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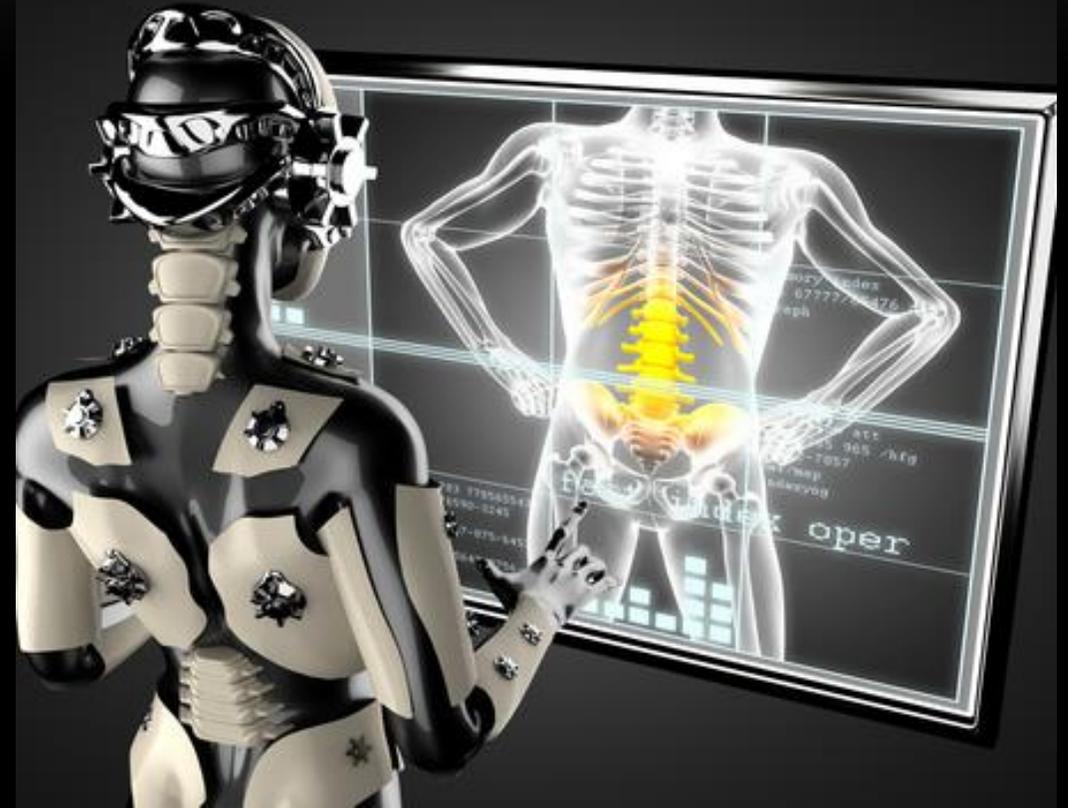
*Epidural Blood Patch for CSF Leak:
Targeted vs Nontargeted EBP*

DISCLOSURES

- No relevant financial disclosures to this lecture
- Paid honorarium as AJNR senior editor

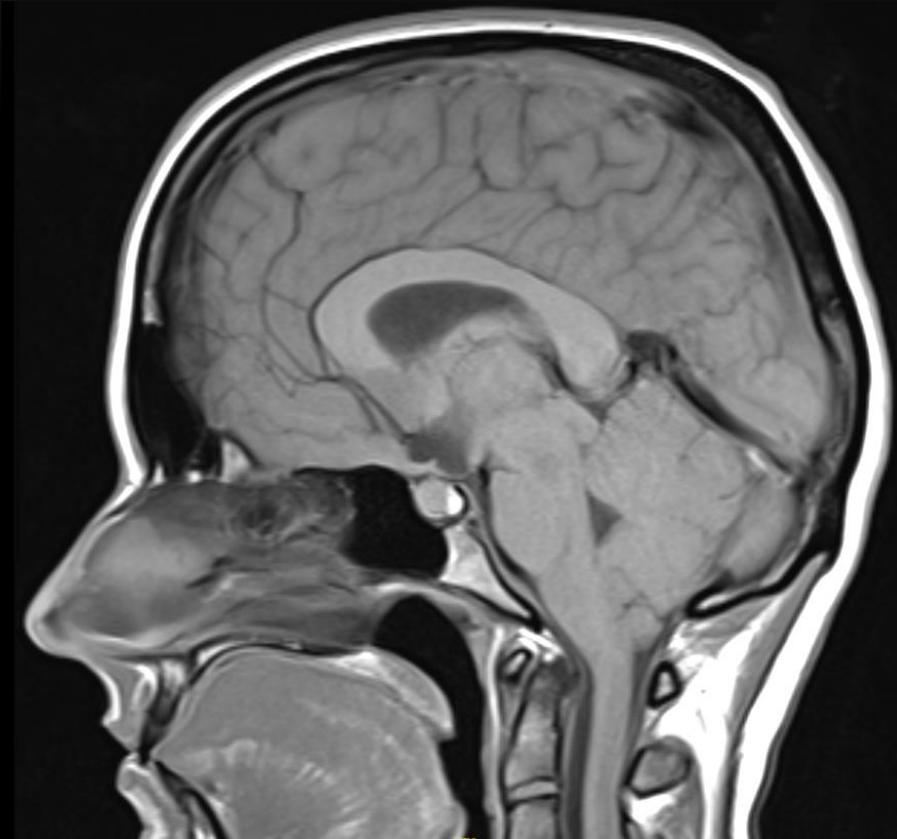
OBJECTIVES

- Define targeted, nontargeted & blind blood patch
- Review physiology of epidural blood patch
- Highlight literature supporting nontargeted vs targeted EBP



