

# Treatment of SIH: *What's new & what's next*

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**Duke**Medicine

## Disclosures

1. No conflict of interest
2. Use of fibrin glue for epidural injection is off label

# What's new & what's next?

## What's new?

### CSF-venous fistula

**Clinical/Scientific Notes**

**CSF-VENOUS FISTULA IN SPONTANEOUS INTRACRANIAL HYPOTENSION**

Spontaneous intracranial hypotension (SIH) is an important cause of new daily persistent headaches.<sup>1</sup> In most patients, the underlying cause is a CSF leak, always at the level of the spine.<sup>2</sup> Once escaped into the epidural space, CSF is rapidly absorbed by the spinal epidural venous plexus, which is often maximally dilated in the setting of SIH. With conventional imaging, the presence of contrast in epidural veins has not been demonstrated in SIH, but indirect evidence for rapid venous absorption such as contrast in the renal collection system on CT myelography or early activity of tracer in the bladder on nuclear scintigraphy is common.<sup>3</sup> We report the radiographic demonstration of direct CSF-venous fistulae in patients with SIH using digital subtraction myelography (DSM). DSM allows real-time high-resolution imaging of contrast injected through a lumbar puncture.<sup>4-6</sup>

**Case reports.** *Case 1.* A 53-year-old woman noted a second half of the day headache, neck stiffness, and interscapular pain. Neurologic examination was normal. MRI showed pachymeningeal enhancement and brain sagging. CT and magnetic resonance (MR) myelography showed multiple chronic cysts but no CSF leak. CSF examination was normal. Bed rest provided little relief. DSM showed a direct fistula originating from the left T-10 cyst into a spinal epidural vein (figure). Percutaneous fibrin glue injection resulted in resolution of symptoms.

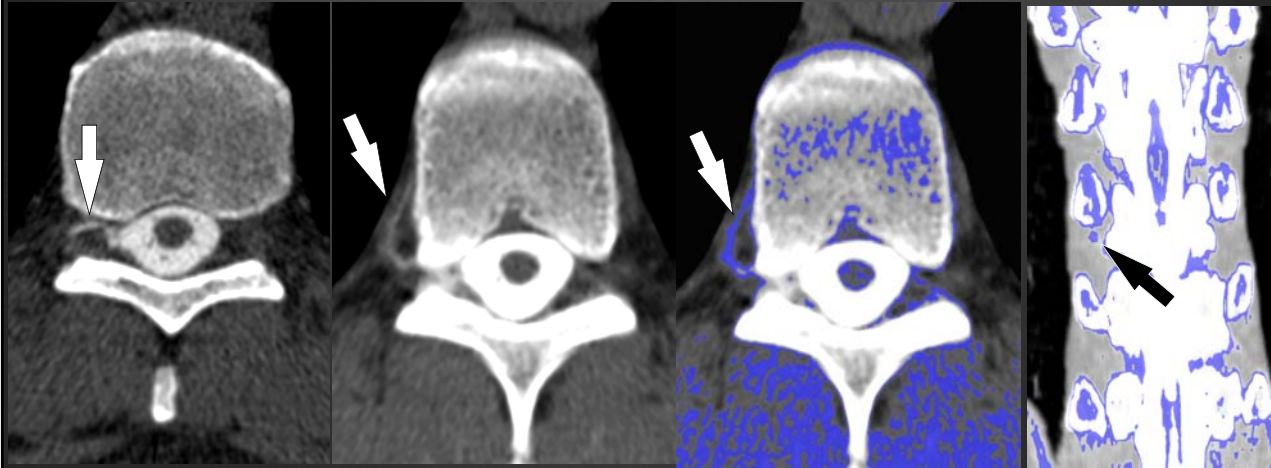
*Case 2.* A 48-year-old woman noted an orthostatic headache, nausea, emesis, and neck stiffness. Neurologic examination was normal. MRI showed pachymeningeal enhancement and brain sagging. CT and MR myelography showed an extensive spinal ventral extradural CSF collection. CSF examination was normal. She underwent numerous epidural blood patches for symptoms persisted. DSM showed a ventral CSF leak at T-5/6 associated with a direct communication into a spinal epidural vein (figure). At surgery, epidural venous dilation was significant and a dorsal tear at the cauda of the left T-4 nerve root was identified and this was sutured, resulting in resolution of symptoms.

**Discussion.** In this report, we demonstrate direct fistulae between the subarachnoid space and spinal epidural veins, a previously unreported finding in SIH. In 2 of the 3 patients, the fistula provided crucial information for localizing the site of the CSF leak. In fact, MRI and CT myelography had not shown any evidence for a CSF leak in these 2 patients. Whether or not DSM should be considered for all patients with refractory SIH has overarching conventional spinal imaging remains to be determined. DSM quality is improved for rapid CSF leaks visible on MRI or CT myelography as extensive longitudinal intraspinal extended fluid collections.<sup>7,8</sup> DSM allows visualization of rapid CSF leaks due to its inherent temporal resolution advantage. The procedure differs from conventional myelography in

**Figure** Direct CSF-venous fistula in spontaneous intracranial hypotension

# What's new?

## CSF-venous fistula



# What's new?

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BRIEF/TECHNICAL REPORT  
SPINE

## The "Hyperdense Paraspinal Vein" Sign: A Marker of CSF-Venous Fistula

P.G. Kranz, T.J. Amrhein, W.J. Schievink, T.O. Karikari, and L. Gray

### ABSTRACT

**SUMMARY:** CSF-venous fistula is a recently reported cause of spontaneous intracranial hypotension that may occur in the absence of myelographic evidence of CSF leak. Information about this entity is currently very limited, but it is of potential importance given the large percentage of cases of spontaneous intracranial hypotension associated with negative myelography findings. We report 3 additional cases of CSF-venous fistula and describe the "hyperdense paraspinal vein" sign, which may aid in its detection.

