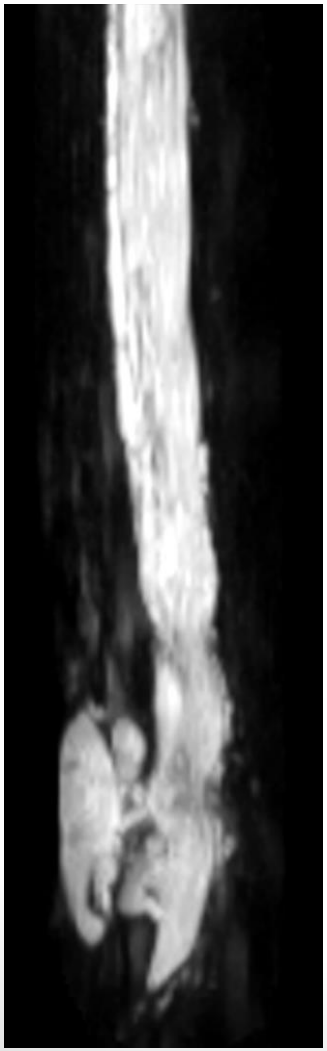
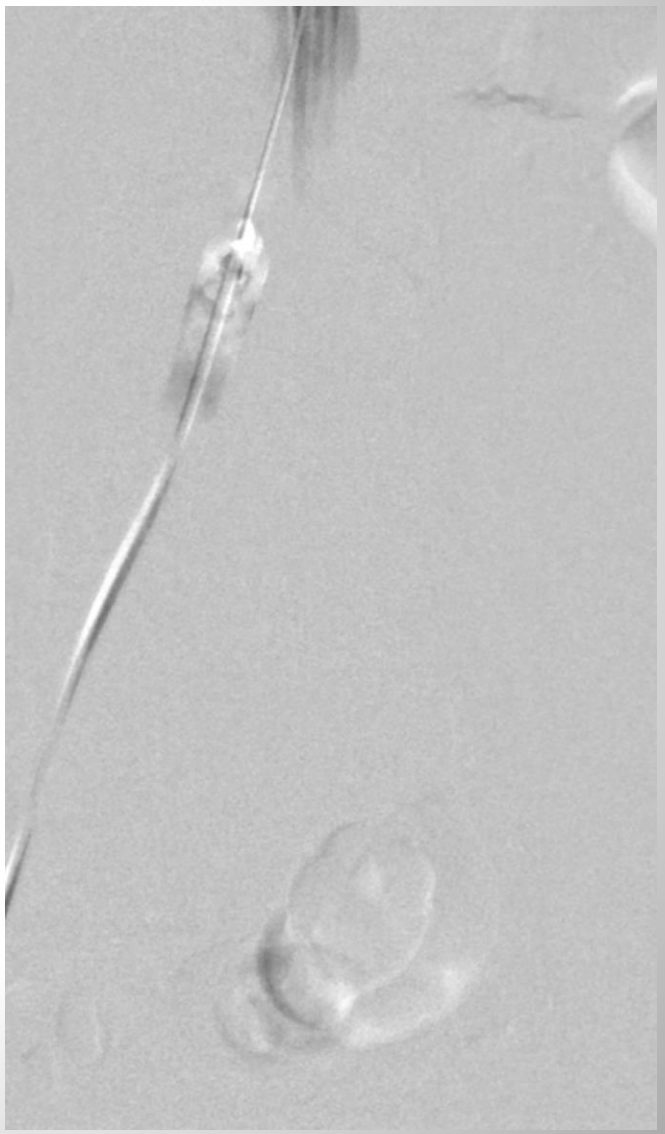
Imaging of SIH: Past, Current and Future Modalities

Marcel Maya, MD

Cedars Sinai

CSF LEAK





Imaging

- Radionuclide Cisternography
- MRI Brain
- MRI Spine
- MR Myelogram
- Intrathecal Gado MR Spine
- Conventional CT Myelogram
- Dynamic CT guided Myelogram
- Digital Subtraction Myelogram

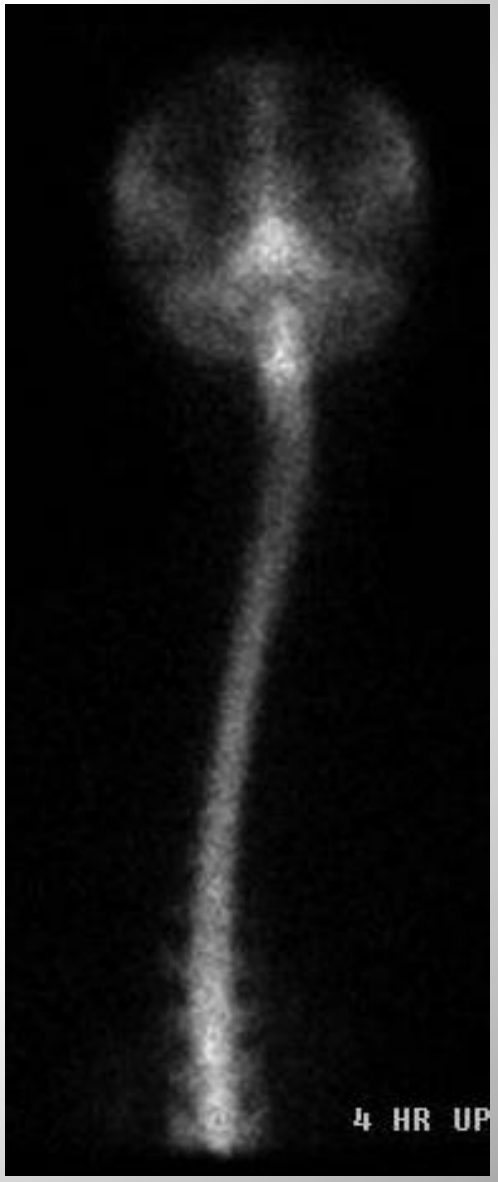
Radionuclide Cisternography

Paucity of activity over the convexities

Parathecal activity

Not good for localizing site of leak

Helpful when all else is unconvincing



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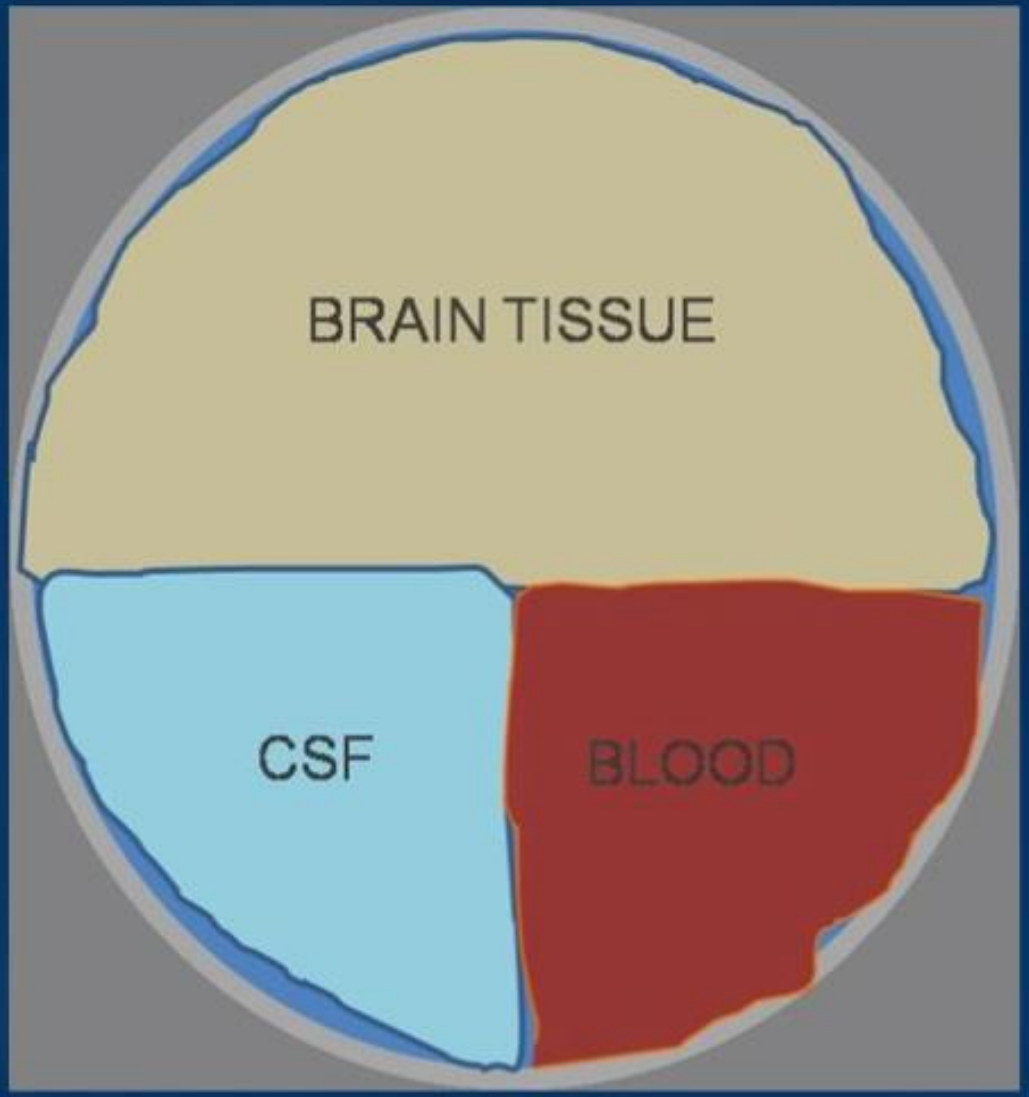
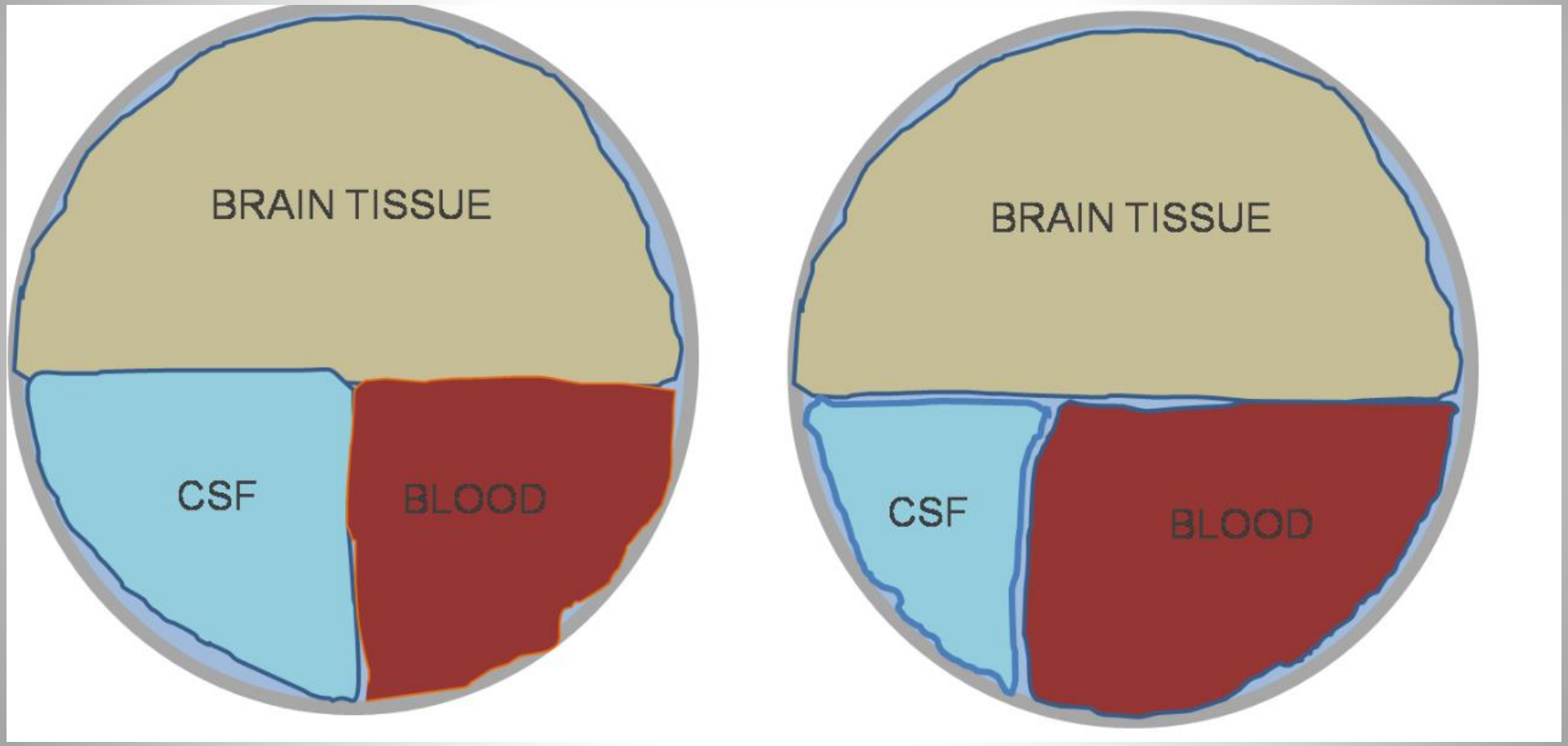
Normal Brain

