



Transvenous Embolization for Treatment of CSF-Venous Fistula

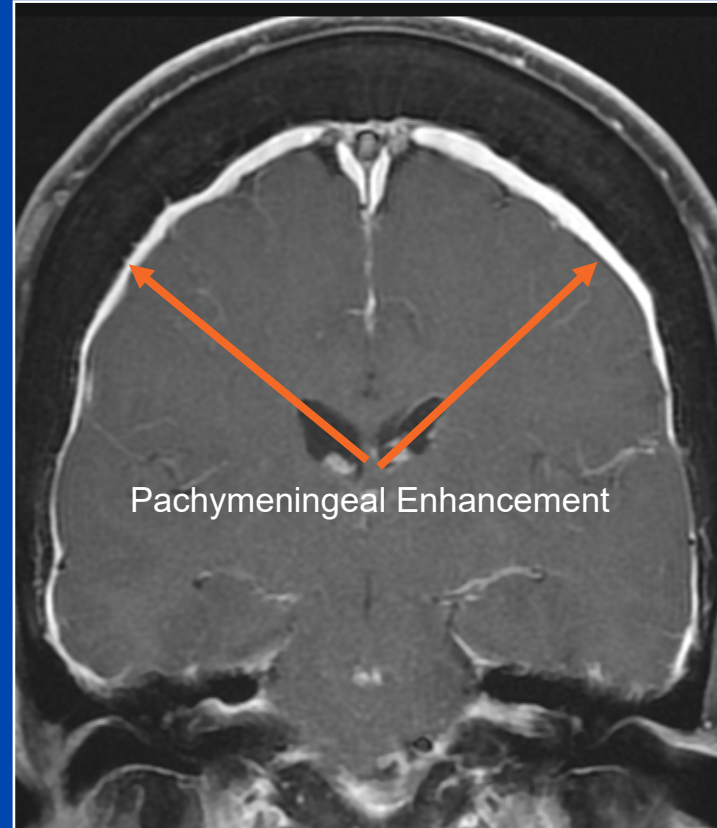
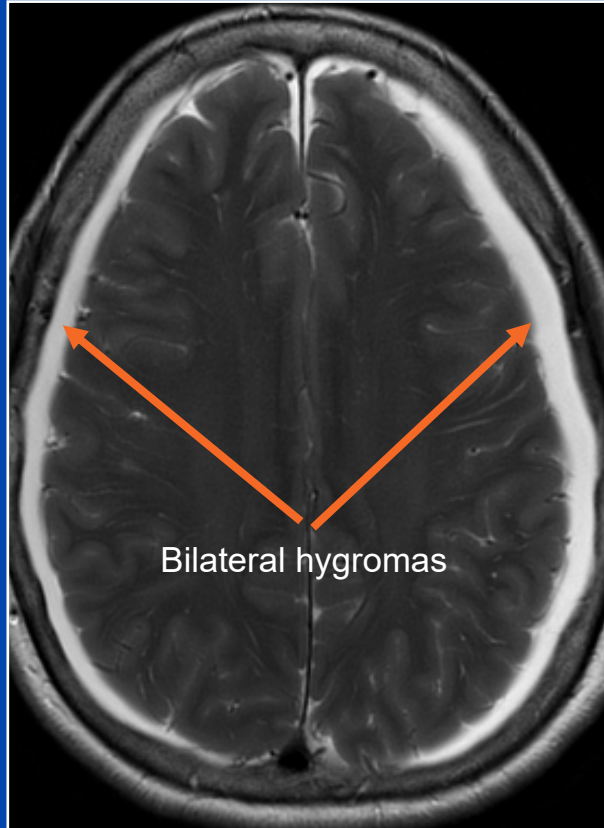
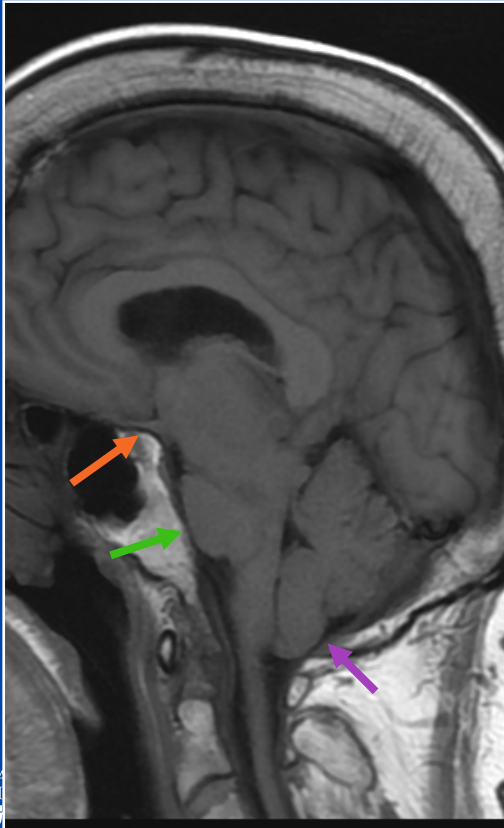
Waleed Brinjikji M.D.
Professor of Radiology and Neurosurgery
Mayo Clinic
Rochester, MN

Cedars Sinai Symposium 10/2/2021

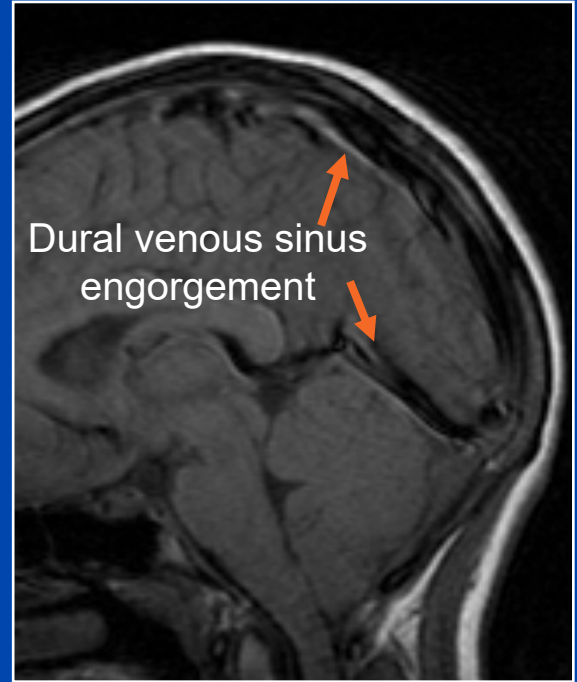
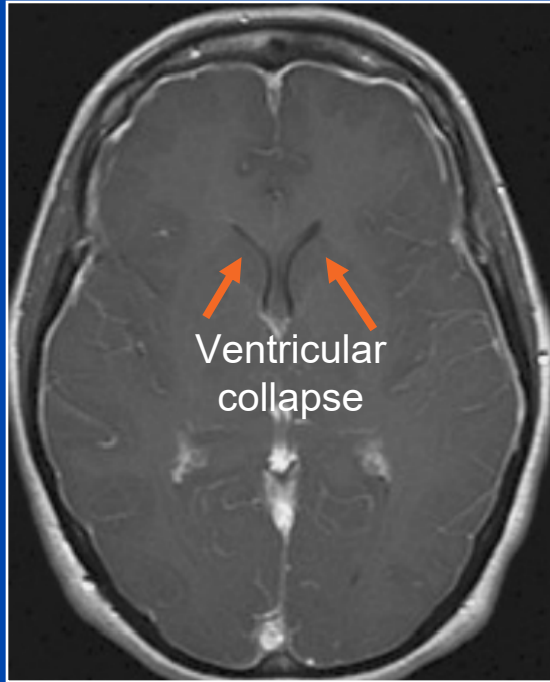
Background of SIH

- Epidemiology
 - Middle aged patients (30-50 years old)
 - More common in women (2:1)
 - Annual incidence of 5-10/100,000 patients in ED setting
- Clinical Presentation
 - Orthostatic headache
 - Gait disturbances
 - Cognitive dysfunction
 - Sensorineural hearing loss and tinnitus
 - Coma

Intracranial Imaging Findings



Intracranial Imaging Findings



Diagnostic Algorithm for SSCSFL in a Setting of High Clinical Suspicion

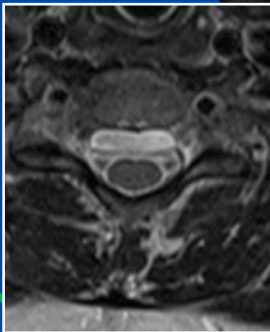
BRAIN + SPINES MRI

Hyperdynamic
CT Myelogram

LEAK?