23-YEAR-OLD FEMALE - ORTHOSTATIC HEADACHE

- What is the next step in management?
 - Spine MRI?
 - Epidural blood patch (non-targeted)
 - CT myelogram or DSM
 - Required for targeted therapy
 - Epidural blood patch (targeted)
 - Fibrin patch
 - CVF embolization
 - Surgical referral



EPIDURAL BLOOD PATCH – NONTARGETED – NOT “BLIND”

HEADACHE

The Journal of Head and Face Pain

REVIEW ARTICLES

Arachnoiditis, a complication of epidural blood patch for the treatment of low-pressure headache: A case report and systematic review

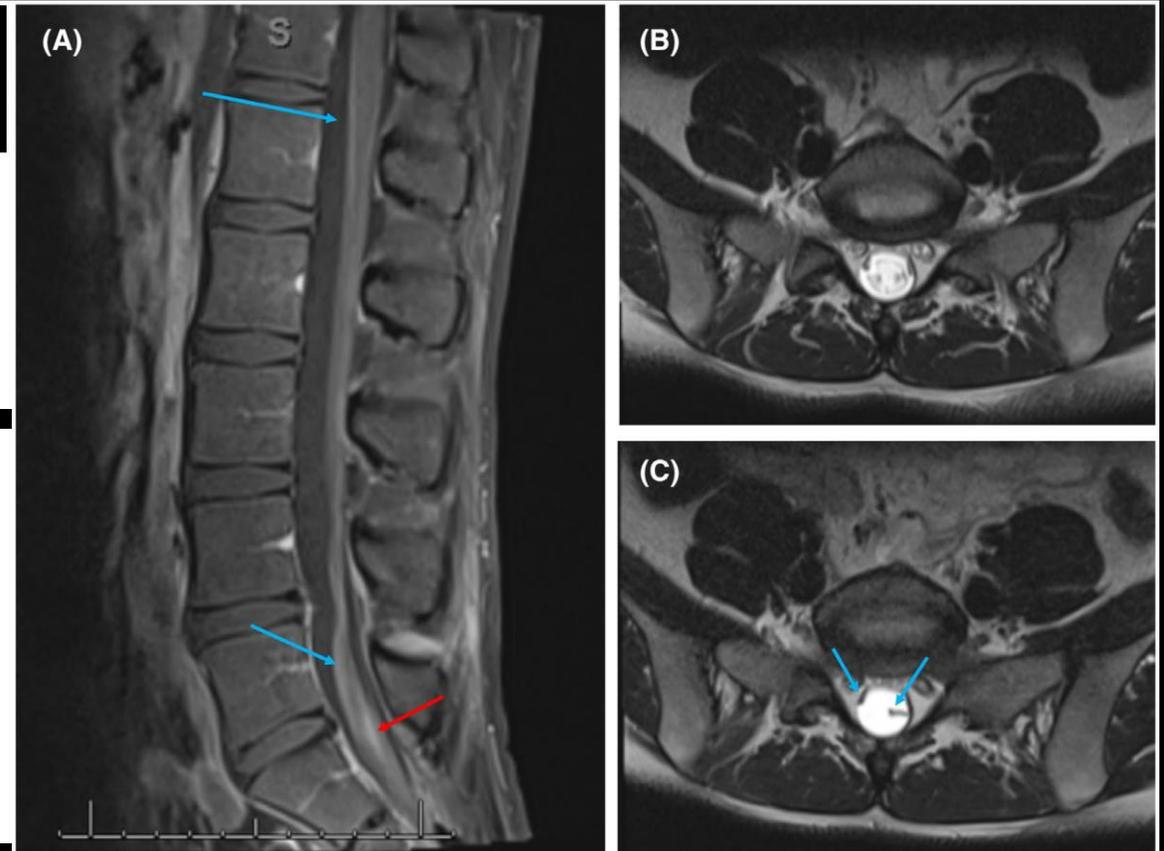
HEADACHE

The Journal of Head and Face Pain

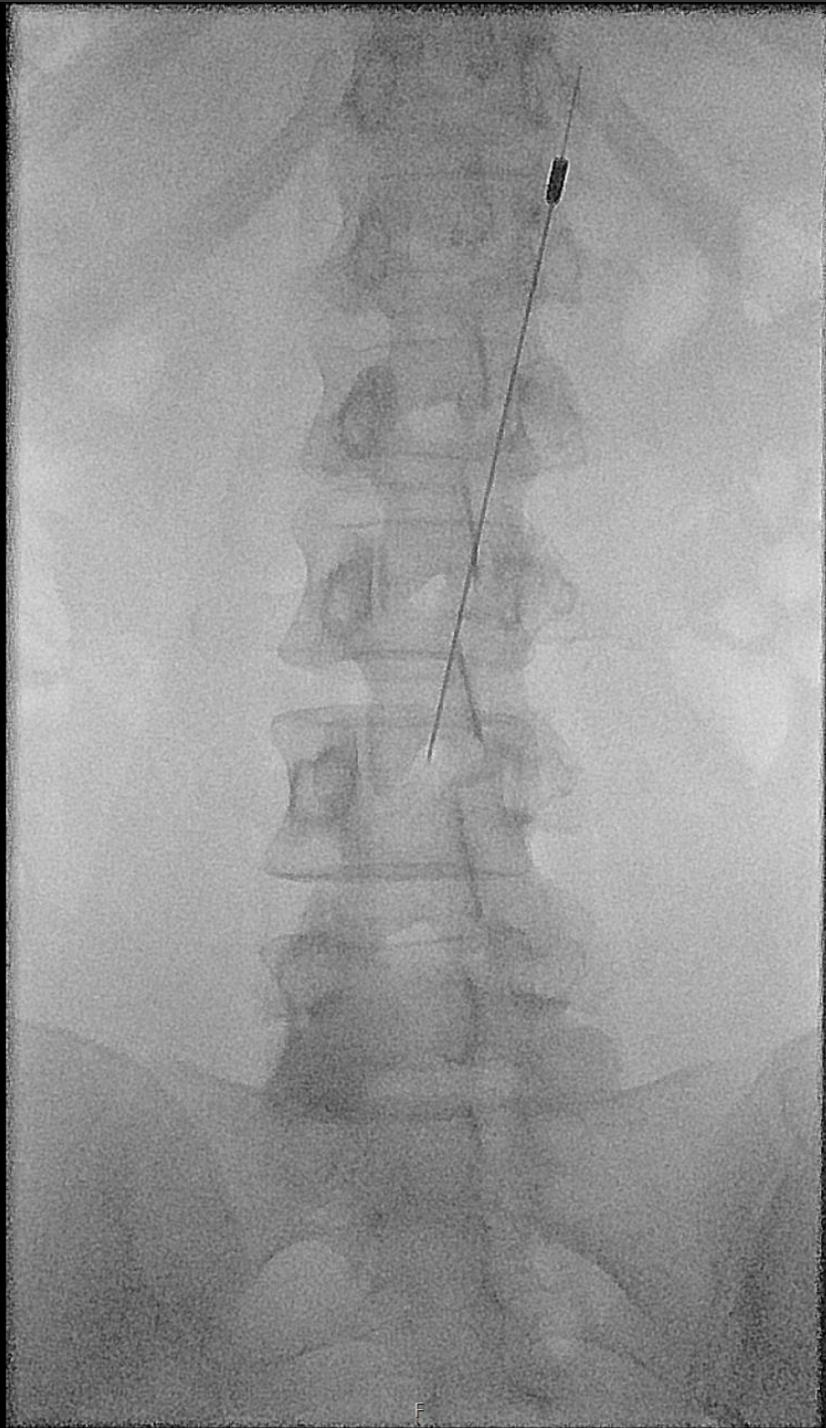
LETTER TO THE EDITOR

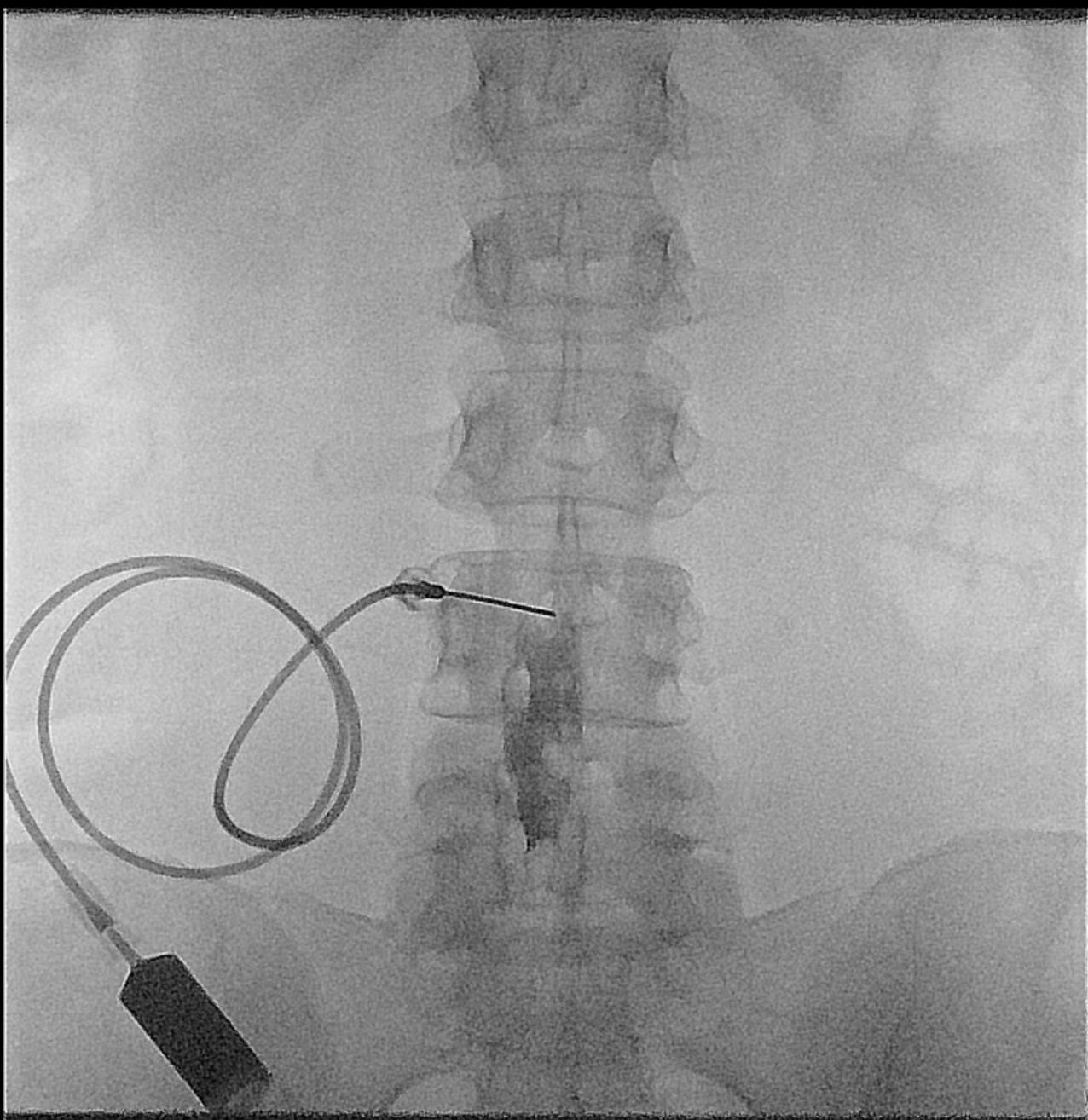
Arachnoiditis following epidural blood patch—An avoidable rare complication due to blind technique