- Monro-Kellie hypothesis
  - Blood
  - Brain
  - CSF

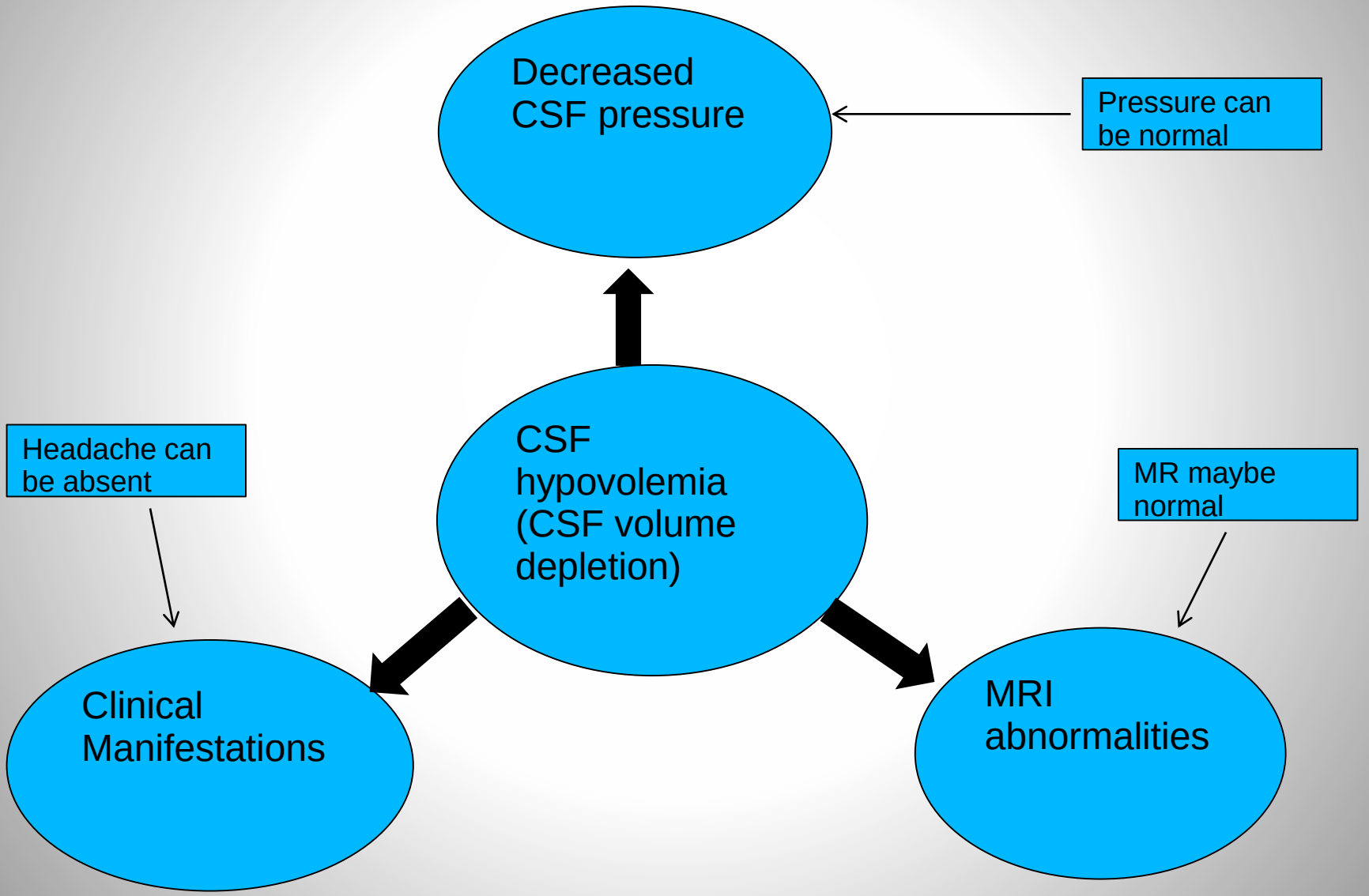
- In adults the intracranial compartment is protected by the skull
- There is a fixed internal volume of 1400-1700mL



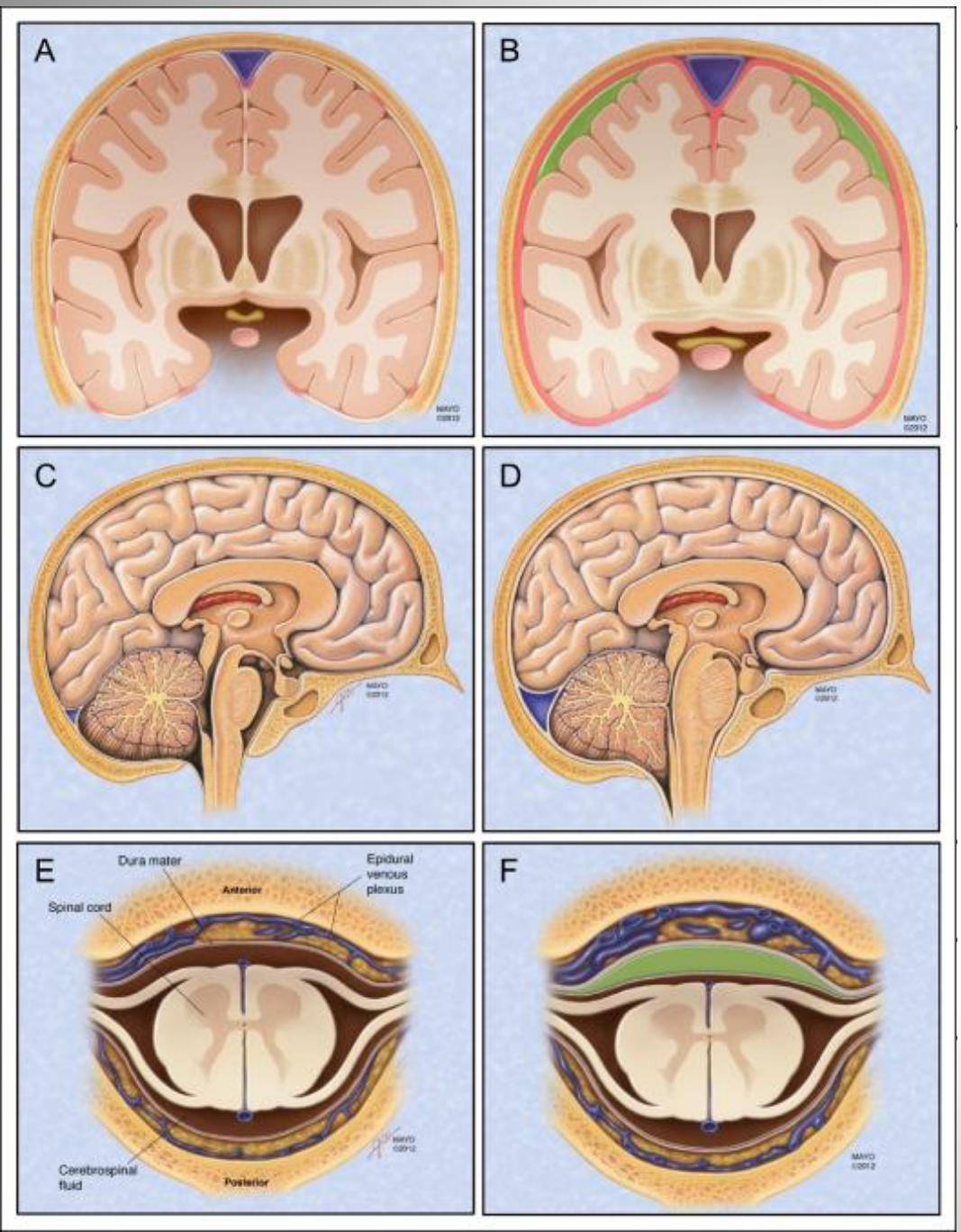
Monro-Kellie Hypothesis



Hypotension or Hypovolemia?



Intracranial Hypotension/Hypovolemia



Pachymeningeal enhancement

Brain “sagging” or “sinking”

- cerebellar tonsils low
- brainstem distortion
- Pontine enlargement
- crowding of the posterior fossa
- flattening of the optic chiasm

Subdural hygromas/hematomas

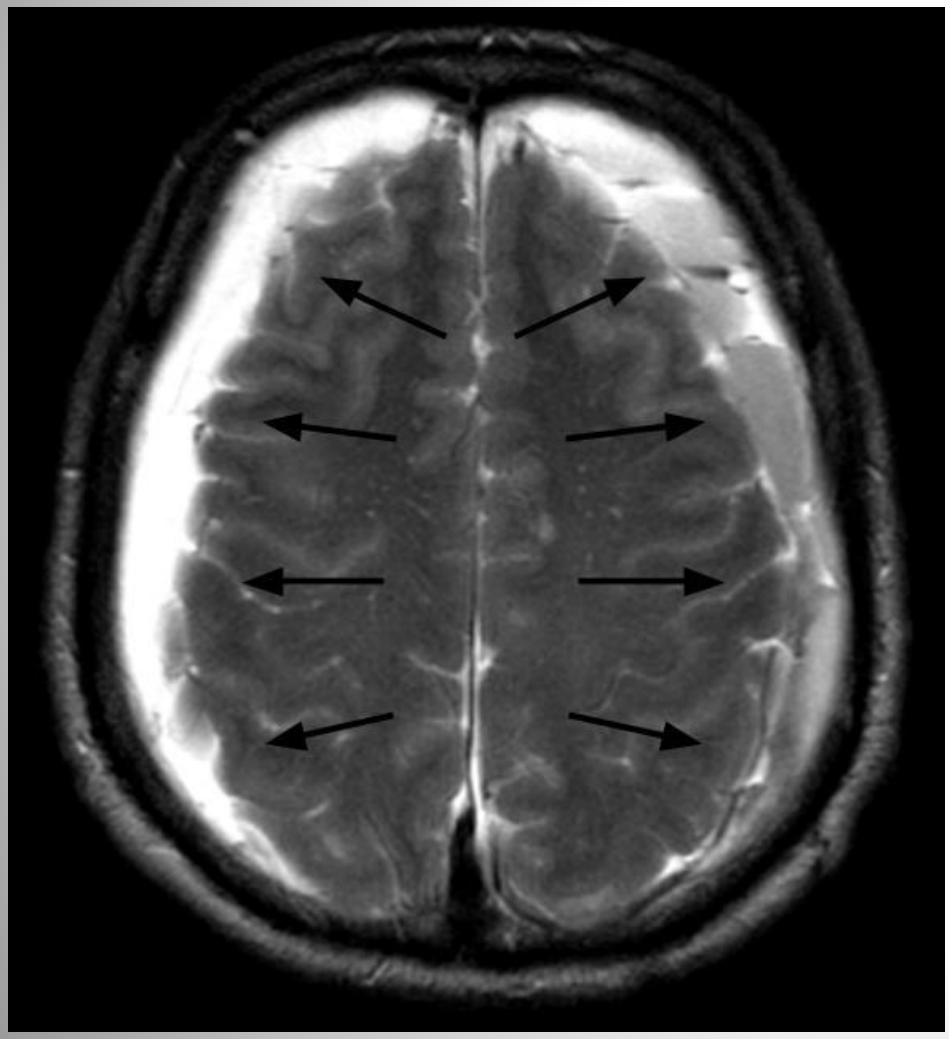
Engorged venous sinuses

Pituitary hyperemia

Cranial MRI

S Subdural hygroma/hematoma
E Enhancement of pachymeninges
E Enlargement of veins
P Pituitary hyperemia
S Sagging of brain

Cranial MRI



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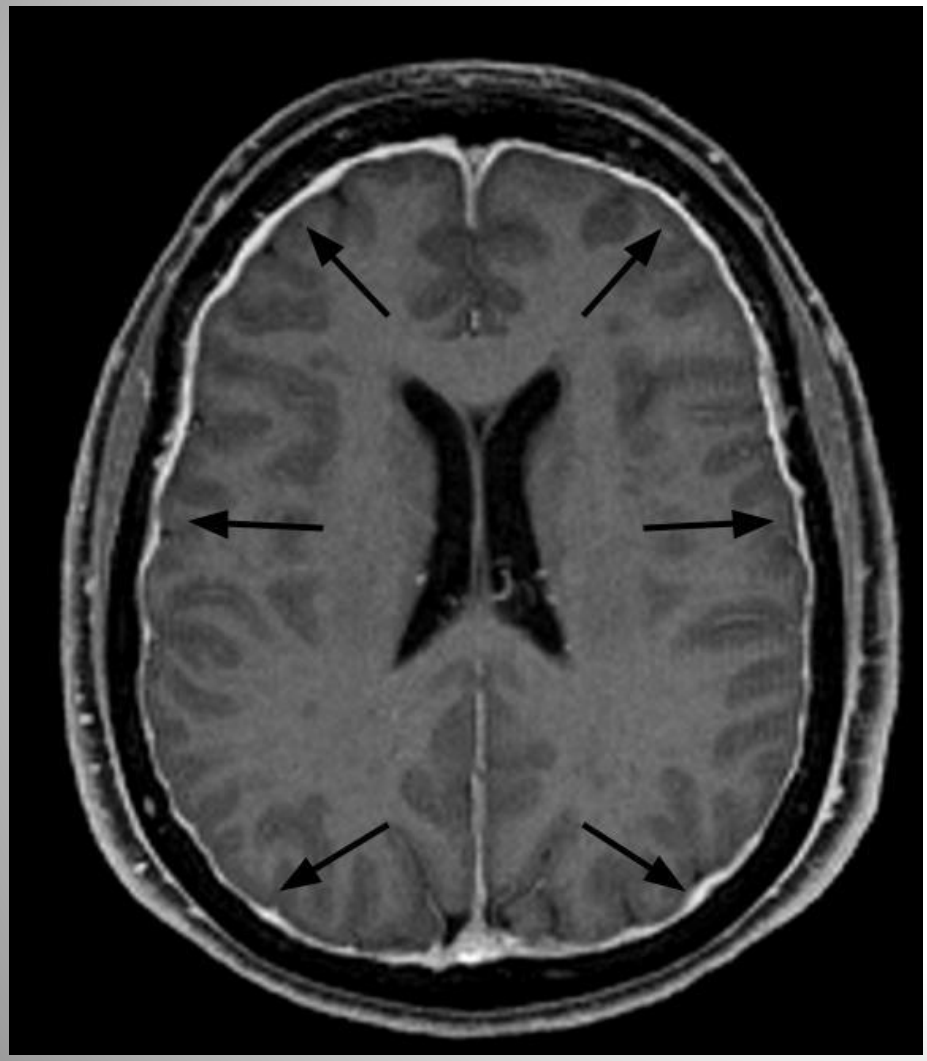
Cranial MRI