**ABBREVIATION:** SIH = spontaneous intracranial hypotension

Spontaneous intracranial hypotension is thought to result from leakage of CSF from the spinal thecal sac, but in approximately half of cases, no leak is seen on myelography.<sup>1-3</sup> Patients may be treated with prolonged bed rest or nontargeted lumbar epidural blood patch, but these therapies may not be successful in a substantial proportion of patients.<sup>1-3</sup> In cases in which targeted treatment is desired (such as when nontargeted lumbar epidural blood patch fails), these cases of SIH with no myelographic evidence of CSF leak can be very challenging, and the inability to determine the site of the leak may preclude effective treatment. It has been previously presumed that these cases may be the result of intermittent or very slow-flow CSF leaks.

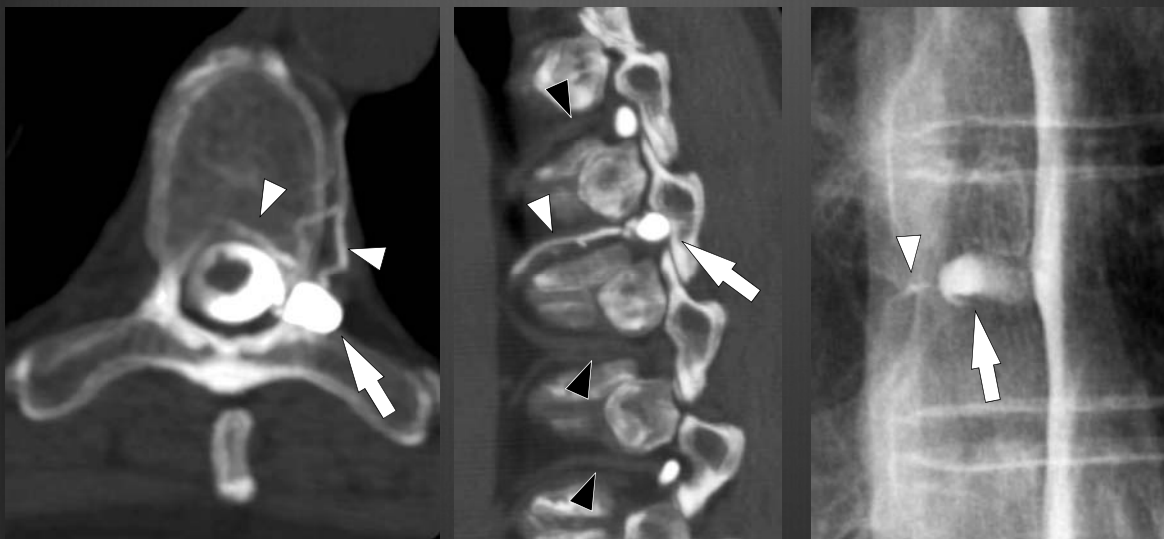
performed at all institutions, is more commonly used in the setting of high-flow CSF leaks, and typically covers only a portion of the total length of the spine.<sup>5,6</sup> Thus, it would be helpful to identify, from clues on cross-sectional imaging, which patients might benefit from a digital subtraction myelogram and where that imaging should be focused to detect these uncommonly recognized, often subtle lesions.

In this Brief Report, we present 3 additional cases of CSF-venous fistulas in patients with SIH and describe a novel imaging sign, the "hyperdense paraspinal vein," which may assist in CSF-venous fistula localization.

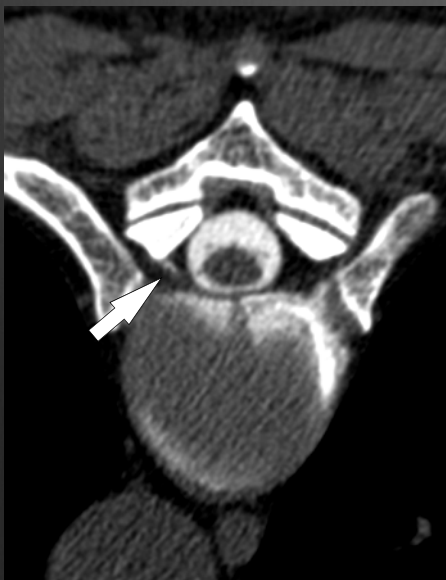
## CVF



## CVF



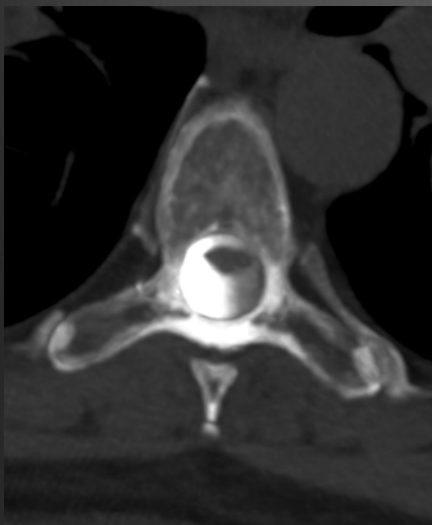


**CVF****CVF**

## CVF



## CVF



Scanned decubitus



Rolled patient, scanned immediately

## CVF



## What's next?

Paradoxically, the biggest challenge in treatment, in my opinion, is improving diagnosis

Knowing who to treat and who will benefit is as important!

