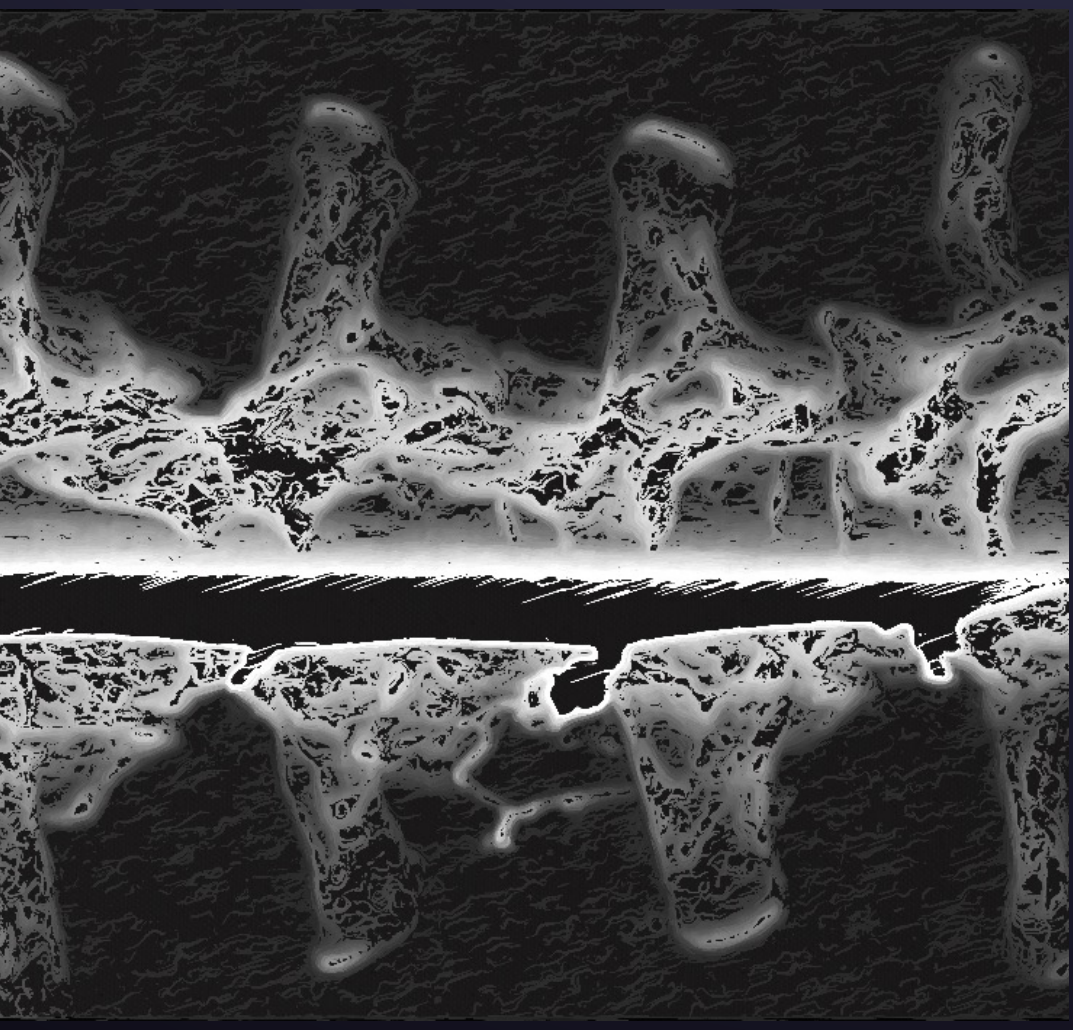


Anatomy & Pathogenesis of CVFs

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DISCLOSURES



Medical advisory board – Spinal CSF leak foundation



Medical advisory board – Spinal CSF leak Canada



Use of fibrin glue is an off-label indication

OVERVIEW



VENOUS ANATOMY

Review normal venous anatomy in the epidural and paraspinal spaces



CVF EXAMPLES

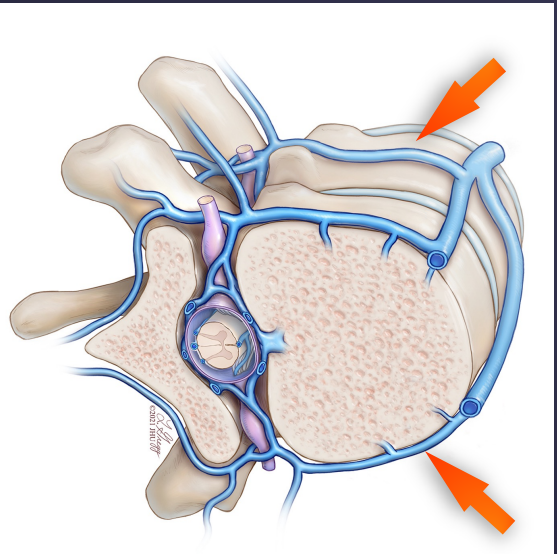
Show examples of CVFs on CT and digital subtraction myelography