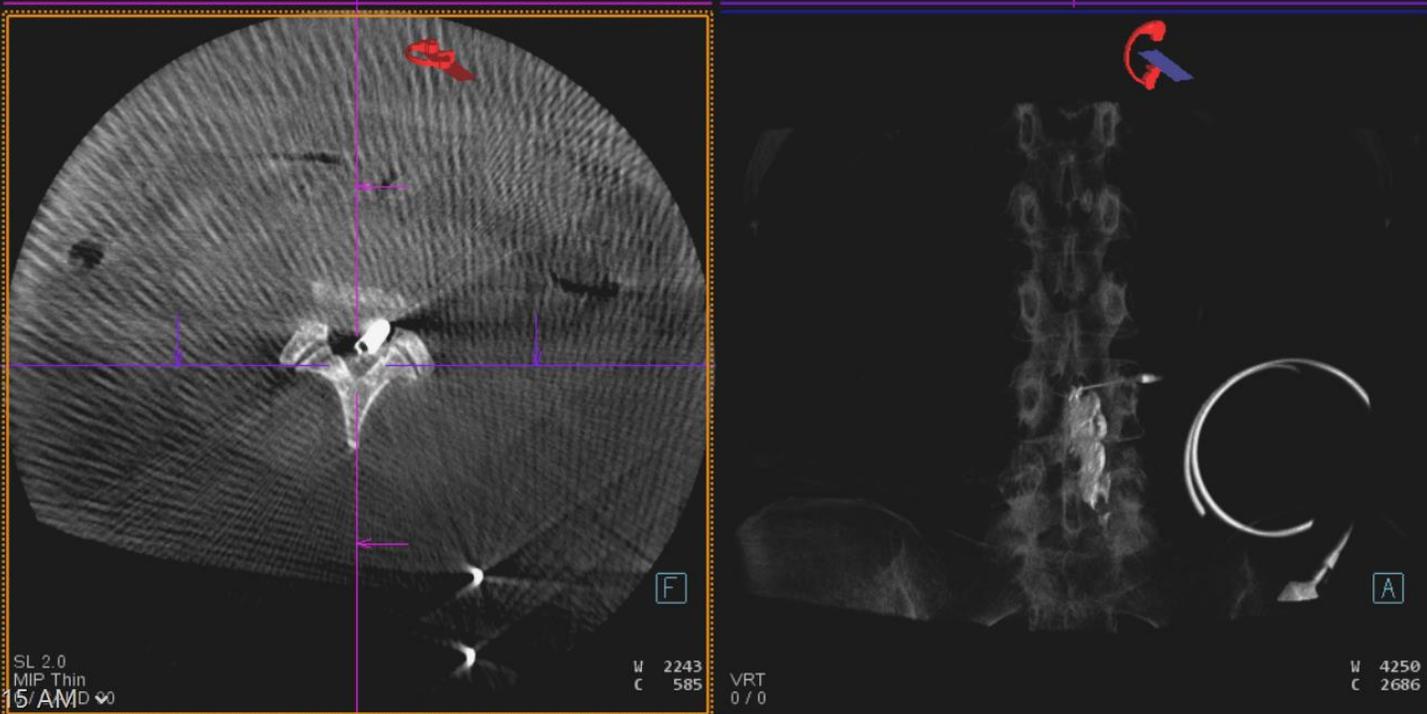
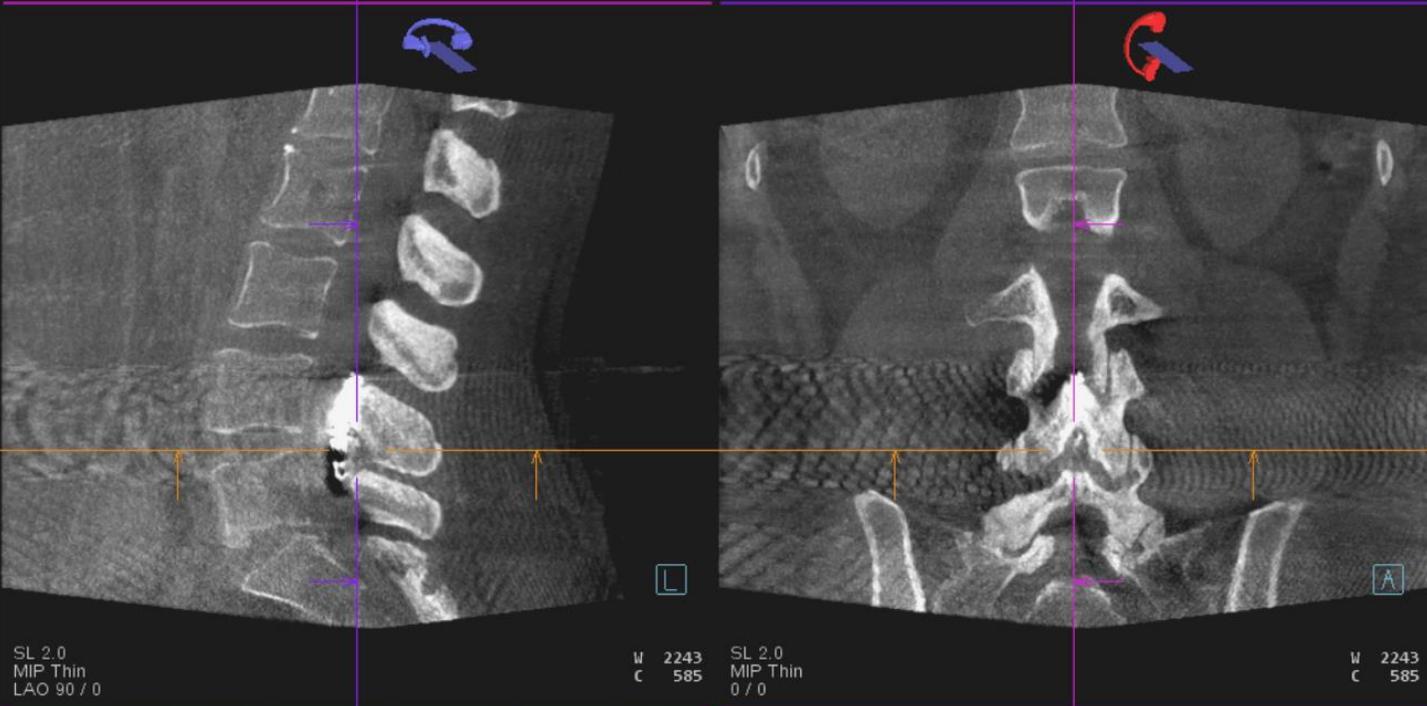
J. Levi Chazen MD ✉, Timothy J. Amrhein MD