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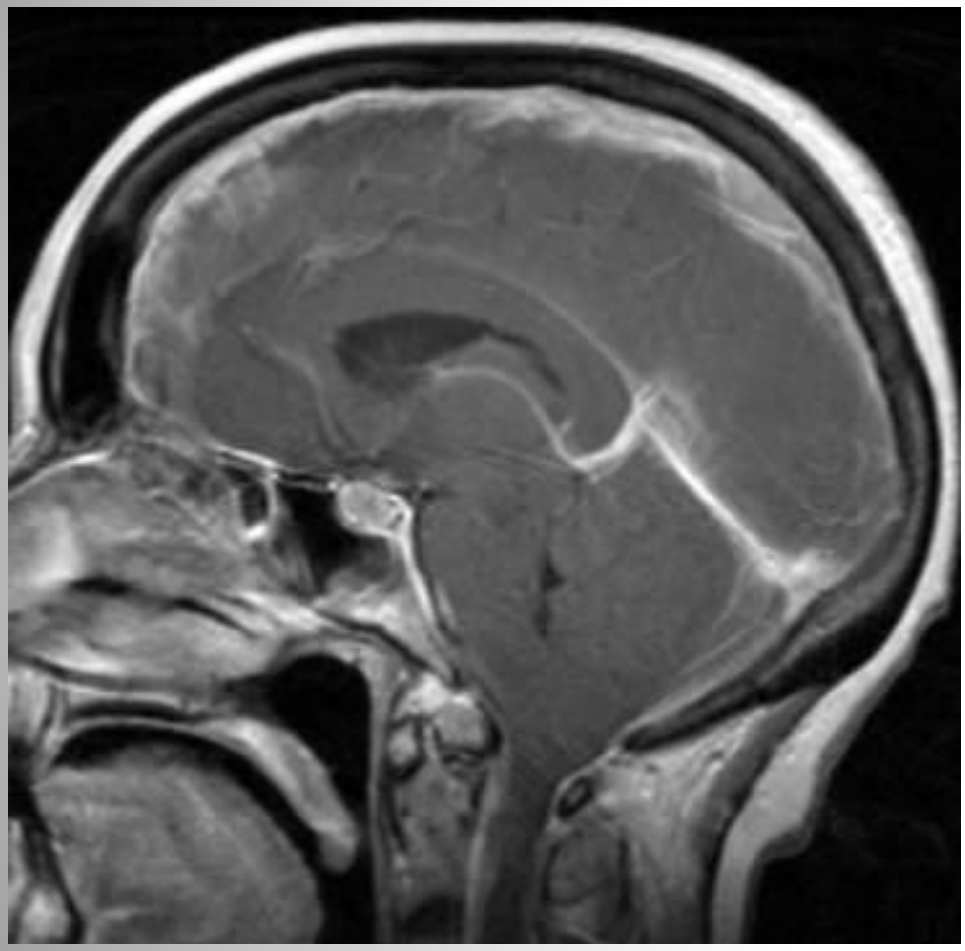

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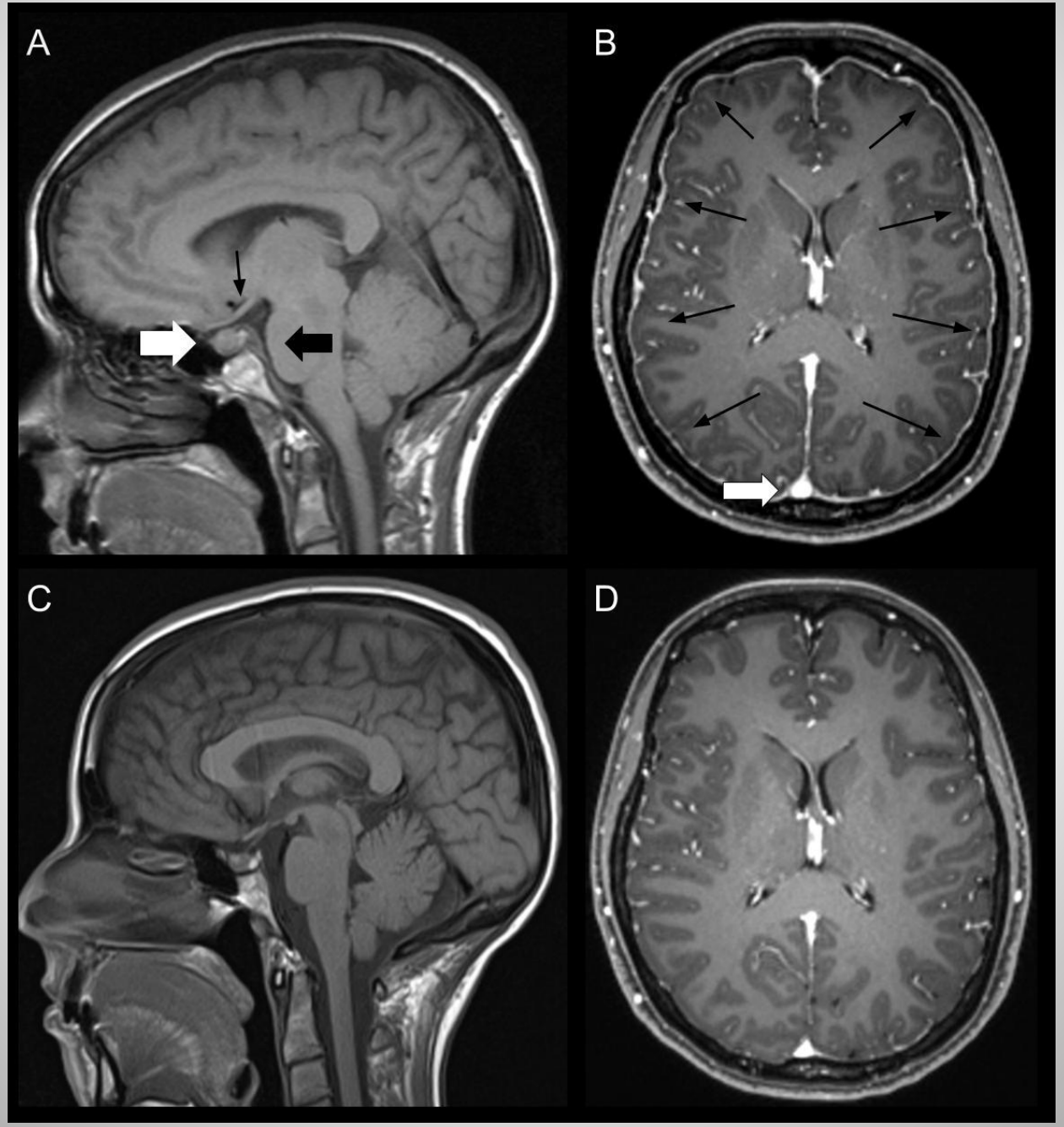
PRE and POST Treatment



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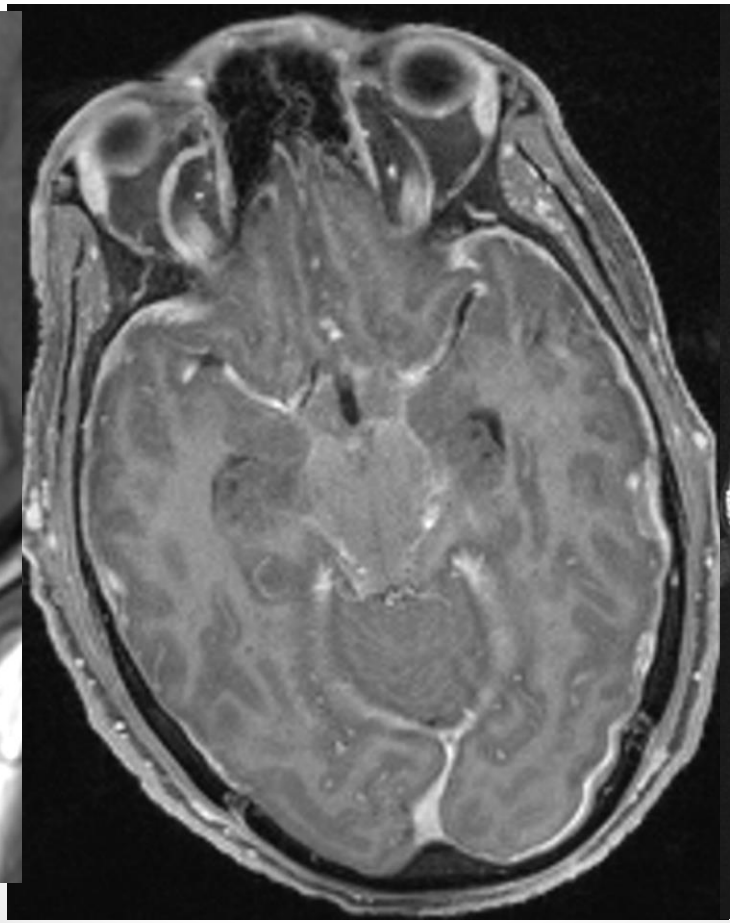
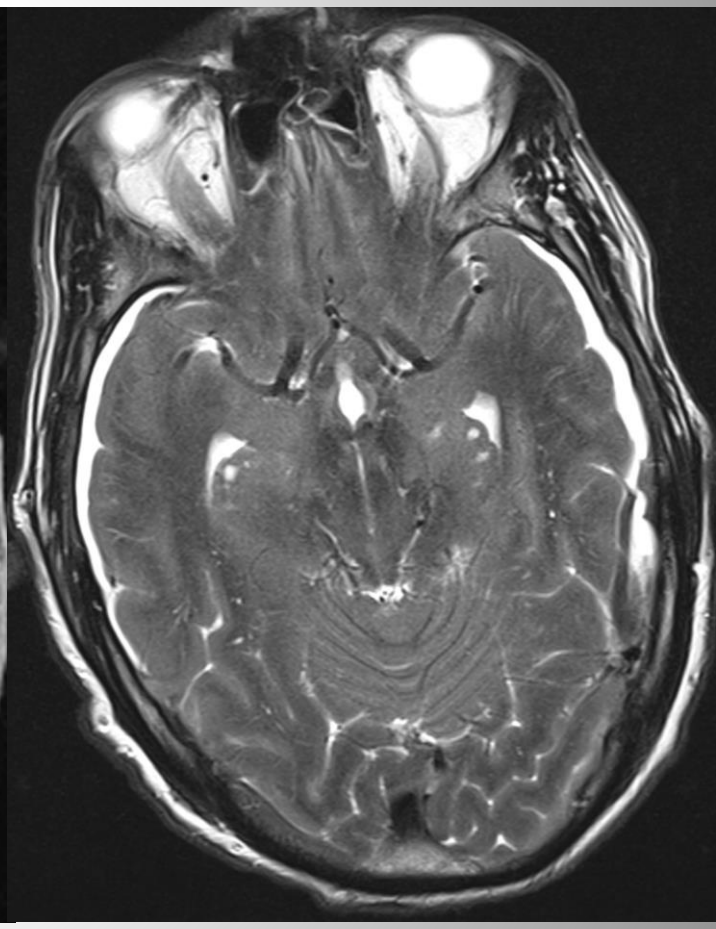
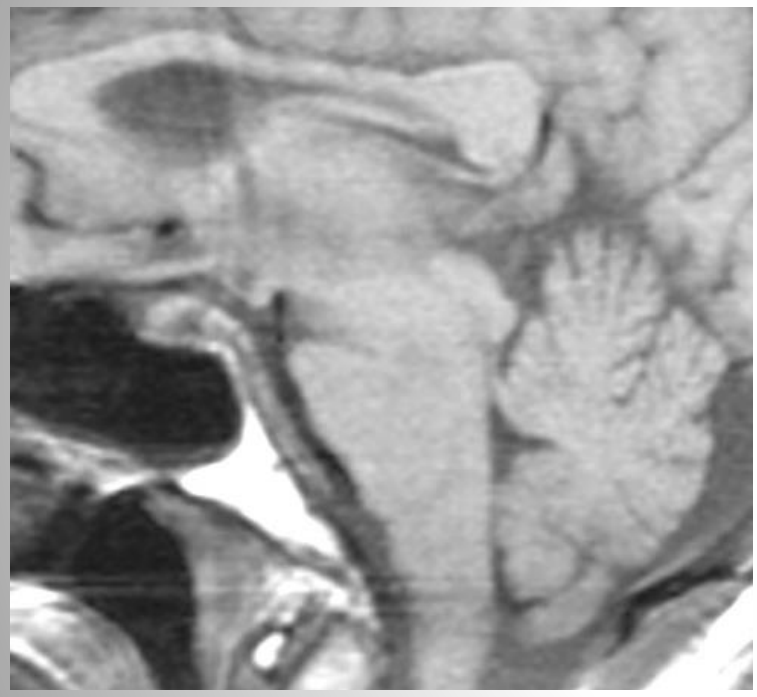
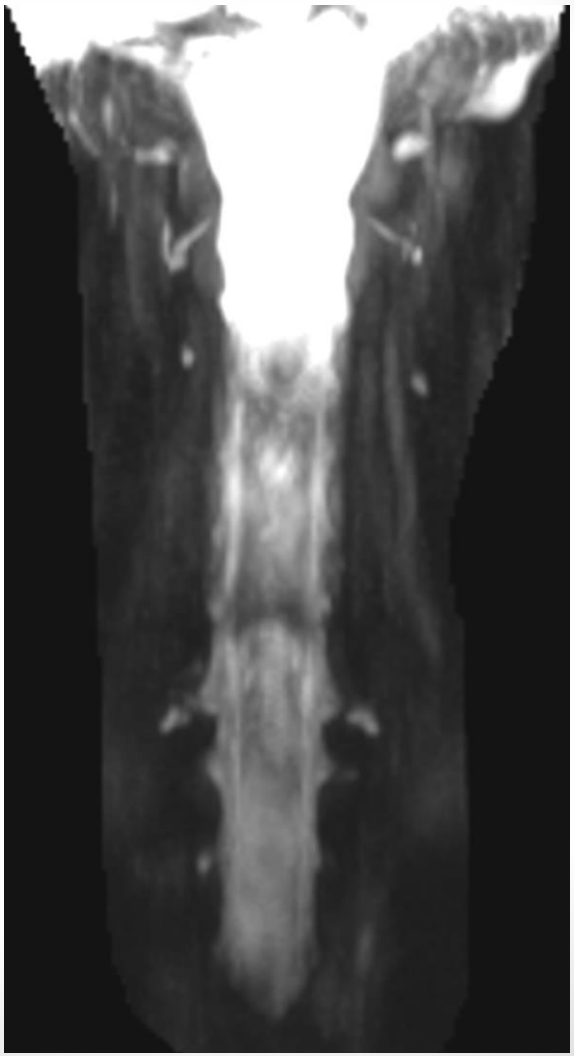
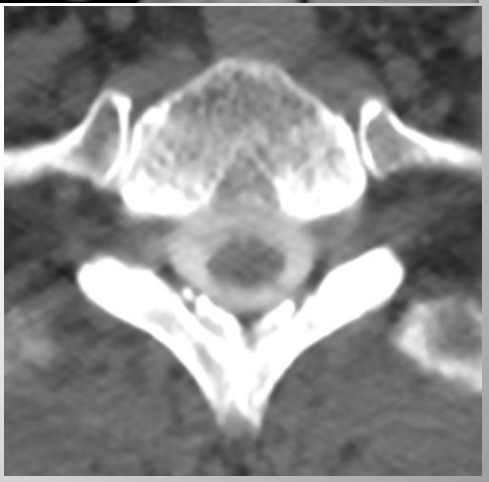