PATHOGENESIS

Discuss possible etiologies for the formation of CVFs

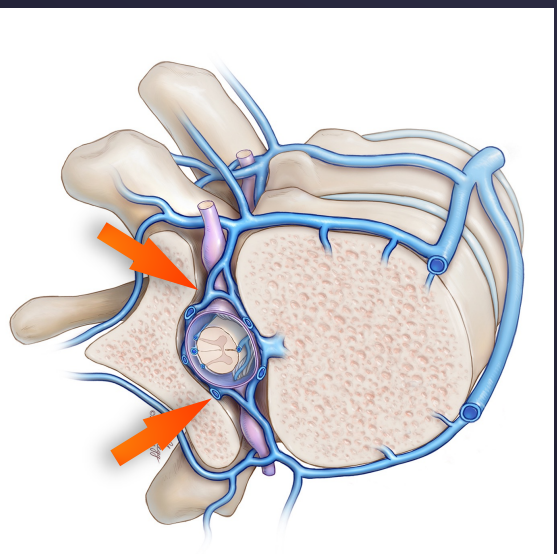
SPINAL EPIDURAL VEINS



External Epidural

EVP surrounds vertebral column, drains to the azygos and hemiazygos system

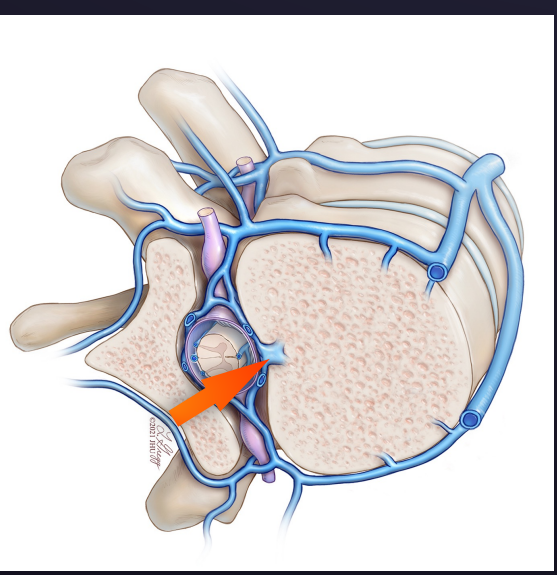
01



Internal Epidural

IWP receives drainage from spinal cord, drains to EVP and basivertebral veins

02



Basivertebral

BV systems drains through the vertebral body to EVP anteriorly

03

IVVP



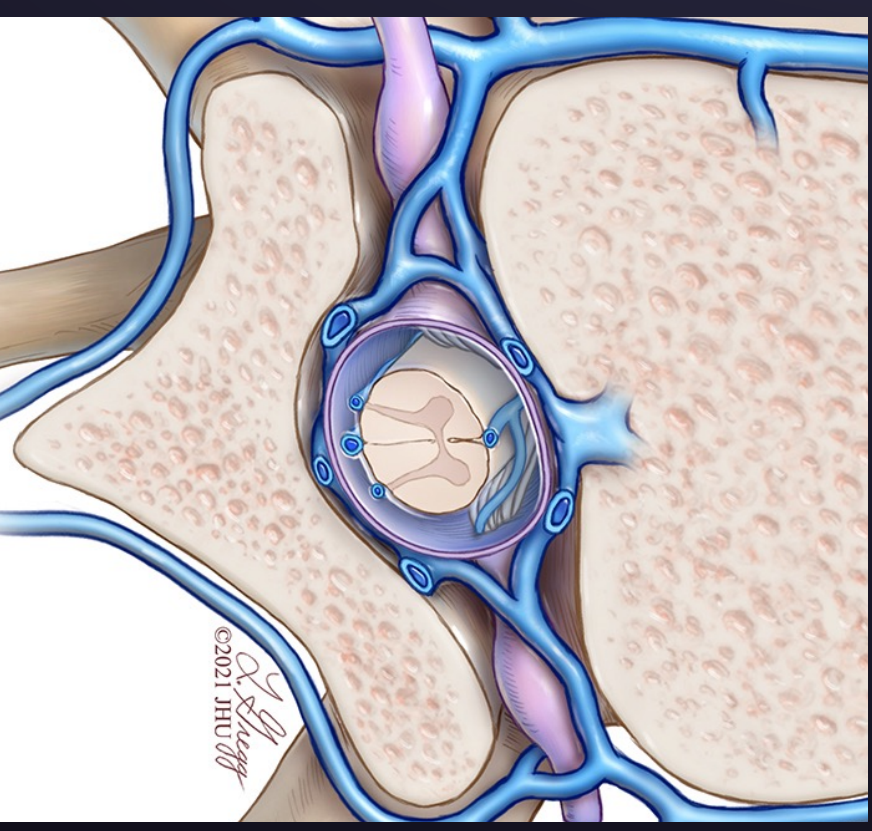
EASY TO MISS

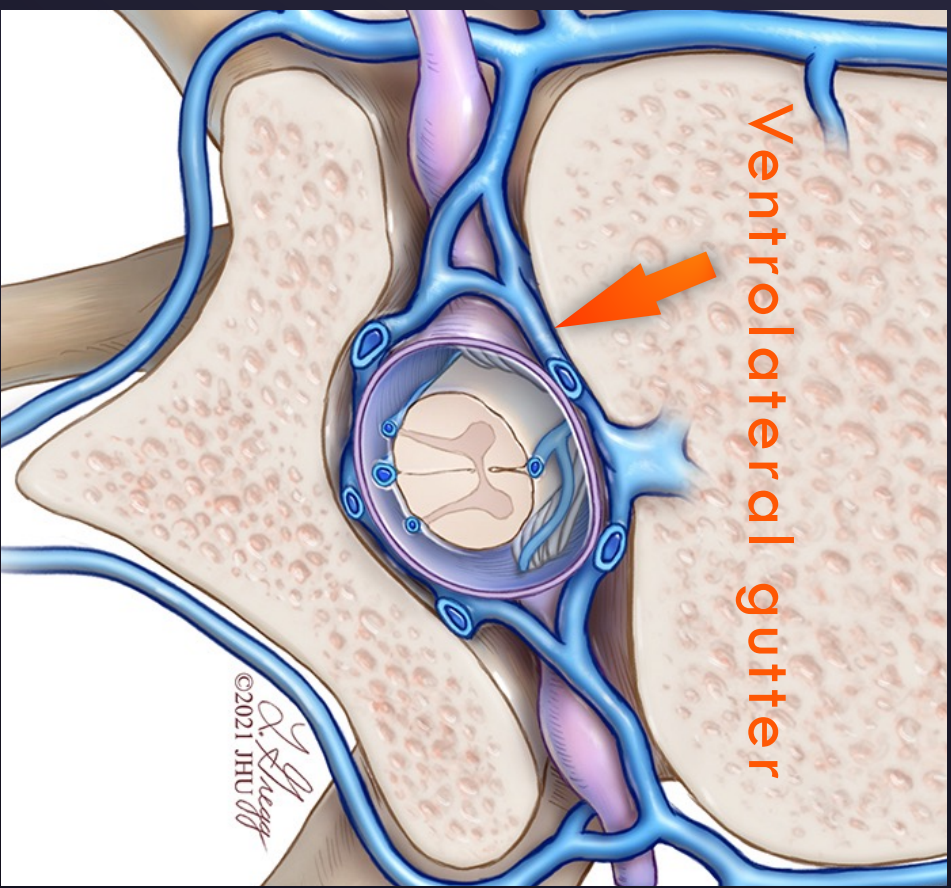
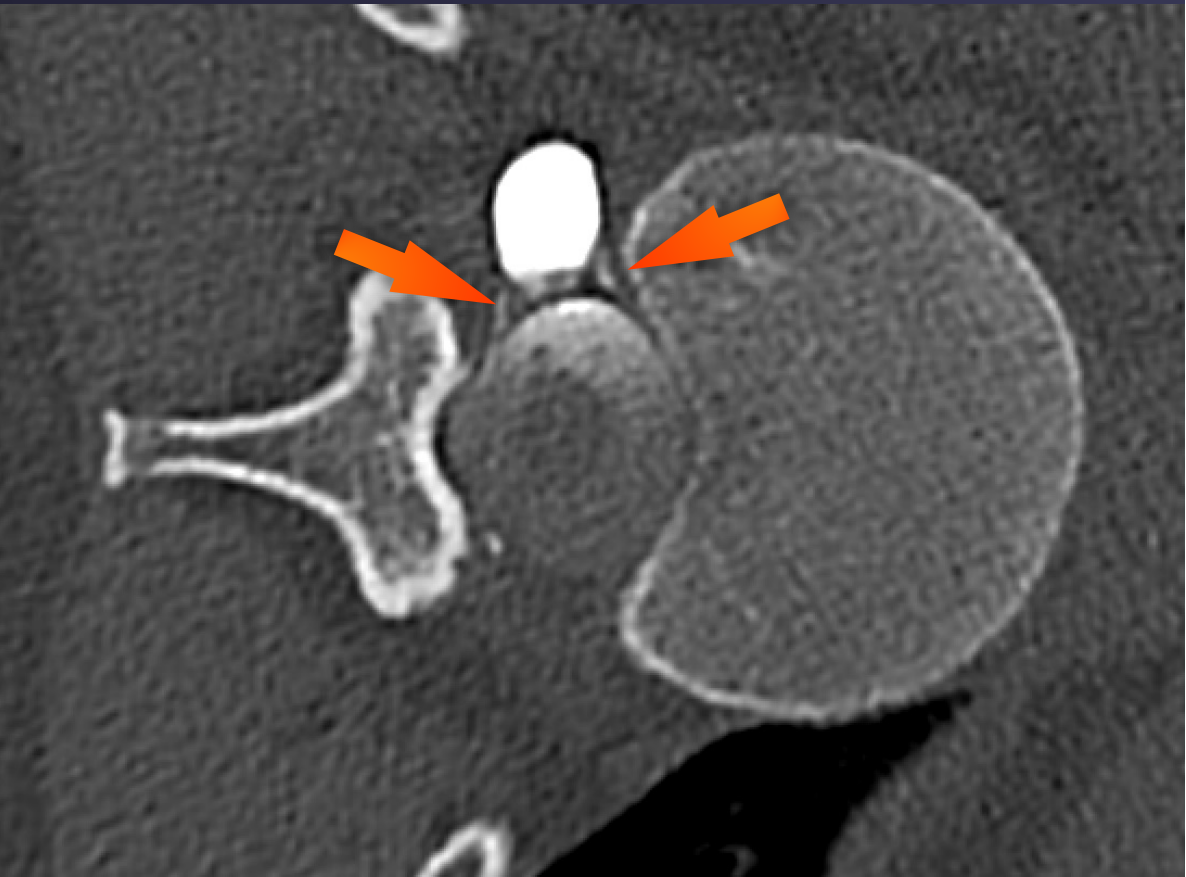
May only be small areas of opacification around nerve root sleeves or around thecal sac

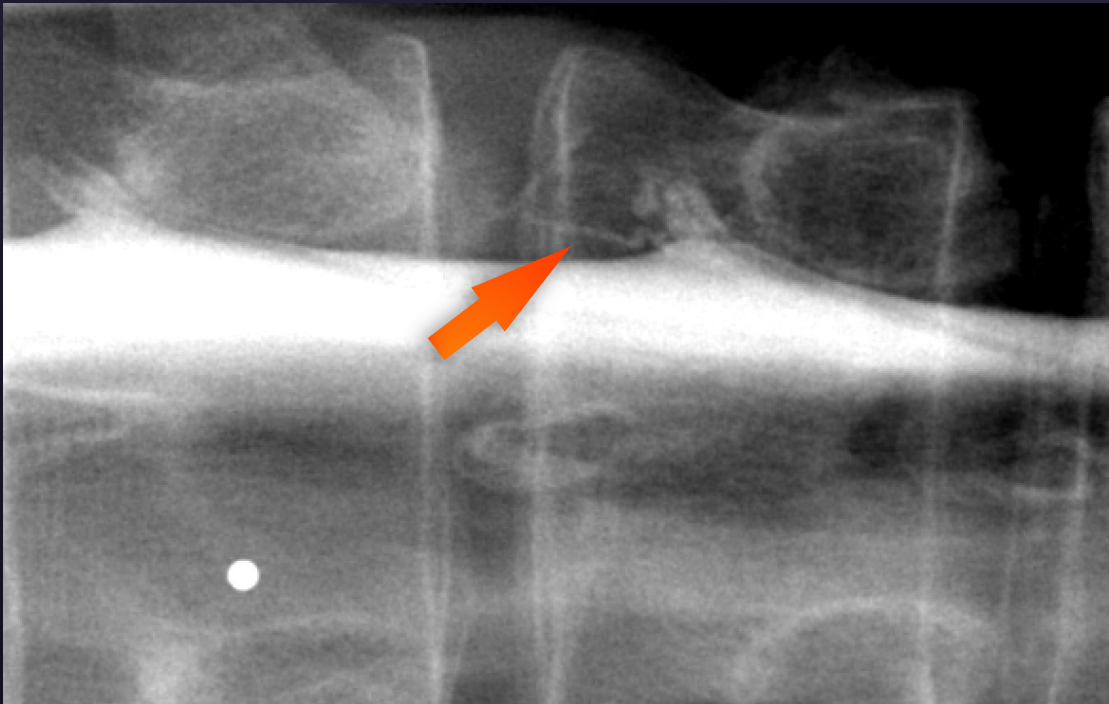


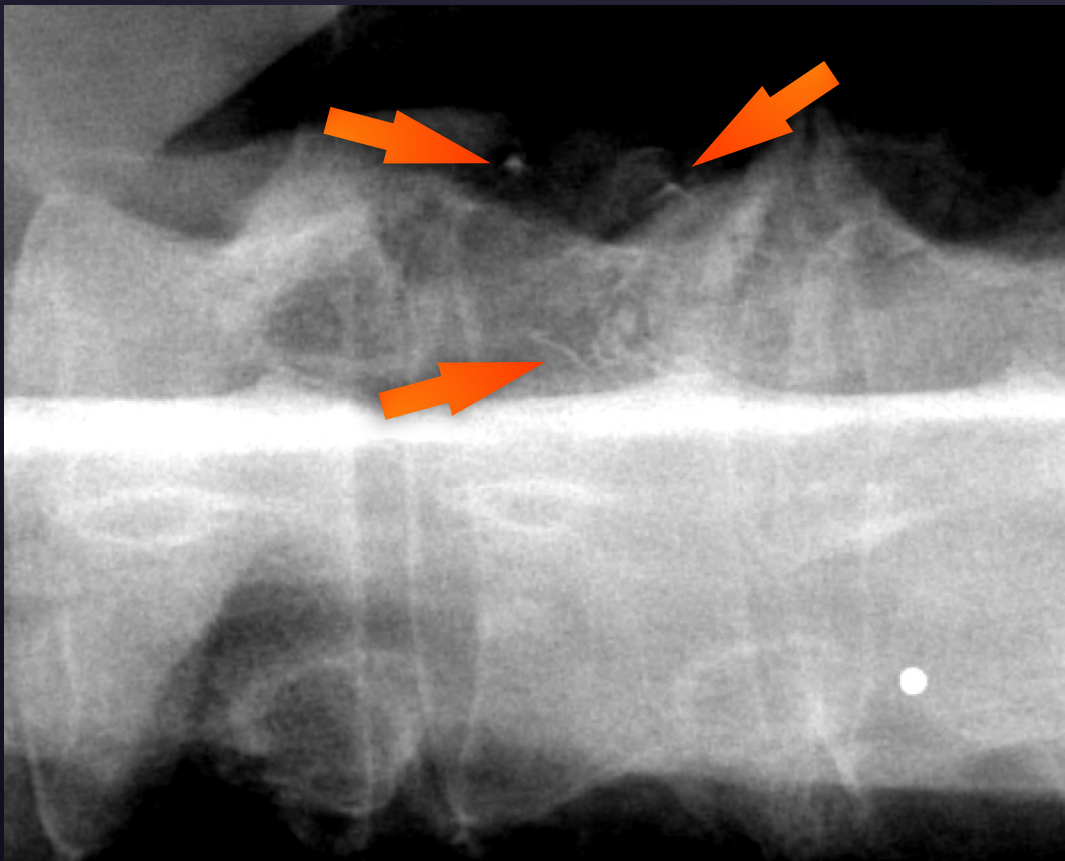
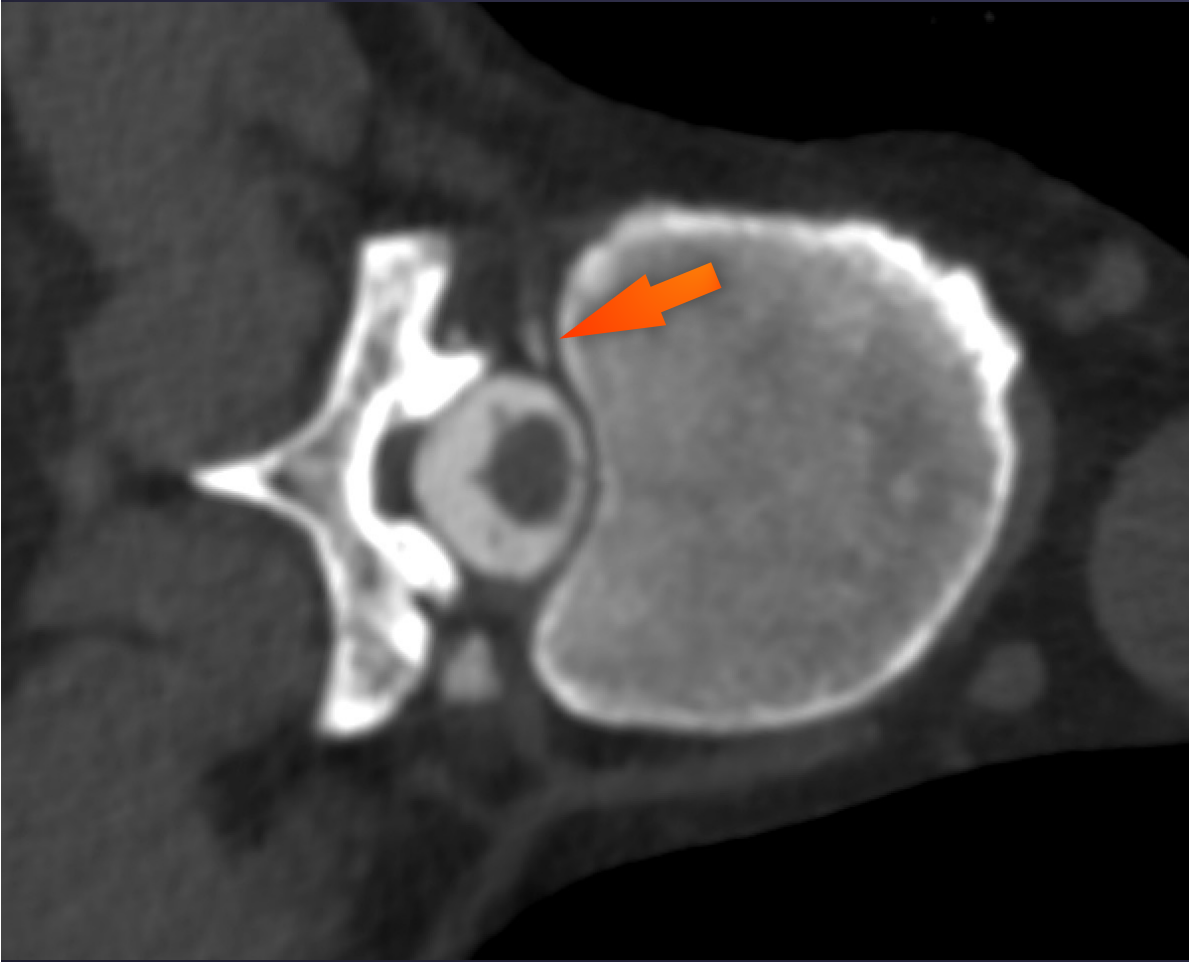
MIMIC EPIDURAL LEAK