- Better dx criteria
- Quantification of positionality
- Outcomes tracking

# Treatment of SIH: *What's new & what's next*

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# CT Guided Approach to Diagnosis and Treatment of Ventral CSF Leaks

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Peter Kranz, MD  
Timothy Amrhein, MD  
Michael Malinzak, MD PhD

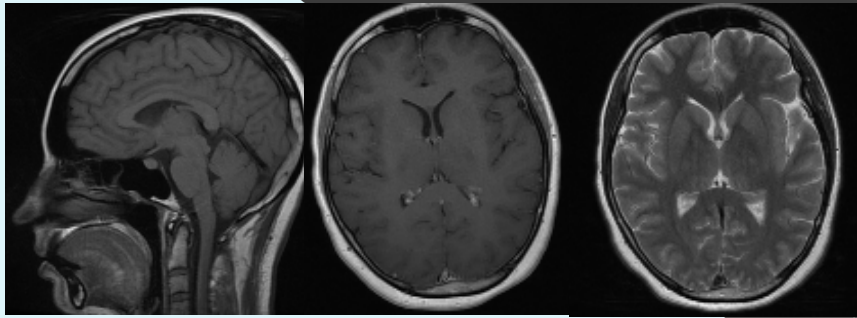
Neuroradiology  
Duke University Medical Center



No disclosures except for  
confusion and ignorance

The more I know, the more I know I don't know  
*(paraphrased) Aristotle*

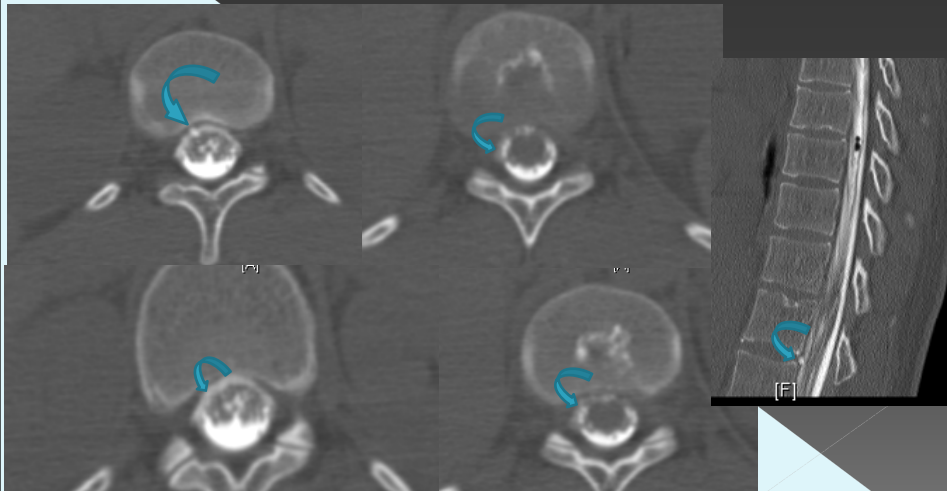
32-year-old female C/O positional headache for several months; now with no upright time, dizziness, tinnitus, nausea, foggy memory, OP 4; 1 blind BP with temporary relief; she has been to 4 different major medical centers with no DX



No MR imaging findings to suggest leak



What was missed? Subtle disc causing subtle leak



## Who Do YOU Know?

With chronic headaches, not responding to therapy  
Misdiagnosis and delayed diagnosis is common



## Objectives

- Strategies for evaluation of CSF leaks
  - Optimized CT Myelography
  - Dynamic Fluoroscopic Myelography
  - MR Myelography with intrathecal Gd
- Causes of ventral CSF leaks
- CT fluoroscopic targeting of ventral leaks

# Imaging Options for Detecting Leaks

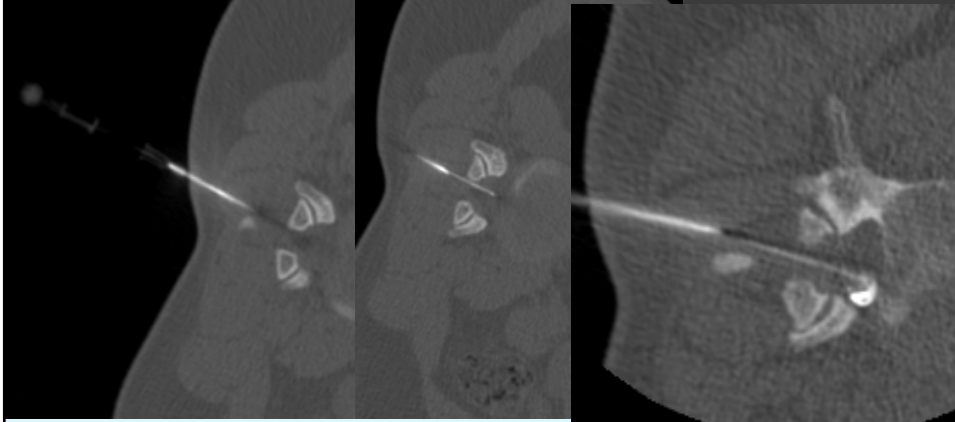
Spinal MRI: Standard or Heavily T2W

Moderate to fast leak	Fast & super fast leak	Slow leak	Super slow or intermittent leak
Optimized CT Myelography	Dynamic Fluoro Myelography DSM	MR Myelography with Intrathecal magnevist	Delayed CT Delayed MR Nuclear Medicine

## CT Fluoroscopic Guided Technique: Localize LP site, Lateral Decubitus



CT Fluoroscopic Guided LP & CSF Pressure Measurement:  
legs extended, relaxed, atraumatic 24g Gertie Marx needle;  
standard and digital manometer



Isovue 300 M

Distributing the contrast: CT “Yoga” and Log Roll  
Initial Scan Prone, may add Lateral Decubitus





Log roll on the table; Scanned: GE 750 128 detectors, 2.5 mm thick slices helically, .625mm recons, Sagittal and Coronal reformats



## Ventral Leaks

- ◉ Iatrogenic
  - LPs
  - epidural catheter placement
  - surgery
- ◉ Spontaneous or traumatic
- ◉ Discs
  - fast leaks
  - intermittent or slower leaks
  - OR no obvious leak seen

