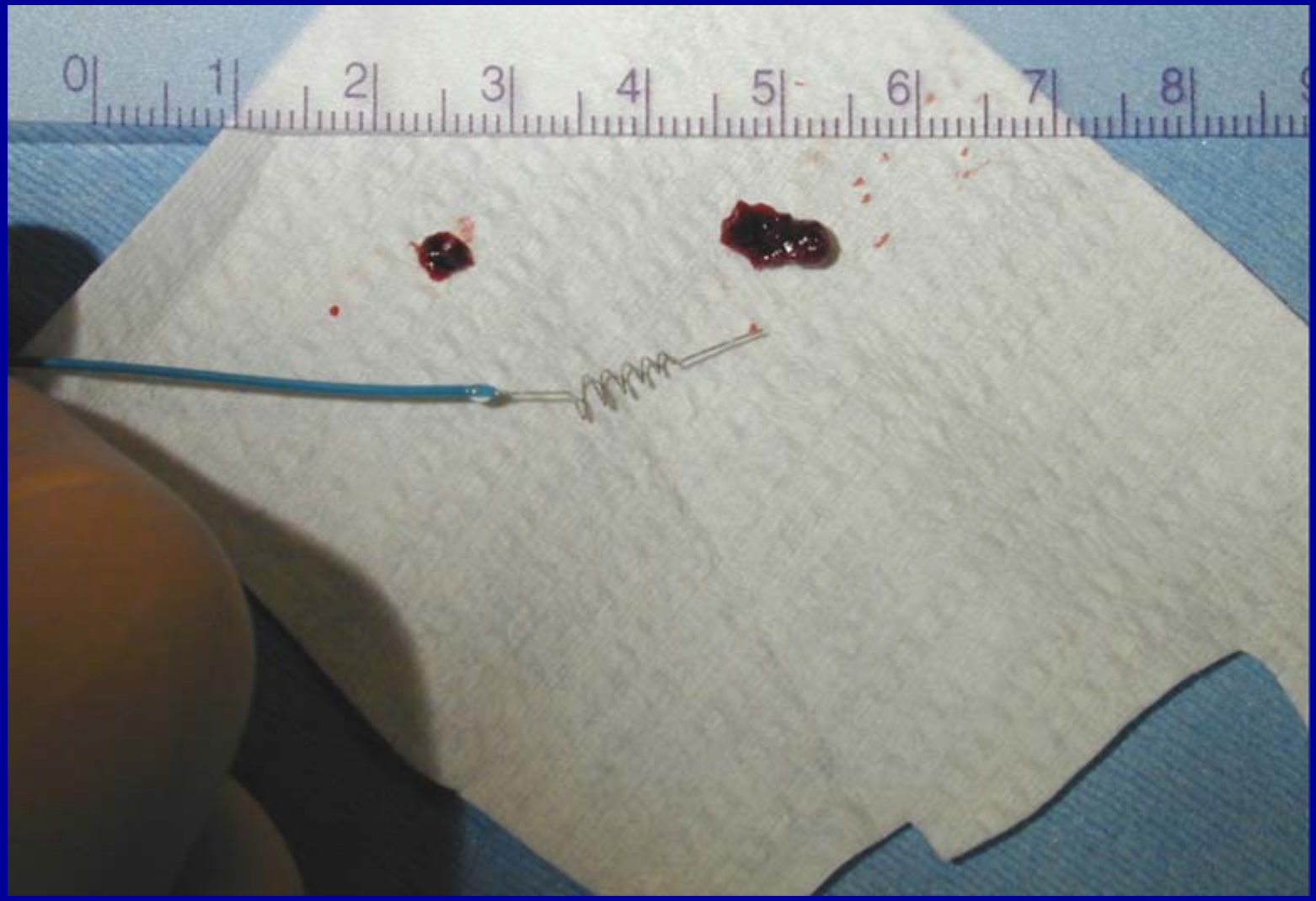

MEMORIAL REGIONAL
Merci retriever


1ST pass
Lt ICA