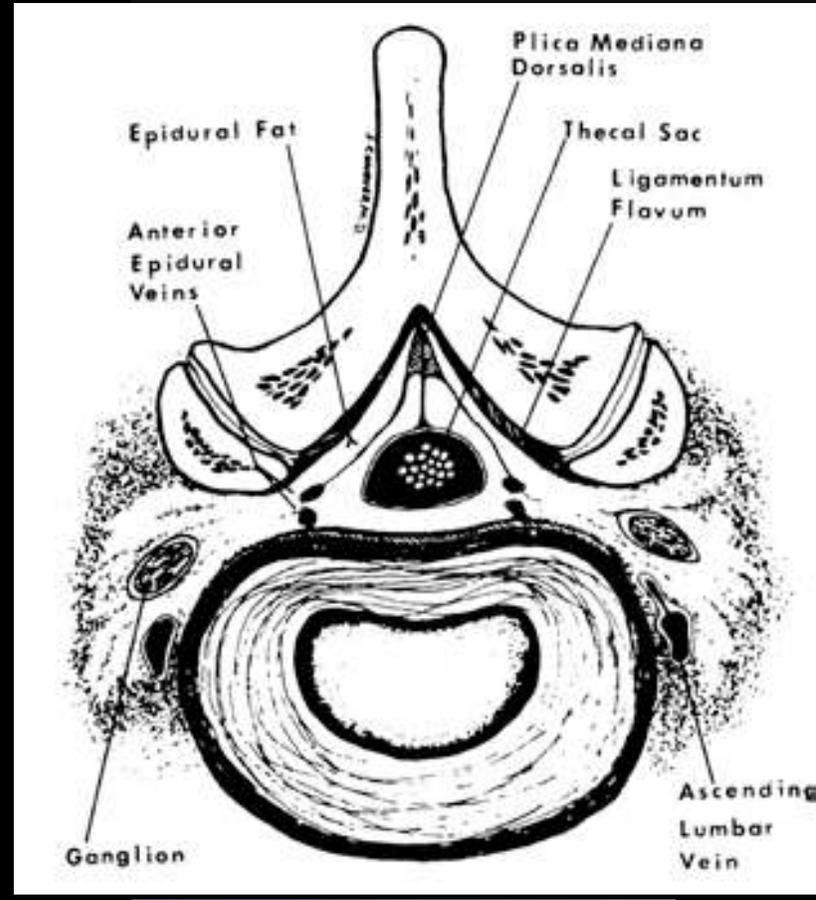
“Image guidance is not described in any of the case reports, and many reports describe frank intrathecal injection of blood products.”





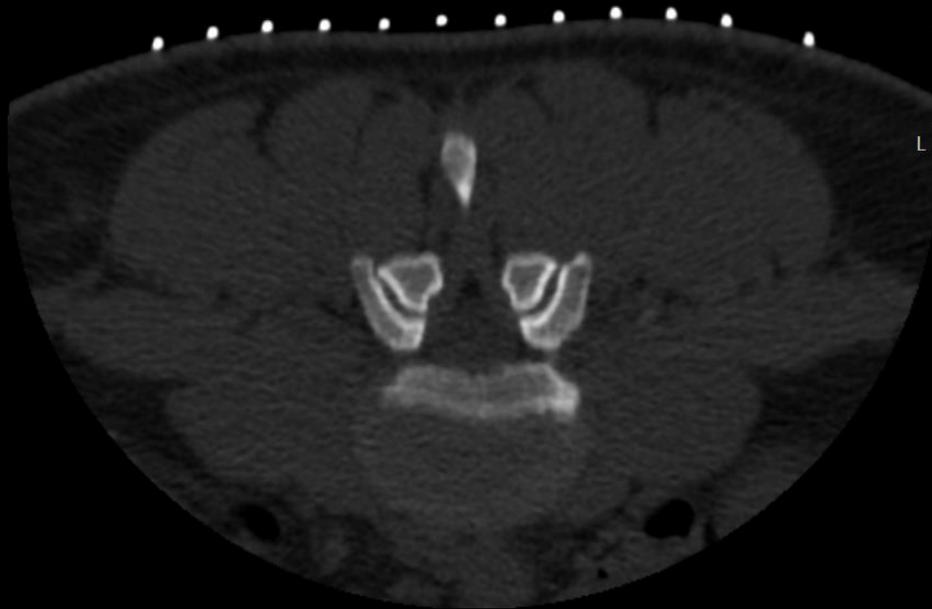


PLICA MEDIANA DORSALIS



Gantry: 0°
FoV: 205 mm
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BONE ▾
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Image 6 of 16
CTGEB