Nontargeted
Multilevel EBP ->
reevaluate

Extradural
Spinal Fluid
Collection



LDDSM (2-day)
(2nd day with 2 hr delay
prone CT images if both
days "-", looking for
nerve root sleeve tear)

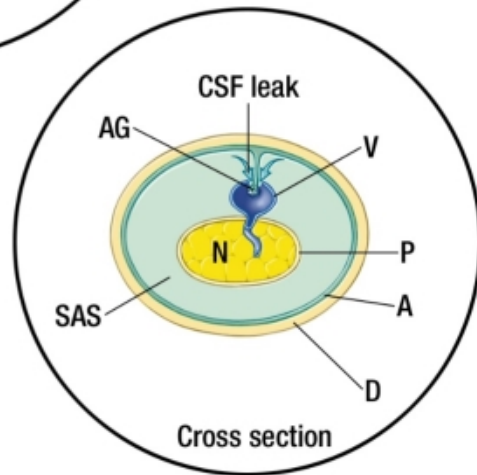
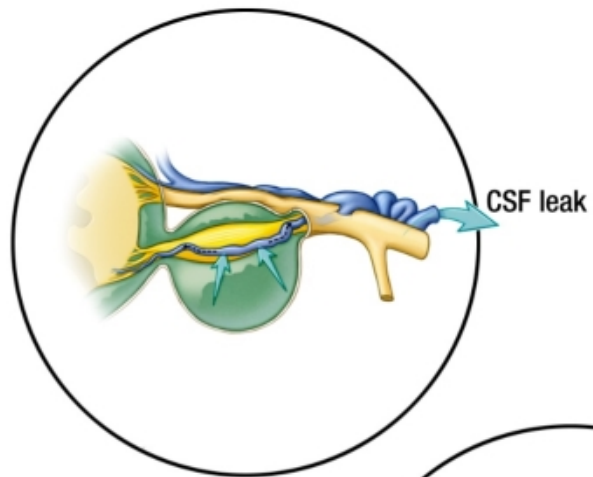
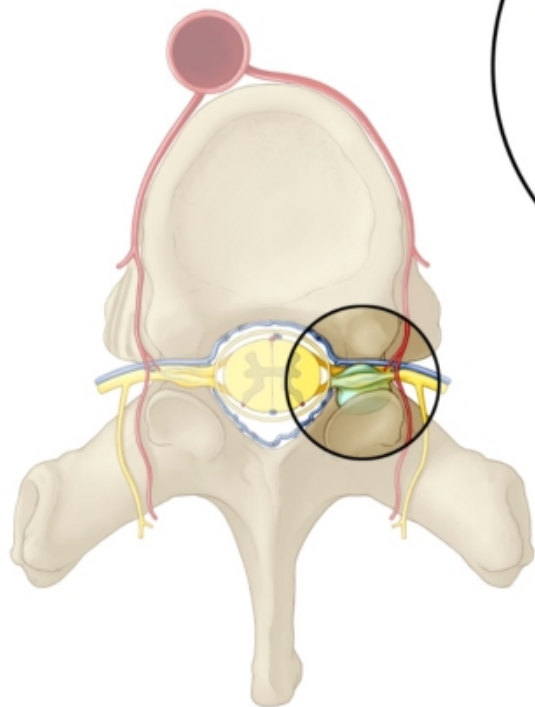
LEAK?

Reevaluate + consider
repeat LDDSM

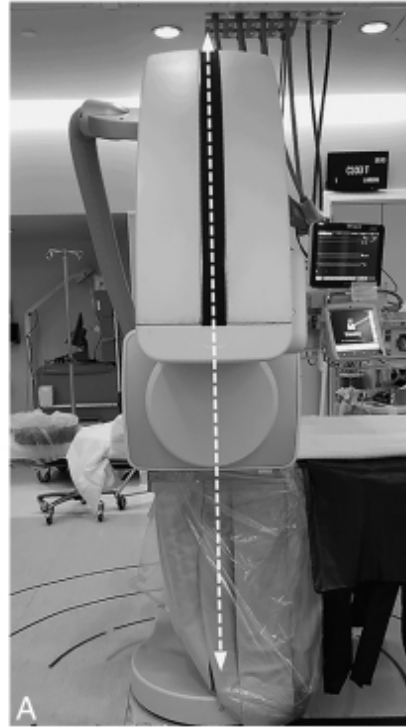
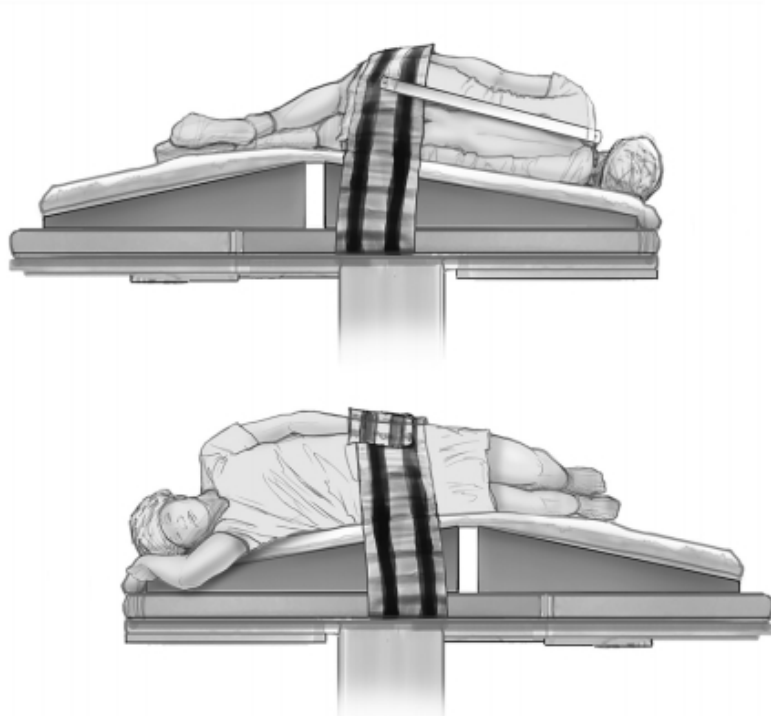
Targeted Therapeutic
Intervention

CSF-Venous Fistula

- Direct connection between intrathecal space (CSF) and a paravertebral vein
- New entity
 - First described 2014
 - Developmental?
 - Arachnoid granulations
- Likely under recognized, elusive diagnosis
- Probably most common cause of SIH
- Generally treated surgically