LMCA MERCI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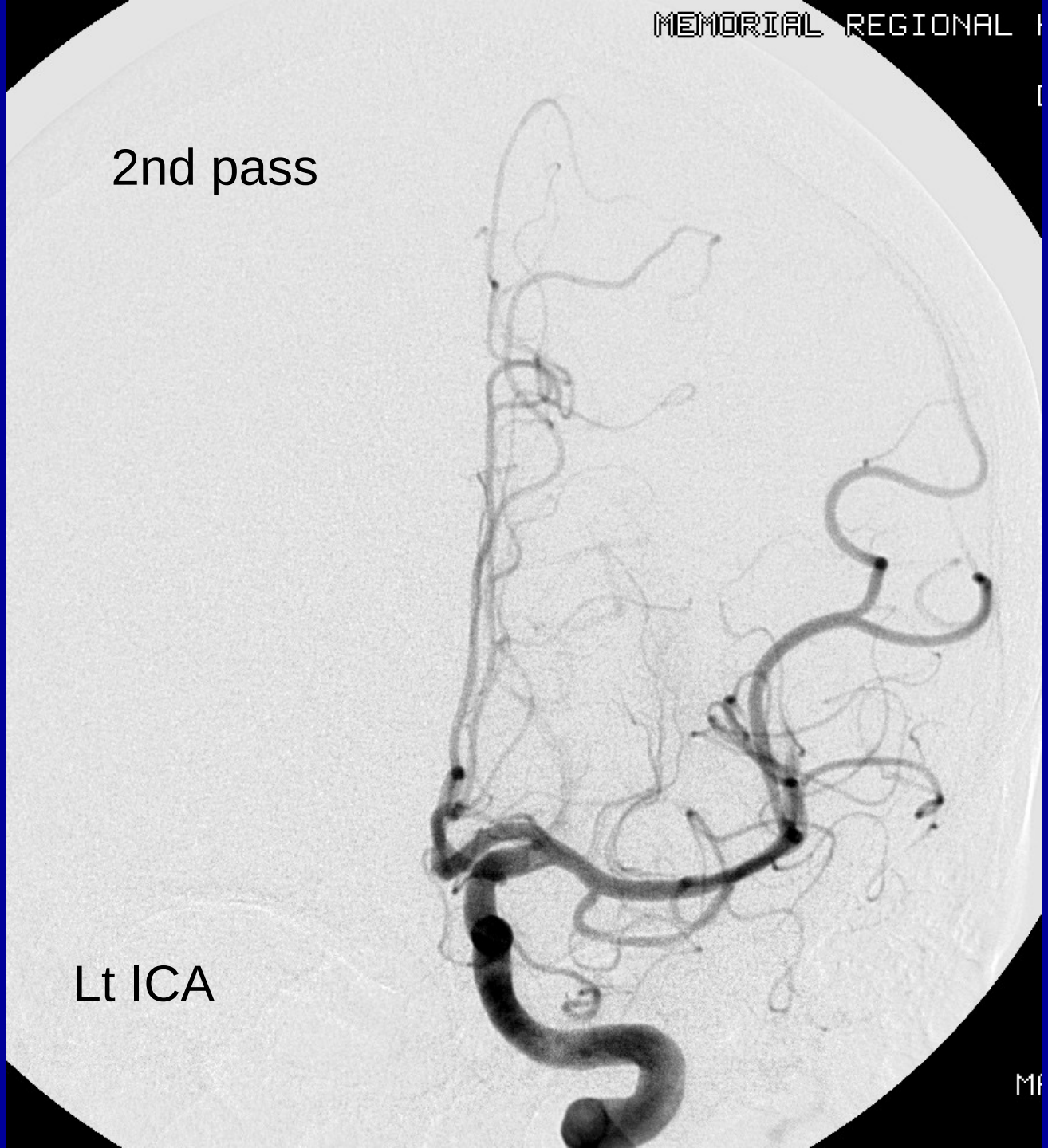