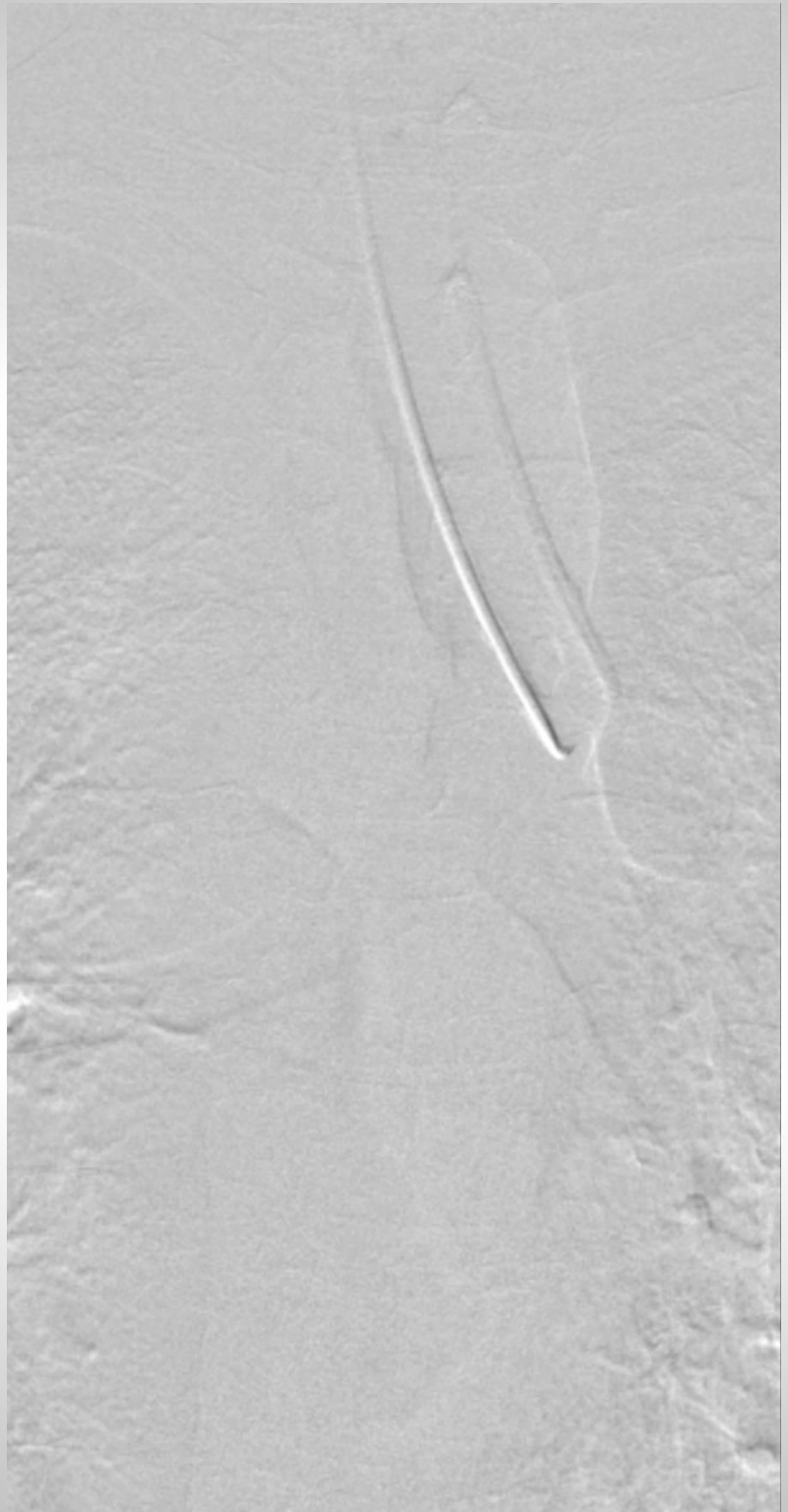


Frontotemporal Dementia

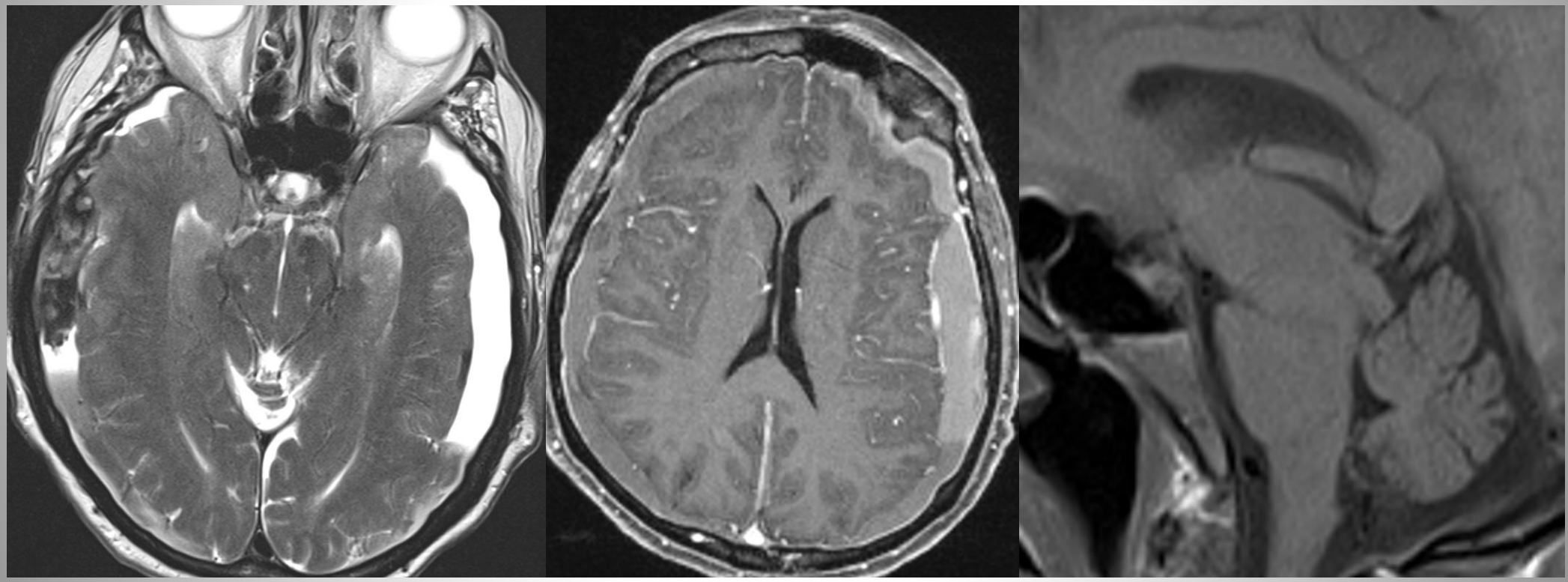








SDH due to CSF leak



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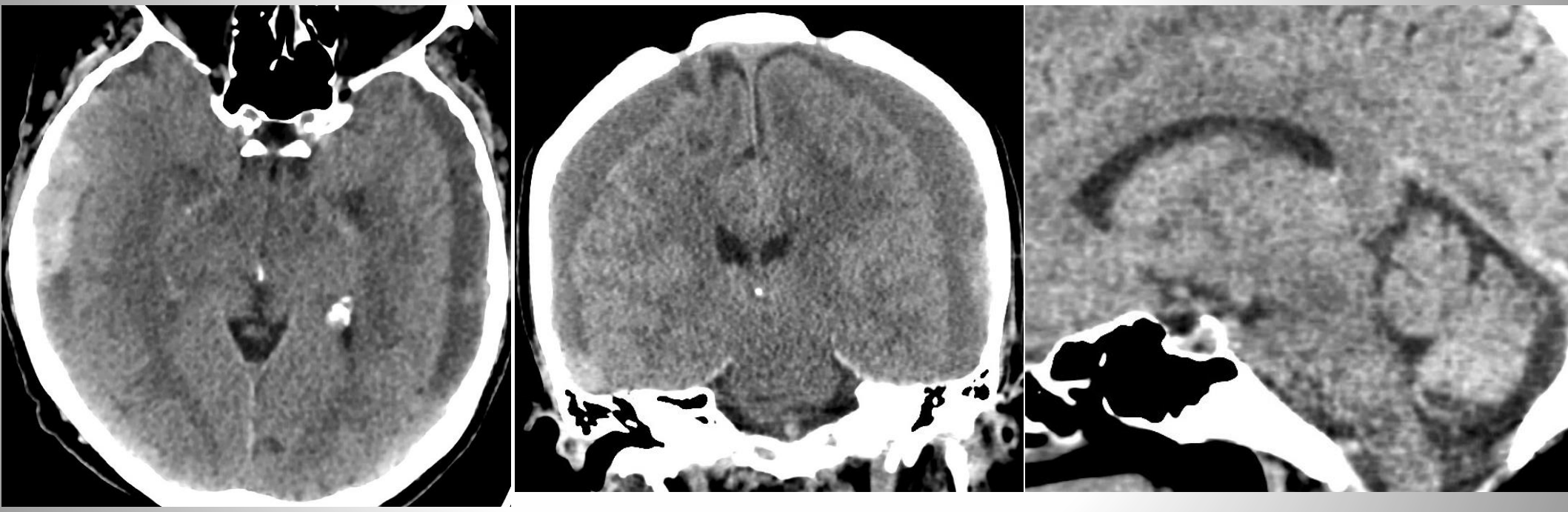


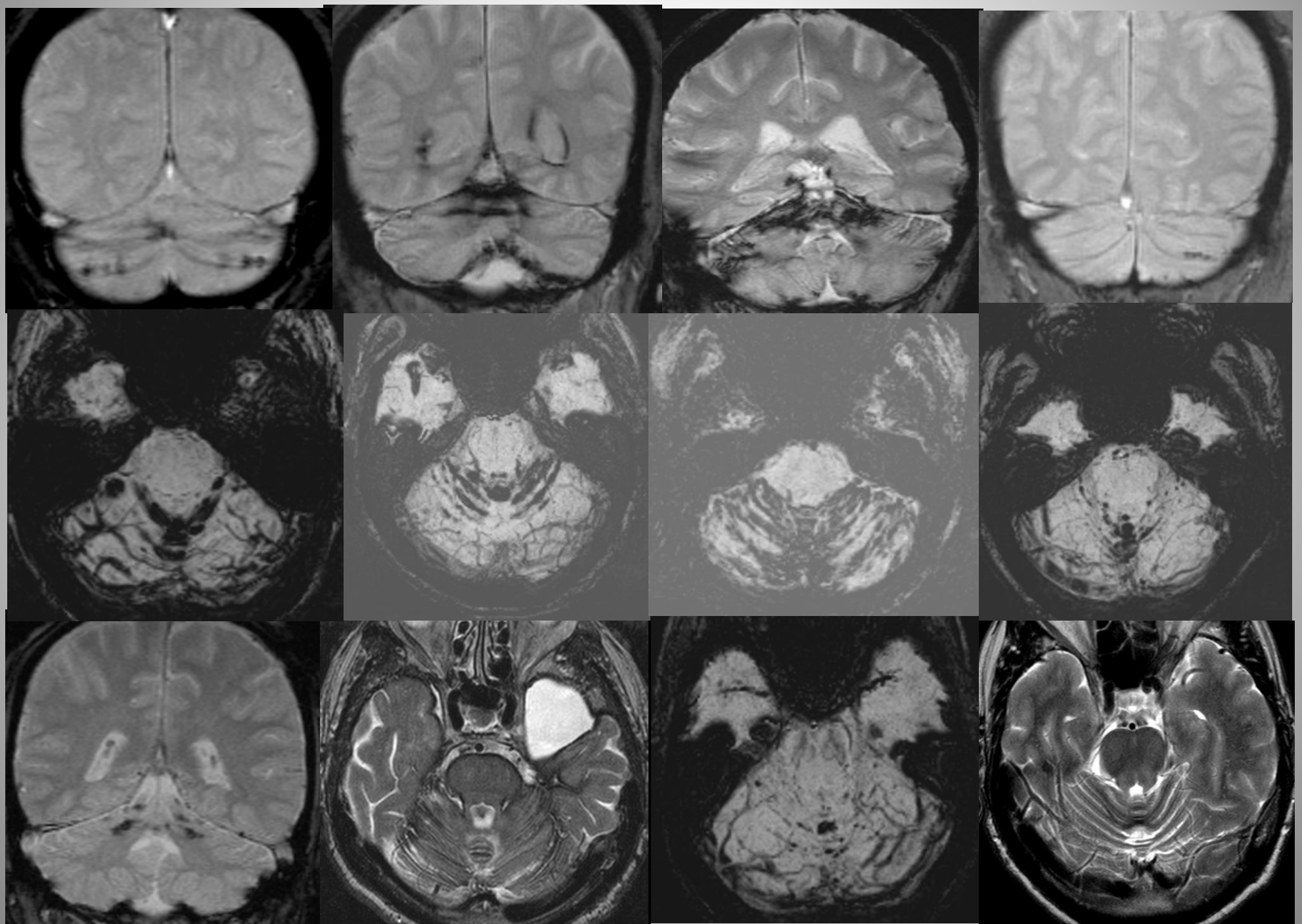
Spinal cerebrospinal fluid leak as the cause of chronic subdural hematomas in nongeriatric patients