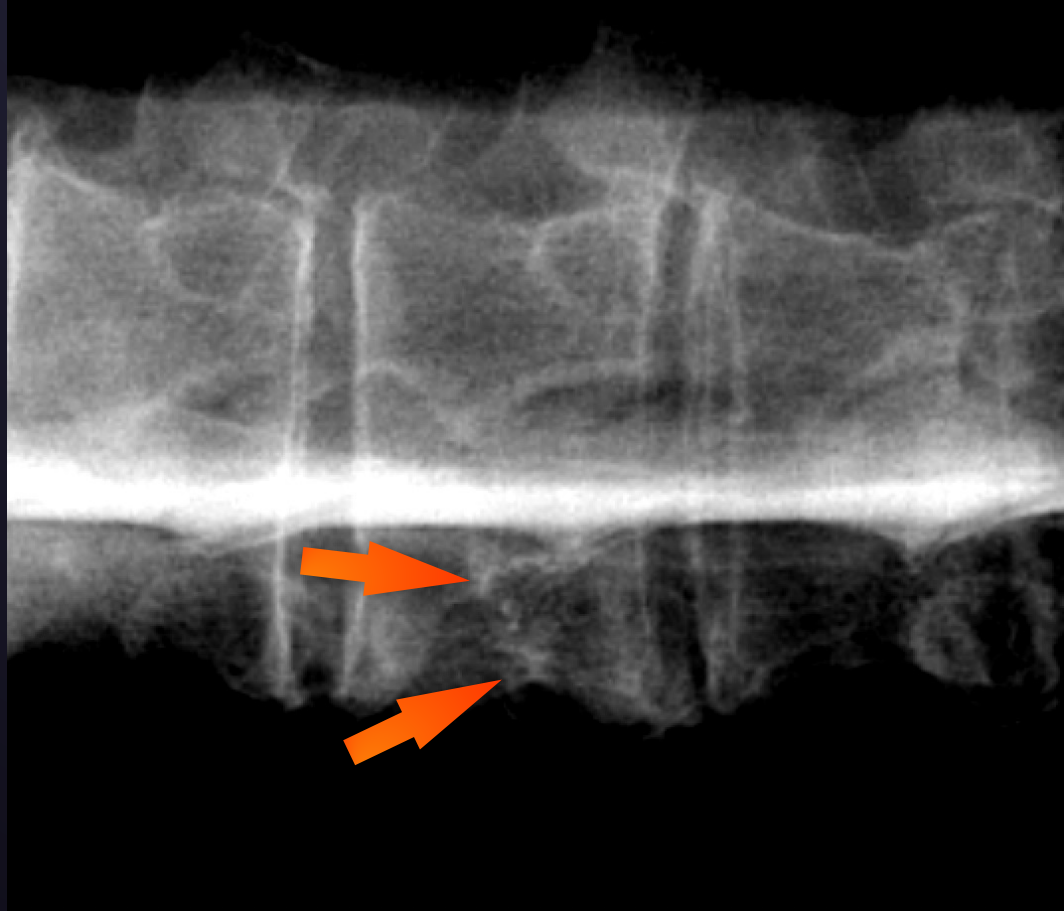
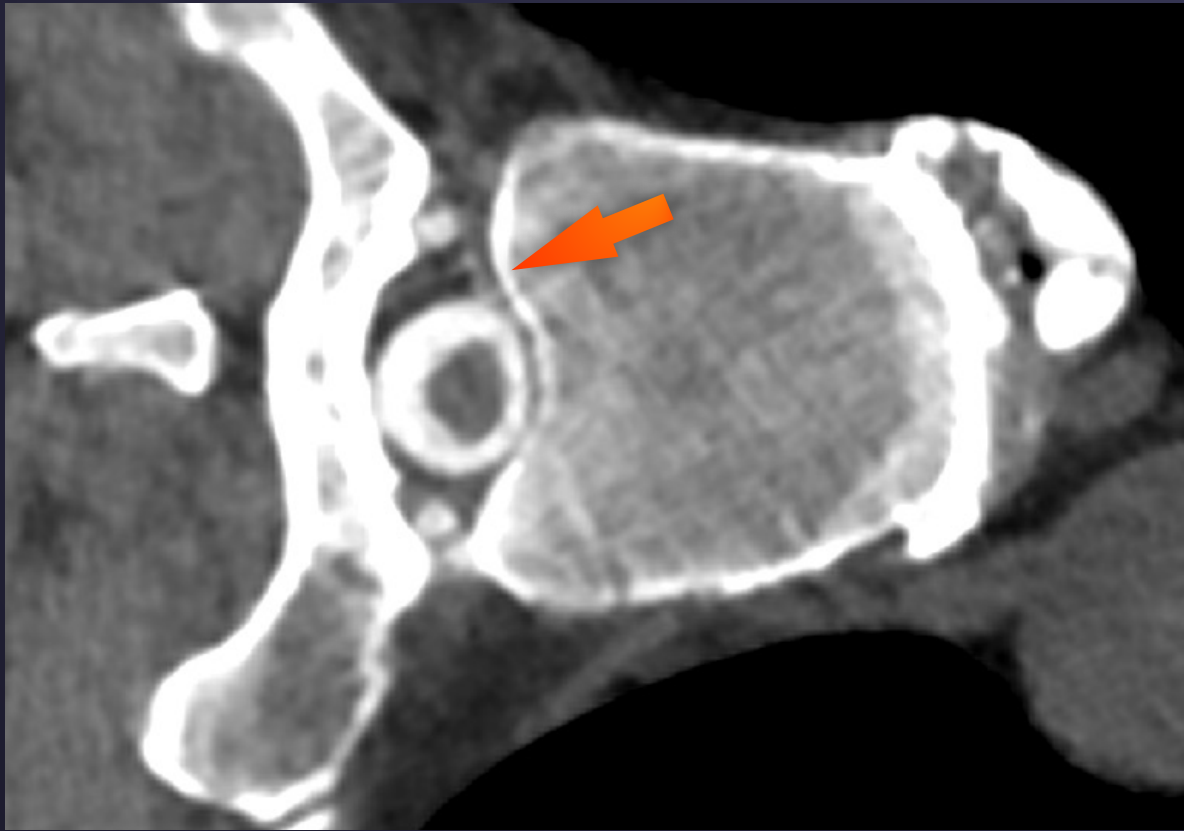
Unlike epidural leak, CVF is typically separated from the thecal sac by a rim of epidural fat

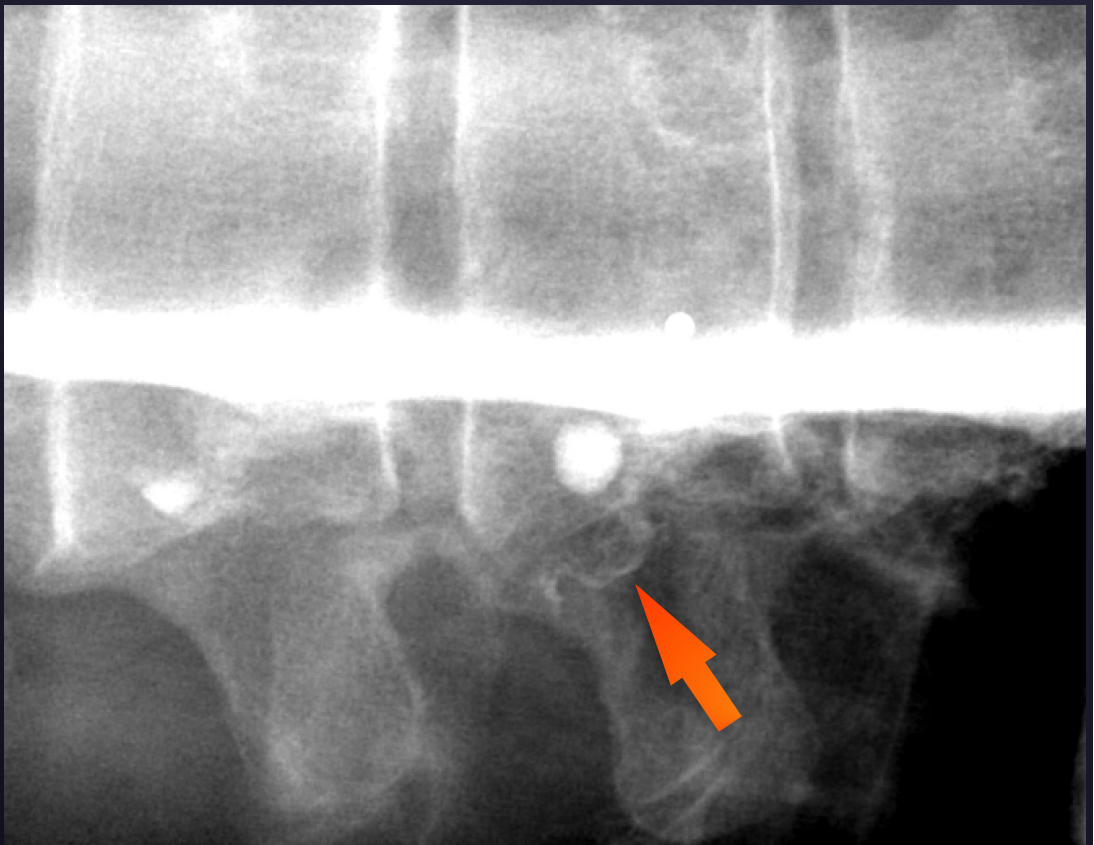
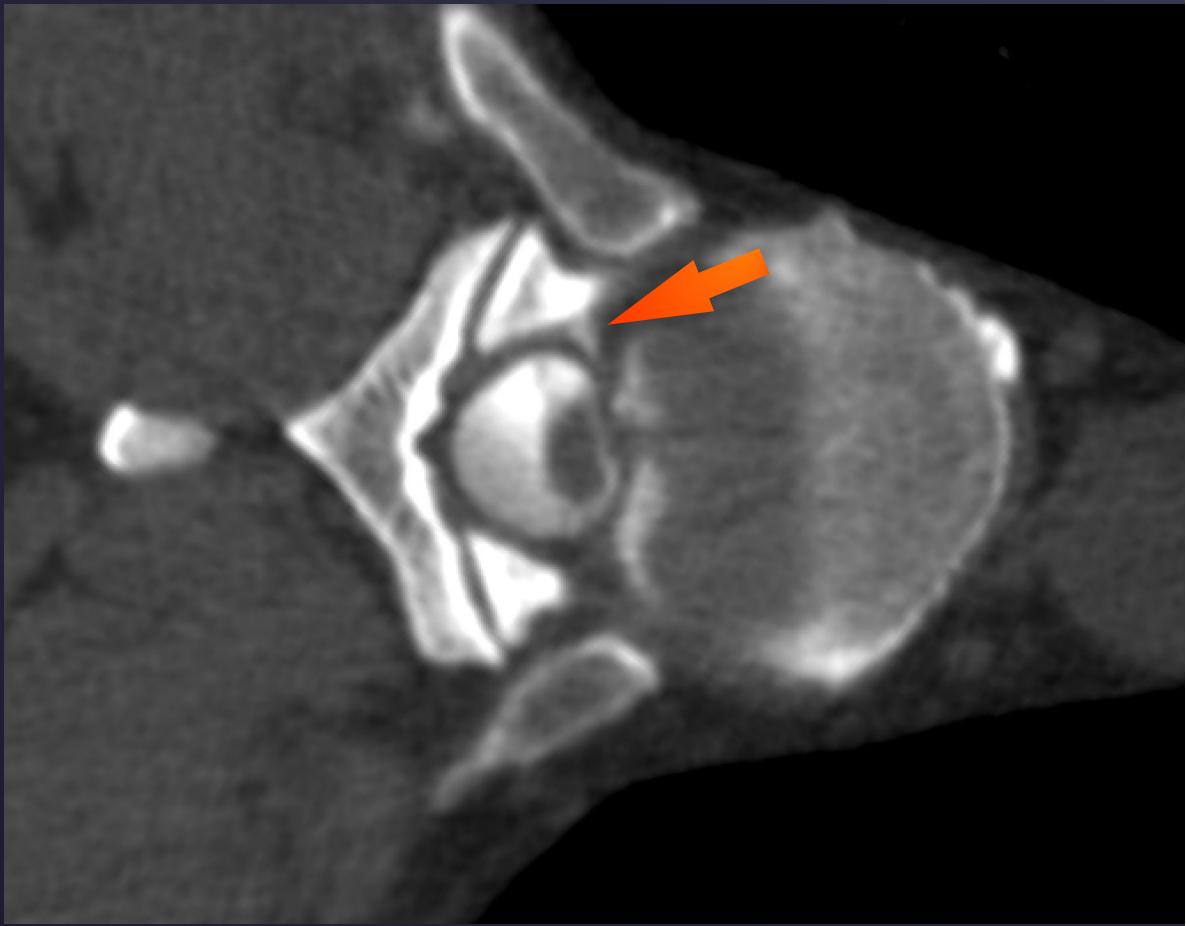




