

Imaging of Iatrogenic Leaks



Bridging the Gap 2024

Andrew L. Callen MD
Associate Professor of Neuroradiology
Director, CU CSF Leak Program



University of Colorado
Anschutz Medical Campus

Iatrogenic (Doctor Caused) Leaks

1. **Intended** lumbar punctures

2. **Unintended** lumbar punctures

Epidural Needles

Spine Surgery

Intended Punctures: (Lumbar Punctures)

~400,000 LPs/year in USA

~10-30%: *post dural puncture headache*

~40,000-120,000 new cases PDPH/year

The Lancet 2018: Nath et al.

Atraumatic versus conventional lumbar puncture needles: a systematic review and meta-analysis

Siddharth Nath, Alex Koziarz, Jetan H Badhiwala, Waleed Alhazzani, Roman Jaeschke, Sunjay Sharma, Laura Banfield, Ashkan Shoamanesh, Sheila Singh, Farshad Nassiri, Wieslaw Oczkowski, Emilie Belley-Côté, Ray Truant, Kesava Reddy, Maureen O Meade, Forough Farrokhyar, Malgorzata M Bala, Fayez Alshamsi, Mette Krag, Itziar Etxeandia-Ikobaltzeta, Regina Kunz, Osamu Nishida, Charles Matouk, Magdy Selim, Andrew Rhodes, Gregory Hawryluk, Saleh A Almenawer

Frequency of PDPH

- Cutting vs atraumatic needles:
11% vs 4% (p < 0.001)
- 62% of PDPH **preventable!!!!**

Cutting

Atraumatic



Unintended Dural Punctures: Epidural Steroid Injections (ESI)

> 10 million ESI/year in USA

~2.7%: *recognized* dural puncture

at a minimum, **~270,000 ESI leaks/year**

Labor Epidurals and Leaks

~2.8 million US women receive labor epidural/year

~1%: unintended dural puncture (UDP)

60-80% with UDP have **acute PDPH**

~30% of UDP develop **new chronic HA**

16,800-22,400 new mothers with PDPH / year

~8,400 new chronic PDPH patients / year

Postsurgical Leaks:

~500,000 lumbar spine surgeries/year in USA

9%: *recognized* intraoperative leak

at a minimum, ~45,000 surgical leaks/year

The Scope of the Problem:

LPs + Epidurals + Surgery =

~370,000-460,000 new cases of PDPH / year

Compare to: {

- Parkinson's Disease: **~ 90,000 / year**
- Colorectal Cancer: **~ 150,000 / year**
- Heart Attacks: **~ 805,000 / year**

Barriers to Care in PDPH

1. Underestimated Rate of Occurrence

2. Underrecognized Imaging Findings

Underestimated

2 days after spine surgery, calling about new headache:

Encounter Date: 9/27/2024

Provider: [REDACTED]

Action Taken/ Message for patient: LVM letting her know -

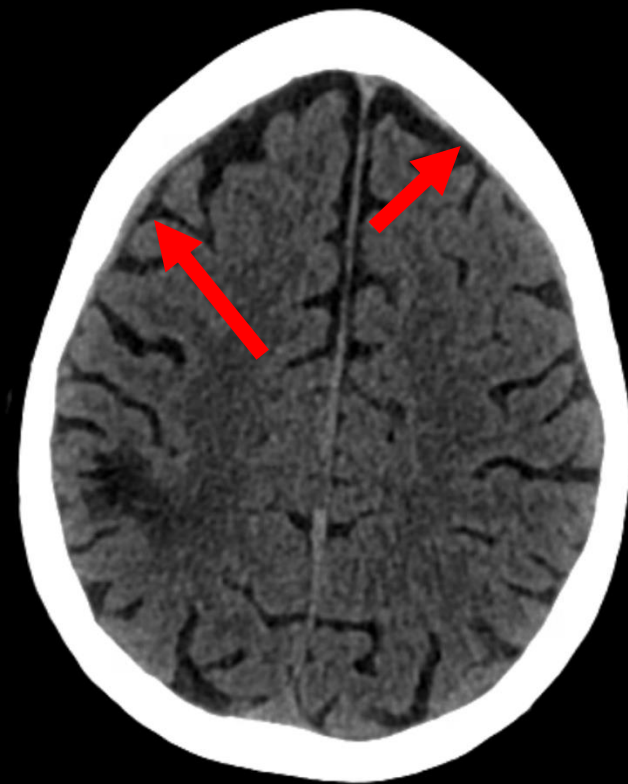
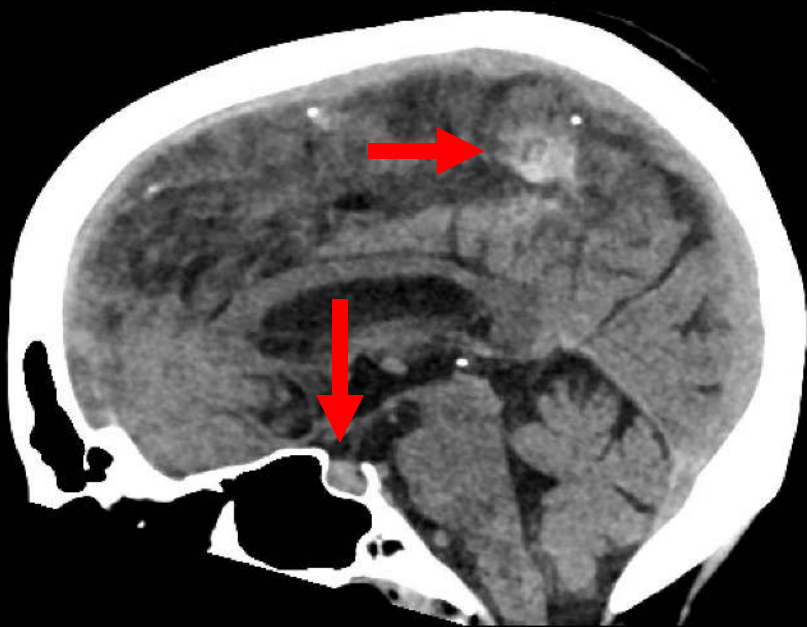