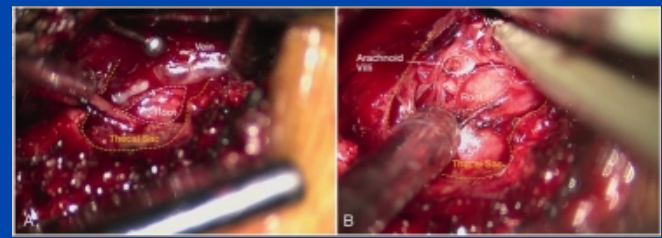


CSF Venous Fistulas Diagnosis: DSM



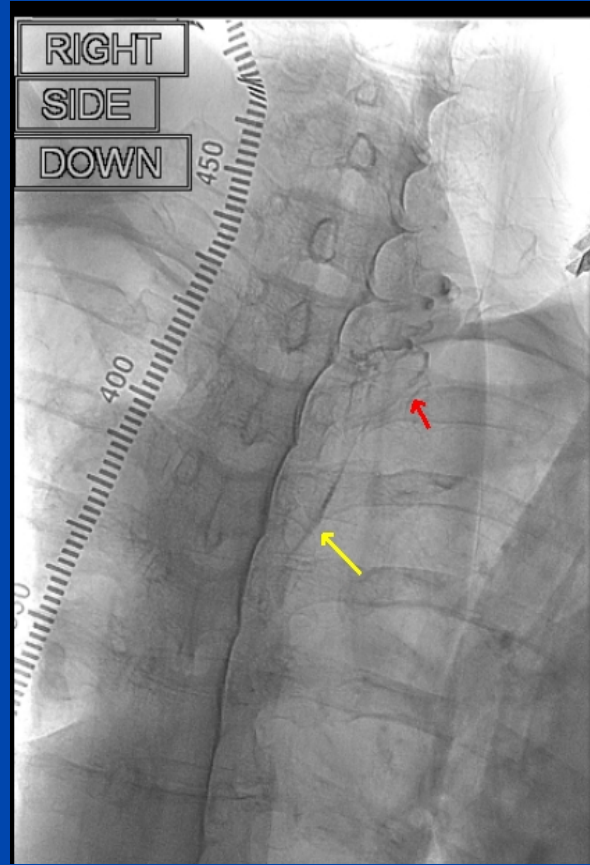


Surgical Outcomes

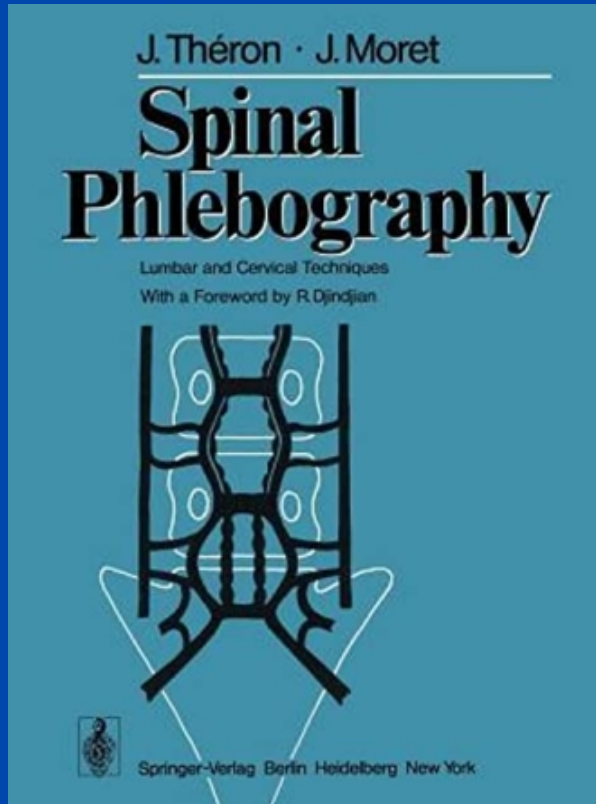


- Duvall et al, 44 patients with CSF venous fistulas
- 40 had blood patches, only 1 had improvement with blood patch
- 42 underwent surgery
 - 49% headache free
 - 27% 50% improvement
- 30 had post-operative MRI, 23 had resolution of MRI findings, 7 no change
- Post-operative events in 28%: rebound hypertension, numbness, paresthesias or burning

Recent Case: CSF-VF draining into Azygous Vein got me thinking...could we catheterize azygous vein and then paraspinal veins...and then embolize?



Could there be an endovascular option?



Lumbar and cervical spinal phlebography is a major new technique in the radiological diagnosis and work up, not only of disc lesions responsible for sciaticas, lumbar neuralgia, or cervicobrachial neuralgias, but of stenosis of the spinal canal, tumors and myelopathies. Although earlier attempts with this almost riskless method remained largely unsatisfactory, the authors have been able to make decisive improvements and have achieved diagnostically perfect pictures.

This method consists of the opacification of the epidural veins (a major anatomic landmark) situated within the anterolateral angles of the spinal canal, connected to the intervertebral discs. For lumbar phlebography, this is achieved by the catheterization of the lateral sacral and ascending lumbar veins and for cervical phlebography, by catheterization of the vertebral veins.

This technique is in use today in almost every university clinic in France.



Figure 41
Lateral right disc herniation L4-L5 (star). Partial interruption of the venous epidural strip on its lateral side by the disc lesion.



Figure 42
Left disc herniation L5-S1 (star). Partial interruption of the left medial epidural vein in front of L5-S1 with stretching of the remaining vein (arrows).

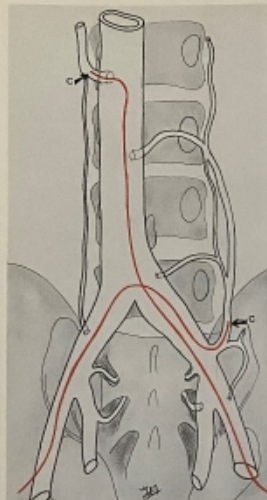


Figure 26a

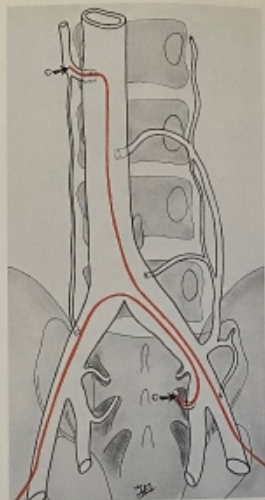


Figure 26b

Figure 26a and b

Various modes of catheterization of a left ascending lumbar vein or a lateral sacral vein associated with catheterization of the second right lumbar vein.

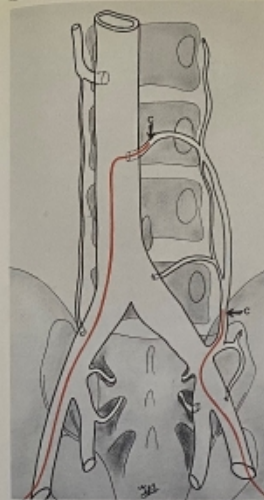


Figure 27a

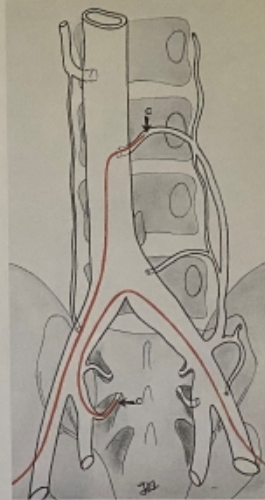
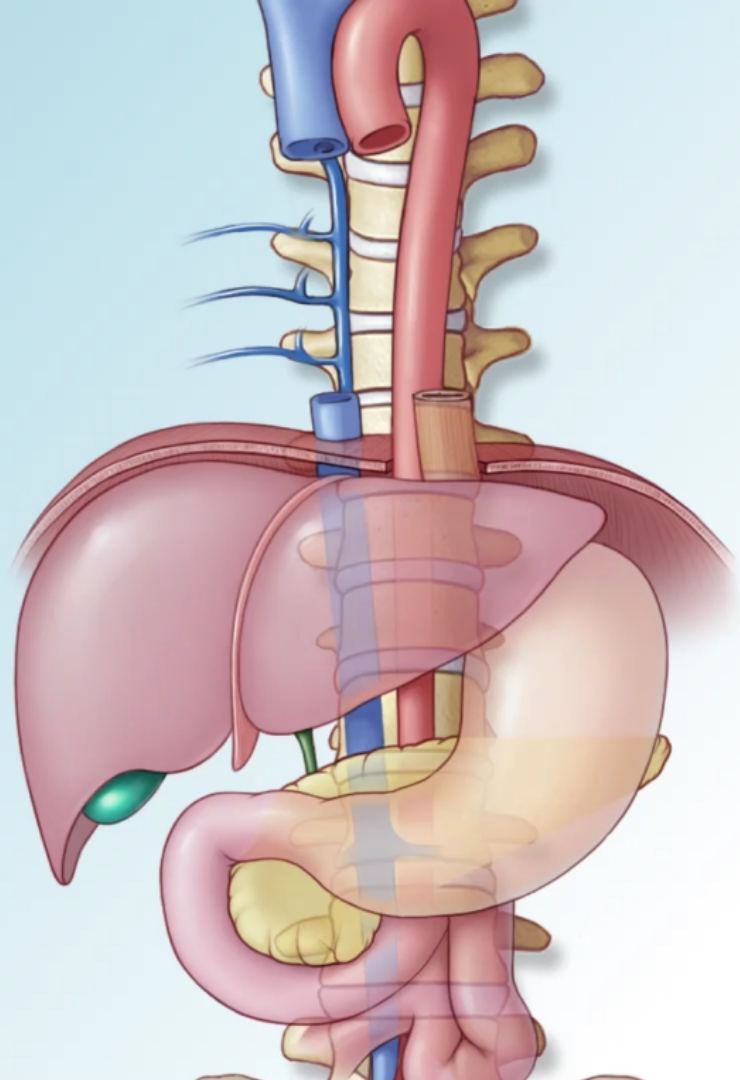