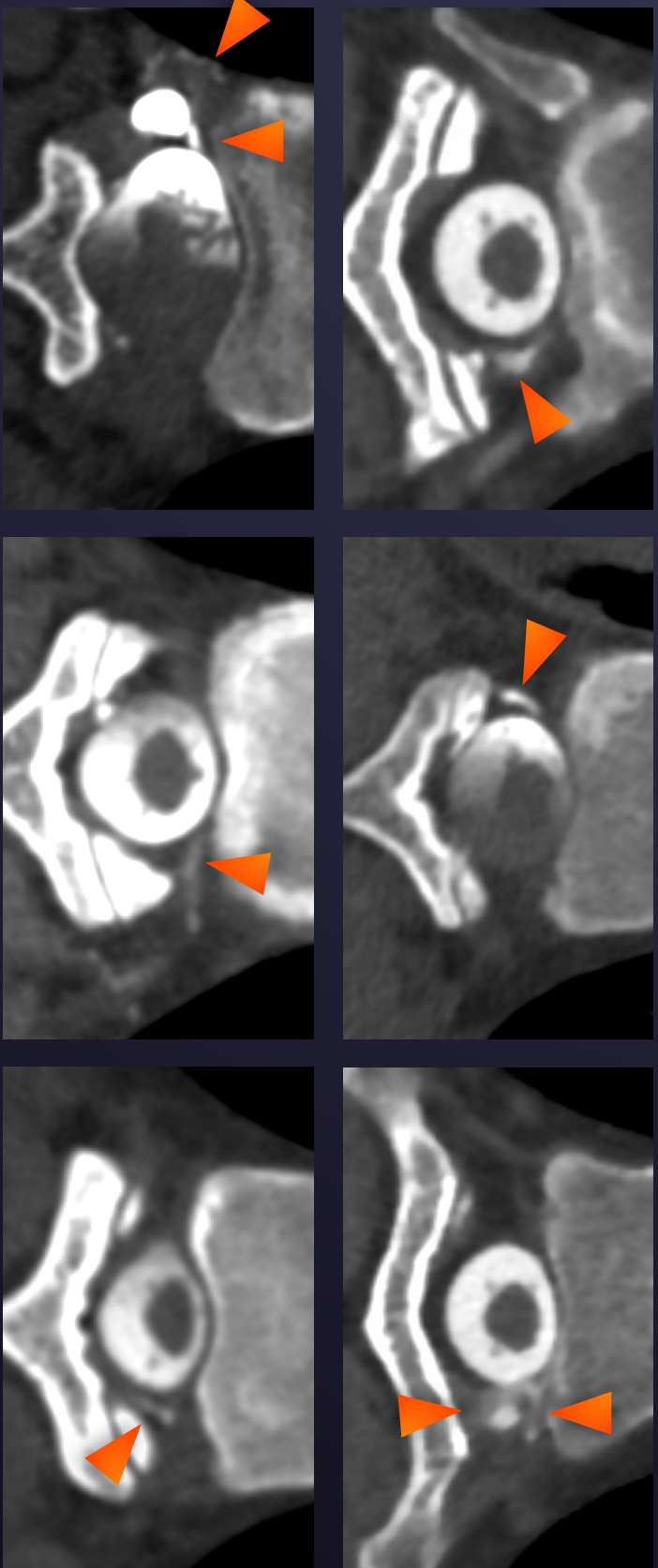


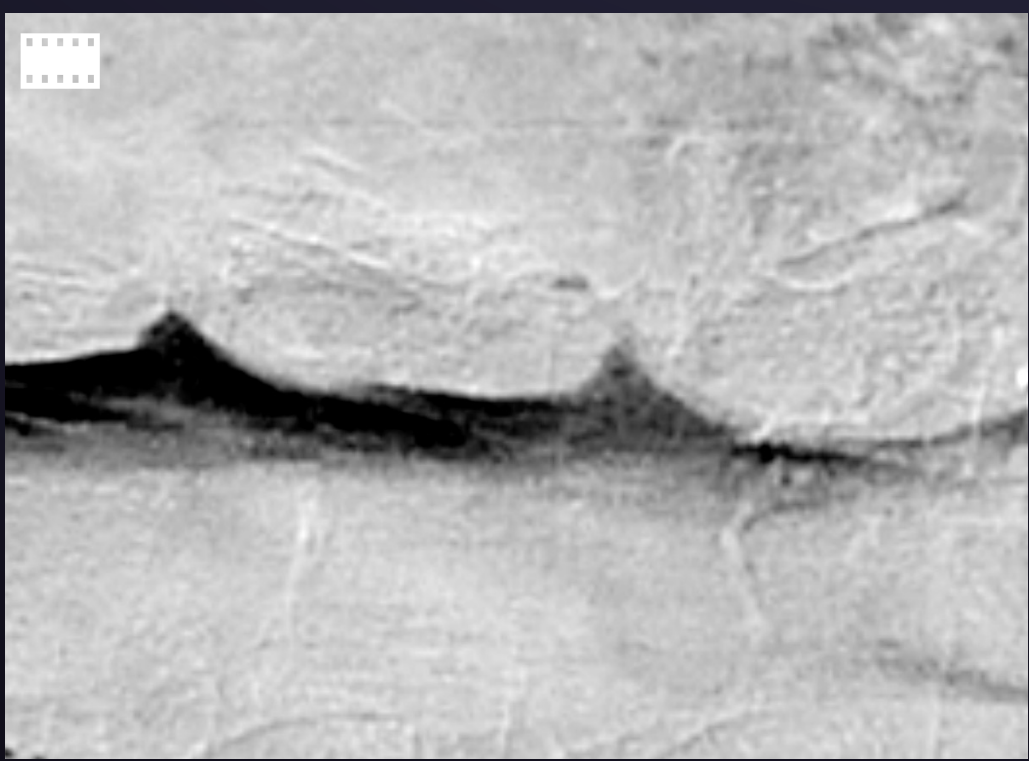
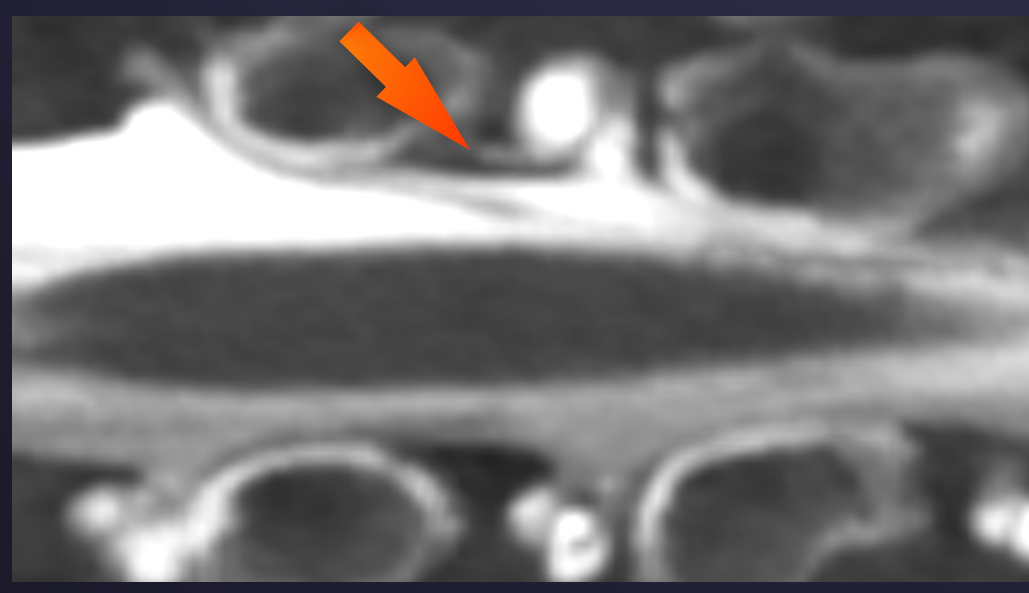
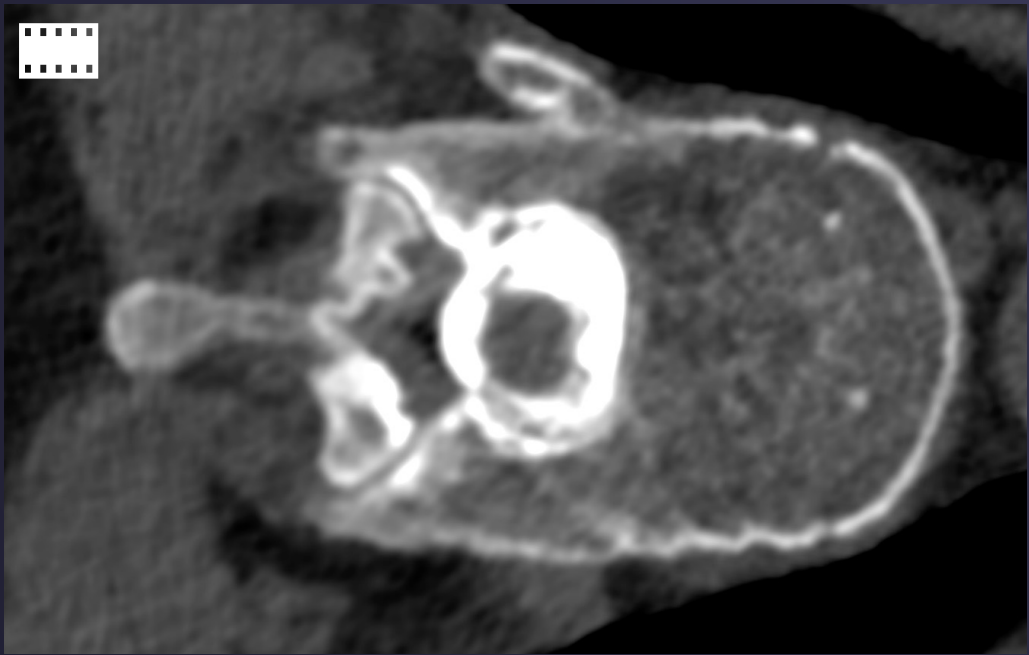