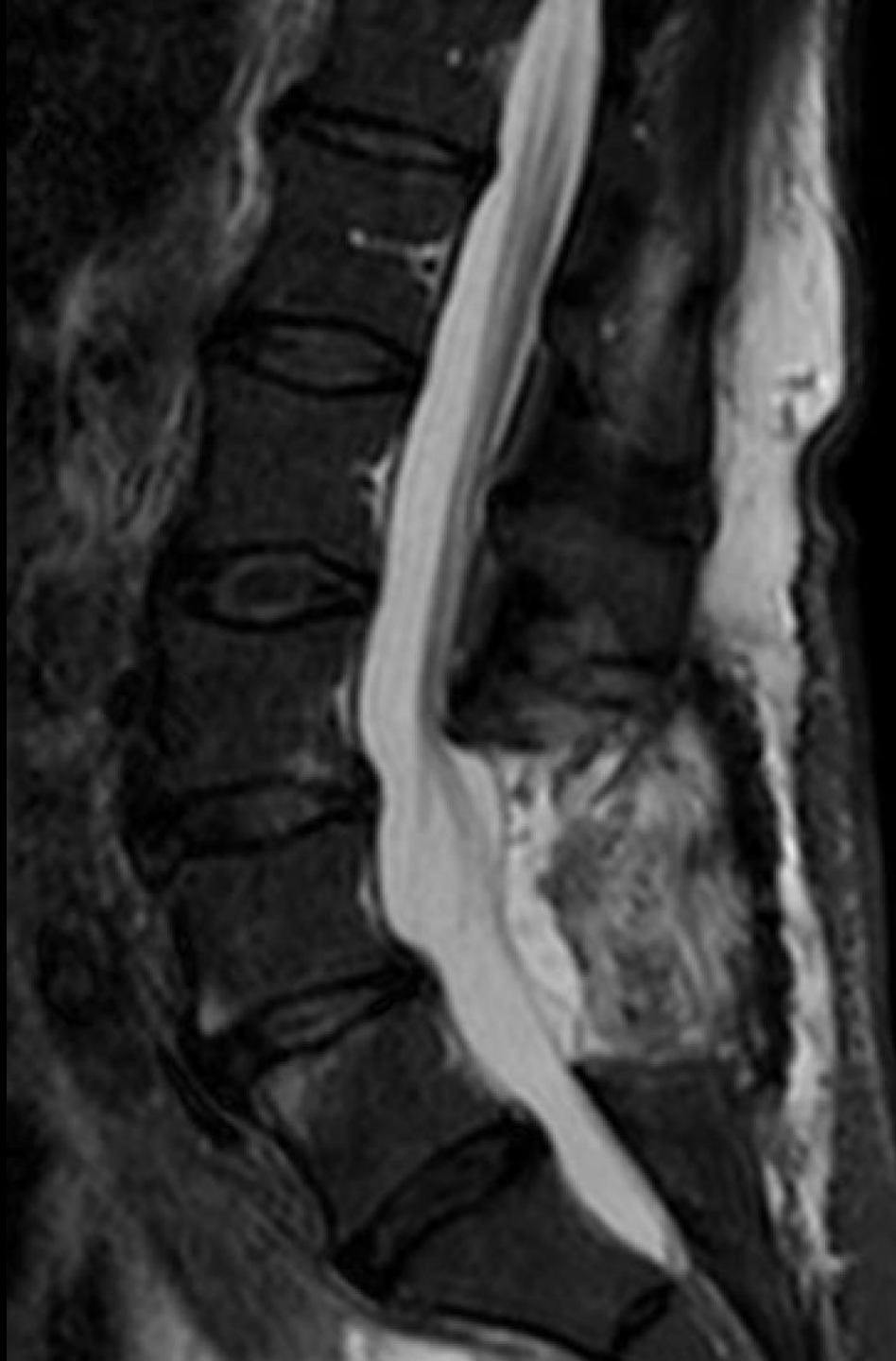
- No dural tears during surgery, unlikely d/t CSF leak.
- Blood clot also unlikely.
- We aren't sure what caused the headache/other symptoms but okay to monitor for now if it is improving.
- Take meds as needed for pain control.
- If headache pain becomes severe again and doesn't respond to medication, she should be seen in an urgent care or ER.

2016



2024





Ortho Spine Brief Post-operative Note



Pre-operative diagnosis: Dural tear

Post-operative diagnosis: same .

Procedures Performed: dural repair

Surgeon(s):

Fellow:

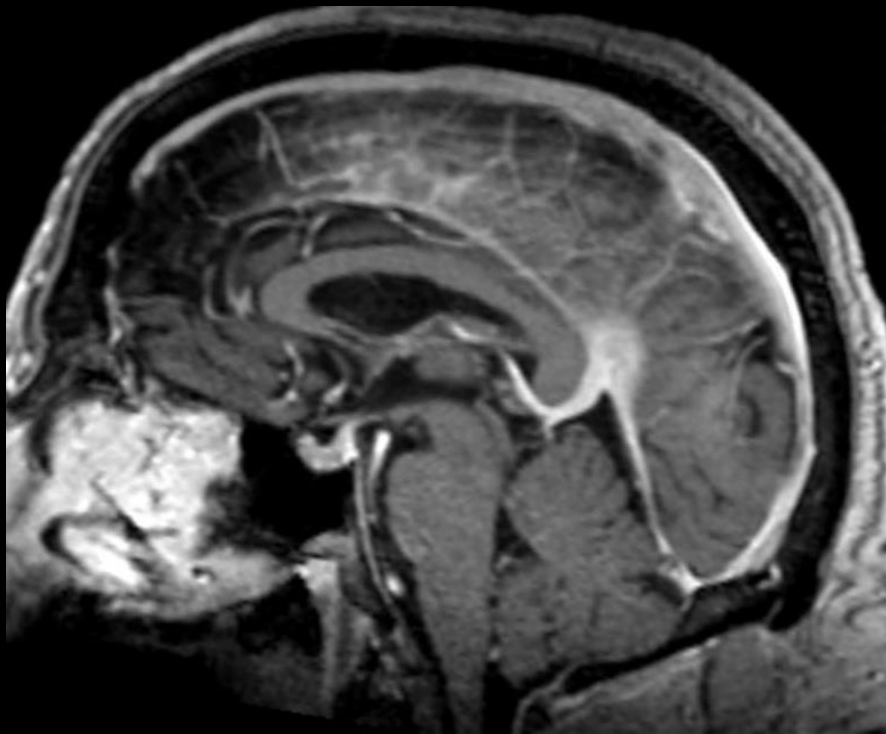
Assistant:

Findings: friable dura with multiple dural tears requiring repair

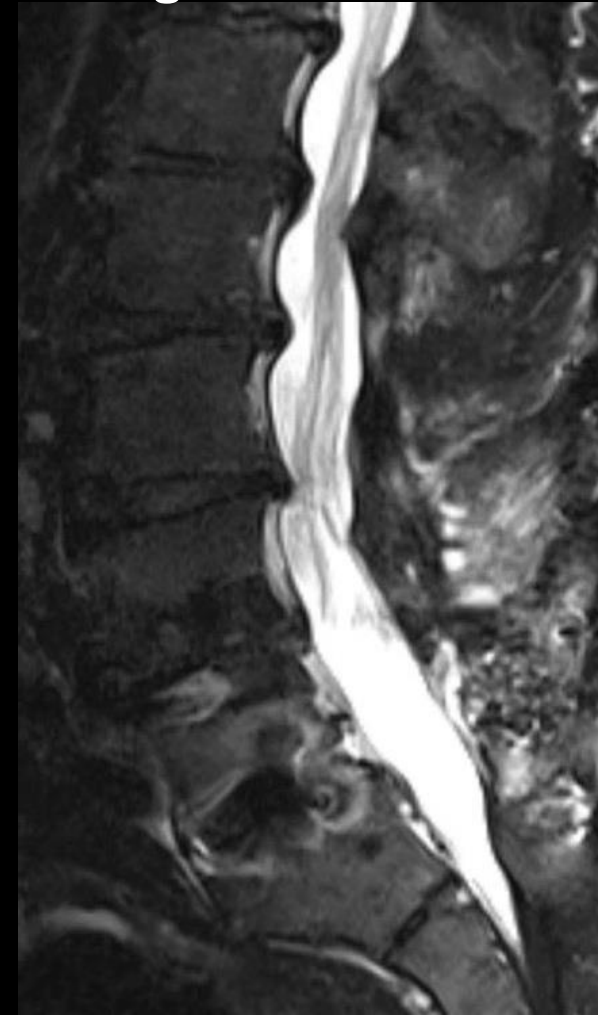
Expected postoperative fluid signal?