Figure 27b

Figure 27a and b

Techniques using the third left lumbar vein



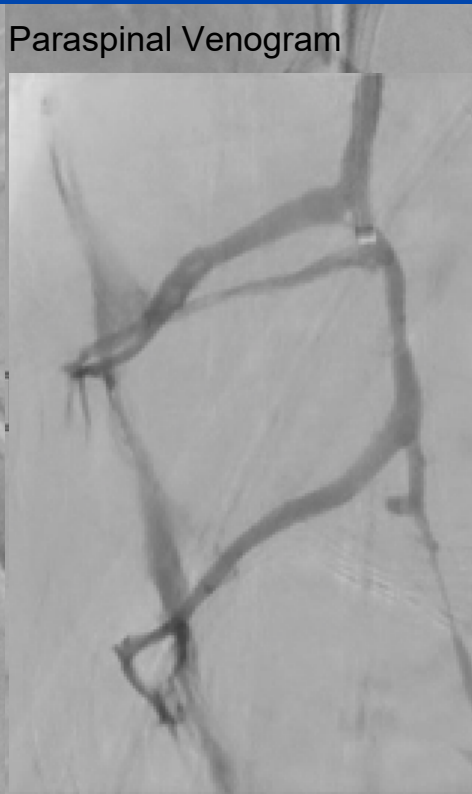
Azygous Vein Cath



Azygous Venogram

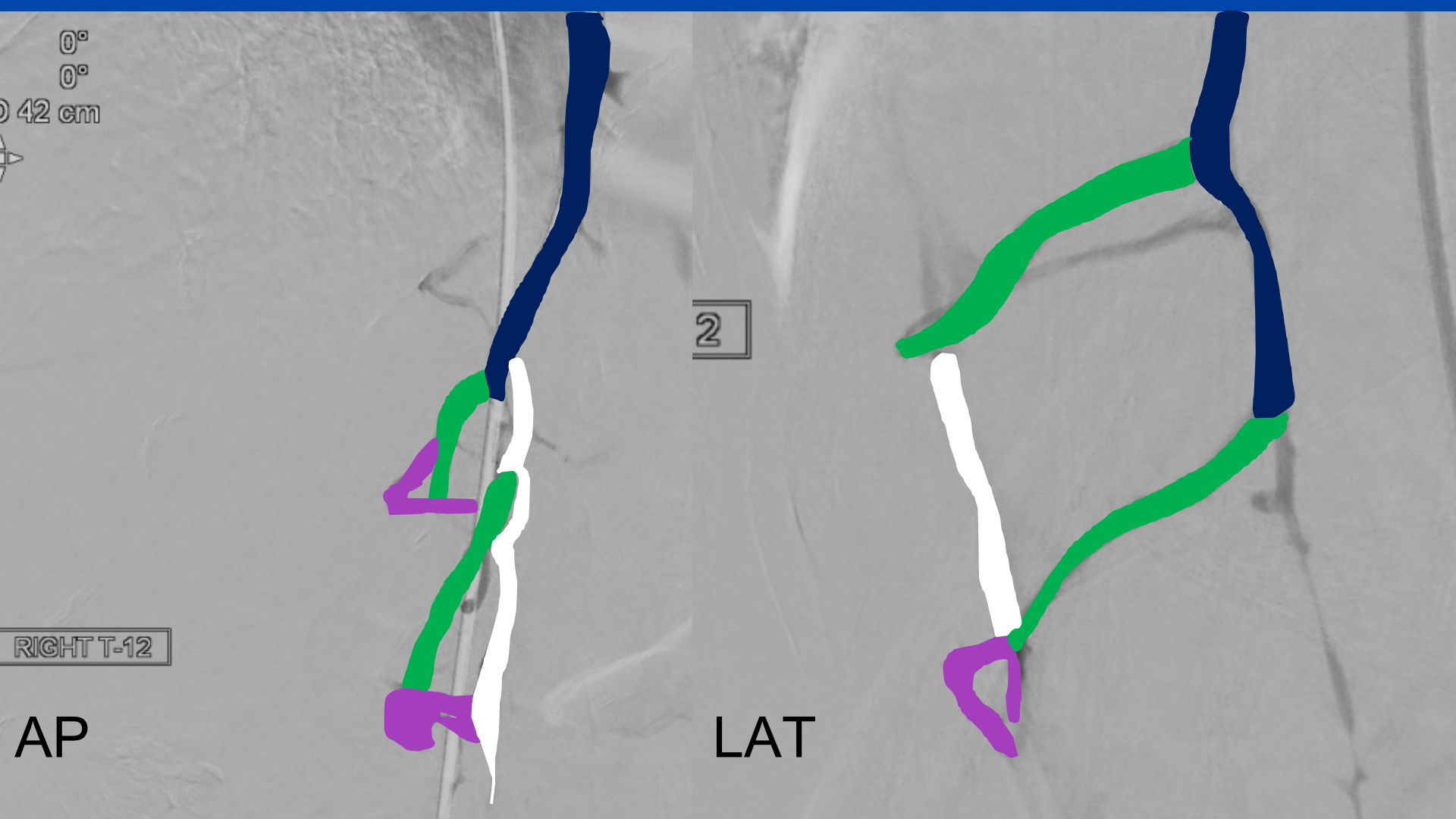


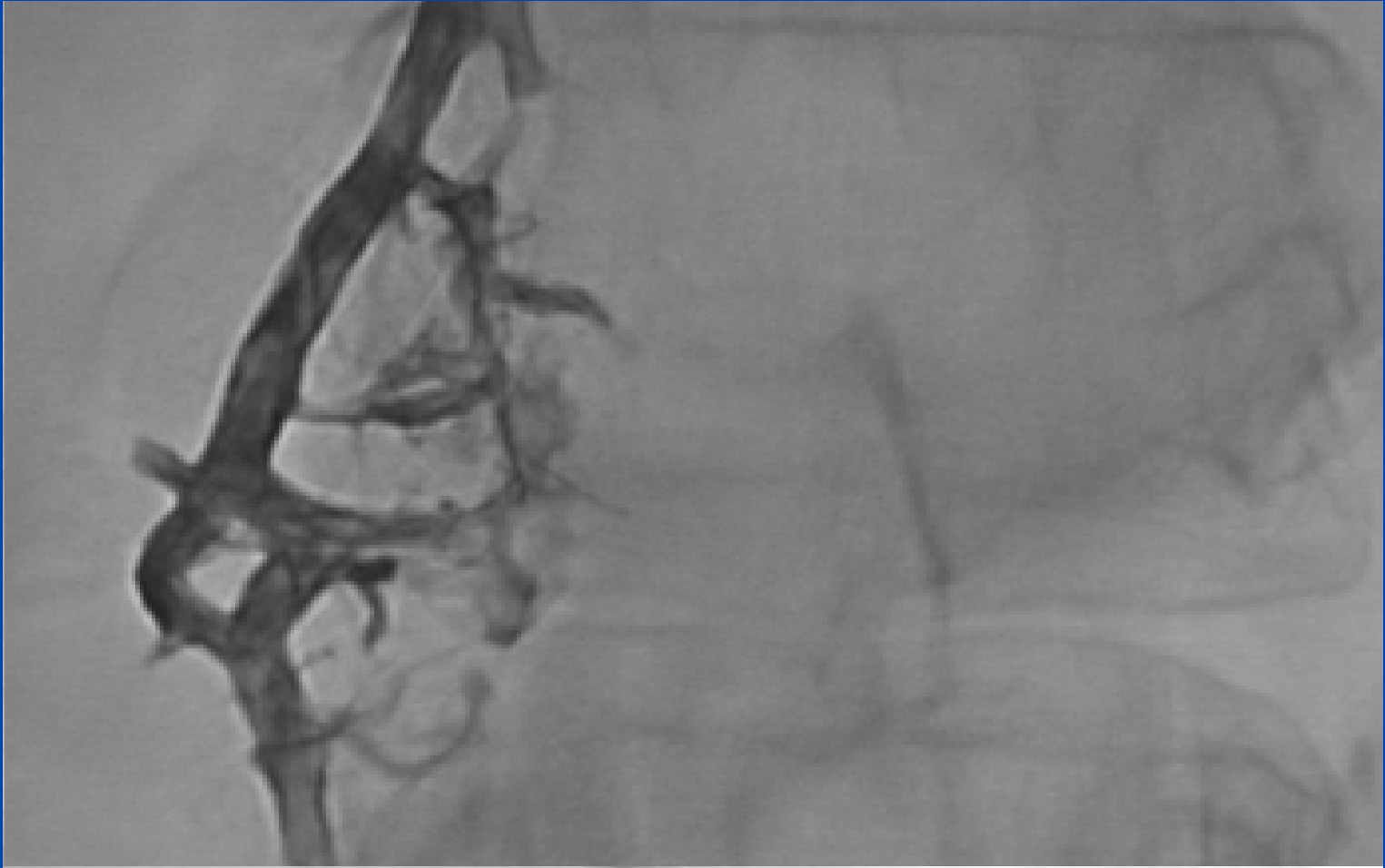
Paraspinal Venogram

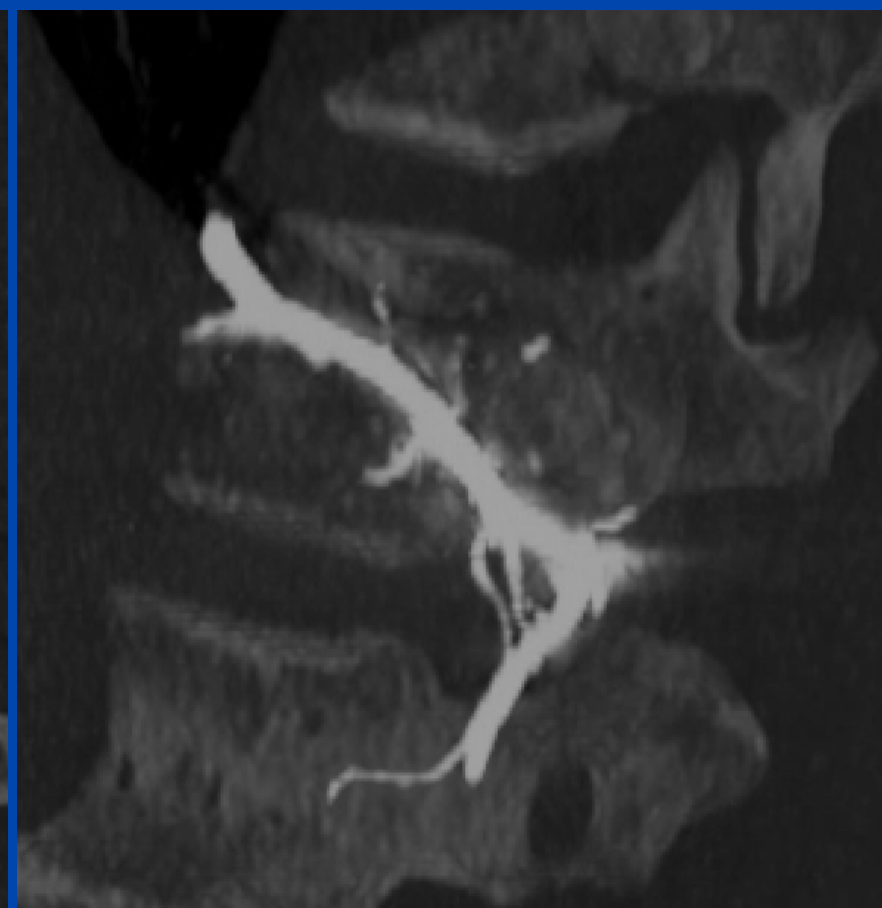