120 kV
76 mA
CTGEB

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Pos: HFP

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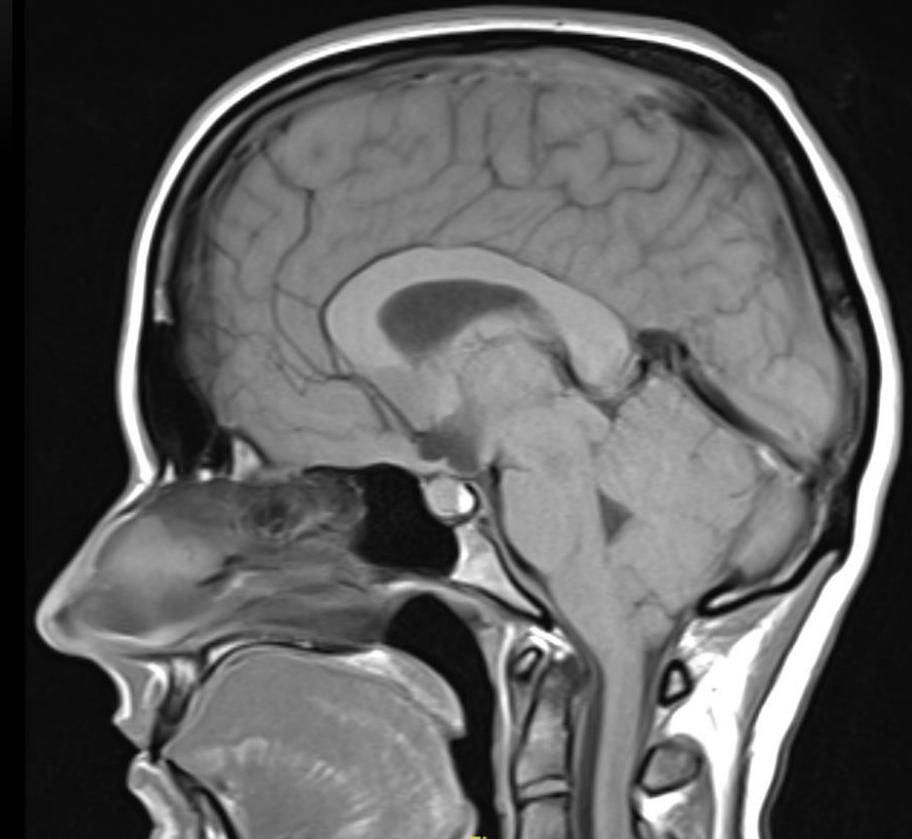


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CTGEB

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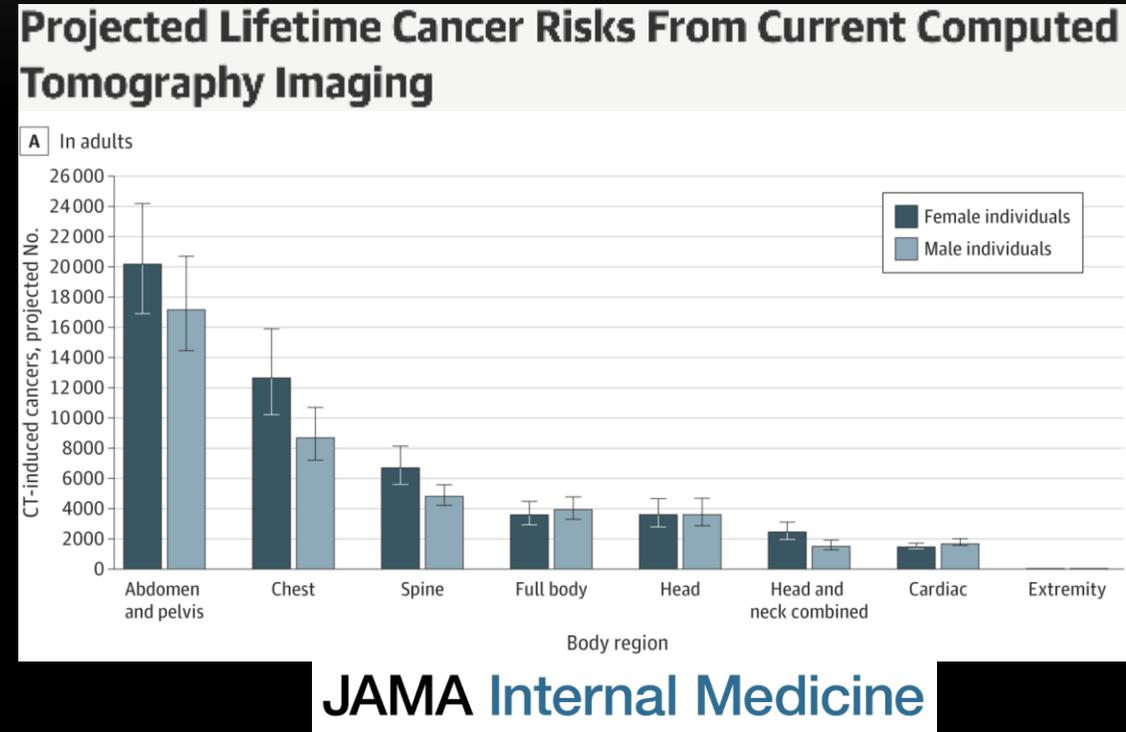
EBP DECISION FRAMEWORK

- Epidural blood patch (non-targeted)
 - How effective is a non-targeted EBP?
 - What is the risk of alternative dx/tx?
 - Localization requires a dural puncture => risk of new leak, intrathecal contrast, ionizing radiation exposure
 - Low risk? Non-zero
- How does a blood patch work?
- How far does a blood patch spread?