Spine surgery 5 years ago, with new orthostatic HA since

MRI Brain



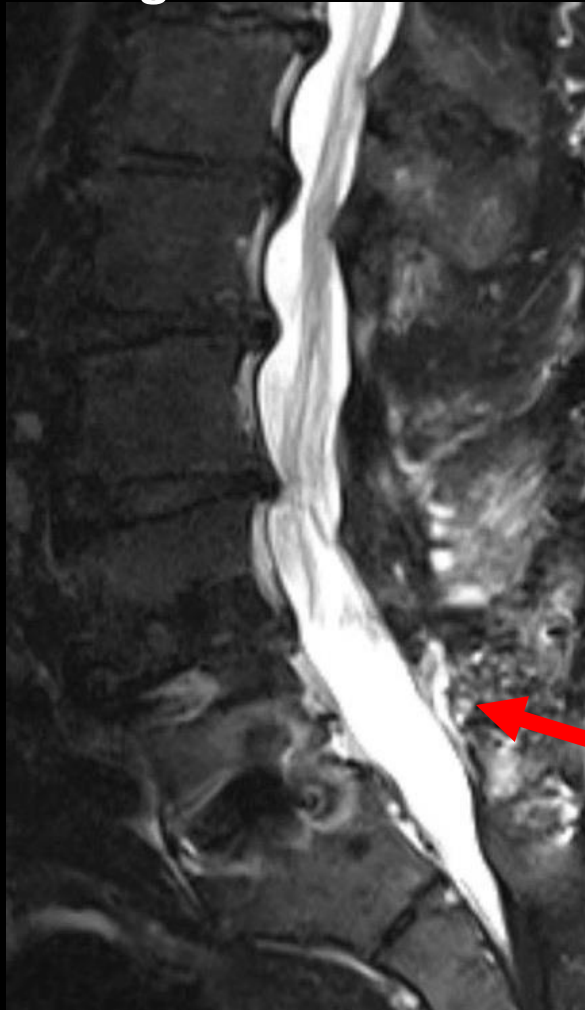
Sagittal T2 FS MRI



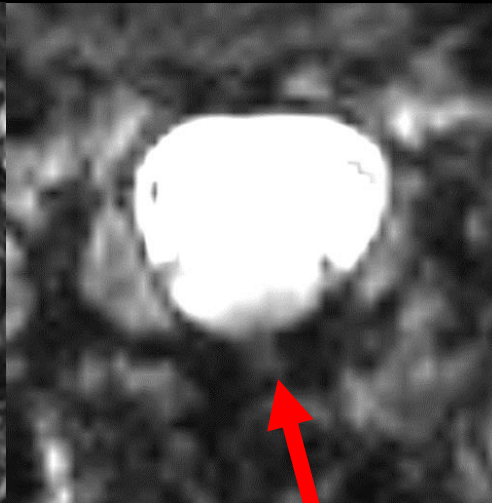
Expected postoperative fluid signal?

Spine surgery 5 years ago, with new orthostatic HA since

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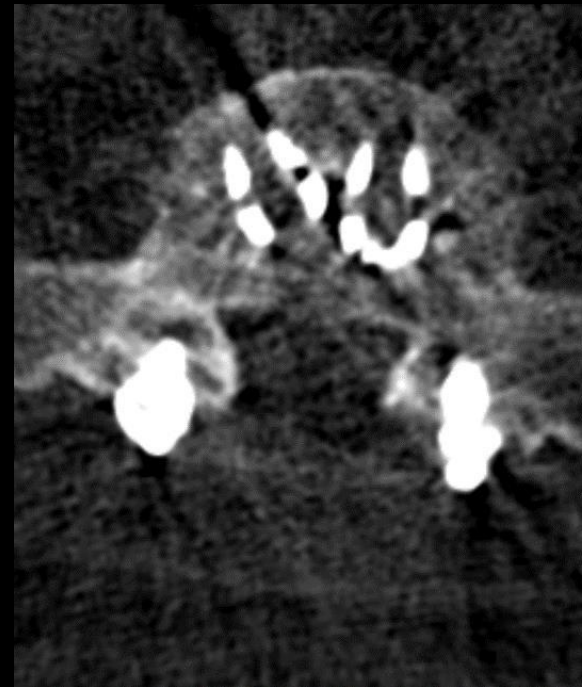
Axial 3DT2FS MRI



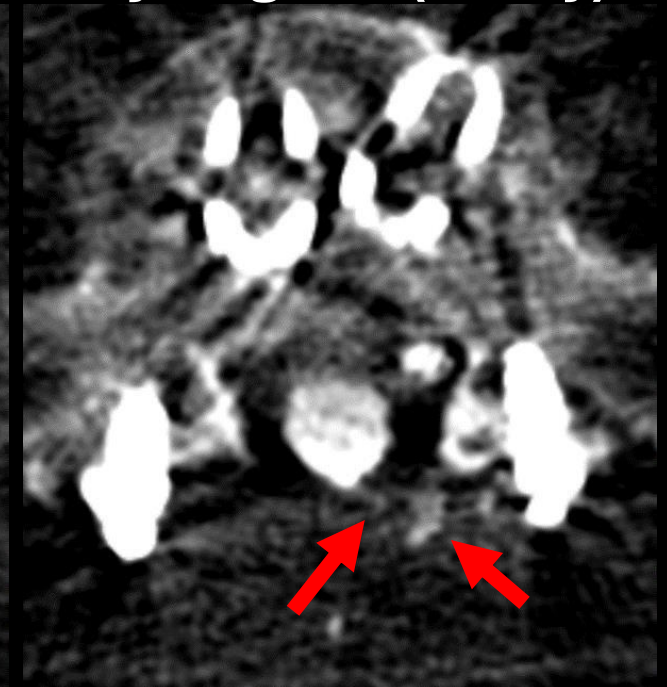
???

“Normal postoperative fluid signal?”

Noncontrast CT



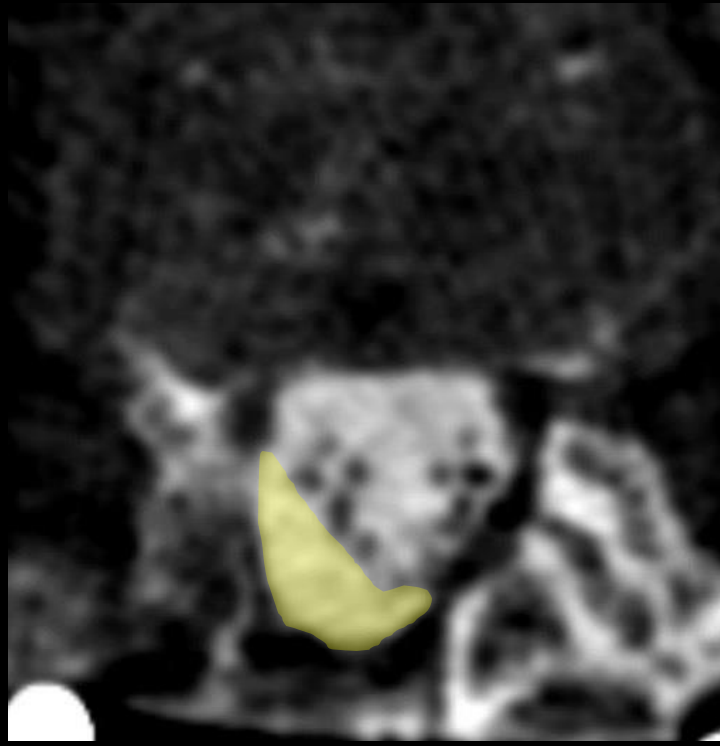
Myelogram (Delay)



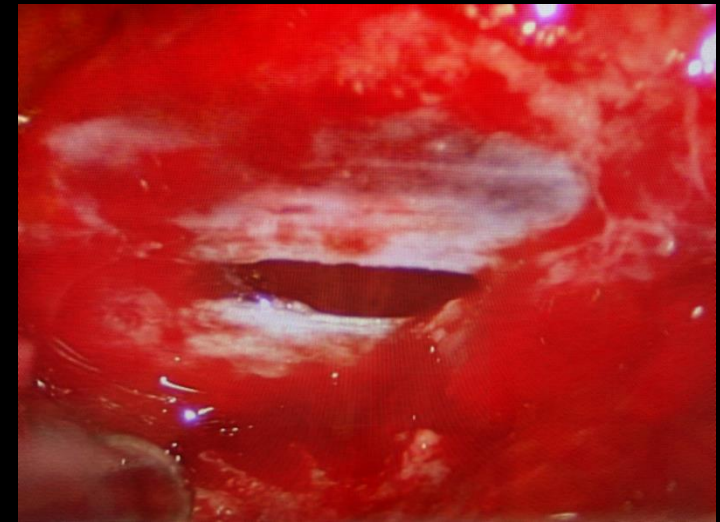
Expected distortion of dura after laminectomy?