Clinical article

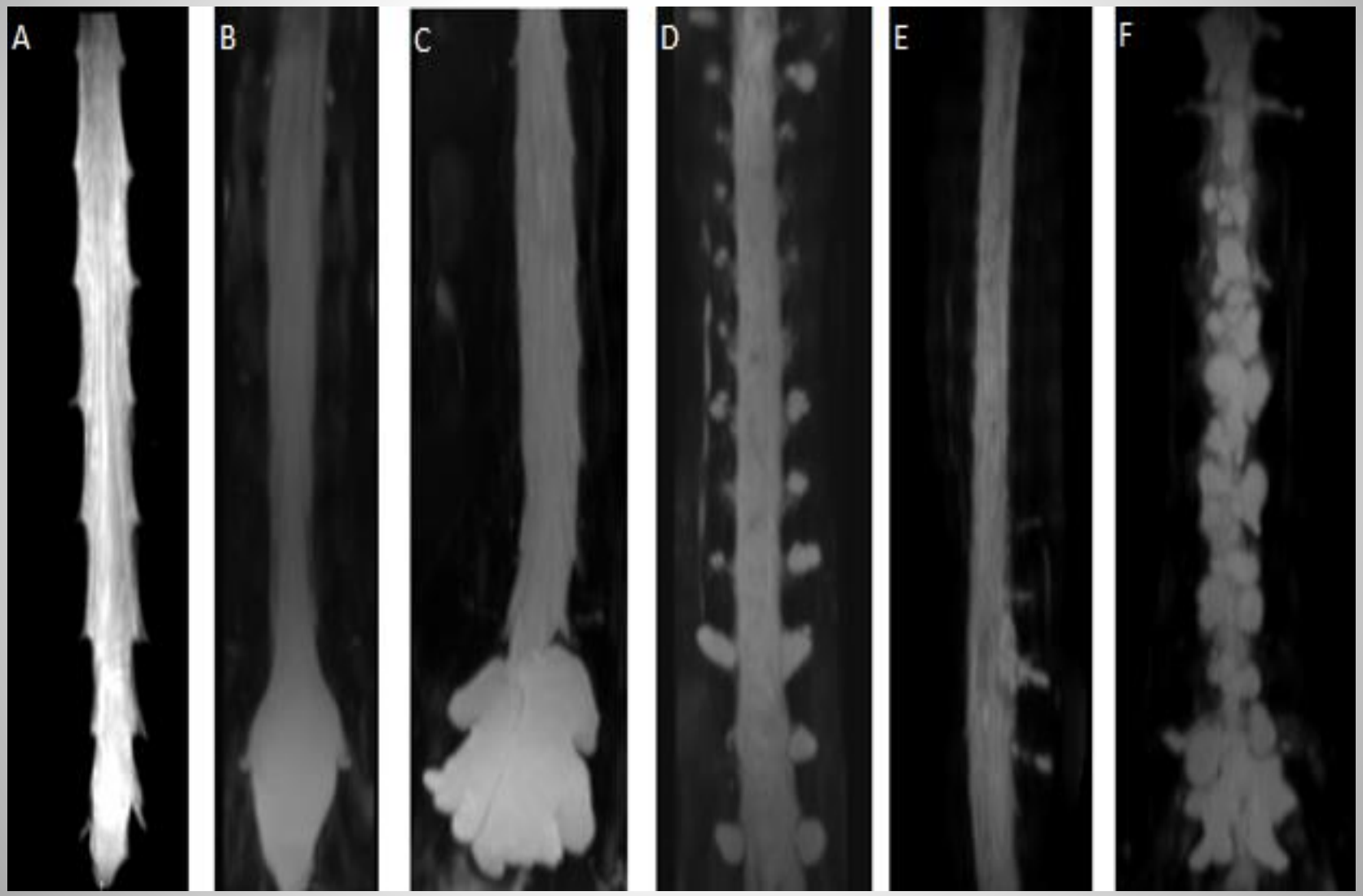
Jürgen Beck, M.D.,[1] Jan Gralla, M.D., M.Sc.,[2] Christian Fung, M.D.,[1] Christian T. Ulrich, M.D.,[1] Philippe Schucht, M.D.,[1] Jens Fichtner, M.D.,[1]

Direct proof of spinal CSF leakage in 25.9% of patients suggests that spinal CSF leaks may be a frequent cause of nongeriatric CSDH

Siderosis



Spinal Leak Detection and Localization



Classification of CSF Leaks

		Incidence
Type 1	Dural Tear	26.6%
Type 2	Meningeal Diverticulum	42.3%
Type 3	CSF Venous Fistula	2.5%
Type 4	Indeterminate	28%

Classification of CSF Leaks recent data since April 2018

		Incidence
Type 1	Dural Tear	40%
Type 2	Meningeal Diverticulum	17%
Type 3	CSF Venous Fistula	23%
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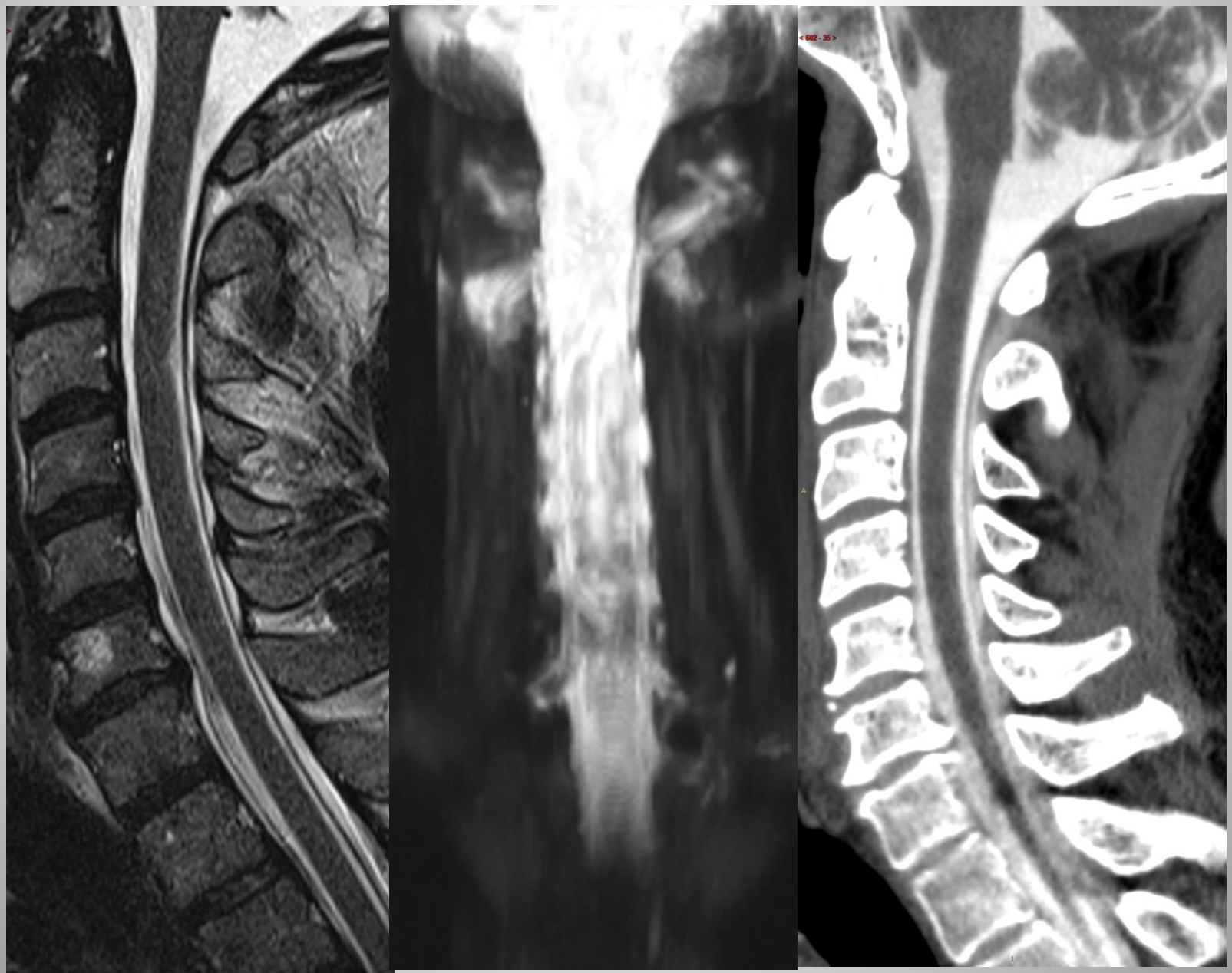
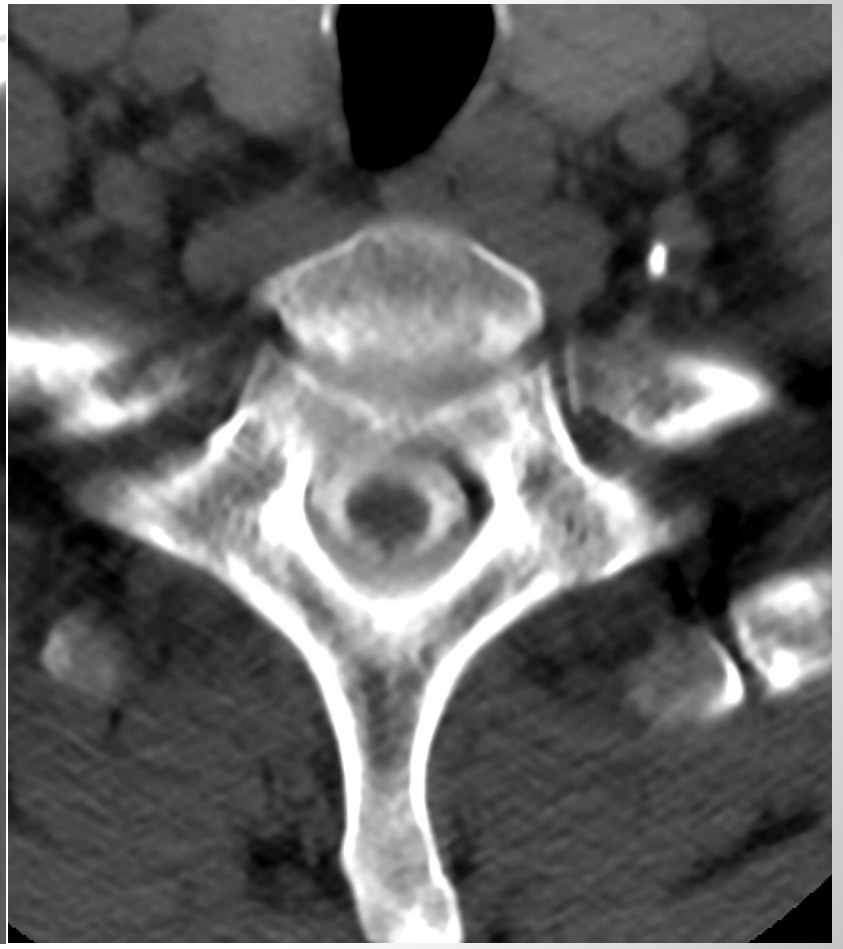
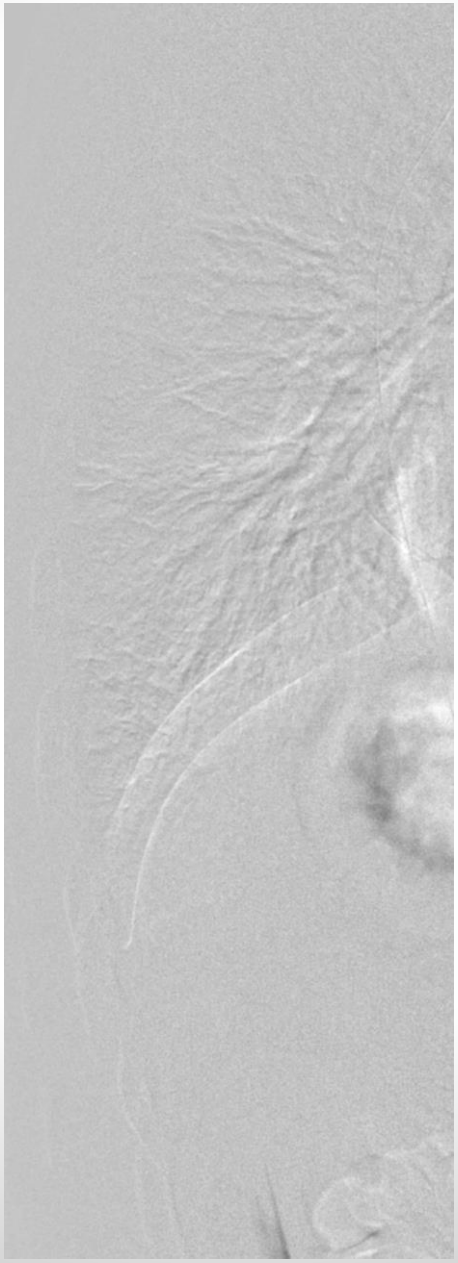
Type 1 (Dural tear)