RADIATION DOSE ASSOCIATED WITH MYELOGRAPHY

- 61 DSMs were performed in 42 patients, 33 of which also underwent CTM
- Median effective dose was 6.6 mSv per DSM study (range: 1.2 - 17.7). On a per-patient basis (i.e. those patients who underwent more than one DSM (as the initial one was negative), the median total effective dose was 13 mSv for their total DSM imaging (range: 2.6 -31.7)
- For the CTM, the median effective dose was 19.7 mSv (range: 3.2 - 82.4 mSv)



RADIATION DOSE EXAMPLE

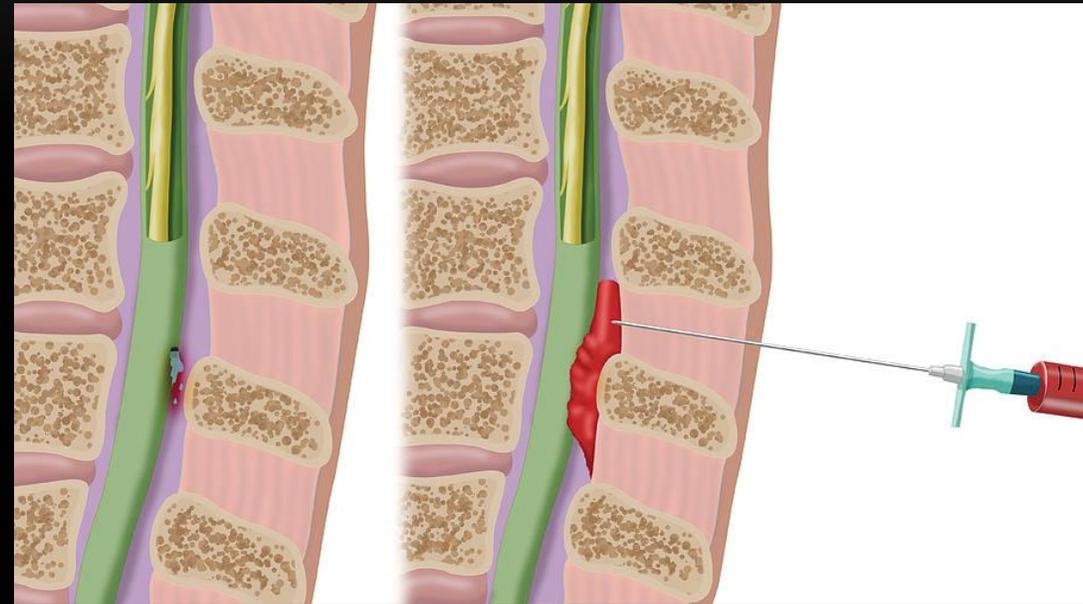
Exam Description: CT MYELOGRAM – TOTAL SPINE

Dose Report					
Series	Type	Scan Range (mm)	CTDIvol (mGy)	DLP (mGy-cm)	Phantom cm
4	Helical	1584.700-1599.700	4.34	13.60	Body 32
4	Helical	1584.700-1599.700	4.34	13.60	Body 32
4	Helical	1574.700-1609.700	4.34	22.27	Body 32
5	Helical	1655.000-145.600	27.32	1707.07	Body 32
6	Helical	146.750-1656.150	20.17	1260.64	Body 32
9	Scout	-	-	-	-
10	Helical	1665.000-144.600	26.19	1665.17	Body 32
Total Exam DLP:				4848.07	

Estimated effective dose ~80 mSv
Lifetime attributable cancer risk ~1%

EPIDURAL BLOOD PATCH - HISTORY

- Epidural injection to stop dural leak first proposed by Robert Danis in 1924 (novocaine and physiologic solution)
- Epidural blood first described in 1960 by Gormley
 - Observed lower rates of post-LP headache with “bloody taps”
 - Initial EBP 15 cc intrathecal saline followed by 2 cc epidural blood
- First report of EBP for SIH by Baker in 1983
- No randomized controlled studies of EBP in CSF leaks