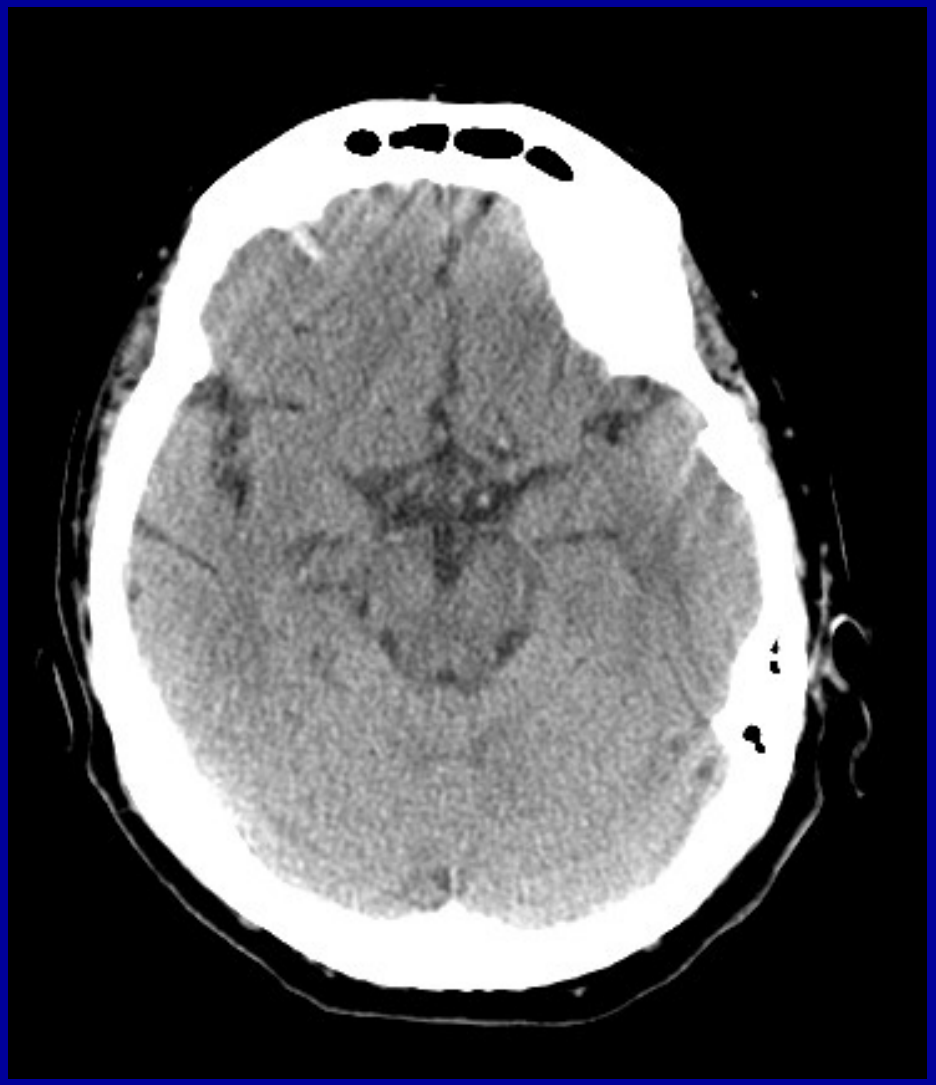
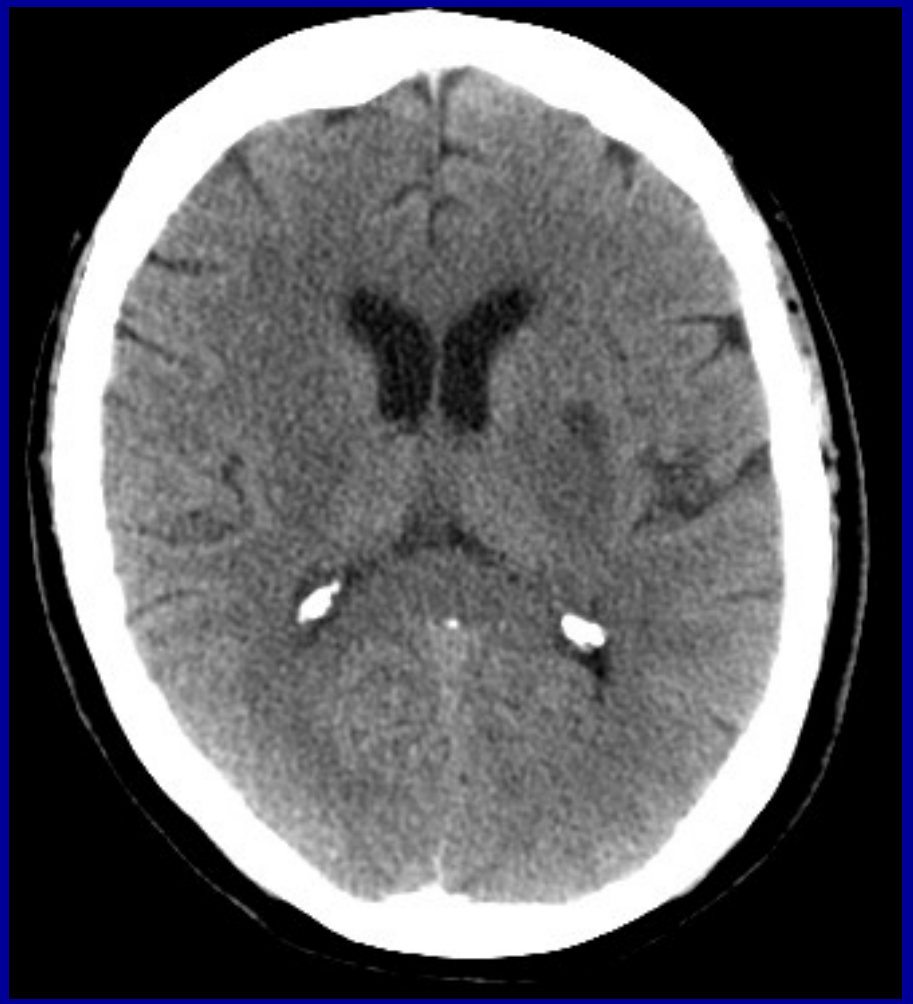