## Ventral Leaks

- **Iatrogenic**

  - LPs

  - epidural catheter placement

  - surgery

- Spontaneous or traumatic

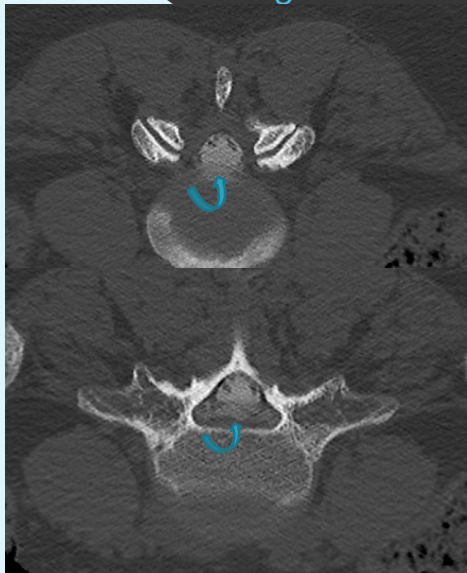
- Discs

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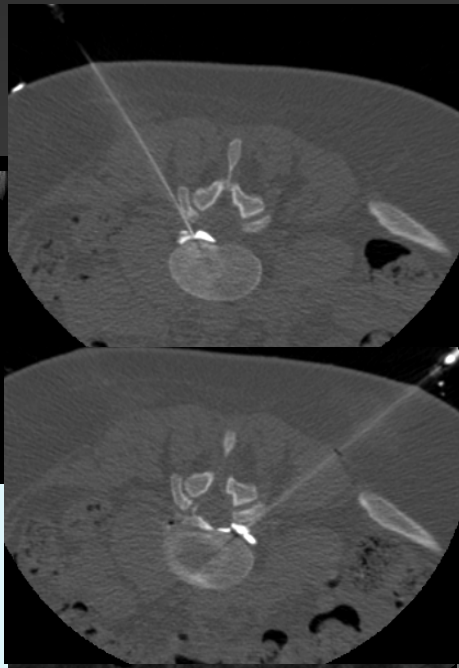
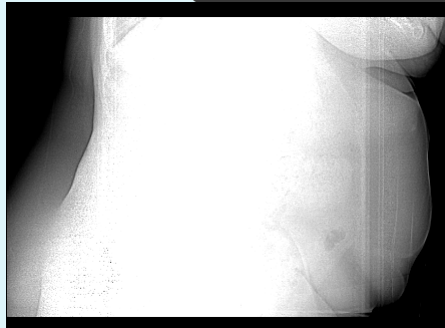
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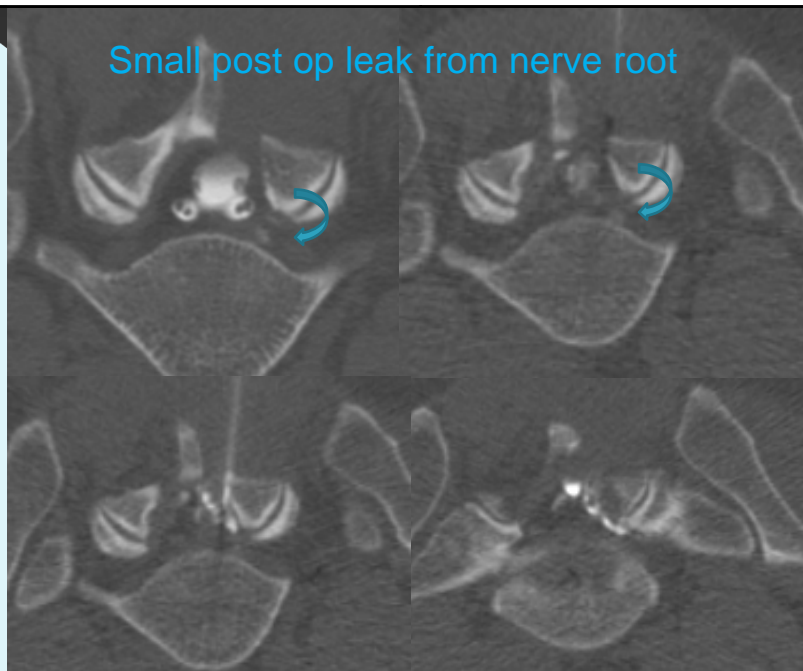
Epidural catheter  
placement causing ventral leak



## Ventral Leak from LP



## Small post op leak from nerve root

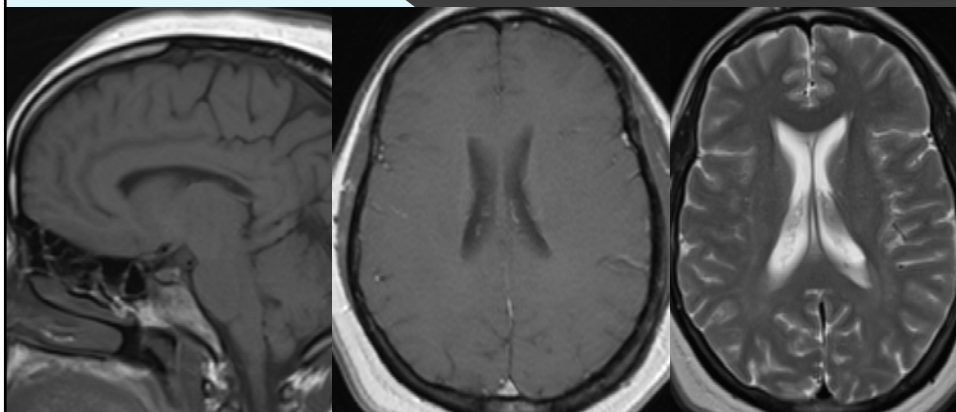


Mihlen F, Kranz PC, Gatten AB, Gray L. J Neurosurg Spine. 2014 Nov;21(5):805-10.