MRI



CT Myelogram

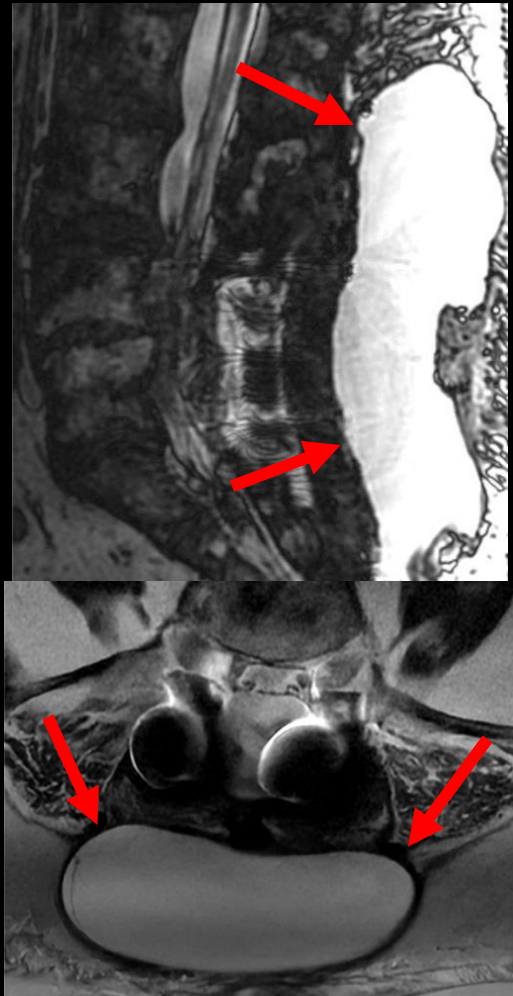


**Intraoperative:
Dural Tear**

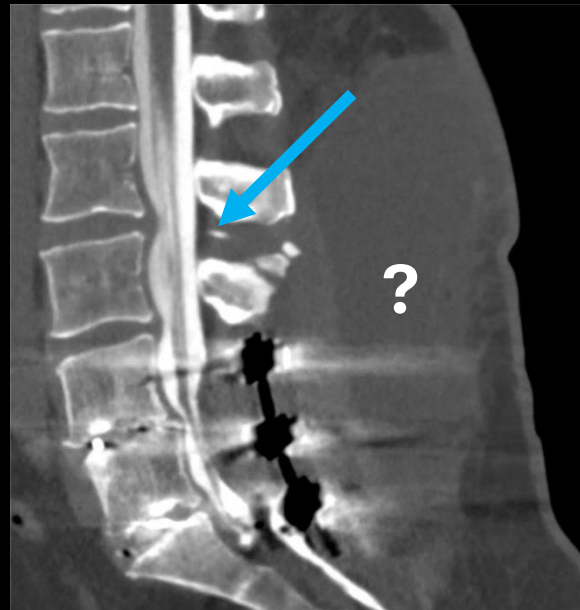
What if fluid doesn't opacify on myelogram?

Spine surgery complicated by leak with intraoperative repair, with persistent headache

MRI

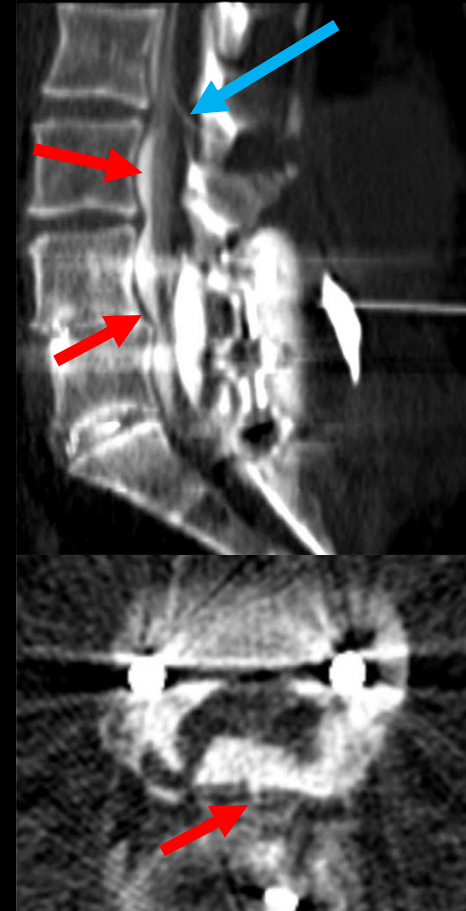


CTM via cervical
puncture

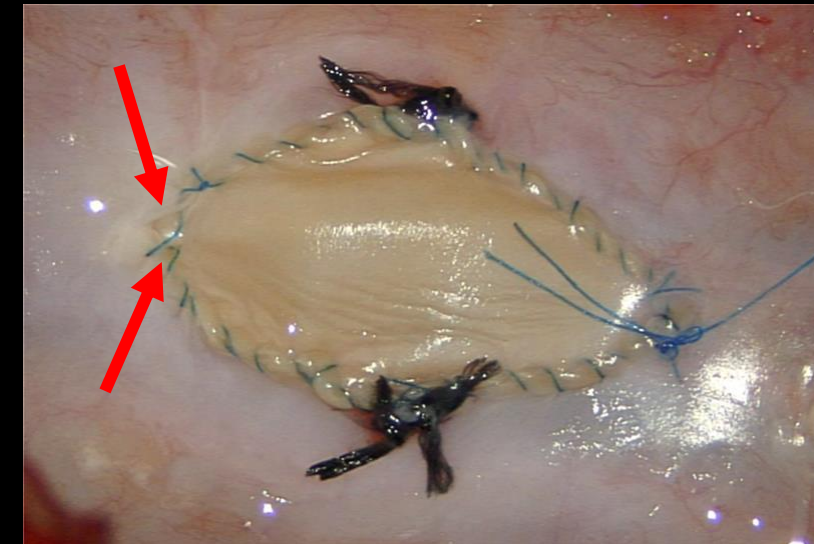


*“Collection doesn't fill,
most consistent with
seroma, not leak”*

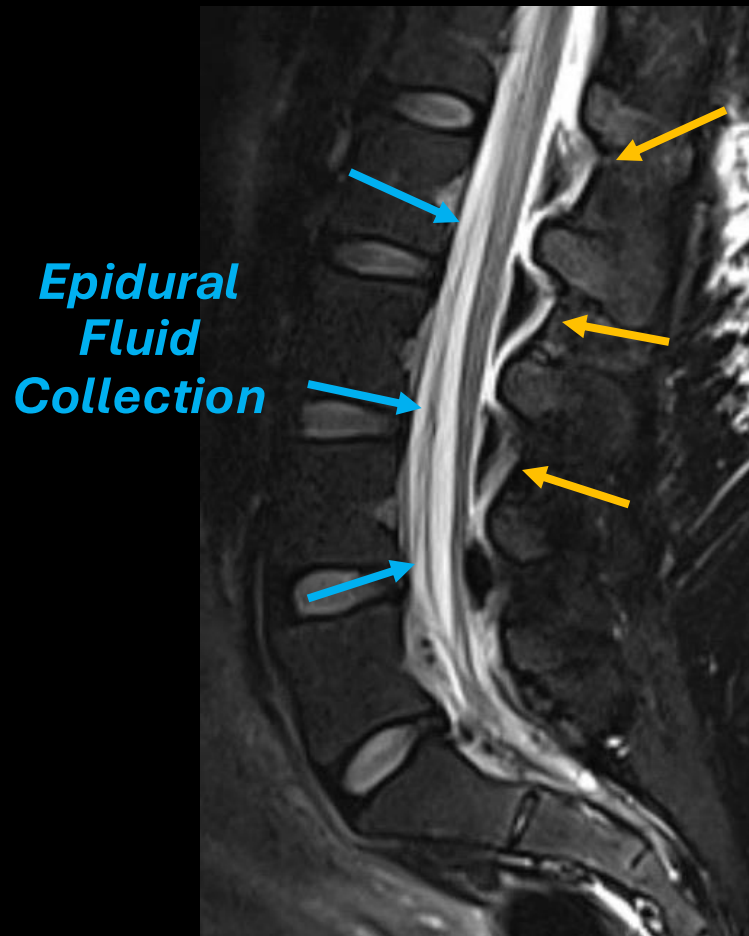
Injection of
pseudomeningocele



Intraoperative



PDPH: If imaged acutely, can be overtly +++



“Dinosaur Tail Sign”