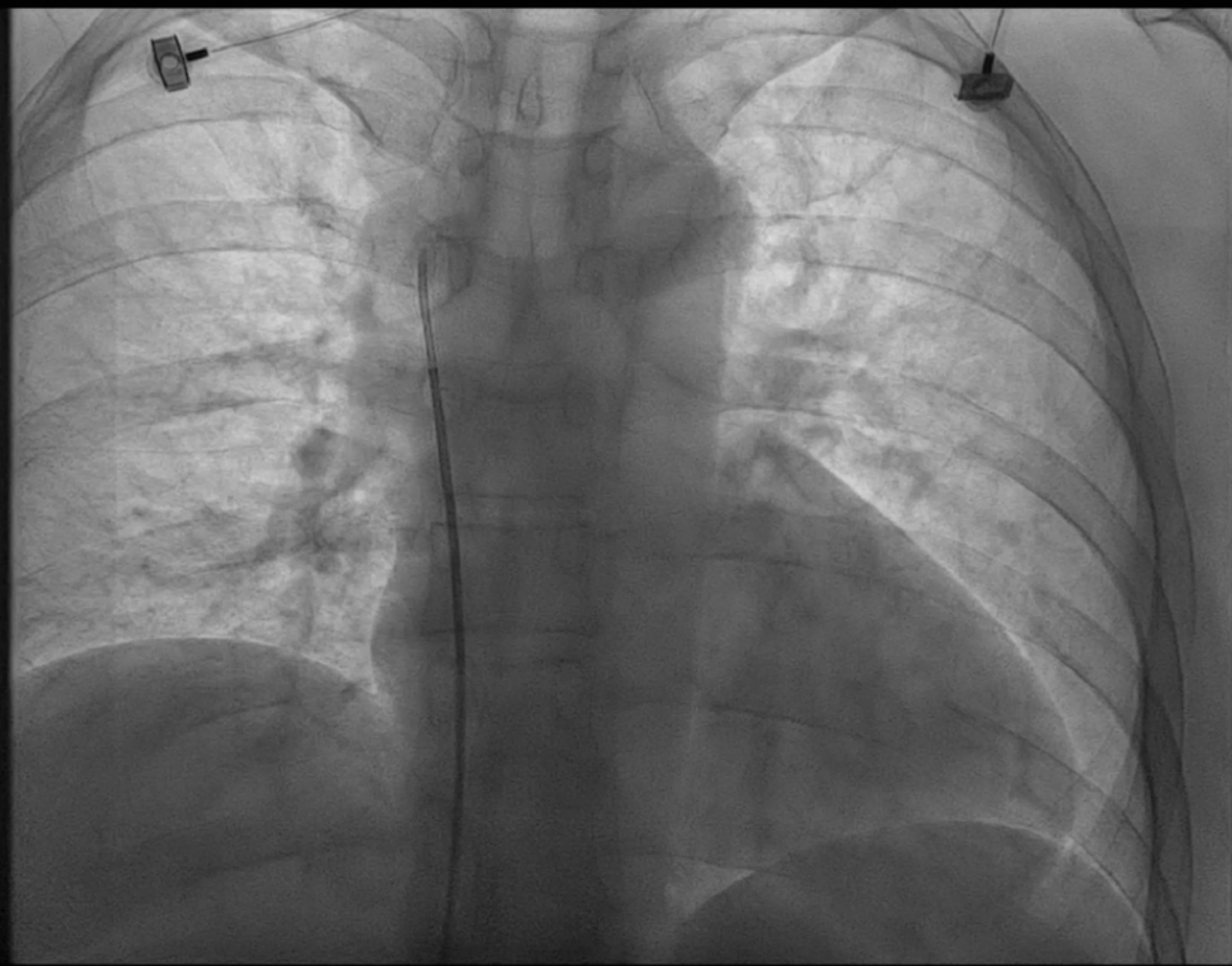
Onyx











70 kV 4.4 mA

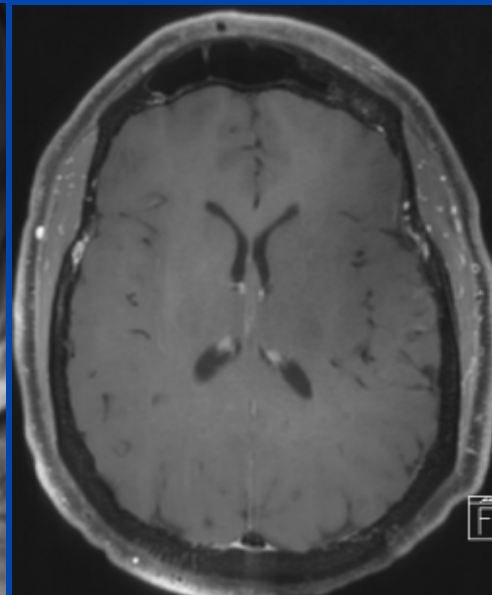
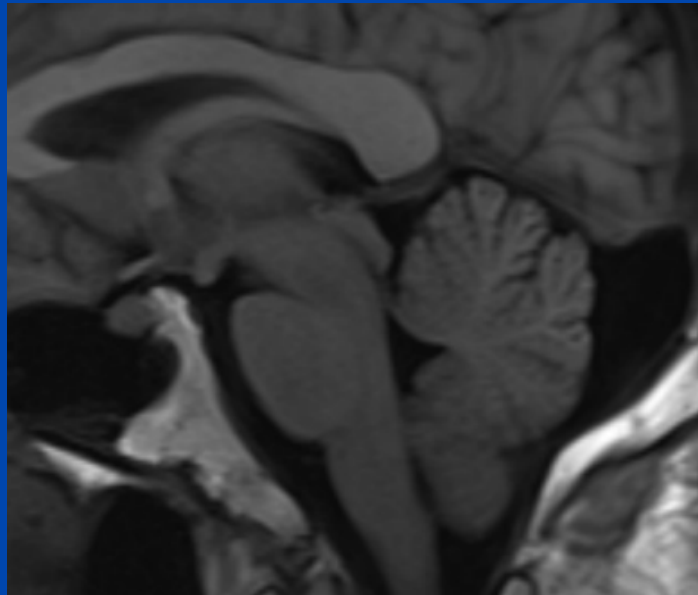
0°
0°
Height cm -3
SID cm 120
FD cm 48

2
Fluo L 12.5fr
Time min 1.2
 \dot{K} 5.61 mGy/min
DAP 31.3 mGy cm^2/s

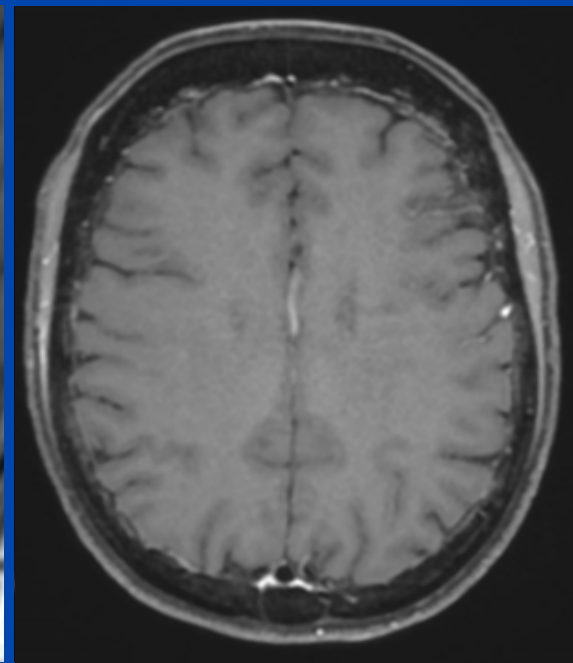