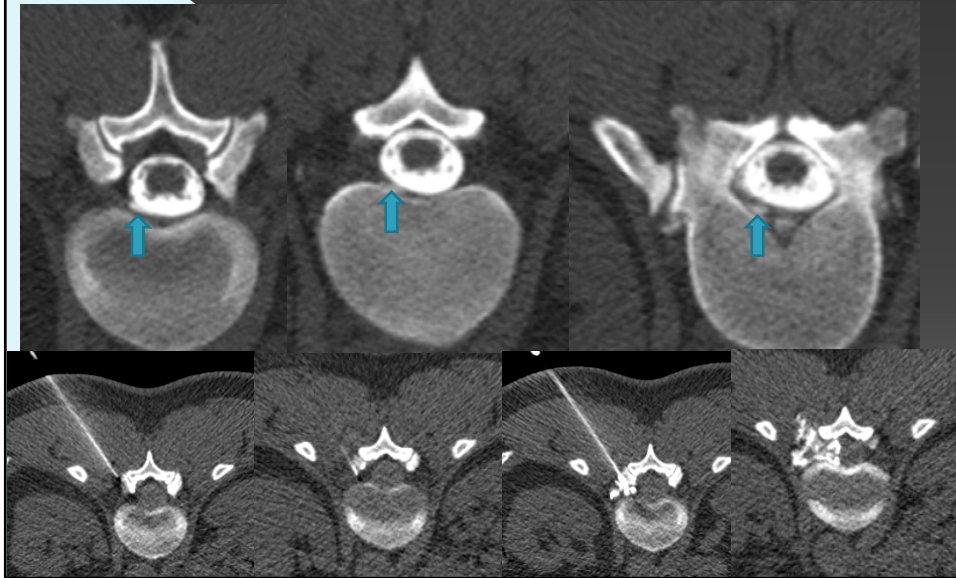
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46-year-old female C/O 2yrs debilitating HA, with cranial neuropathies that started after Zumba and Boot Camp class, she was doing "burpees", Required prolong hospitalization; Normal MRI