Patching

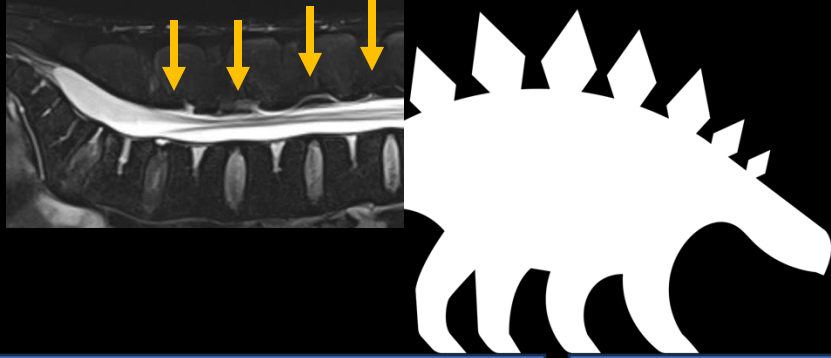


Complete symptom resolution



“Dinosaur Tail Sign”

Sakurai et al. Headache 2017



7 w/Confirmed SIH

23 w/post puncture
leak on imaging

6/7 SIH

19/23 Post Puncture Leak

6/23 had PDPH

None (0/4) without sign had headache

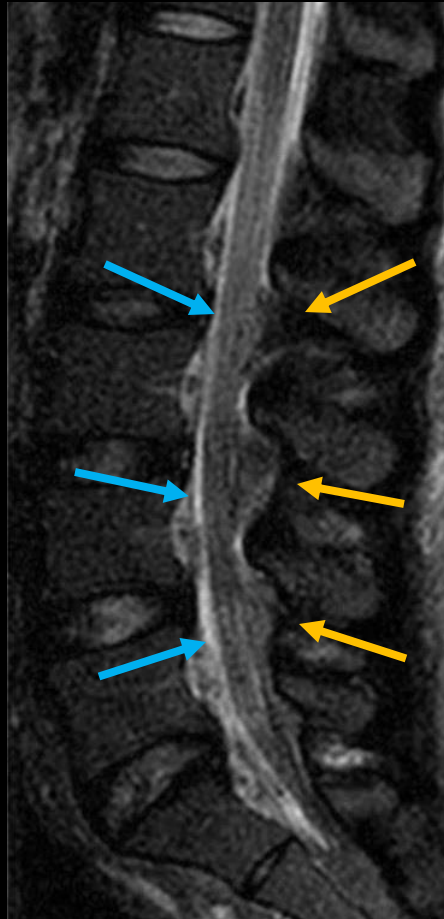


Spontaneous leaks too!

35 Controls
(no SIH or PDPH)

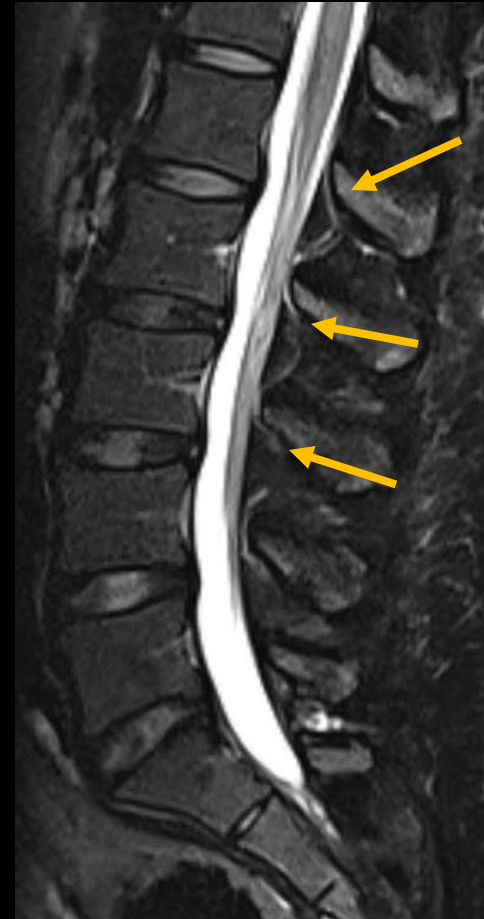
2/35 Controls
(single interspace)
(NONE with >1 interspace)

If imaged chronically,
look for more subtle clues.