False localizing C1-2

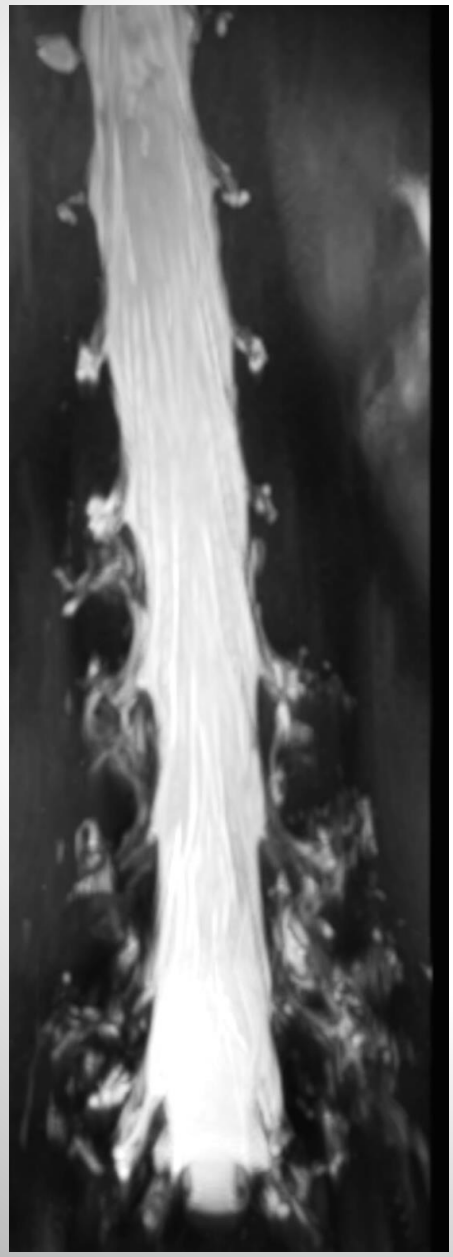


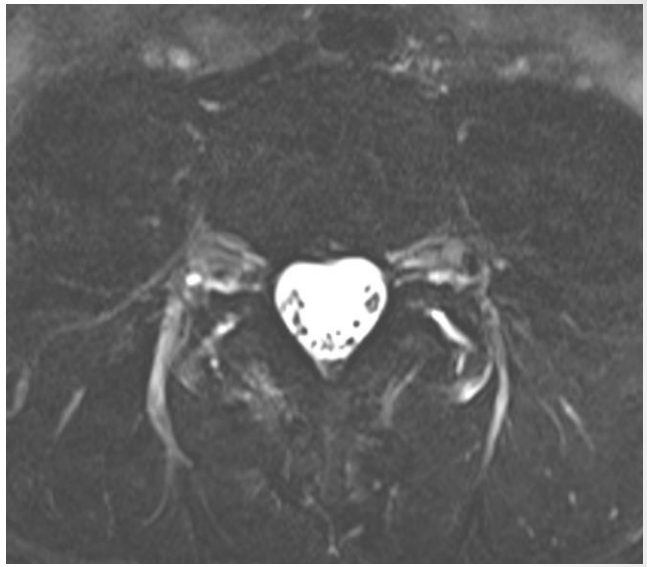
Ventral Leak DSM

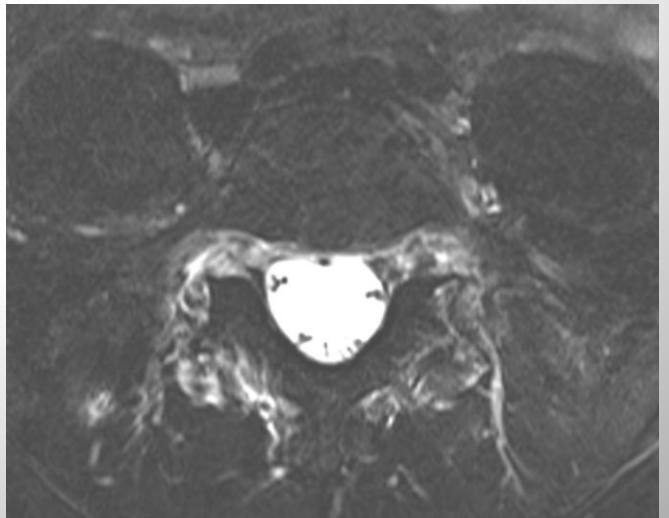


Ventral Leak Dynamic CT guided Myelogram

Type 2 (Meningeal diverticulum)







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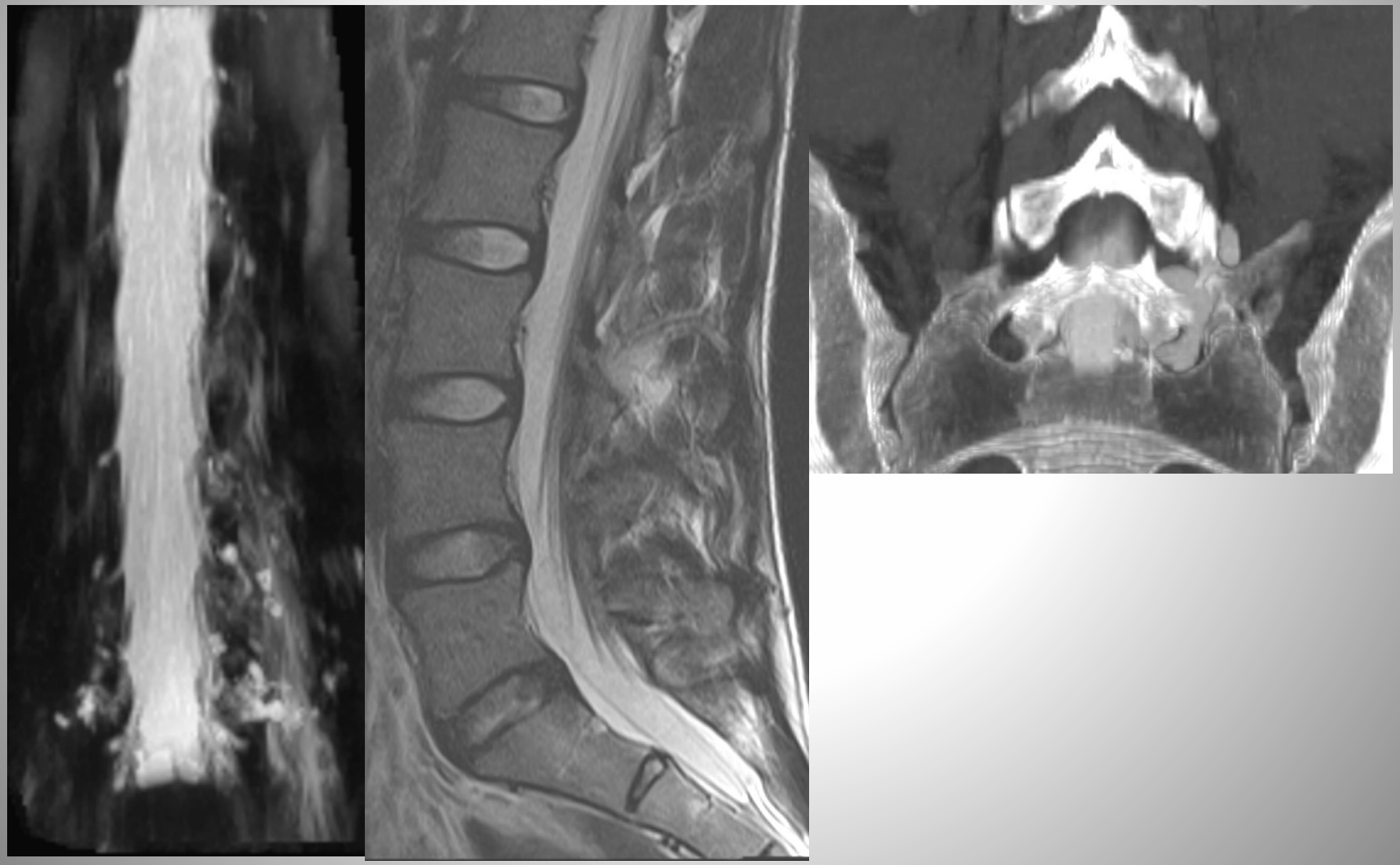
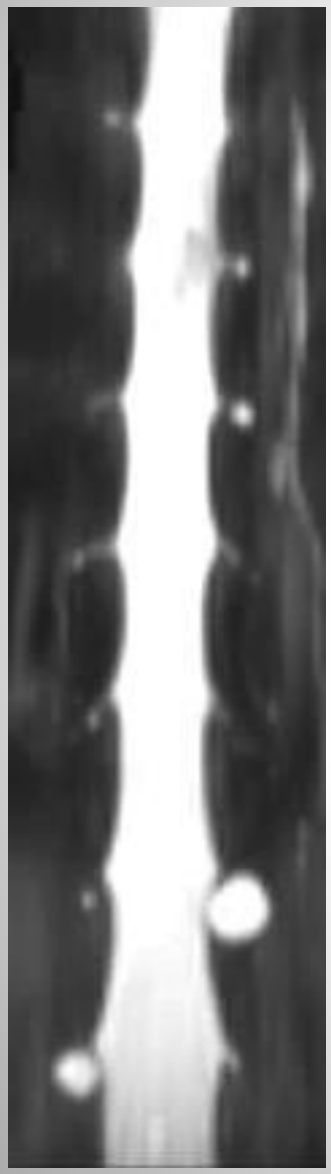
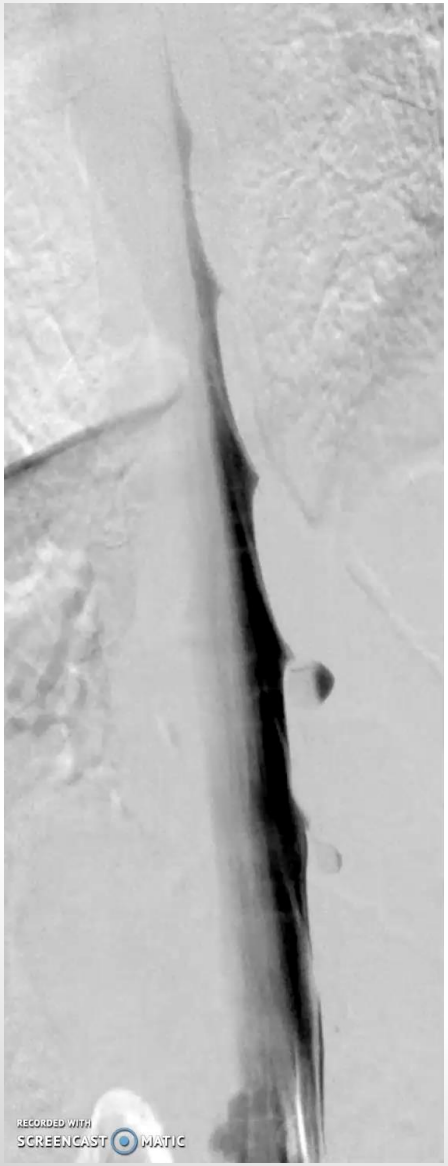


Type 3 (CSF Venous Fistula)





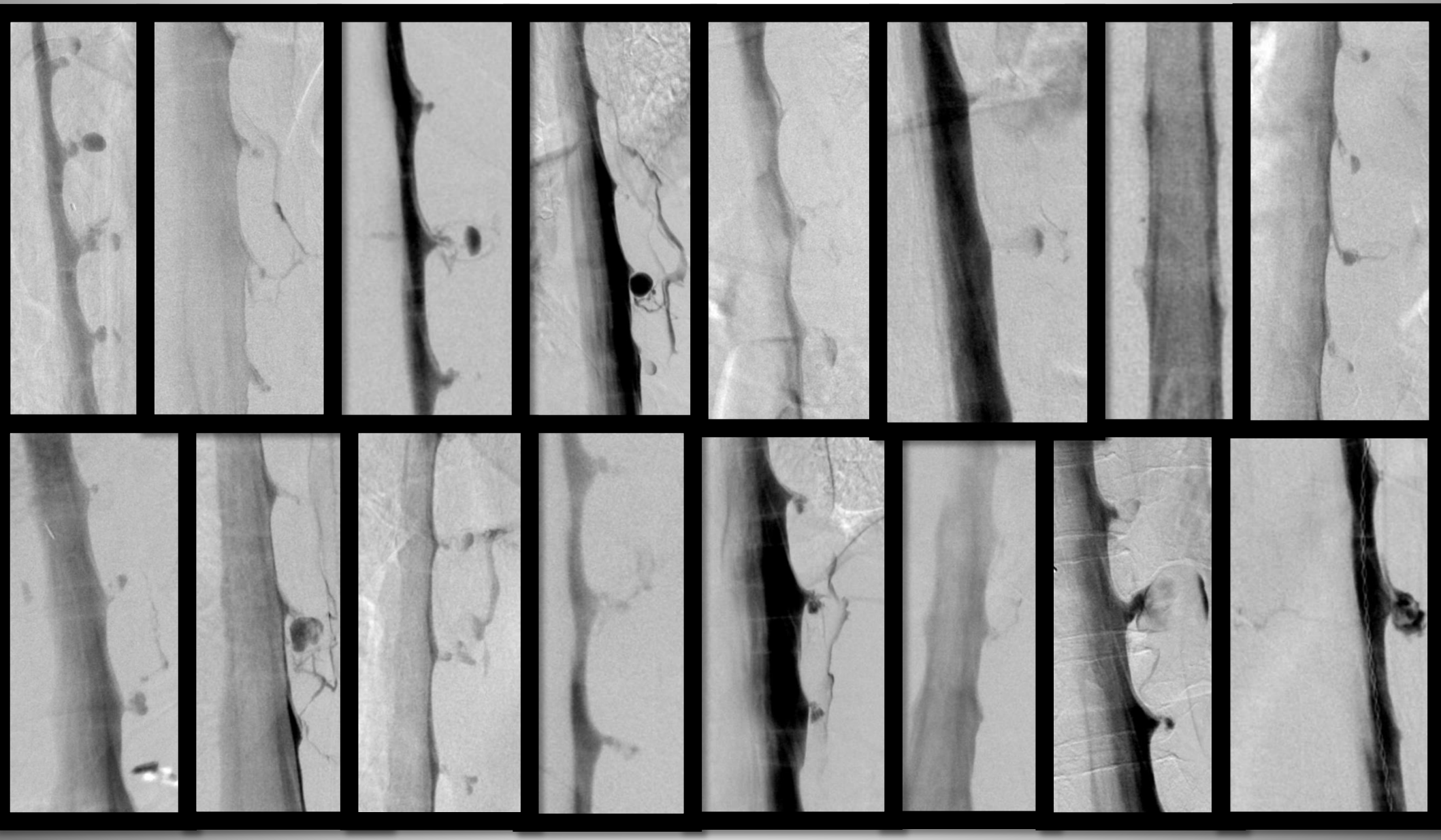
CSF Venous Fistula

DSM in lateral decubitus position

23 new patients April-September 2018

16 patients positive for fistula

DSM LATERAL DECUBITUS



Spinal Leak Detection and Localization

Modality	Initial	High Flow	Low Flow	Radiation
CTM	+++	+	++	10-30 mSv
Dynamic CTM	-	++	+	20-200
DSM	?	+++	+	2-35
MR/MYELO	+++	-	+	0
MR IT Gado	-	-	++	0
Radionuclide		-	++	2-6