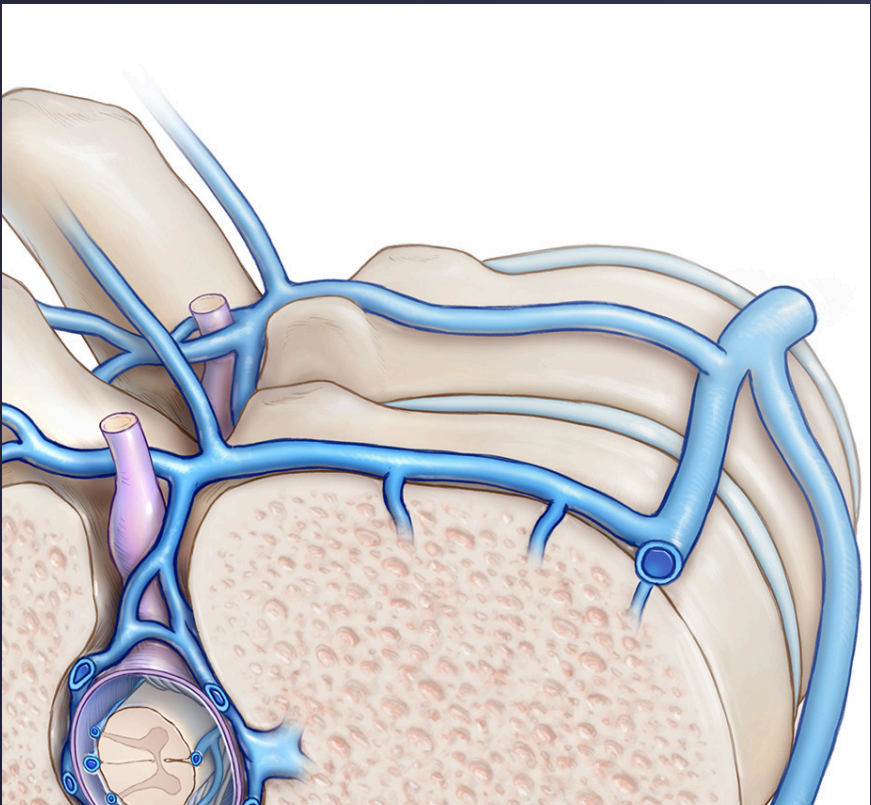




IVVP Gallery







EVVP



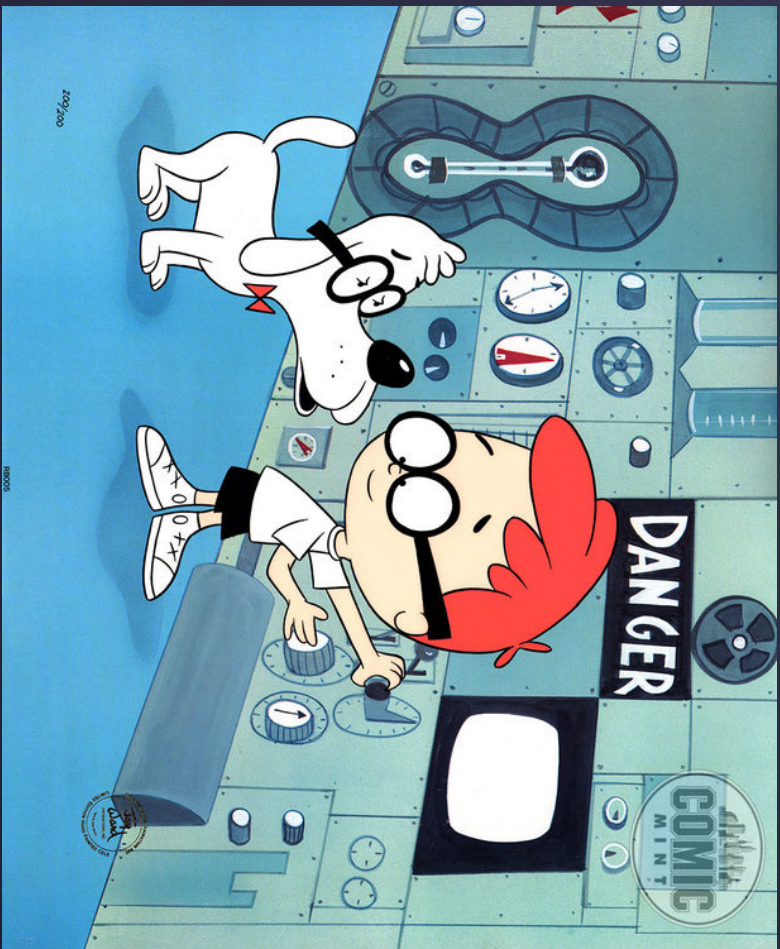
SEGMENTAL VEINS

Most common location to see drainage, directed toward azygos/hemiazygos system

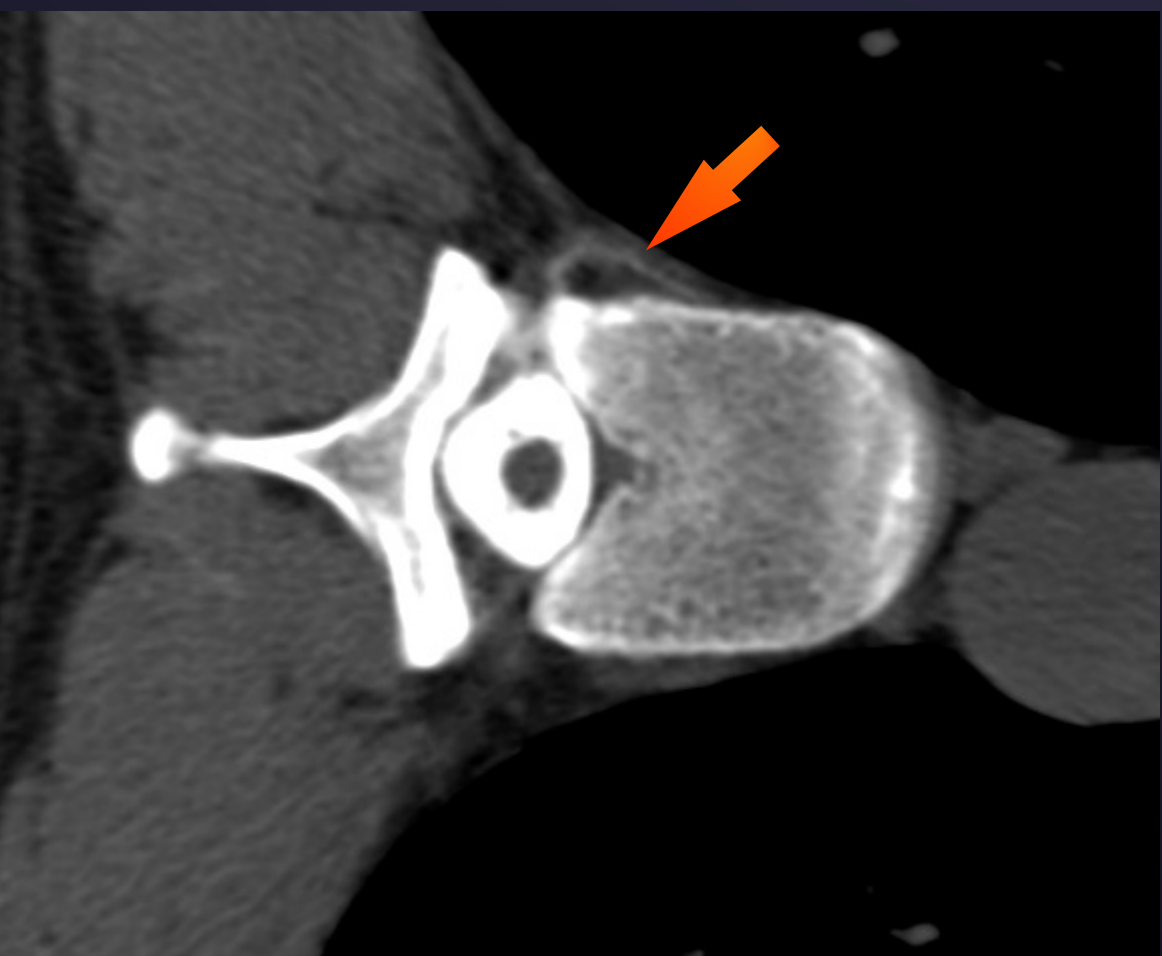


LATERAL & MUSCULAR BRANCHES

Also important locations to check, may differentially fill with different phases of respiration

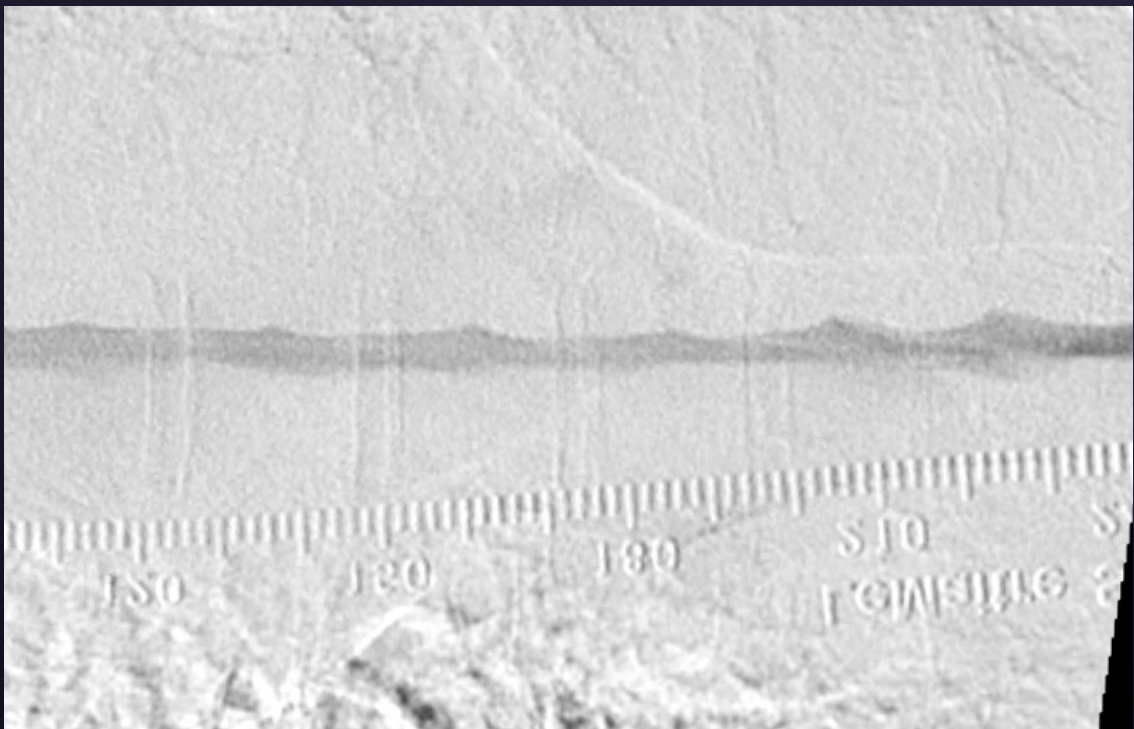
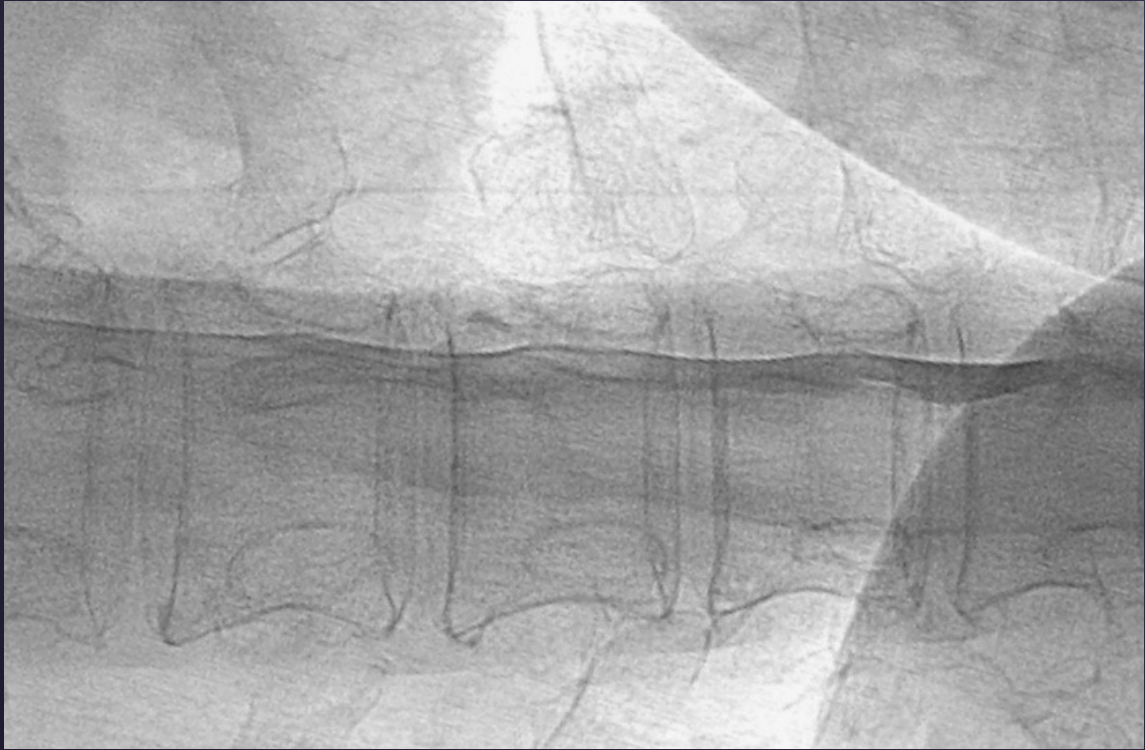