1 day postpartum

Patching
→
Headache 70%
improved



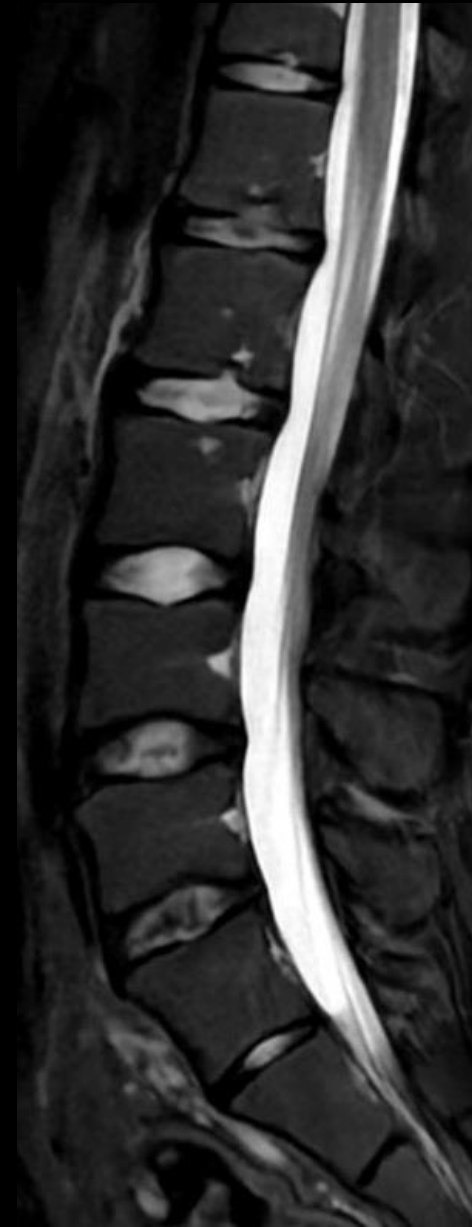
5 months postpartum



Sometimes the Only Finding

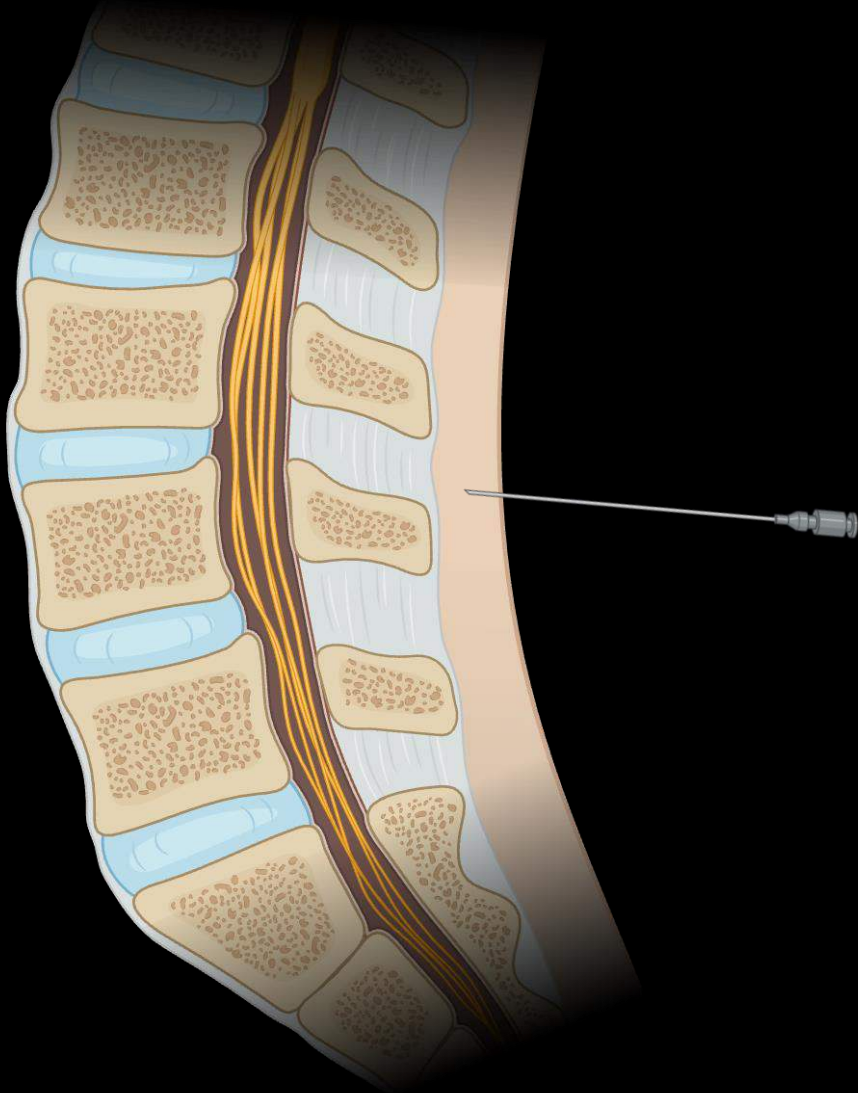


Patching

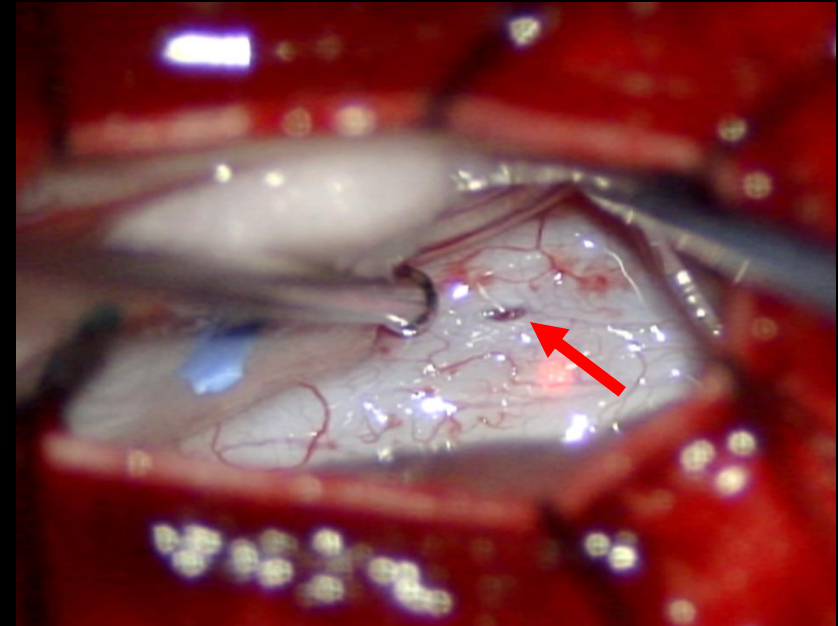


If no resolution with dorsal patching, think ventral!

HA after LP, no improvement with patching



Dynamic CTM



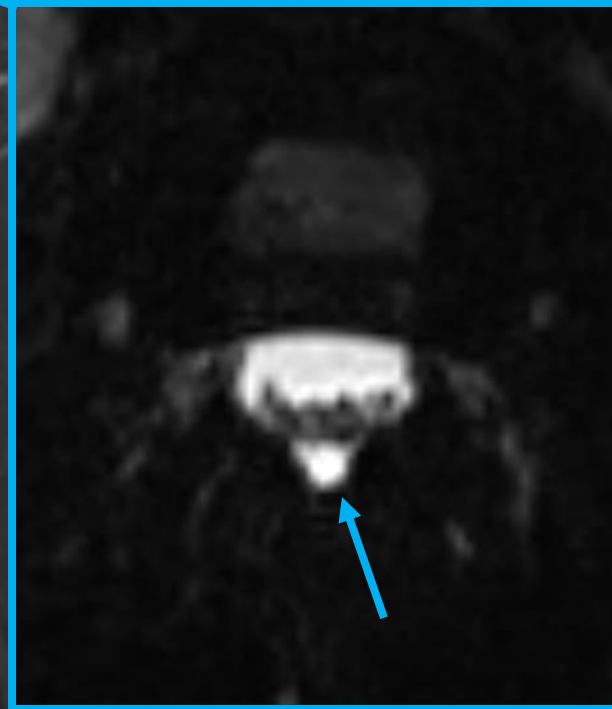
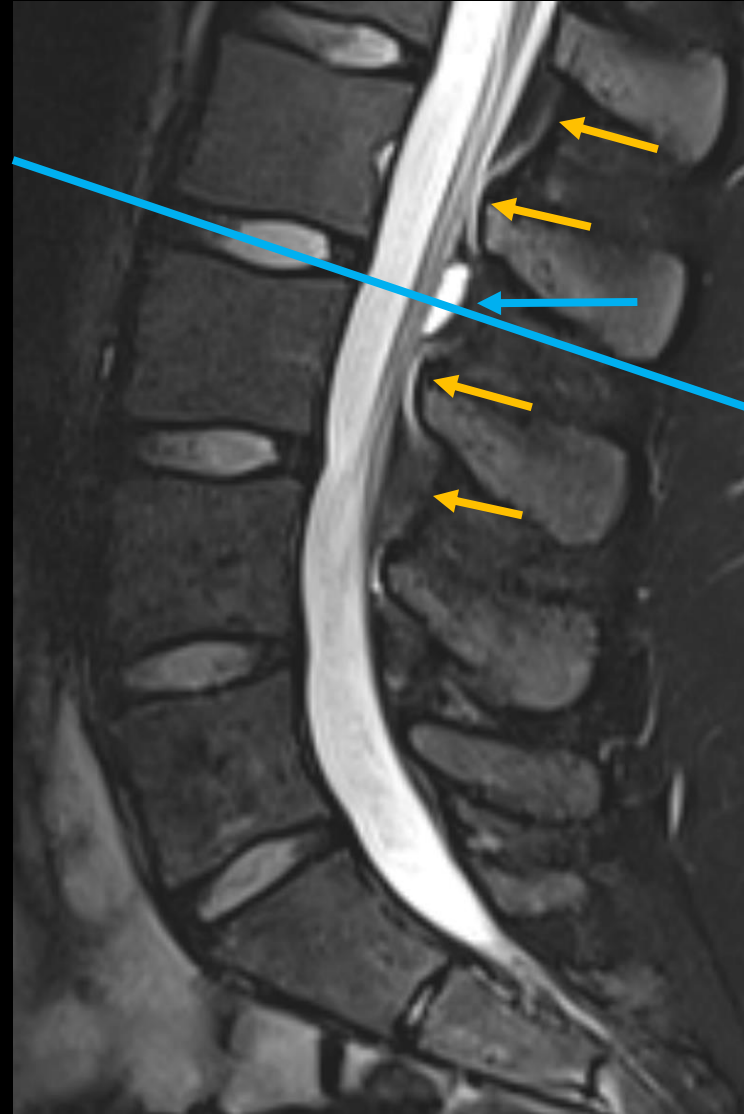
Intraoperative:
Ventral Dura

Dino Tail + Focal Fluid signal?