## Ventral epidural collection OP: 31.20

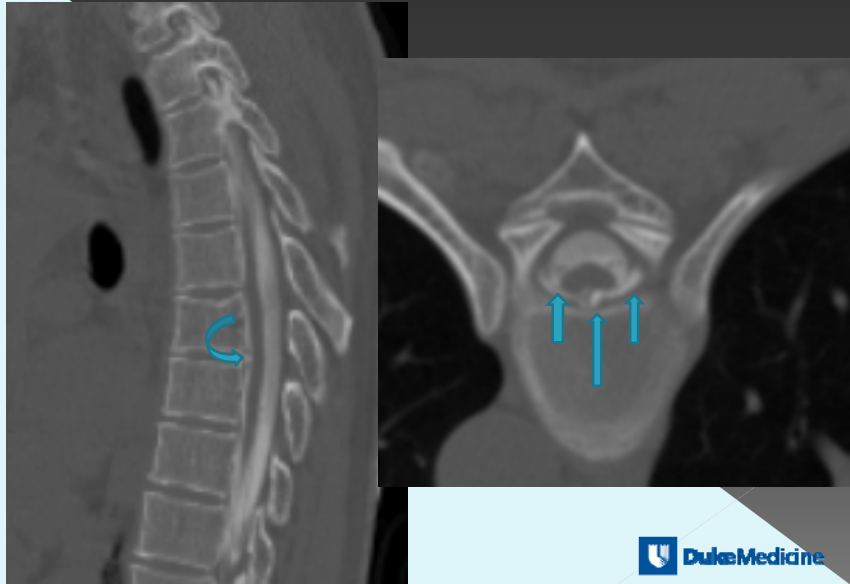


## Ventral Leaks

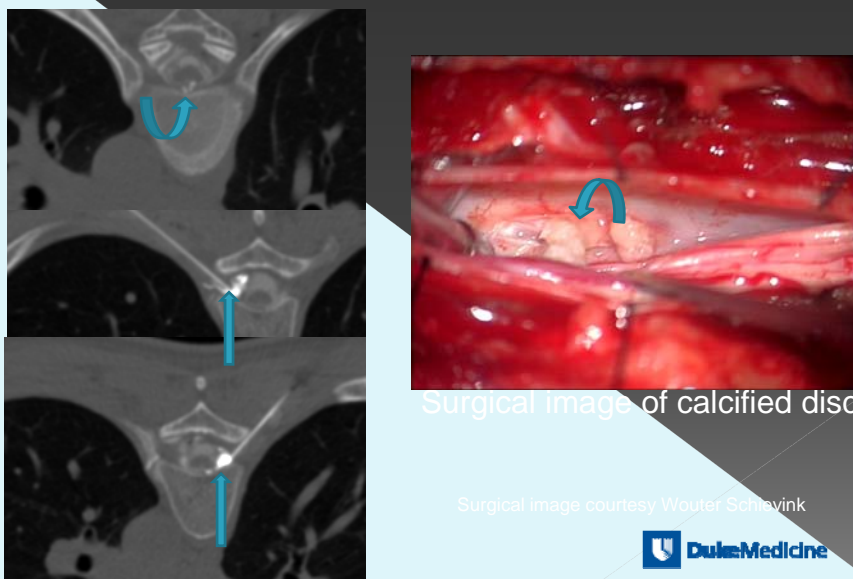
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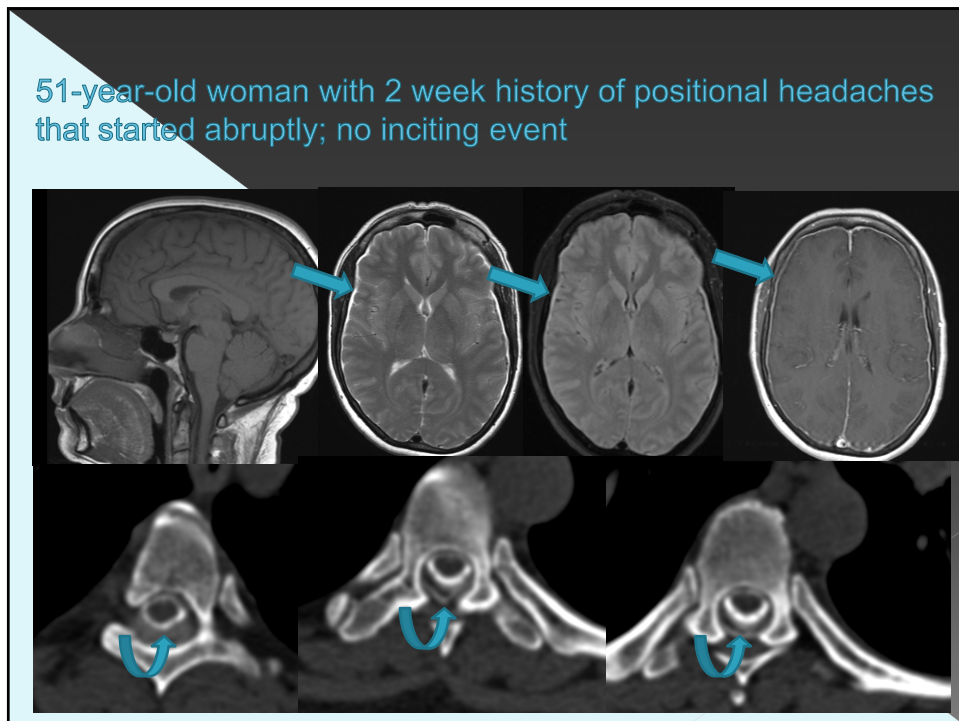
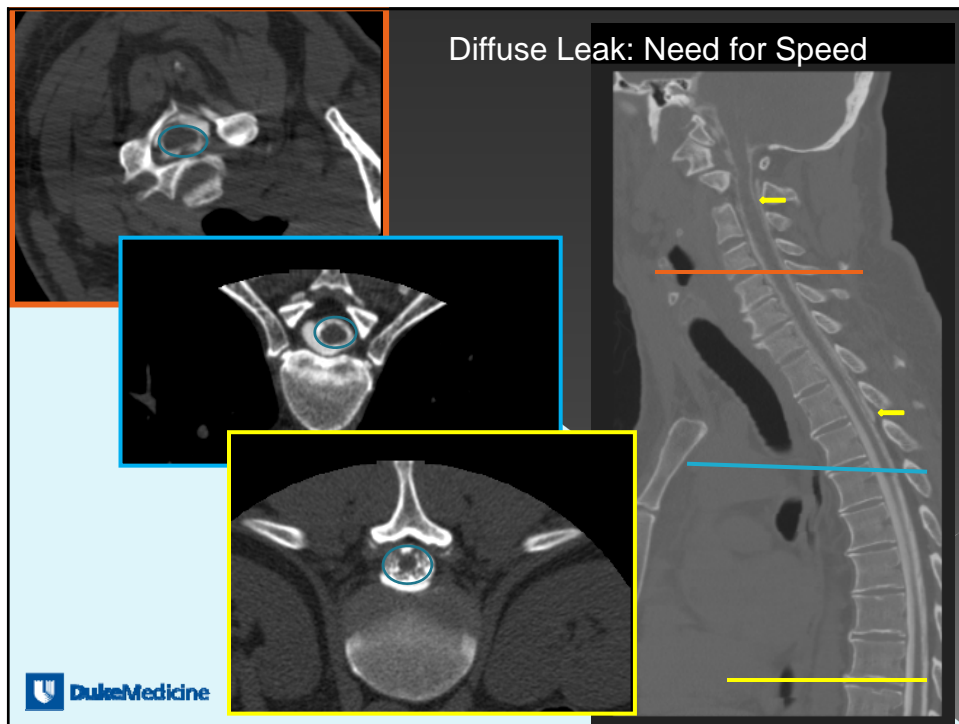
CT Myelography: Calcified Thoracic Disc  
penetrating the dura causing a leak: OP 8.25

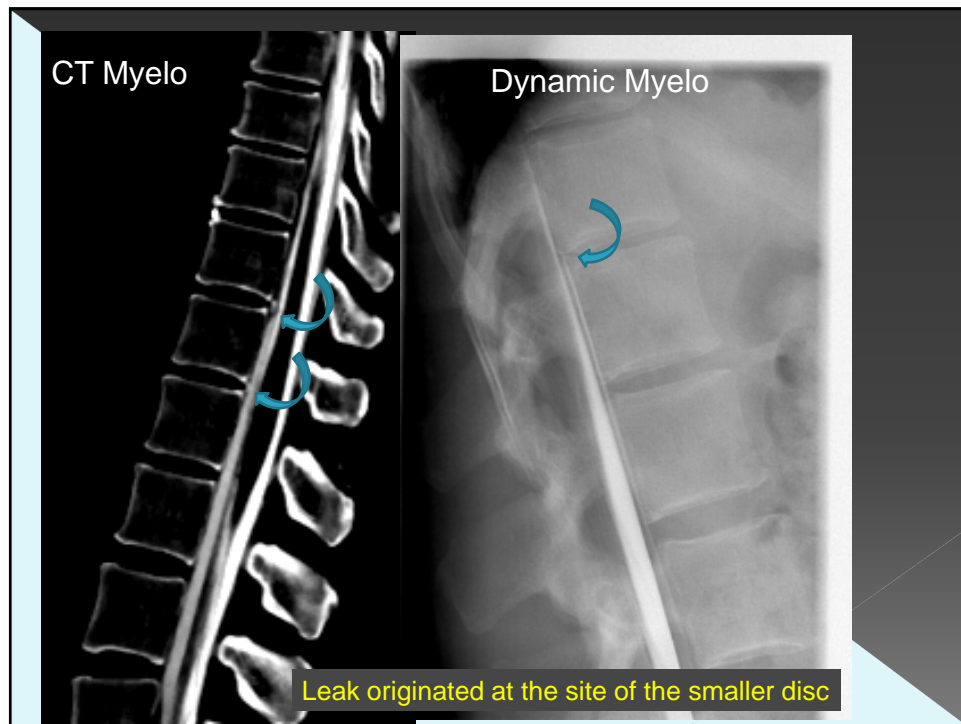


Calcified thoracic disc treated with targeted  
fibrin glue and bloodpatch x2 required surgery