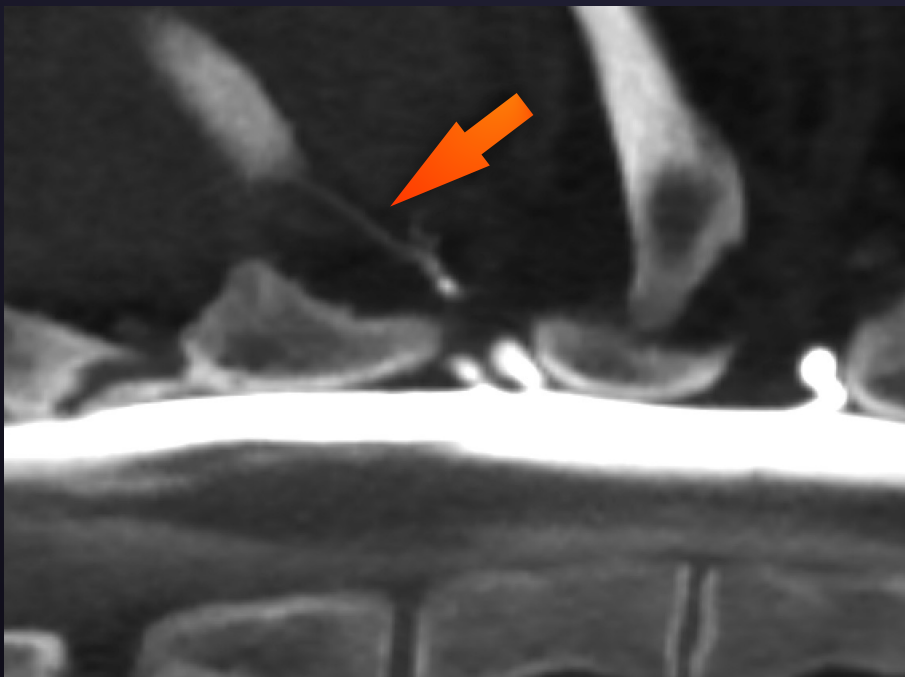
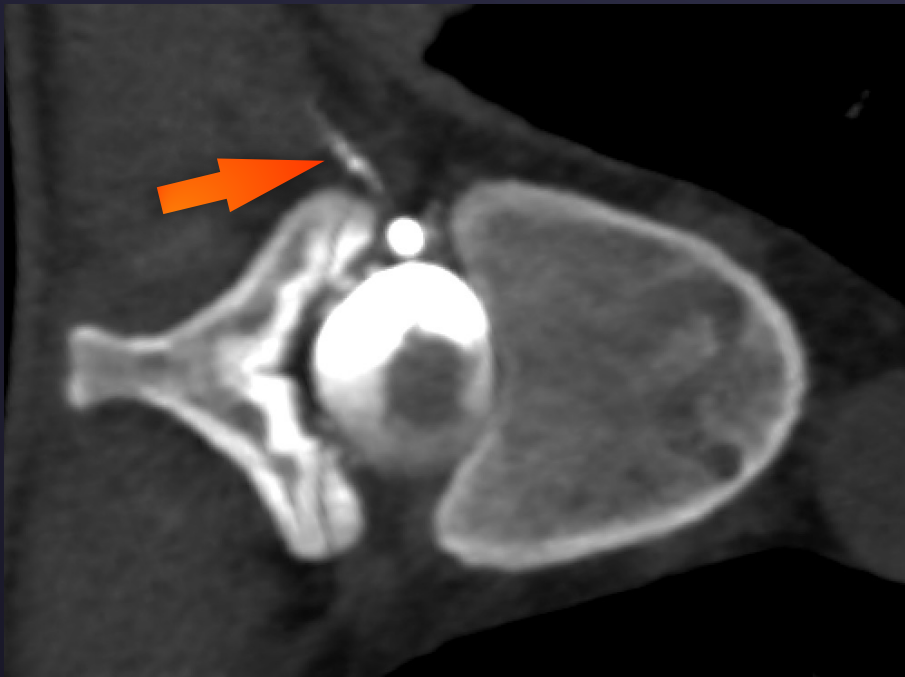
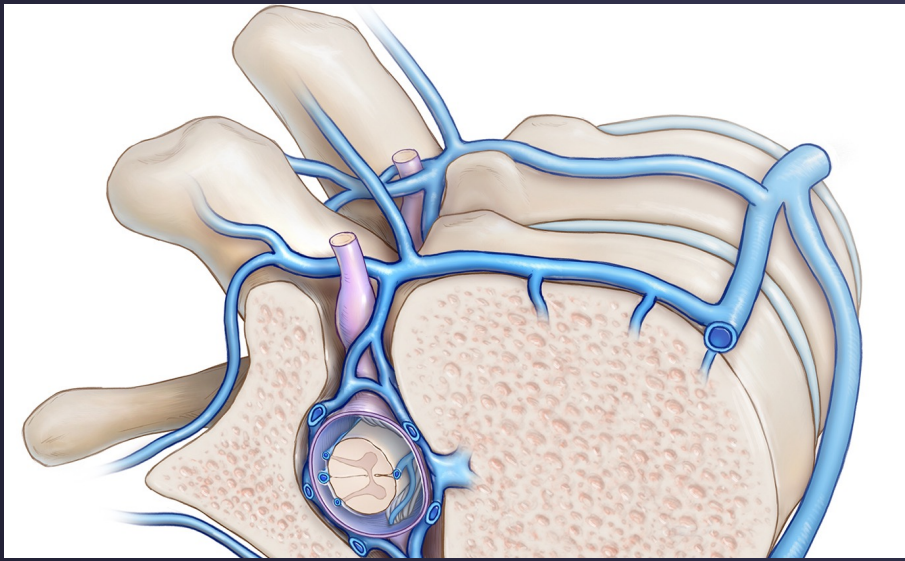
<https://www.comic-mint.com/classic-cartoons/peabodyandsherman-tv-000-405-325dm>

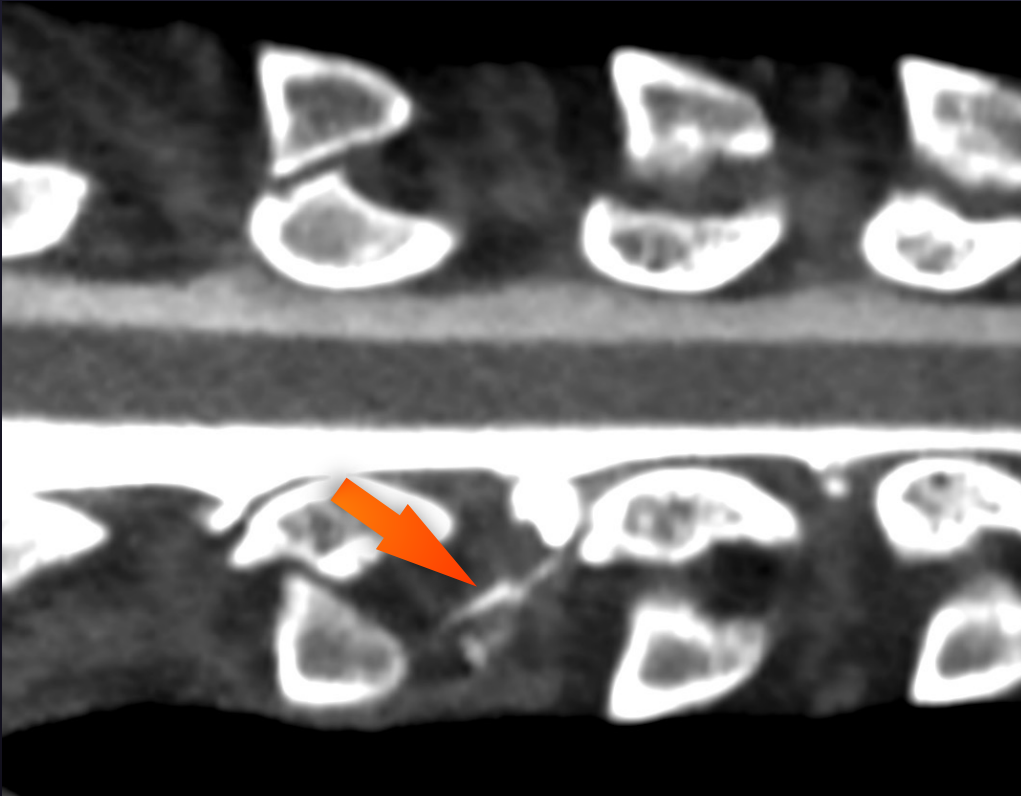
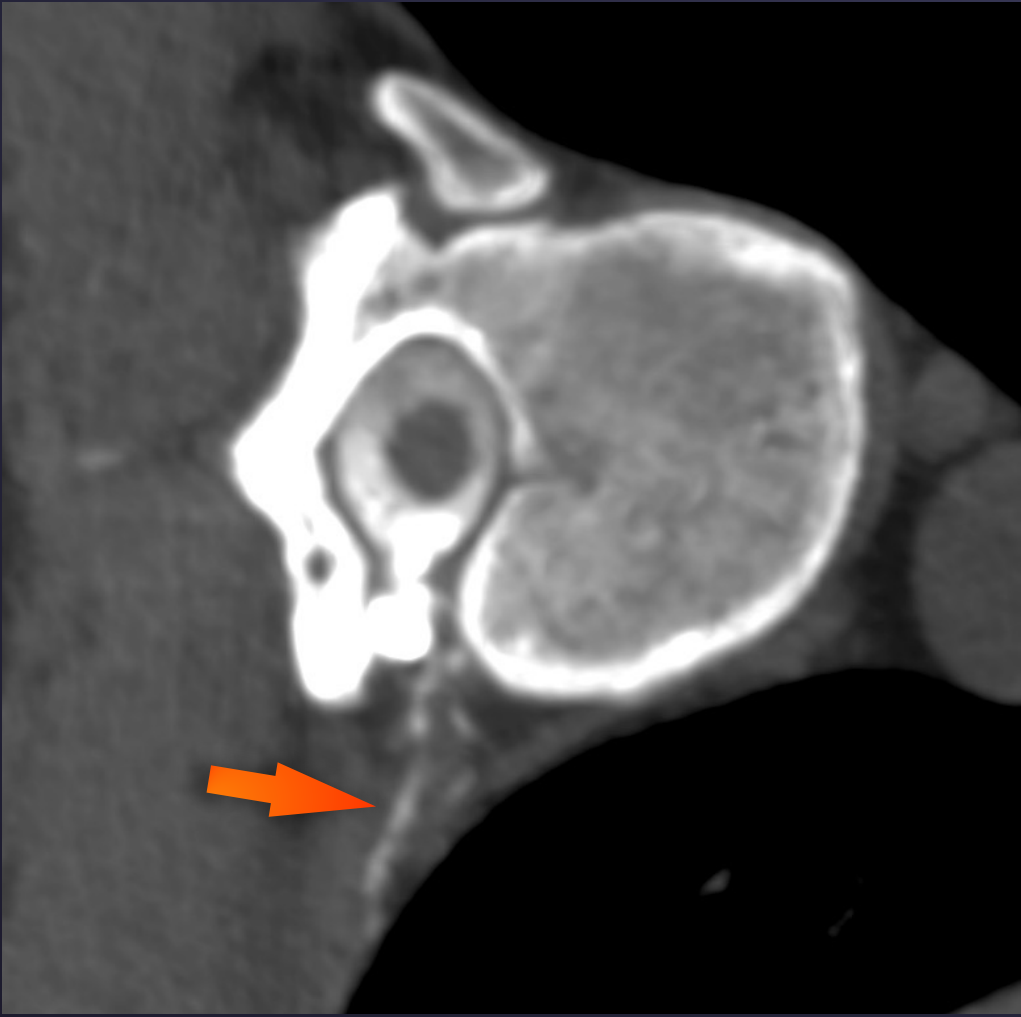