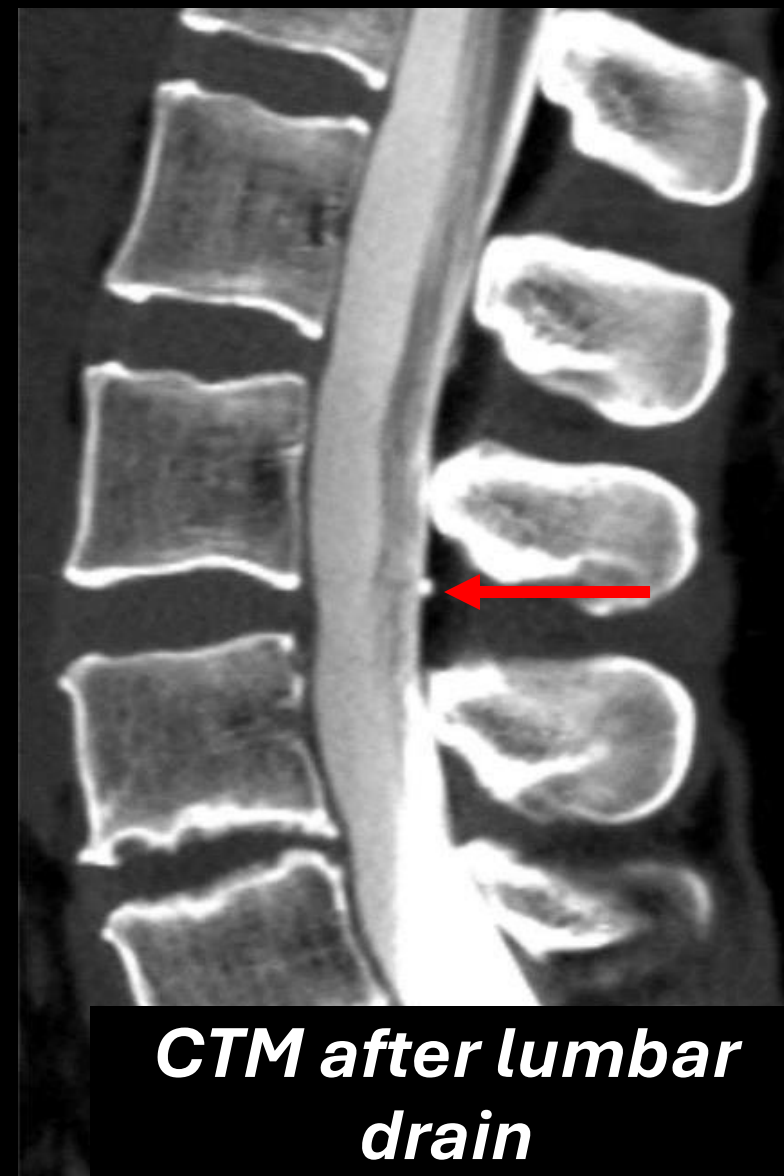
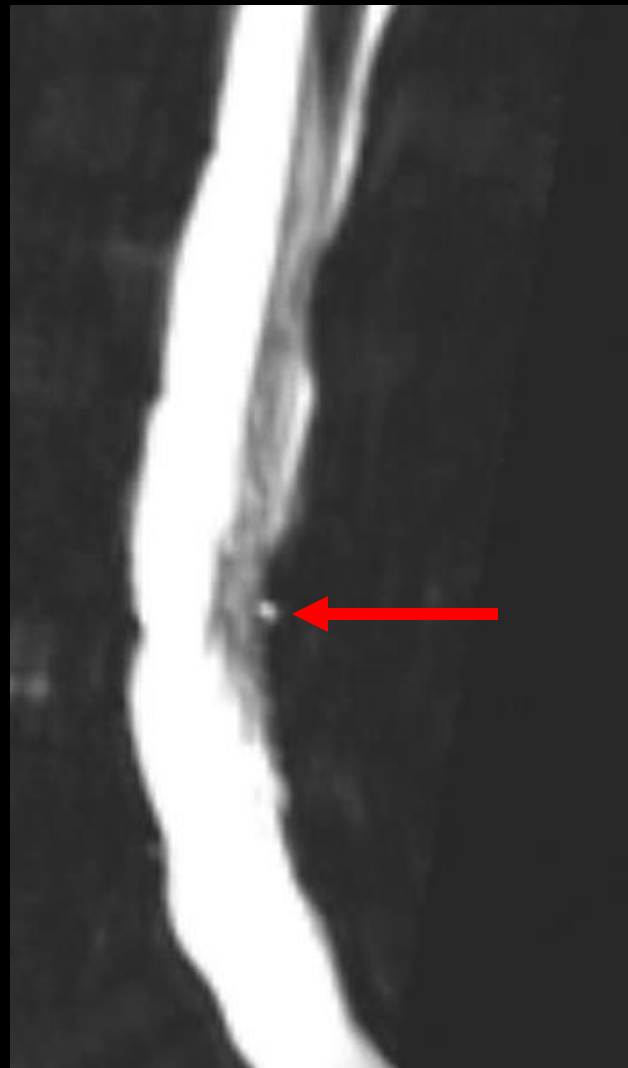
HA after lumbar drain