Surgical image courtesy Wouter Schievink

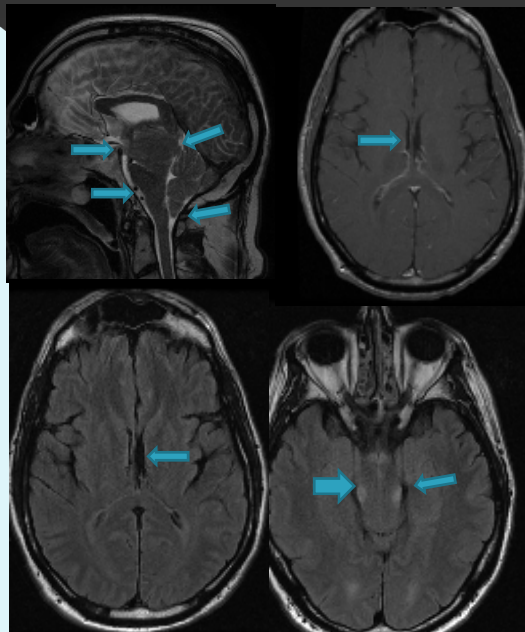




## Ventral Leaks

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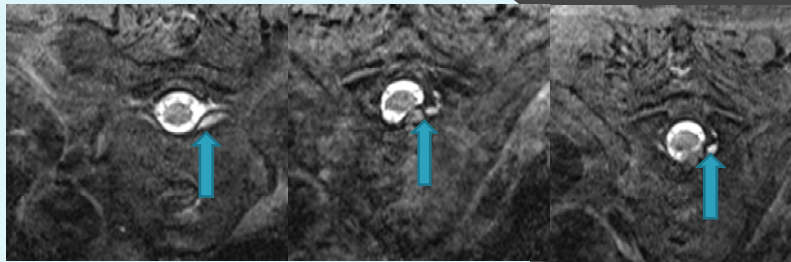
53 yo developed symptoms after coming in from golf



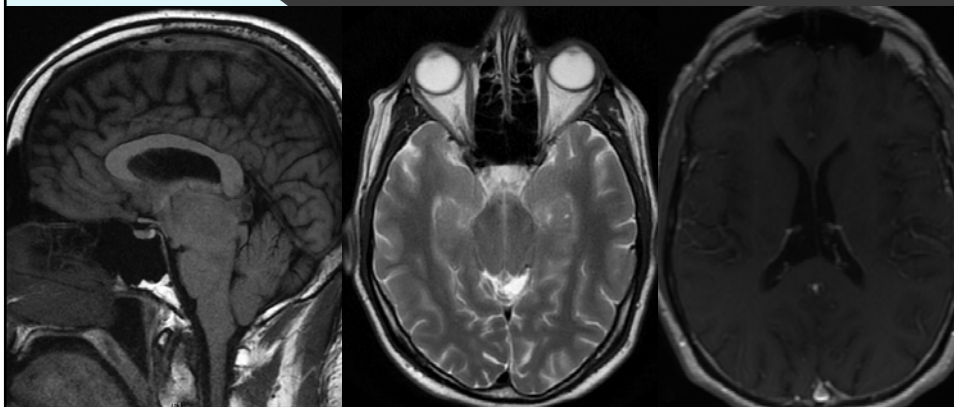
No obvious leaks on CT myelography



MR Myelography for slow leak: confirmed leak under a disc

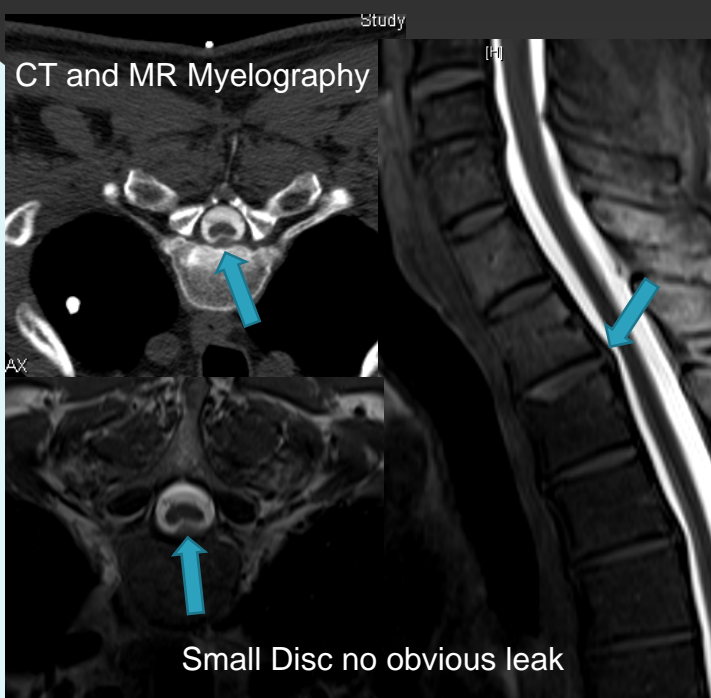
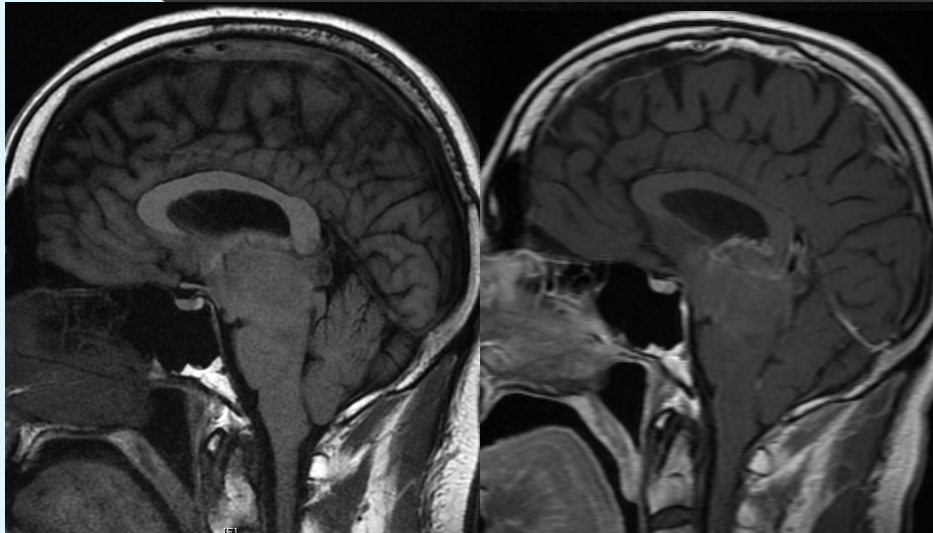