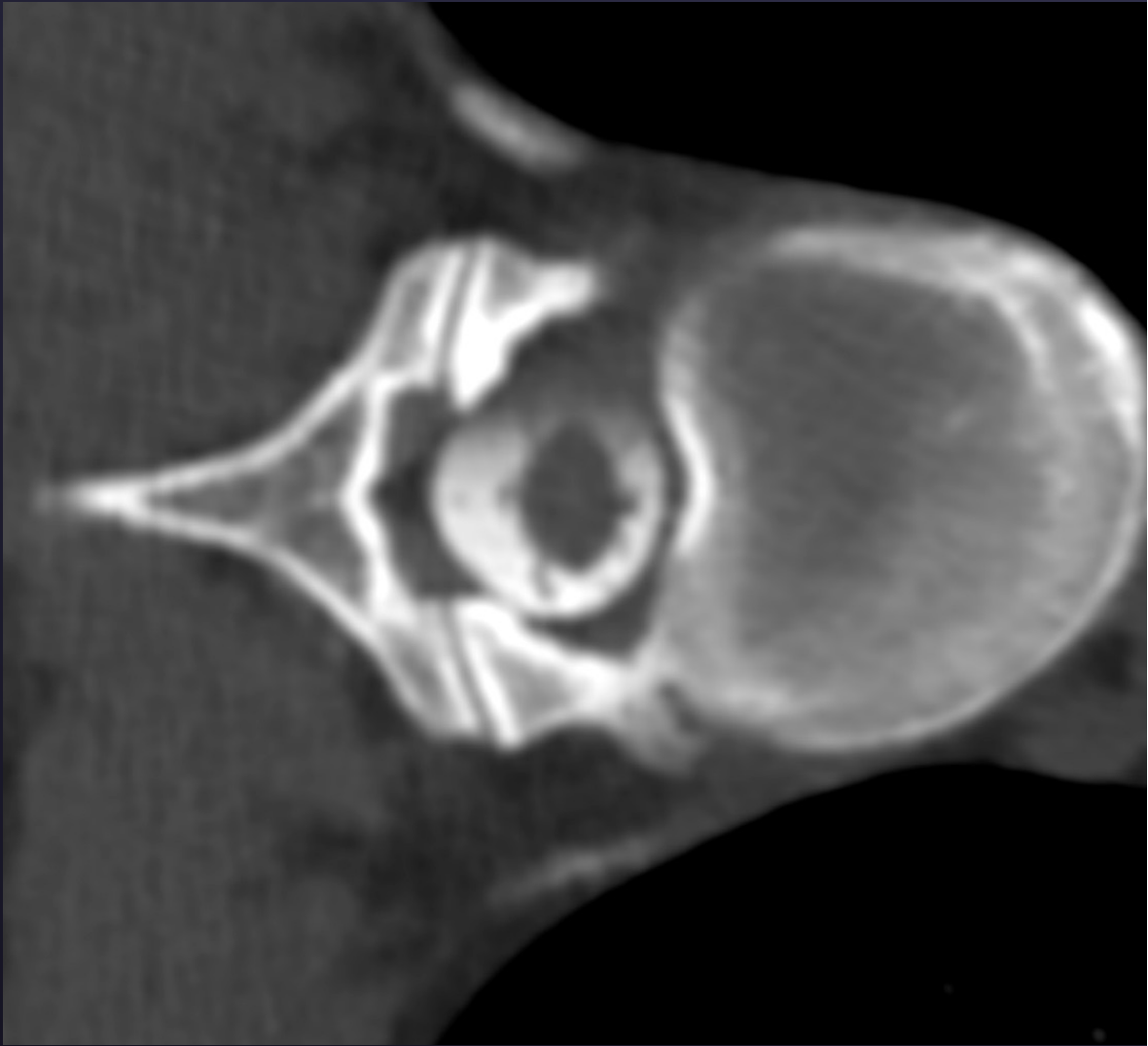


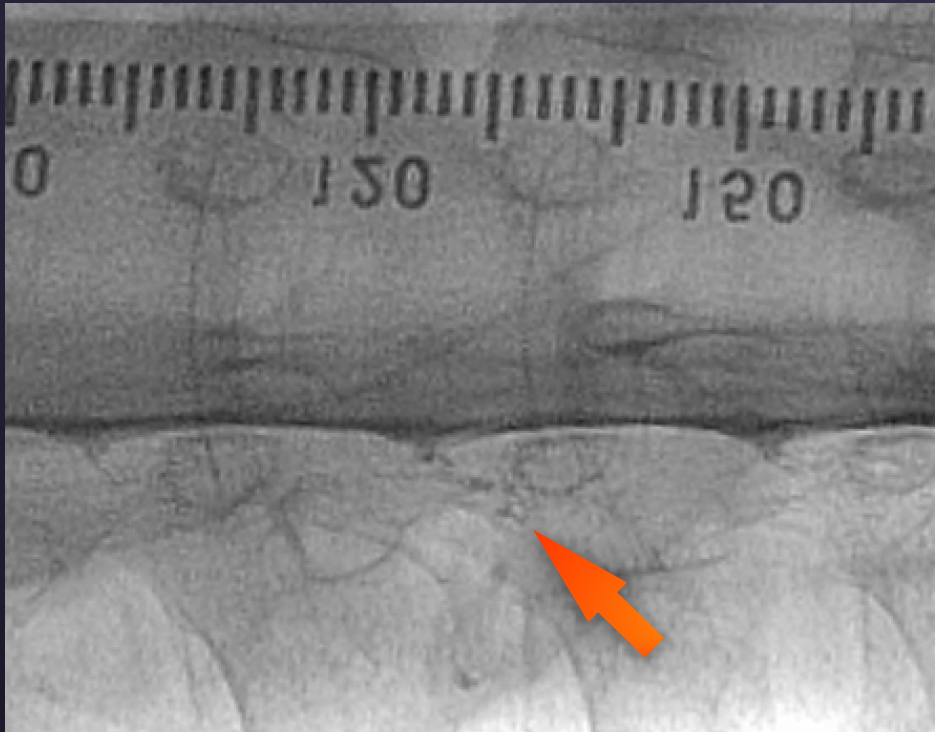
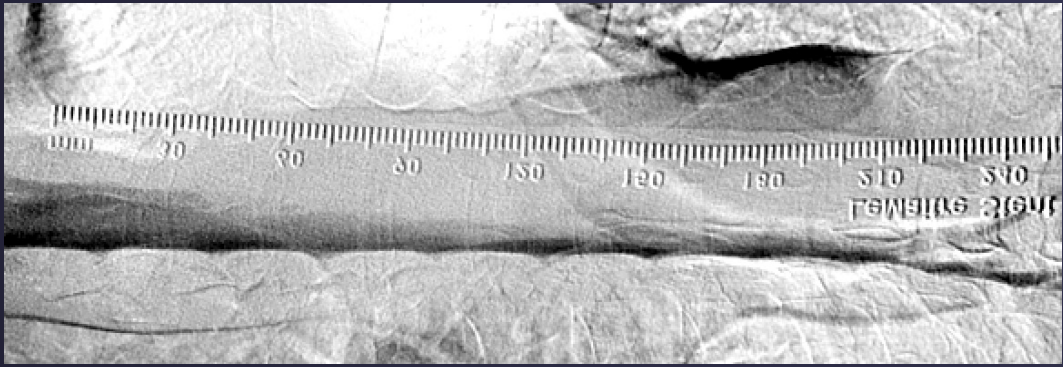




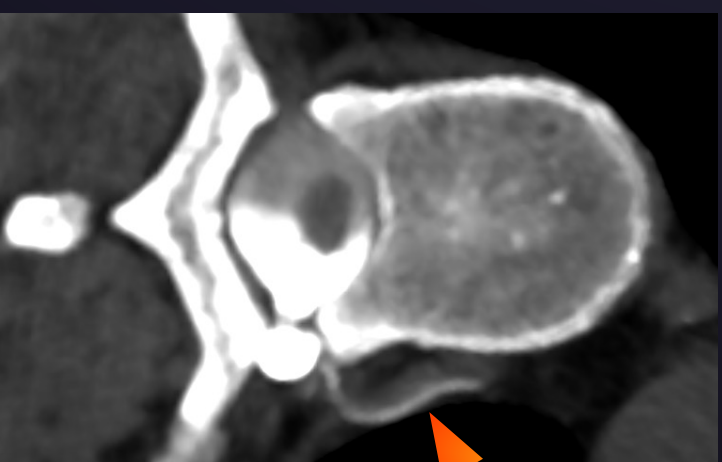








EVVP Gallery



BASIVERTEBRAL



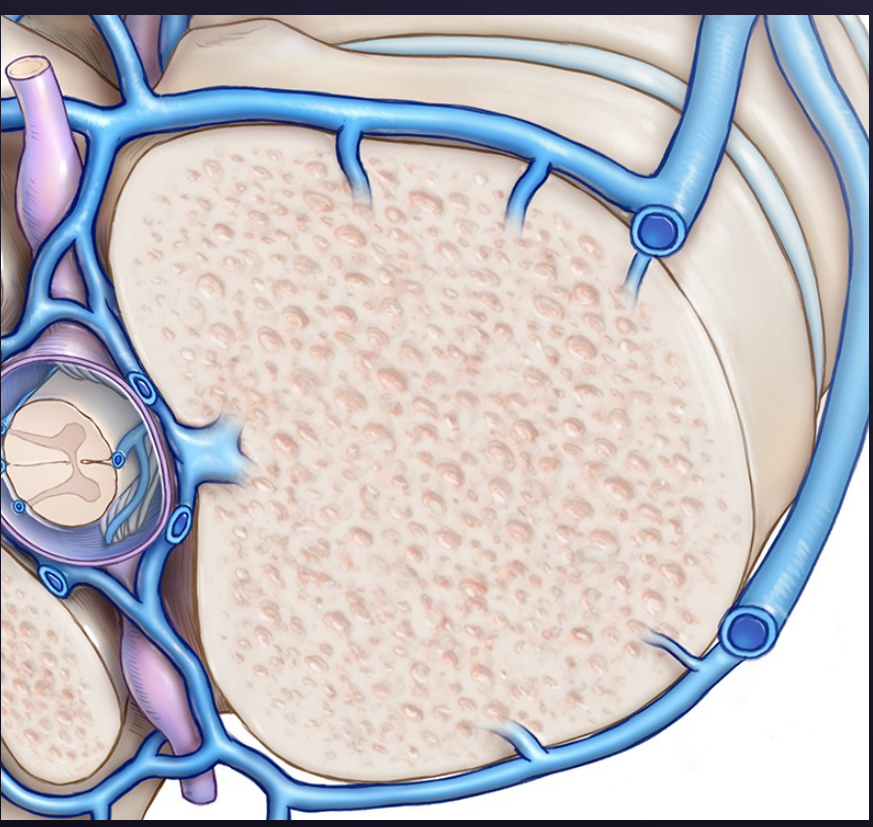
LOOK IN THE VERTEBRA

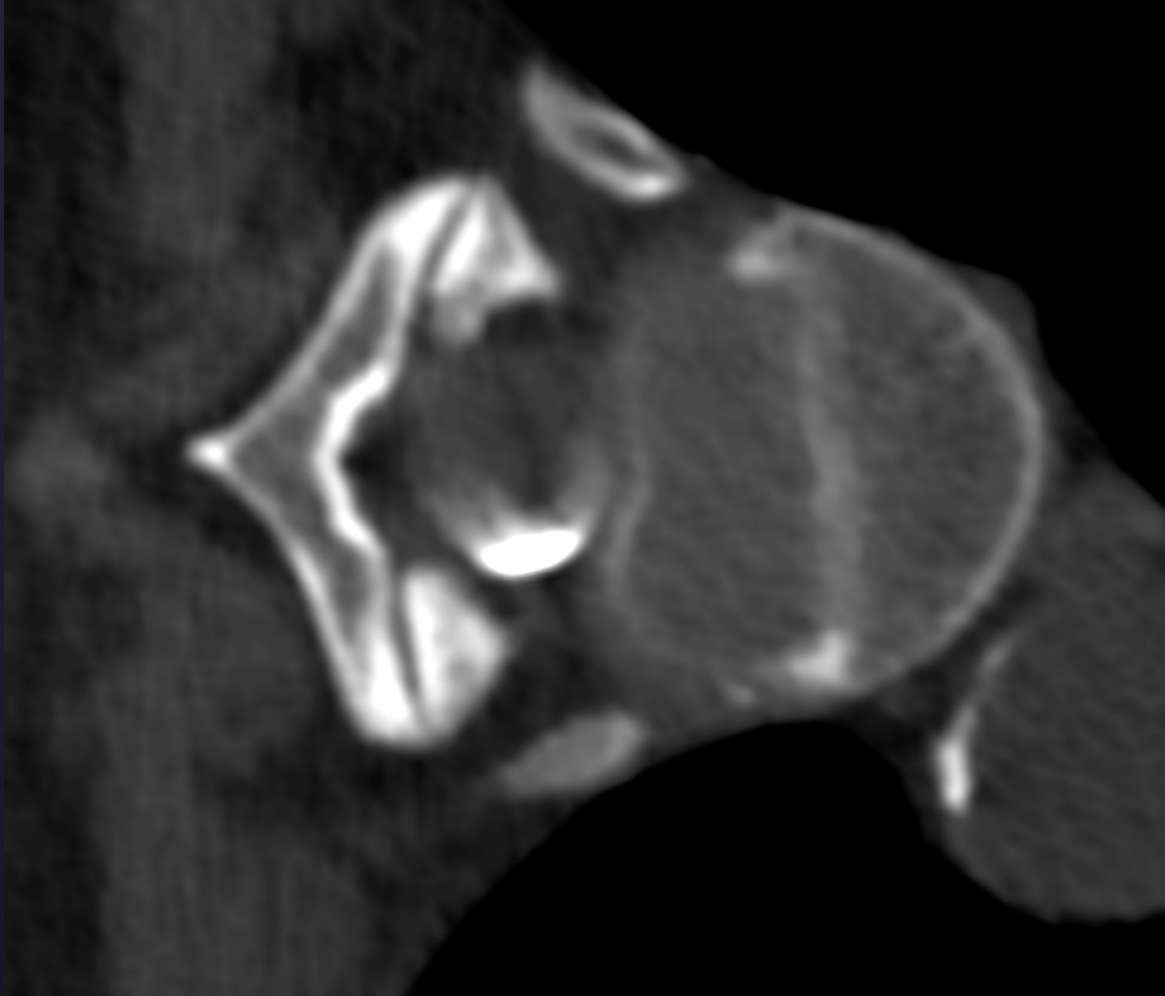
Usually fill by basivertebral vein, but can enter through other venous channels, or be in the posterior elements



OTHER PATHWAYS

Basivertebral filling is usually associated with visualization of veins in the IVVP or EVVP. In rare cases, it may be the solitary drainage pathway.





PATHOGENESIS



We don't know how or why they arise



Seem to be unidirectional



What are the normal relationships between CSF and spinal veins?