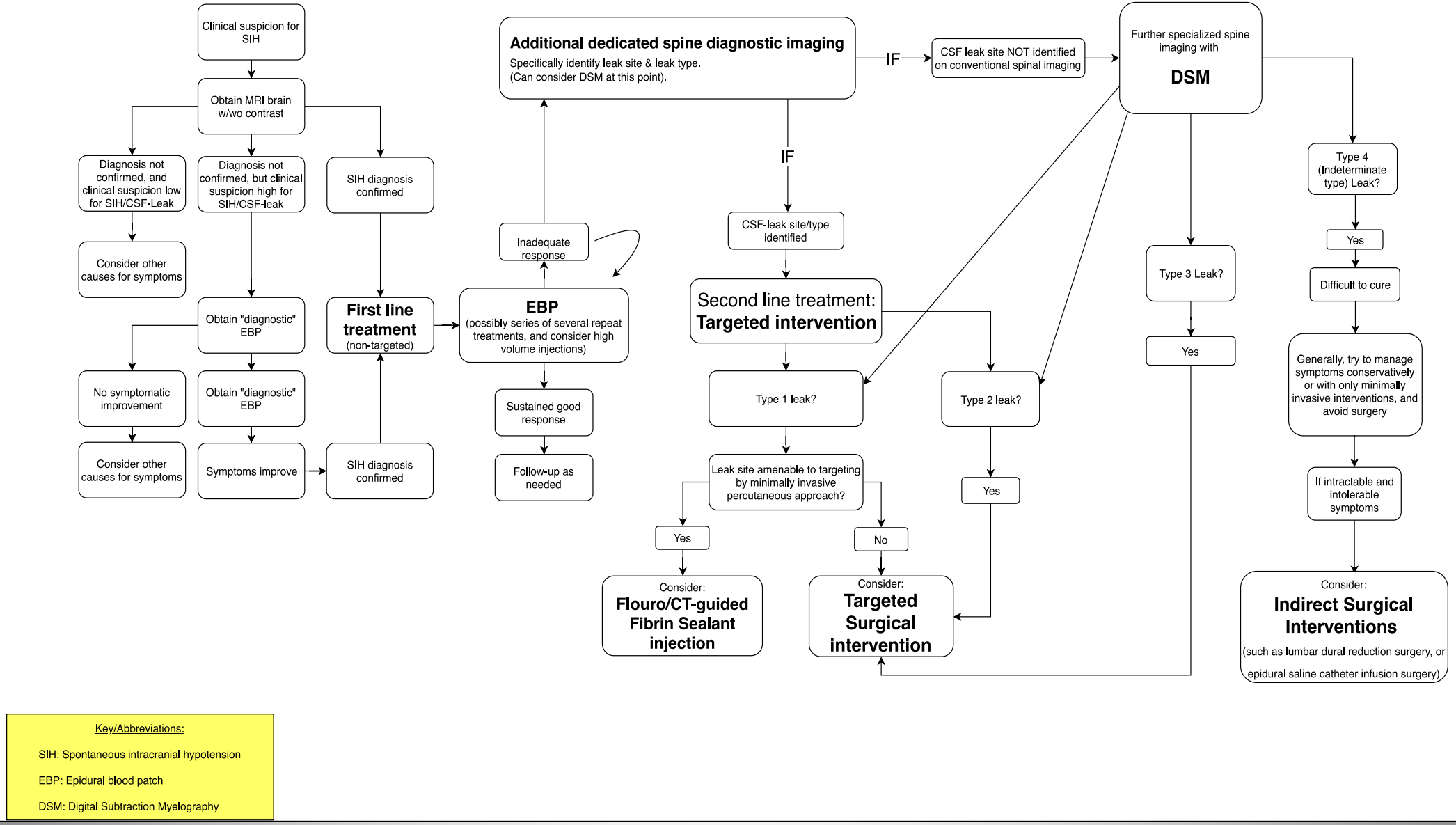
Kranz et al AJR

Thank You

Percutaneous Treatment: Cedars-Sinai Approach

Charles Luoy and Marcel Maya

Cedars Sinai



Key/Abbreviations:

SIH: Spontaneous intracranial hypotension

EBP: Epidural blood patch

DSM: Digital Subtraction Myelography

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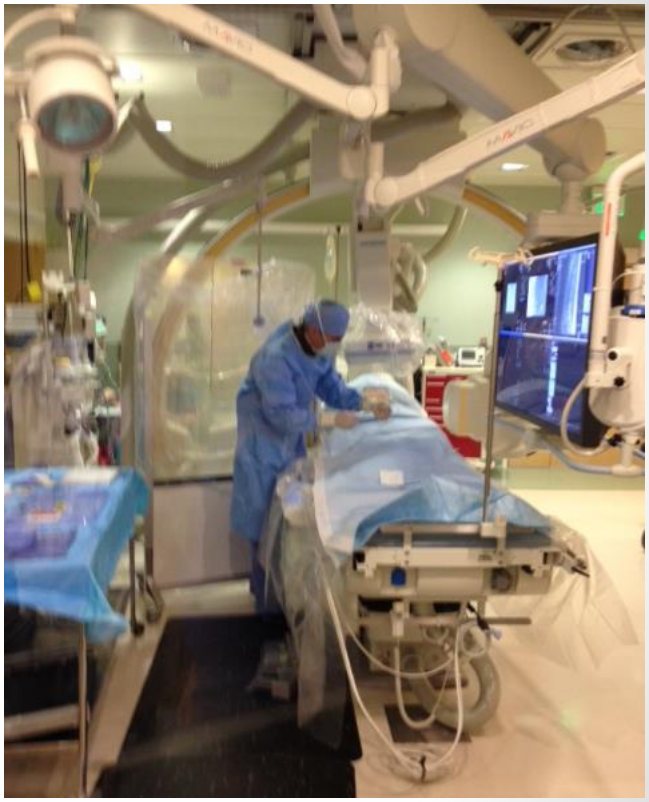
Interventional Options

- Blood Patch
  - Single level
  - Multilevel
  - Targeted
- Fibrin Glue



Quadris Order#:	Location:	Date of Birth:
3738058	OP01	01/01/1959

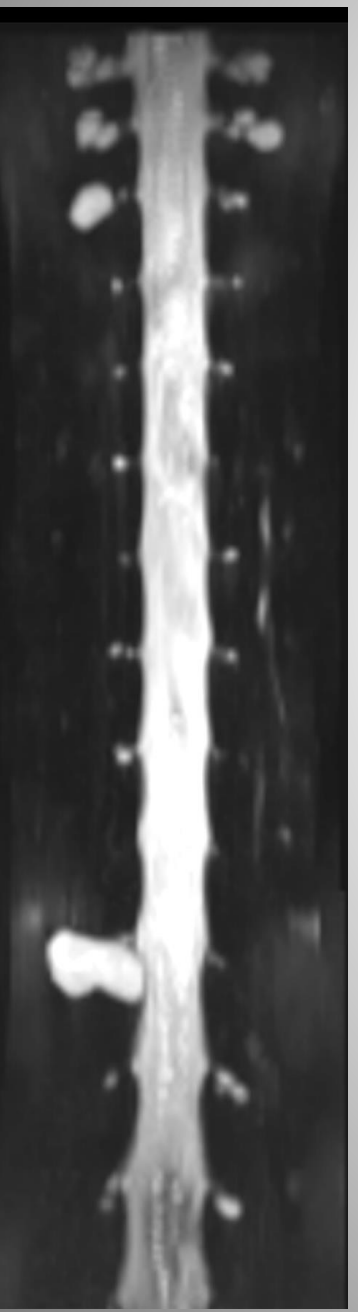
NERVE ROOT LOCALIZATION AND FIBRIN GLUE DEPOSITION

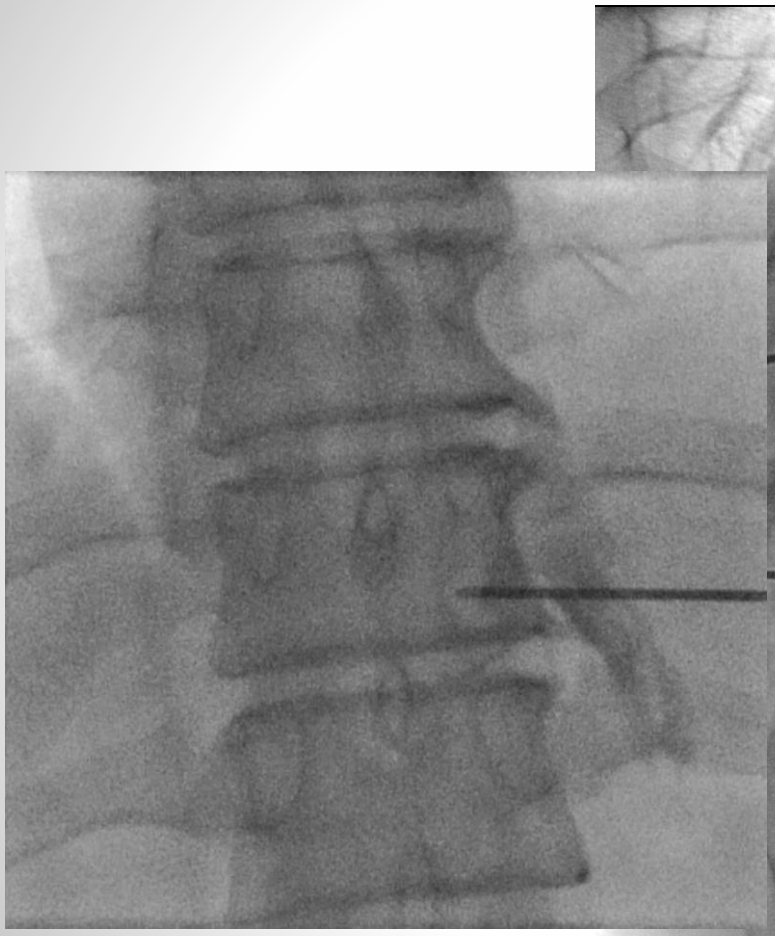
DATE OF STUDY: 01/30/2003

CLINICAL INDICATION: CSF leak.

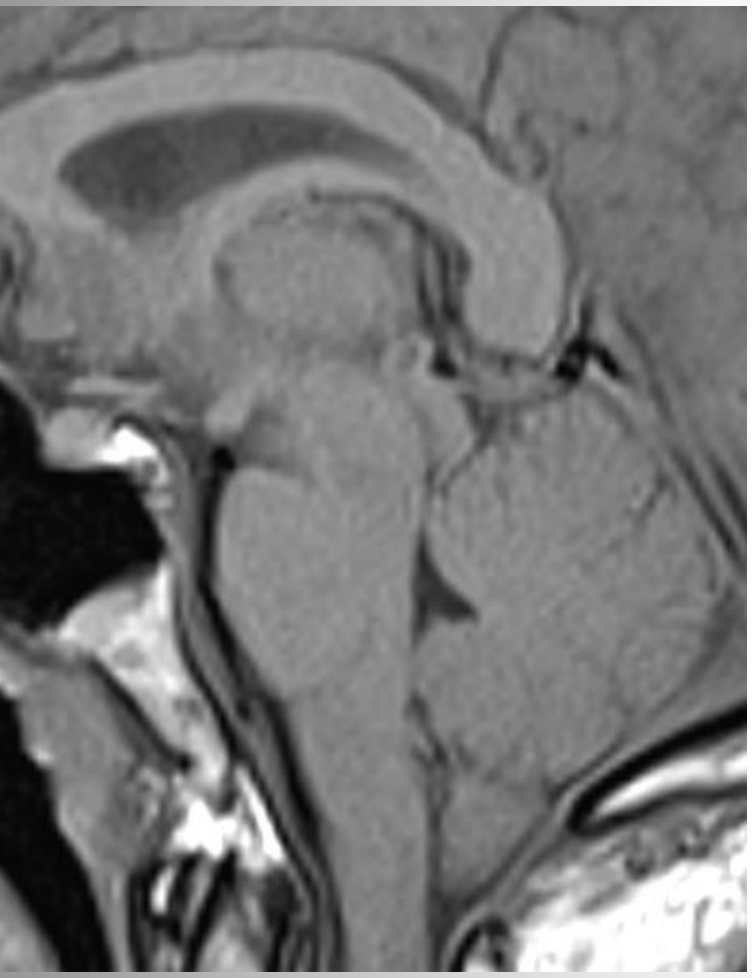
Year	Blood Patch	Fibrin Glue
2013	138	46
2014	160	34
2015	169	40
2016	209	51