This 55-year-old male presenting with C/O headaches starting 2012, blurry and double vision, short-term memory loss, swallowing problems and disequilibrium causing falls, sleeping 18 hours per day, he would fall asleep driving, unable to add 2+2

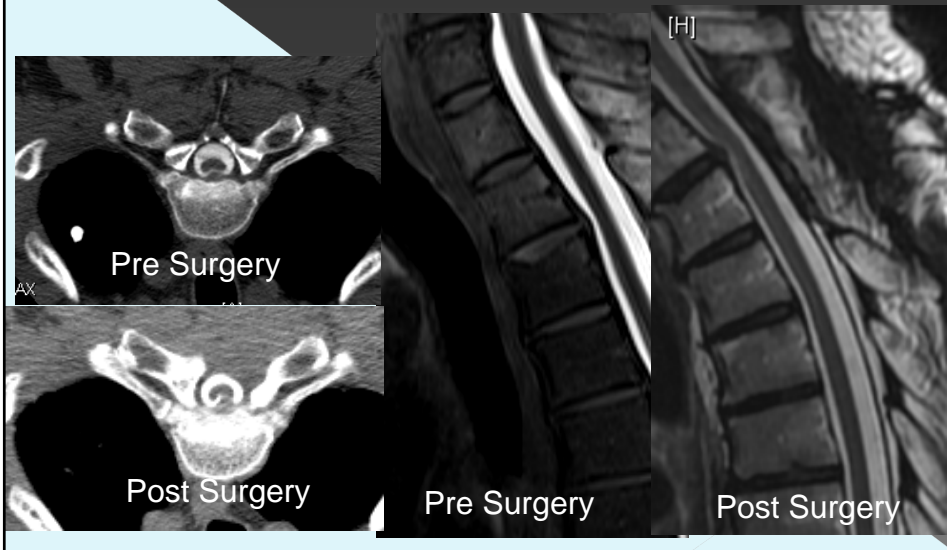




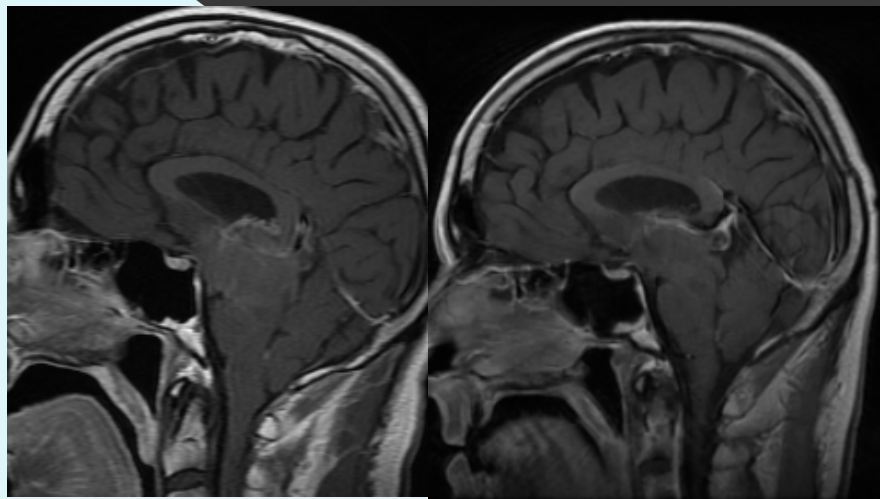
From 2012-2016 worsening herniation



s/p 1<sup>st</sup> Surgery: Disc increased in size,  
more mass effect on spinal cord



Oct 2017 MRI :s/p 2nd surgery on disc, repeat  
MRI 6 mos later; improved downward herniation



## Treatment for CSF Leaks

- Bedrest, caffeine, fluids
- Blood and/or Fibrin glue patching:
  - nontargeted
  - targeted to site of leak
- Surgery

## Headache: ? Pressure Problem

Brain MRI + Contrast  
(normal imaging & pressure do not exclude leak)

? Leak

Spinal MRI

LP & pressure / CT Myelo

+ Leak

- Leak

Further Eval

Dynamic Myelo  
DSM

Delayed Myelo CT  
Gado Myelo

Treatment

Target with Blood and/or  
Fibrin Glue x 2  
Failed patch x2 surgery

Nontargeted patch  
Targeted to most  
likely potential site

## What can we take away from this??

- ◉ Headache : could this be a pressure related problem?
- ◉ Evaluation: MRI brain with and if leak suspected, consider MRI of spine
- ◉ Suspicion for leak: consider CT myelo for 1<sup>st</sup> evaluation
- ◉ Further evaluation: may require matching speed of leak with the best imaging strategy
- ◉ No leak seen: consider most likely potential site
- ◉ Treatment: nontargeted vs targeting most likely site with blood and /or fibrin glue

40 yo: HA suddenly in a frontal location and then extended to the occipital area, now with face and jaw pain; may have been related to working out in the gym and yoga