MEMORIAL REGIONAL
2nd pass
Lt ICA





CT without contrast

MERCI TRIAL

- 121 pts enrolled: 114 pts were treated with the Merci Retriever System. Median age: 71 yrs
- Median baseline NIHSS score: 19
- Median time from symptom onset to angio: 6 hours
- Procedure related adverse events: 7%
- Symptomatic ICH: 8%
- Recanalization in 54%
- Mortality 39% through 3 months
  (25% with recanalization vs 53% if not recanalized)

Stroke 2005;36:1432-1440

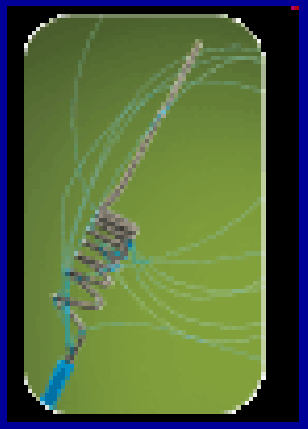
MERCI TRIAL
3 MONTH FOLLOW-UP DATA

- Overall, 34% pts achieved a >10 point improvement in NIHSS
- Of those pts successfully revascularized, 53% had a >10 point improvement in NIHSS
- Of those pts unsuccessfully revascularized, 16% had a >10 point improvement in NIHSS
- Received FDA approval since August 2004

MULTI MERCI TRIAL

- 164 patients with angiographically proven large vessel occlusive strokes
- 15 participating stroke centers in North America
- Same study design as MERCI trial except:
  - Included failed IV lytic (t-PA) patients
  - Included next generation Merci® Retriever L5

L5



New V series

MULTI MERCI TRIAL

Revascularization		
Successful Revascularization Post-Procedure	68.3%	(112/164)
Symptomatic Hemorrhage		
Overall	9.8%	(16/164)
Symptomatic PH-2	2.4%	(9/164)
Failed IV t-PA Patients		
10.4%	(5/48)	
Symptomatic PH-2	2.1%	(1/48)
Good Outcome (90-day mRS $\leq$ 2)		
Overall	36.3%	(58/160)
Mortality at 90 days		
Overall	33.5%	(54/161)

>2/3 of patients achieved revascularization
>1/3 patients are functionally independent at 90 days
Large symptomatic hemorrhages (PH-2) were infrequent

OTHER STROKE DEVICES

- NeuroFlo (CoAxia)
- MicroLysUS infusion catheter (EKOS)
- Neuronet device (Guidant)
- Catch device
- Phenox clot retriever
- Alligator retrieval device (Chesnut Medical)
- Balloon angioplasty
- Stents: Neuroform, Enterprise, Leo, Solitaire/Solo, Wingspan

CONCLUSION

- Activate brain attack
- Do not remove femoral sheath!
- Send STAT coags
- Review of meds given intraprocedurally
- Consider STAT CT brain
- Consult Neurology and INR
- Admit patient to Neuro ICU