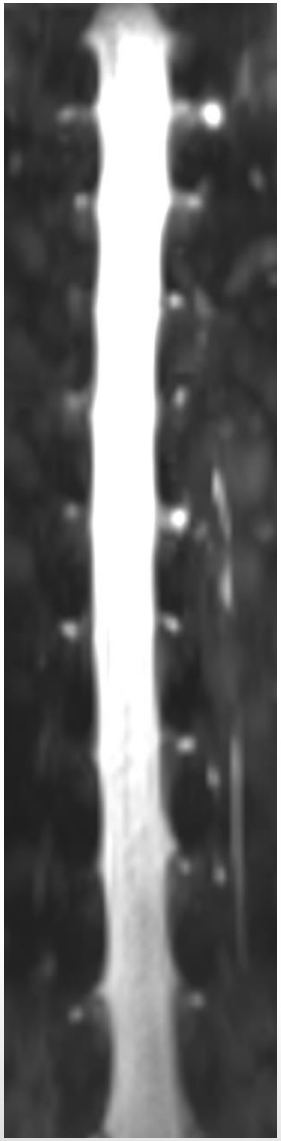
Fibrin Glue

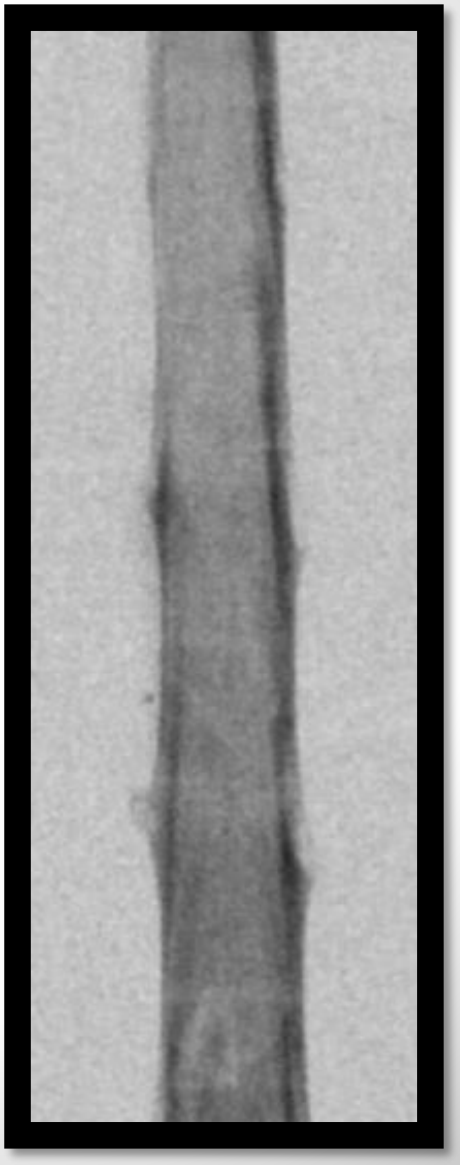




Fibrin Glue CSF fistula







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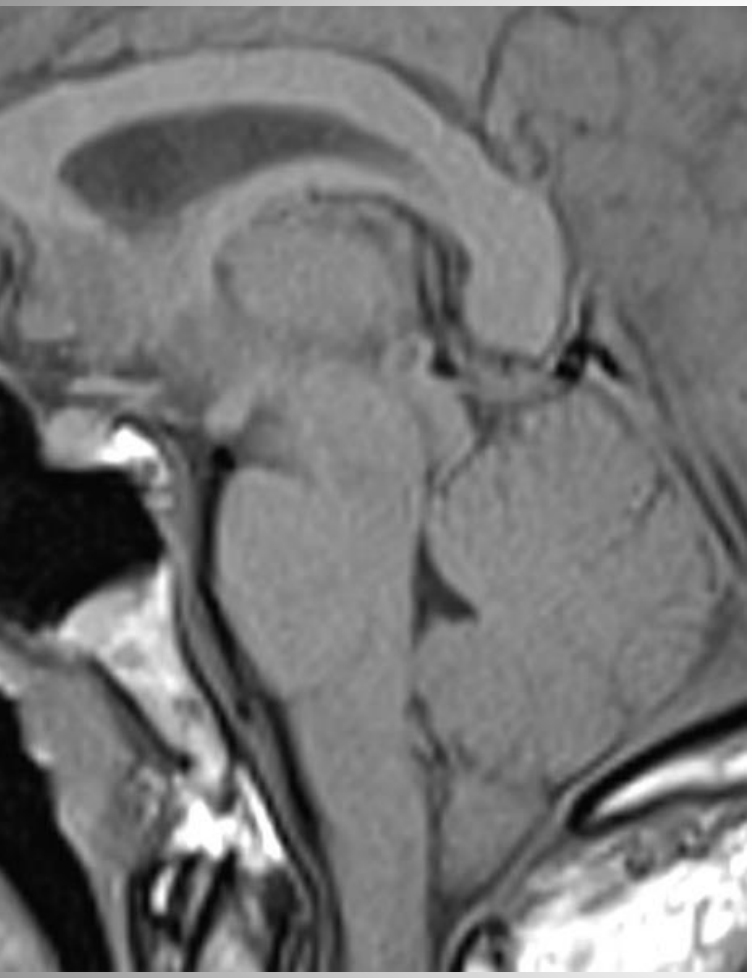
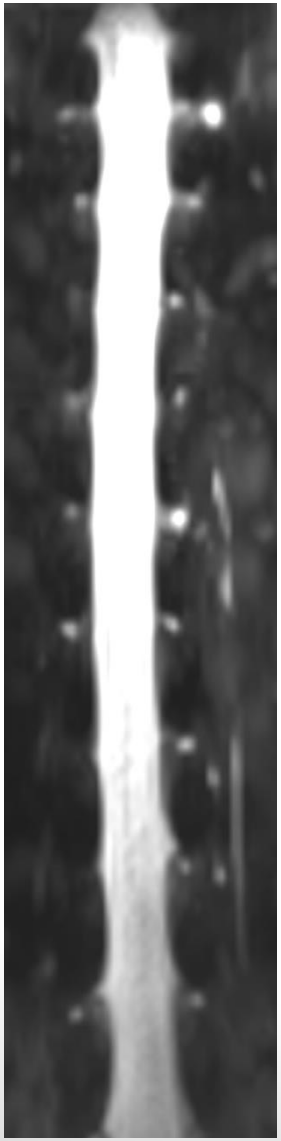
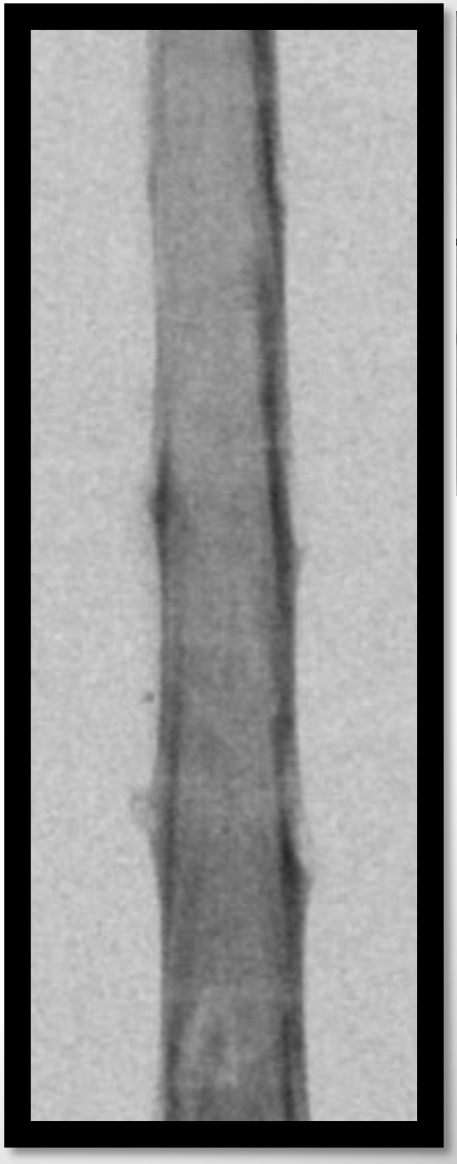
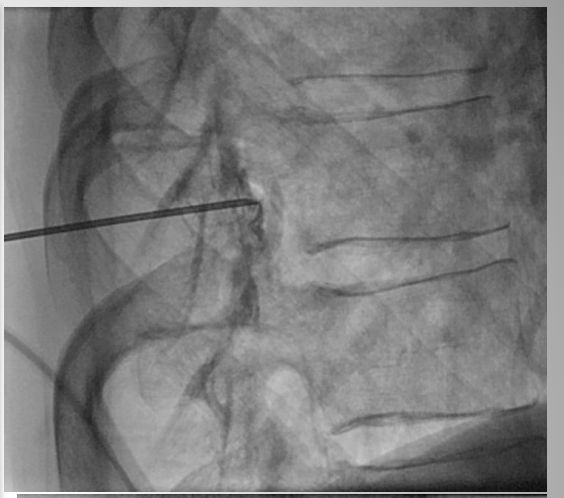
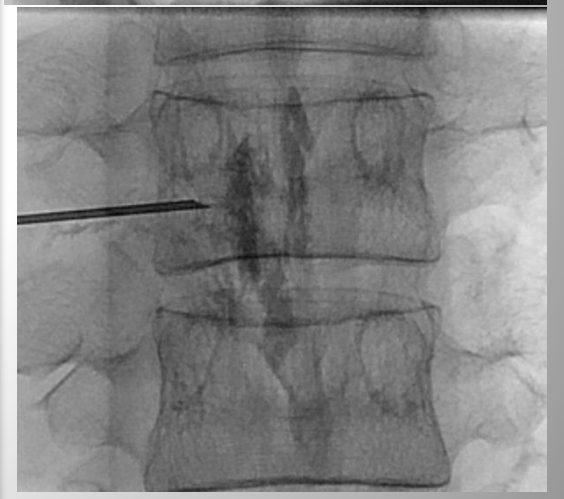




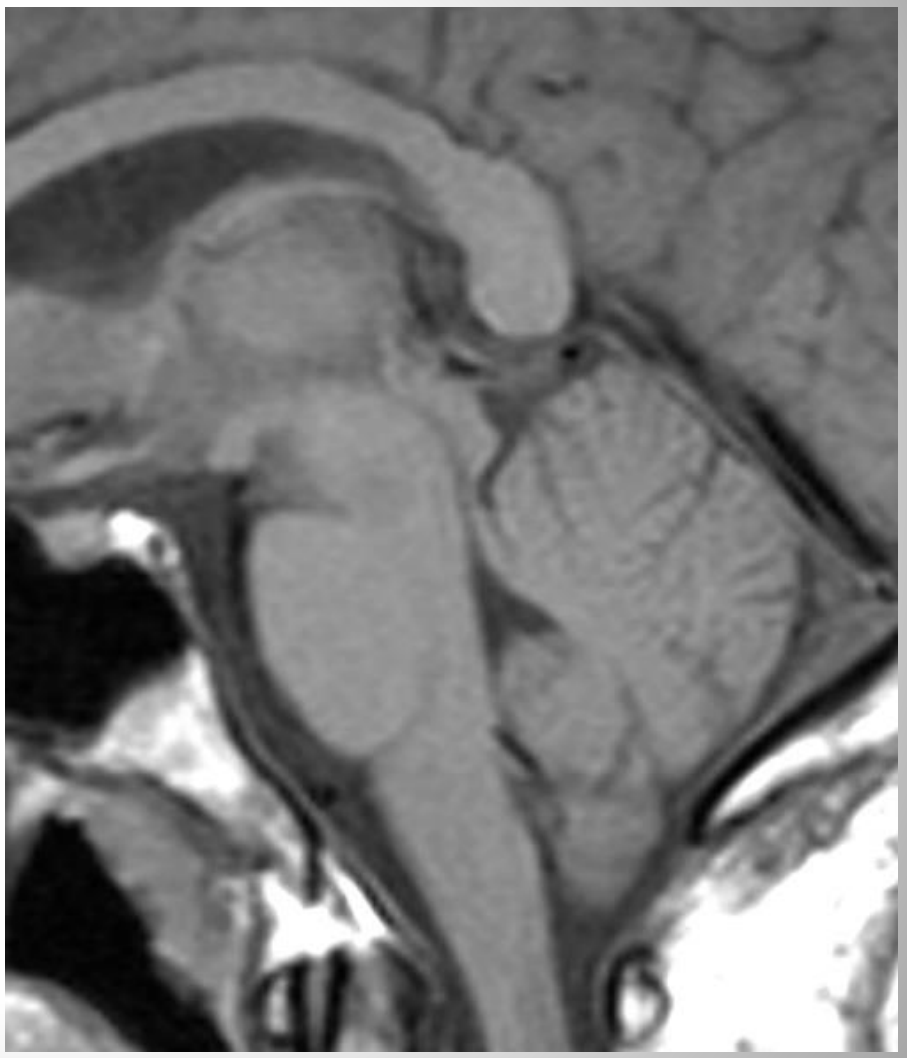






Fibrin Glue CSF fistula

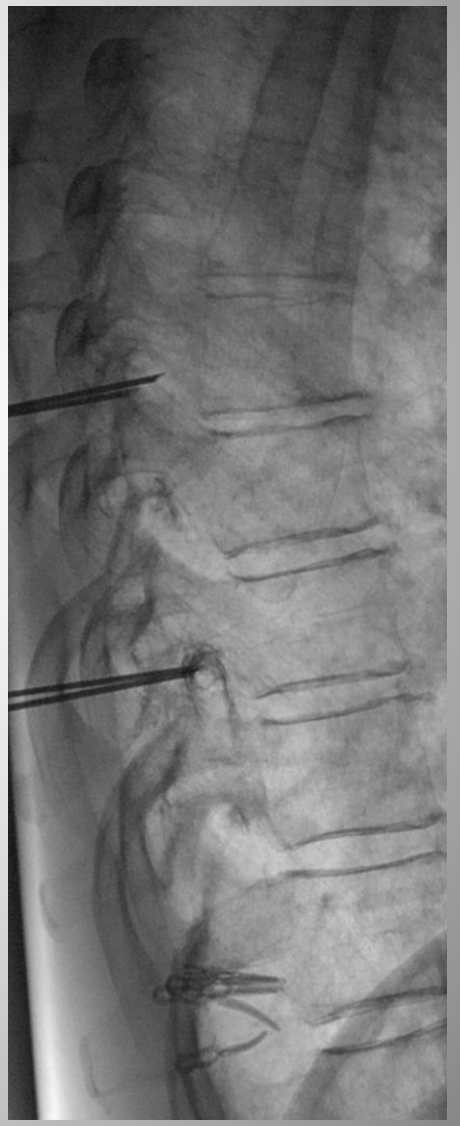
Pre Treatment



Post Treatment

Sacral cysts

Meningeal diverticulum



Results

- Epidural blood patch
  - 30-70% initial response
  - Relapse not uncommon
  - Maintenance patching may be necessary
- Percutaneous glue
  - 40% cure rate
  - Depends on accurate localization of leak