*Focal contour
irregularity of dura with
fluid signal*

*Dural disruption with
herniation of arachnoid
(inner layer)*



Bleb after Lumbar Drain

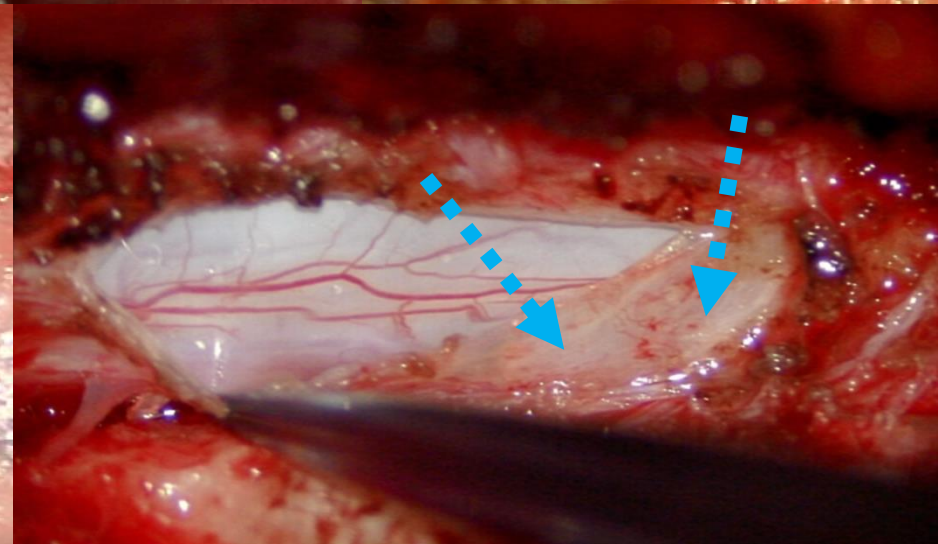
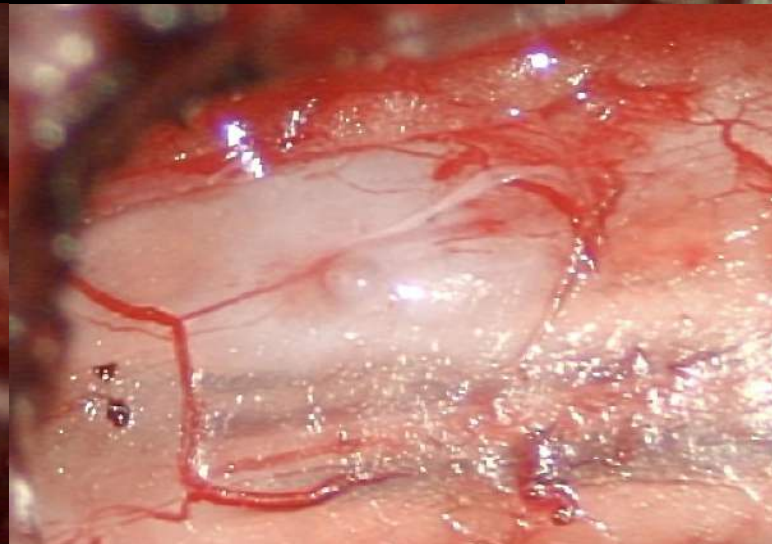
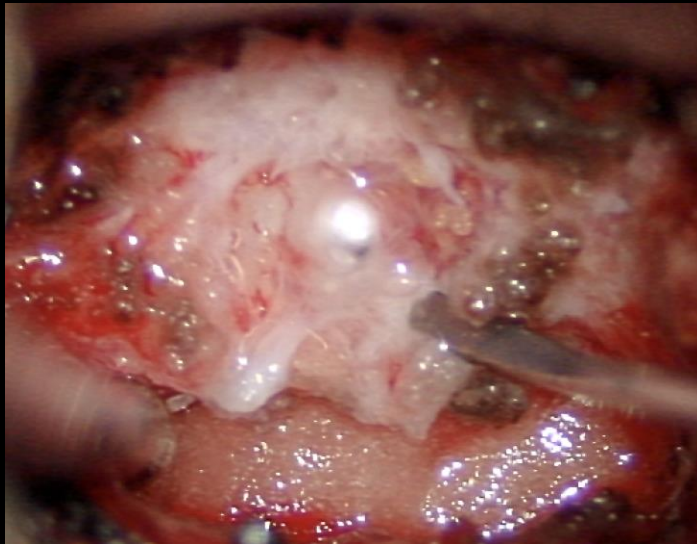
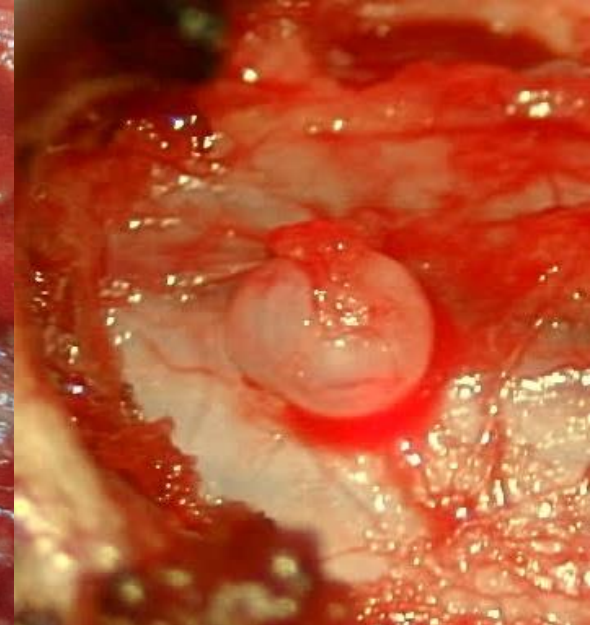
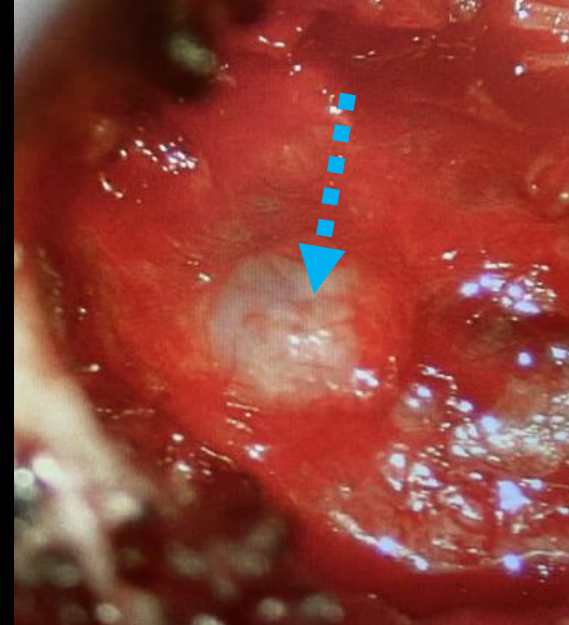


Bleb/Pseudomeningocele

*Often covered by
vascularized membranes*

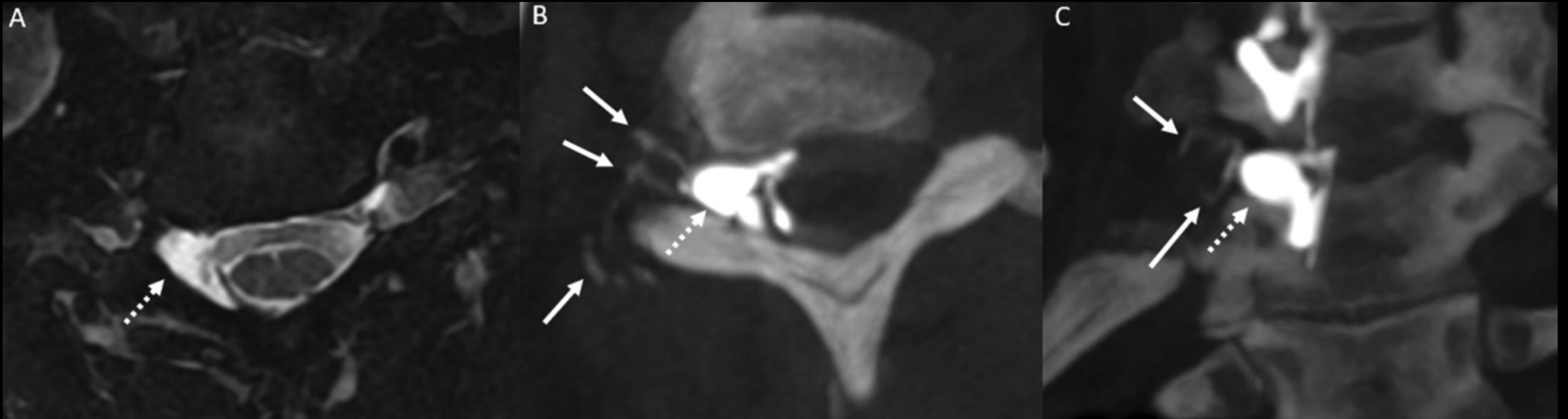
*Slow leak? Ball/valve
mechanism?*

Component of CVF?



CSF-venous fistulas associated with traumatic spinal pseudomeningoceles

Ajay A Madhavan¹ , Jeremy K Cutsforth-Gregory², Neeraj Kumar²,
Ivan Garza², Mark A Whealy², Narayan R Kissoon² and Waleed Brinjikji¹



Spontaneous intracranial hypotension mimicking iatrogenic spinal cerebrospinal fluid leaks

Angelique Sao-Mai S. Tay MD¹  | Marcel M. Maya MD² | Wouter I. Schievink MD¹

**9 patients referred for suspected iatrogenic leak :
symptom onset following spine procedure**

4 ESI, 3 spine surgeries, 1 epidural anesthesia, 1 LP

ALL with leak >5 levels from site of instrumentation

3 with ventral tears, 2 with lateral tears, 4 with CVF

Spontaneous intracranial hypotension mimicking iatrogenic spinal cerebrospinal fluid leaks

Angelique Sao-Mai S. Tay MD¹  | Marcel M. Maya MD² | Wouter I. Schievink MD¹

WHY??

Patient positioning during surgery and effects of general endotracheal anesthesia on ICP?

Anchoring bias? Symptoms after spine surgery must be a related leak?

Take Home Points

1. Don't underrecognize the rate of puncture

Even if no leak seen during procedure, if new symptoms, consider leak

2. Brain MRI not "positive"

Likely negative, especially if chronic.

3. Look at the spine

Bleb, ANY fluid, dinosaur tail sign

4. Consider possible SIH!

Particularly if directed treatments = 0 relief

Thank you!



Peter Lennarson MD



Dave Bhaumik, MD



Samantha Petrucci, MD PhD



Nadya Andonov, NP



University of Colorado
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