ORIGINALS

Human Spinal Arachnoid Villi and Granulations

D. K. Kido, D. G. Gomez, A. M. Pawese, Jr., and D. G. Potts

Department of Radiology, Cornell University Medical College and the Neuroradiology Research Laboratory, William Hale Harkness Building, New York, N. Y. USA

D. K. Kido et al.: Human Spinal Arachnoid Villi and Granulations

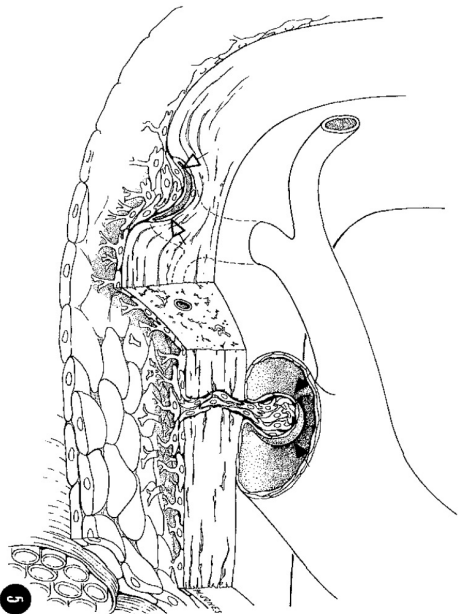


Fig. 5. Diagram showing spinal arachnoid proliferations projecting into and through the dura mater. The proliferation within the dura mater (open arrows) projects into a venous sinus which has penetrated the dura. The epidural proliferation (closed arrows) has a venous sinus surrounding its body and fundus. Both proliferations have their bases associated with the subarachnoid space which is bridged by trabeculae formed by the cytoplasmic extensions of the arachnoid cells. The subarachnoid space narrows toward the right of the diagram as it approaches the subarachnoid angle

Nerve Root	Location	Relation to Nerve Root	Relation to Dura Mater	Relation to Venous Sinuses	Size $10^3 \mu^3$
1	I L	Th ₁₁	0	None	0
2	I R	Th ₁₁	Epidural	None	1.03×10^7
3	I L	Th ₁₂	0	None	0
4	I L	L ₁	Dural	Possible	2.62×10^6
5	I L	L ₁	Internal to Dura	Definite	4.52×10^7
6	I L	L ₂	Internal to Dura	Definite	2.59×10^7
7	II R	Th ₈	Dural	Definite	3.39×10^7
8	II R	Th ₈	Dural	Definite	5.00×10^7
9	II R	Th ₉	Dural	Possible	8.20×10^6
10	II R	Th ₉	Dural	Definite	2.61×10^7
11	II R	Th ₁₀	Epidural	Possible	5.56×10^7
12	II R	Th ₁₀	Dural	Definite	2.86×10^7
13	II R	Th ₁₀	Epidural	Definite	5.43×10^6
14	II R	Th ₁₀	Dural	Definite	2.36×10^8
15	II R	Th ₁₁	Epidural	Possible	2.45×10^7
16	II R	Th ₁₁	Dural	Definite	7.73×10^7
17	II R	Th ₁₁	Epidural	Definite	1.17×10^8
18	II R	L ₁	Dural	Definite	1.10×10^8
19	II R	L ₁	Dural	Definite	8.48×10^7
20	II R	L ₁	Dural	Possible	1.55×10^7
21	II R	L ₁	Dural	Definite	2.18×10^6
22	II R	L ₁	0	None	0
23	II R	L ₁	Dural	Definite	2.51×10^8
24	II R	L ₁	Epidural	Definite	6.22×10^7
25	II R	L ₁	Internal to Dura	Definite	3.39×10^7
26	II R	L ₁	Dural	Possible	7.82×10^7
27	III R	Th ₄	Dural	Definite	2.76×10^7
28	III R	Th ₄	Internal to Dura	Definite	2.93×10^7
29	III R	Th ₅	Dural	Possible	7.82×10^7
30	III R	Th ₅	Internal to Dura	Definite	2.76×10^7
31	III R	Th ₅	Epidural	Definite	2.93×10^7
32	III R	Th ₅	Dural	Definite	2.68×10^7
33	III R	Th ₅	Epidural	None	6.88×10^6
34	III R	Th ₅	Dural	None	1.36×10^6
35	III R	Th ₅	Epidural	None	1.22×10^6
36	III R	Th ₆	Dural	Definite	5.18×10^7
37	III R	Th ₆	Dural	Definite	1.67×10^7
38	III R	Th ₆	Epidural	Definite	1.06×10^7
39	III R	Th ₆	Dural	Possible	1.71×10^7
40	III R	Th ₆	Epidural	Definite	6.91×10^7
41	III R	Th ₇	Dural	Definite	1.01×10^7
42	III R	Th ₇	Dural	Possible	1.55×10^7
43	III R	Th ₇	Dural	Definite	4.34×10^6
44	III R	Th ₈	Dural	Possible	1.92×10^7
45	III R	Th ₈	Dural	Definite	2.52×10^6
46	III R	L ₂	Dural	None	9.27×10^6
47	III R	L ₂	Epidural	Definite	8.67×10^7
48	III R	L ₃	Dural	Possible	1.83×10^7

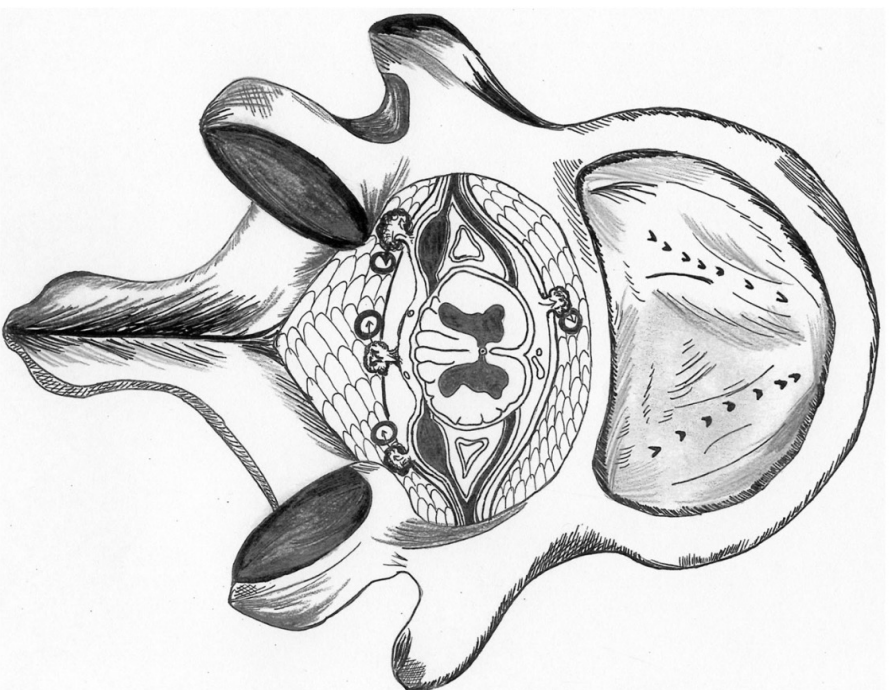


Fig. 1 Schematic diagram of the entire vertebra and spinal cord with spinal arachnoid granulations. The entire vertebra and cord with arachnoid granulations which contact with epidural veins (*curved arrows*)

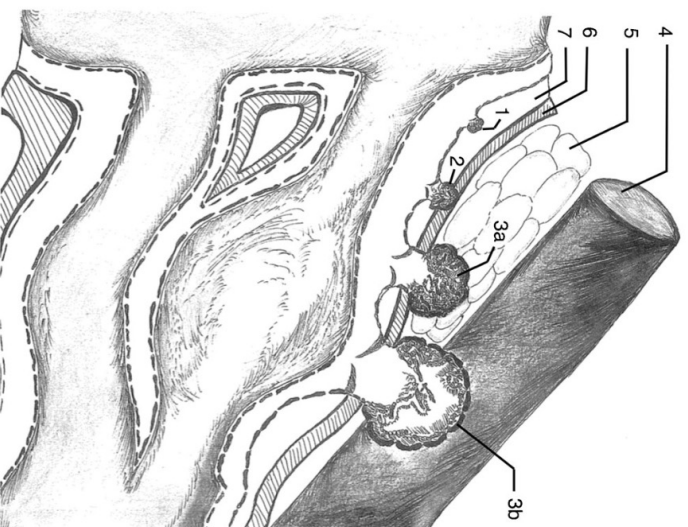
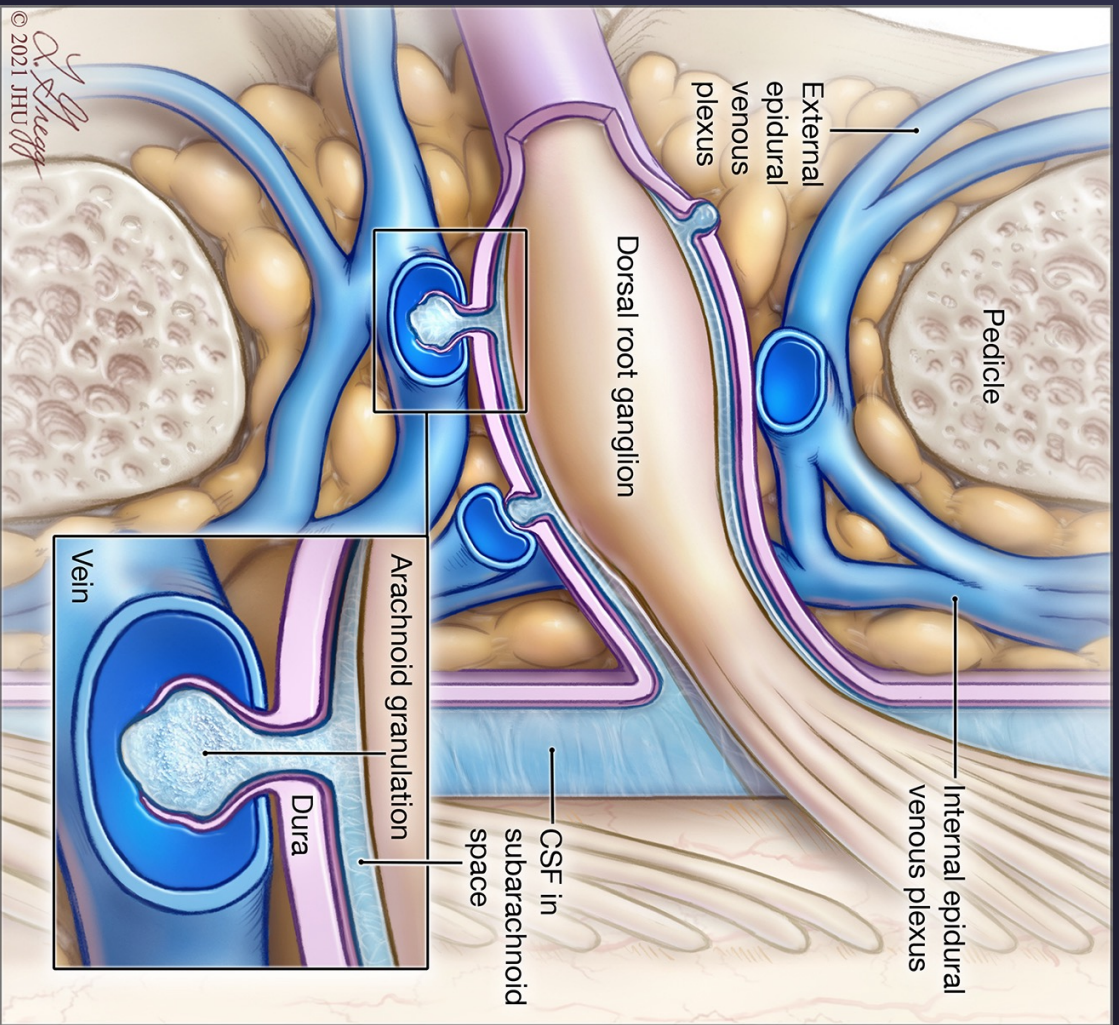


Fig. 2 The classification of spinal arachnoid granulations (SAG). Type 1 SAG (1): slightly protruding, which is completely inside the subdural space (7) and does not break into dura (6); type 2 SAG (2): protruding within the dura, which penetrates into the dura but not beyond it; type 3 SAG (3a and 3b): protruding through the dura, which completely penetrates the dura and protrudes into the epidural space (5). This type of SAG can be further grouped into two subtypes based on their relationship with the epidural veins (4), as some directly contact with a vein (3b) while others do not (3a)



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CVF EXAMPLES

Show examples of CVFs on CT and digital subtraction myelography



PATHOGENESIS

Discuss possible etiologies for the formation of CVFs

Thank you to Cedars-Sinai and Spinal CSF Leak Foundation



...and to all those who support SIH research!

Anatomy & Pathogenesis of CVFs

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