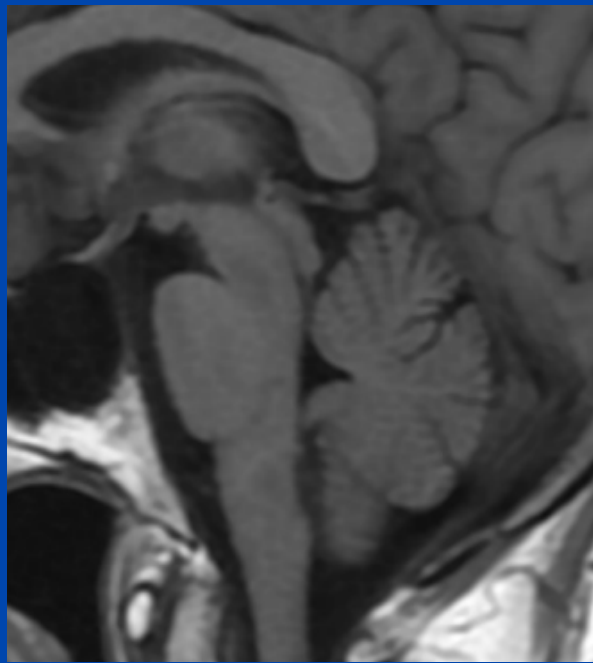
First Case Series

- 5 patients with SIH secondary to DSM confirmed CSFVF
- All had brain sag
- All headaches
- 3 cognitive problems
- 4 tinnitus/hearing problems

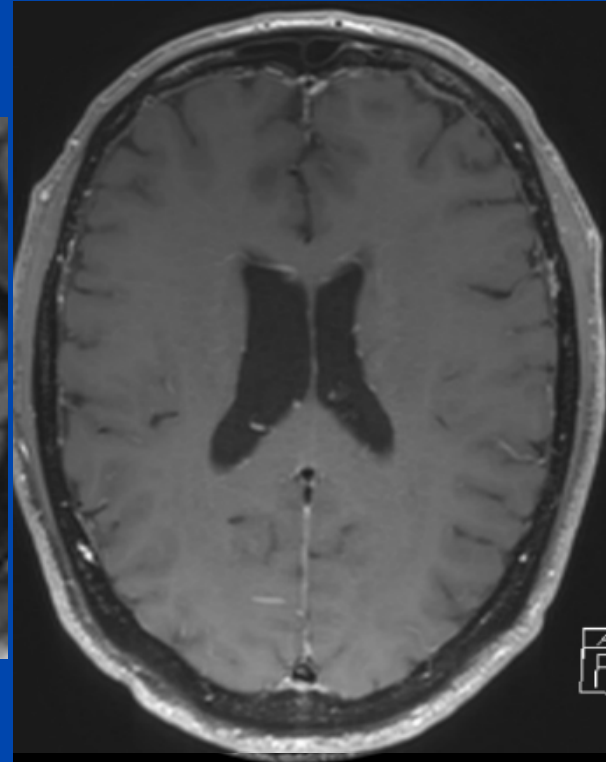
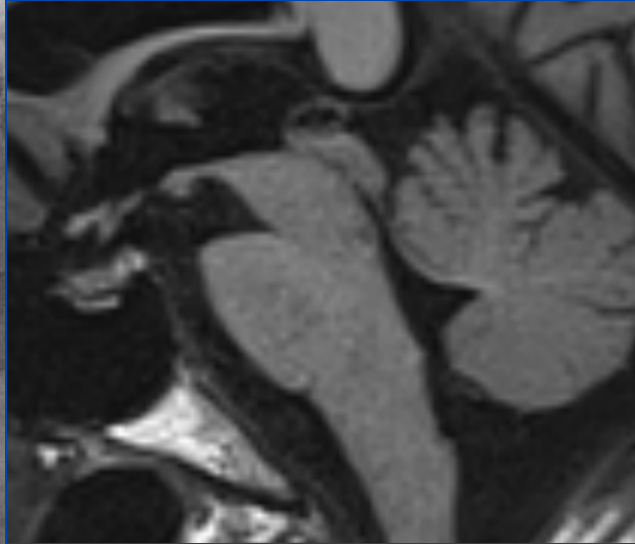
Patient 1



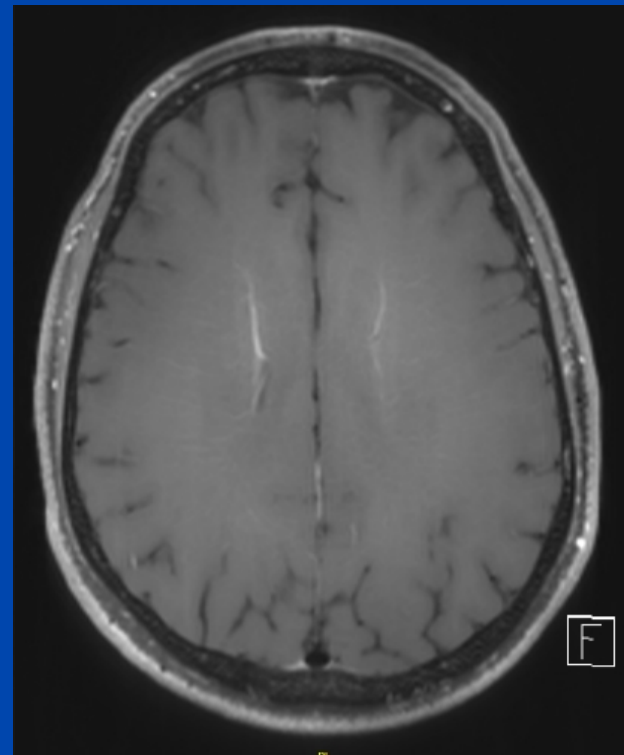
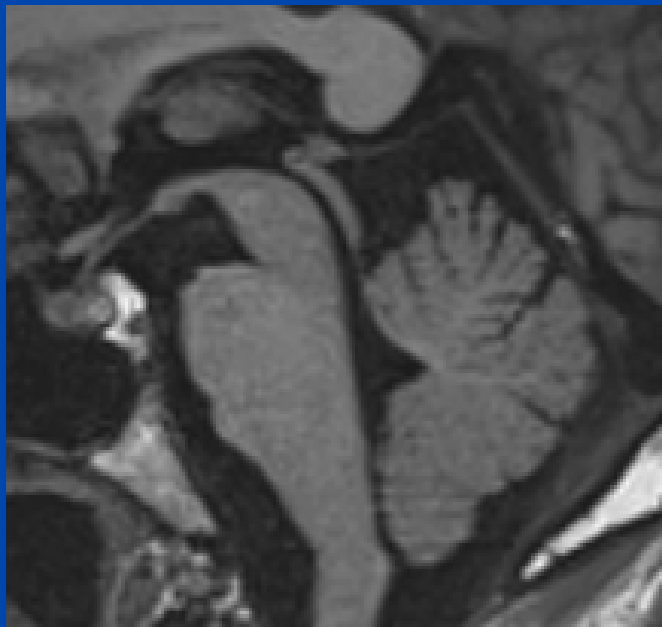
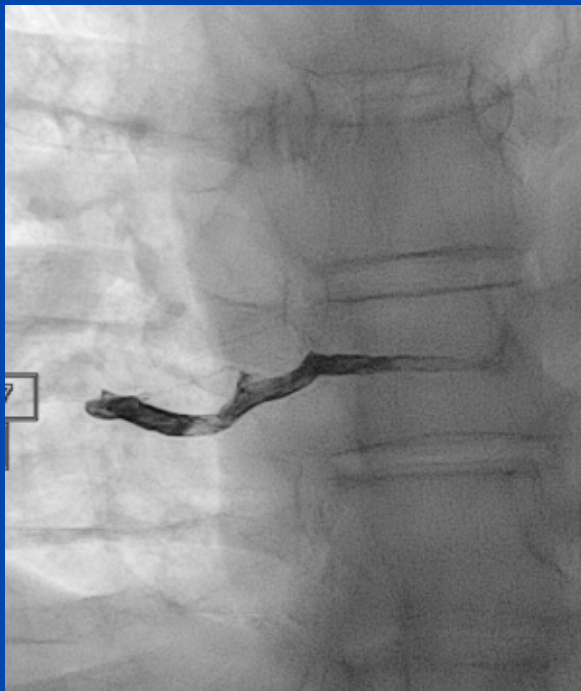
Patient 2



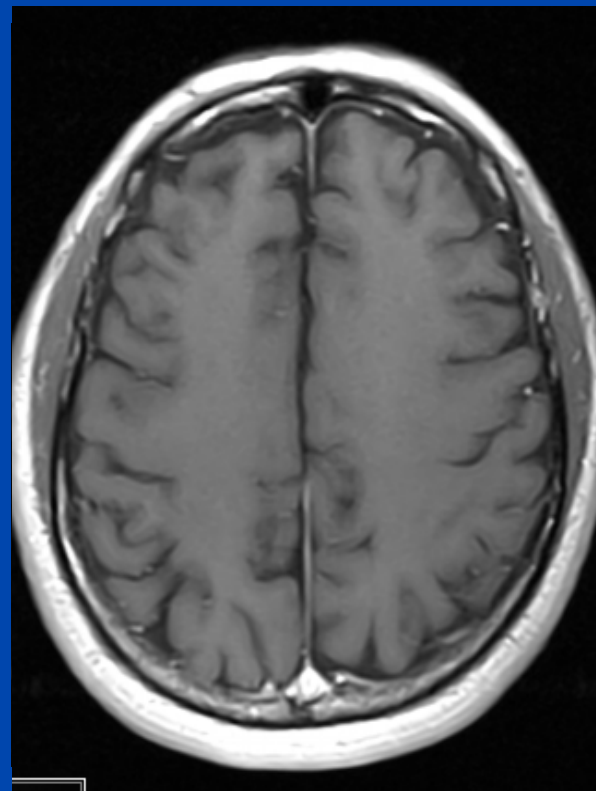
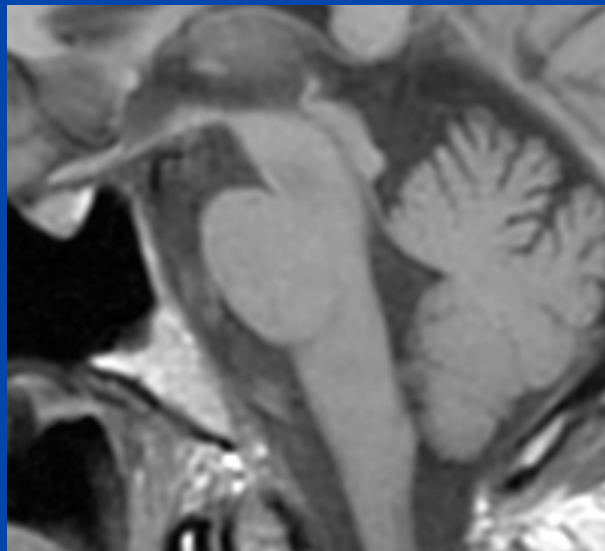
Patient 3



Patient 4



Patient 5



Patient characteristics and outcomes

Patient No.	Age (yr)/Sex	Symptoms	Fistula Level	Approach	Complications	Bern Score Pre-Tx	Bern Score Post-Tx	Improvement in Symptoms?
1	44/M	Position- and Valsalva-dependent headache	Right T8	Transfemoral	None	8	0	Complete resolution
2	67/F	Position- and Valsalva-dependent headache, tinnitus, brain fog	Right T4	Transfemoral	Pain at right T4, resolved after 1 month	9	0	Complete resolution
3	58/M	Position- and Valsalva-dependent headache, tinnitus, brain fog, hearing loss	Right T7	Transfemoral	None	6	2	50% Improvement in headache and hearing loss, stable tinnitus
4	65/M	Position- and Valsalva-dependent headache, tinnitus, brain fog	Right T4	Transjugular	Pain at right T4, resolved after 1 month	9	0	Complete resolution
5	68/M	Position- and Valsava-induced headache, tinnitus, hearing loss, vertigo	Bilateral T9	Transfemoral	None	6	1	Complete resolution of headache and hearing loss, persistent tinnitus with SCC dehiscence

Note:—SCC indicates semicircular canal; TX, treatment.

Series to date

- 63 patients with DSM confirmed CSF-VF and brain sag on MRI
- All discharged date of procedure
- Complications
 - Rebound hypertension requiring medical therapy 6/63
 - One patient blew a new leak
 - Paraspinal vein perforation 2/63 (no hematoma or clinical consequences)
 - Onyx pulmonary emboli (3/63) no hematoma or clinical consequences

HIT-6™ (VERSION 1.1)

This questionnaire was designed to help you describe and communicate the way you feel and what you cannot do because of headaches.

To complete, please circle one answer for each question.



▼ If You Scored 60 or More

Your headaches are having a very severe impact on your life. You may be experiencing disabling pain and other symptoms that are more severe than those of other headache sufferers. Don't let your headaches stop you from enjoying the important things in your life, like family, work, school or social activities.

Make an appointment today to discuss your HIT-6 results and your headaches with your doctor.

▼ If You Scored 56 – 59

Your headaches are having a substantial impact on your life. As a result you may be experiencing severe pain and other symptoms, causing you to miss some time from family, work, school, or social activities.

Make an appointment today to discuss your HIT-6 results and your headaches with your doctor.

▼ If You Scored 50 – 55

Your headaches seem to be having some impact on your life. Your headaches should not make you miss time from family, work, school, or social activities.

Make sure you discuss your HIT-6 results and your headaches at your next appointment with your doctor.

▼ If You Scored 49 or Less

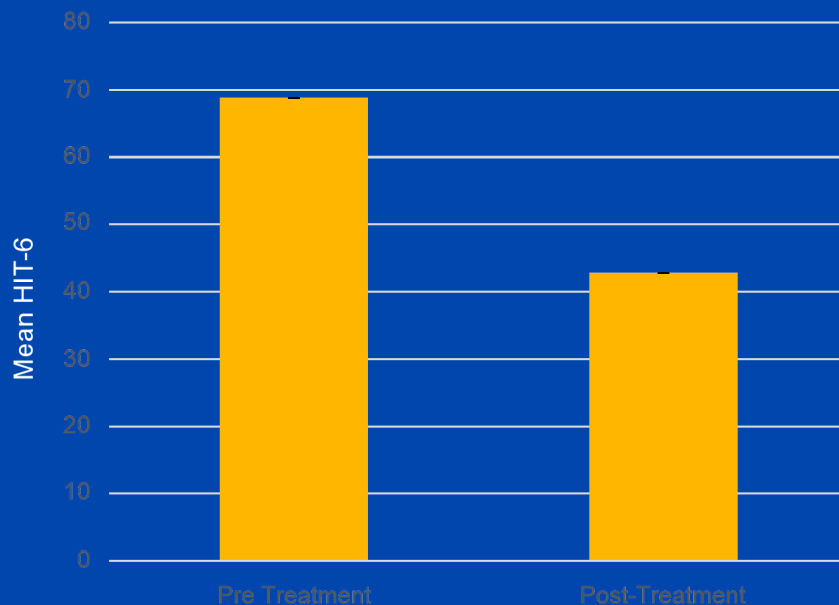
Your headaches seem to be having little to no impact on your life at this time. We encourage you to take HIT-6 monthly to continue to track how your headaches affect your life.

▼ If Your Score on HIT-6 is 50 or Higher

You should share the results with your doctor. Headaches that are disrupting your life could be migraines.

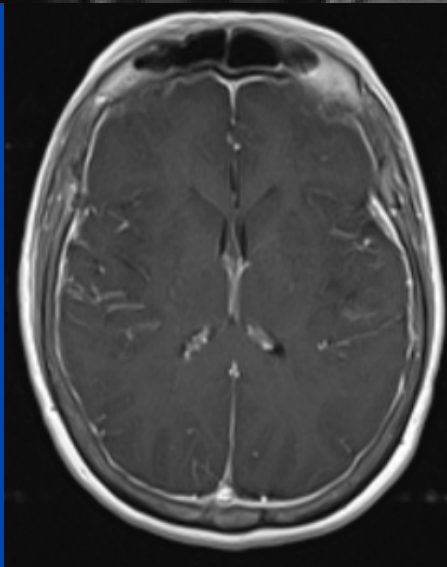
Take HIT-6 with you when you visit your doctor because research shows that when doctors understand exactly how badly headaches affect the lives of their patients, they are much more likely to provide a successful treatment program, which may include medication.

HIT-6 SCORE

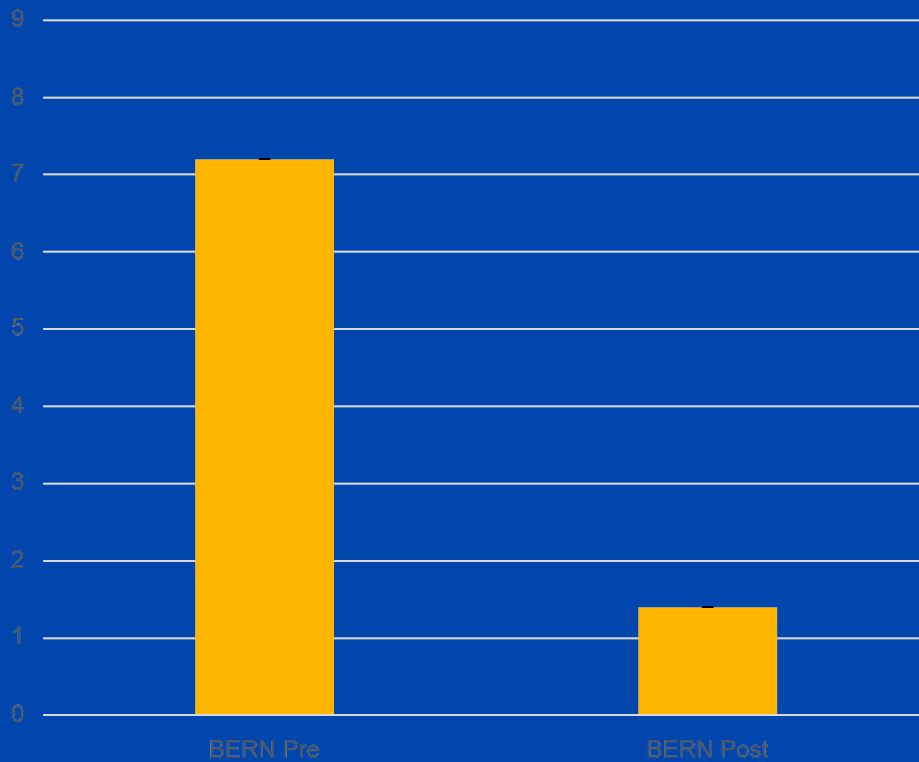


Since the start of the study, my overall status is:

- | | | | |
|-----|----------|--------------------------|---------------------------|
| 65% | 1 | <input type="checkbox"/> | Very Much Improved |
| 19% | 2 | <input type="checkbox"/> | Much Improved |
| 6% | 3 | <input type="checkbox"/> | Minimally Improved |
| 7% | 4 | <input type="checkbox"/> | No Change |
| 3% | 5 | <input type="checkbox"/> | Minimally Worse |
| | 6 | <input type="checkbox"/> | Much Worse |
| | 7 | <input type="checkbox"/> | Very Much Worse |



Bern SIH Score Pre and Post



Technical Nuances

- Cervical versus Thoracic versus Lumbar
- T1-T4 fistula (superior intercostal vein)
- Catheter stability
- Balloon versus no balloon
- Choice of liquid embolic agent
- Epidural Space Navigation

Future Directions

- RCT versus blood patching?
- Newer liquid embolic agents? PHIL, SQUID, etc
- Older liquid embolic agents? Glue
- Prospective clinical registry (Multicenter?)
- 15 centers have already treated at least one patient!



brinjikji.waleed@mayo.edu
[@wbrinjikji](#)