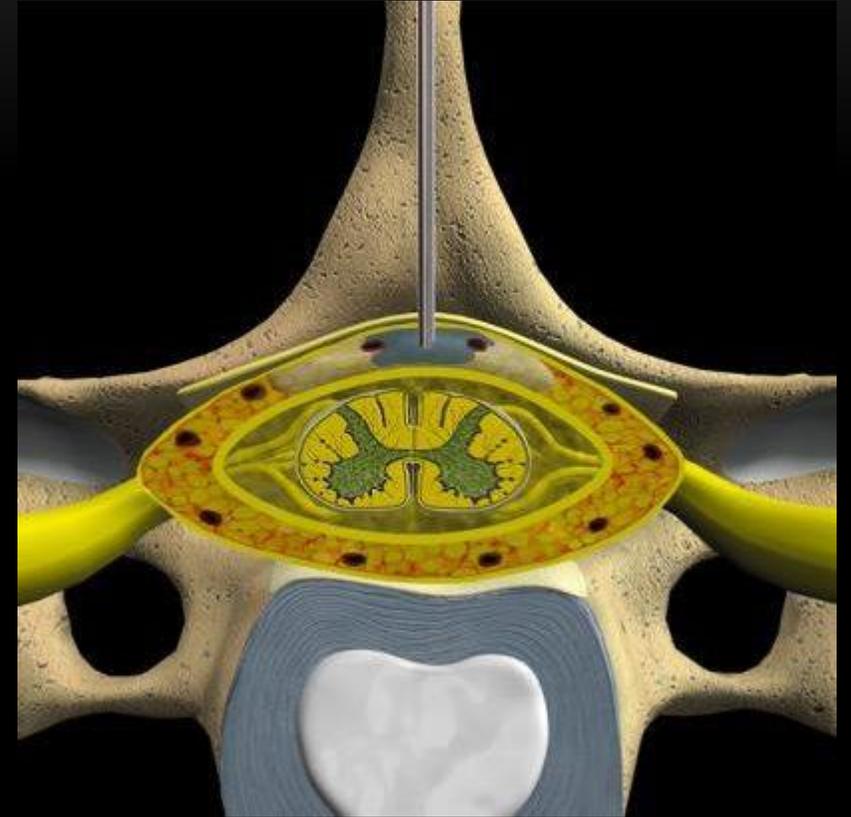
Zetlaoui PJ et al. Epidural blood patch: A narrative review. *Anaesth Crit Care Pain Med*. 2022 Oct;41(5):101138.

Sencakova D et al. The efficacy of epidural blood patch in spontaneous CSF leaks. *Neurology*. 2001 Nov 27;57(10):1921-3.

Baker 1983. Headache due to spontaneous low spinal fluid pressure. *Minn Med*. 66(1983): 325-328.

EPIDURAL BLOOD PATCH – MECHANISM OF ACTION

1. Immediate effect – epidural blood results in increased CSF pressure
2. Subsequent sealing of puncture site or tear through clot formation



EPIDURAL BLOOD PATCH – IMMEDIATE EFFECT

- Controlled epidural hematoma – direct increase in epidural and CSF pressure
 - CSF pressure above 80cm H₂O after 20mL EBP
 - Pressure increase NOT sustained with normal saline
- Vakharia et al. showed on MRI 20mL of EBP spread on average over 4.6 interspaces and created a tamponade effect on thecal sac
- Szeinfeld et al. showed Tc99m-labeled blood spreads 7-14 spinal segments, “homogenously in all directions from posterior needle tip in craniocaudad and circumferentially in epidural space”
- EBP has been shown to decrease cerebral blood flow and normalize vasodilation on Doppler

Tc99M-LABELED EBP

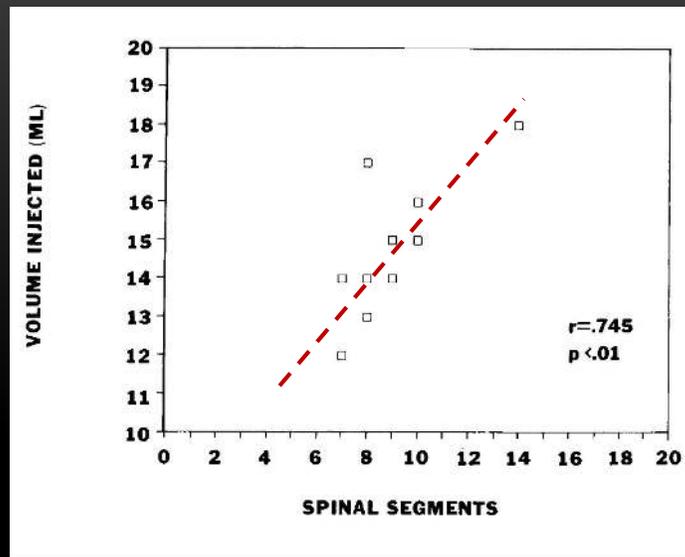


TABLE I. Individual Volumes and Corresponding Number of Segments of Spread

Patient No.	Sex	Age (yr)	Height	Site	Spread	Spinal Segments*	Volume† (ml)
1	F	30	5'5"	L 4-5	L1-S2	7	12
2	F	20	5'5"	L 3-4	T12-S1	7	14
3	F	25	5'6"	L 3-4	T11-S1	8	14
4	F	25	5'4"	L 2-3	T5-S1	14	18
5	F	24	5'9"	L 2-3	T9-S1	10	16
6	F	18	5'4"	L 3-4	T11-S1	8	13
7	M	20	5'9"	L 4-5	T11-S2	9	15
8	M	51	5'9"	L 3-4	T7-L4	10	15
9	F	30	5'0"	L 2-3	T10-S1	9	14
10	F	42	5'5"	L 4-5	T11-S1	8	17

* Mean spinal segments = 9.00 ± 1.95 SD.

Mean volume per segments = 1.64 ± 0.23 SD.

† Mean volume (ml) = 14.80 ± 1.72 SD.

MRI OF EBP



	Patient				
	1	2	3	4	5
Age	31	44	43	40	35
Sex	Male	Male	Female	Female	Female
Preblood patch headache (VAS 0–10) ^a					
Supine	2	0	0	3	<1
Sitting	9–10	7–10	8	10	10
Postprocedure headache	0	0	0	1–2	0
Initial lumbar puncture	L3-4	L2-3	L3-4	L3-4	L4-5
Extrathecal CSF/hemosiderosis	L2-4		L3-6	L2-3	L4-5
Blood patch placement	L2-3	L2-3	L3-4	L3-4	L4-5
Spread of blood patch	T12-L3	T11-L4	L1-L4	T12-L4	L2-L5

Average spread of the blood patch was 4.6 vertebral segments (SD = ± .9).

VAS = visual analog scale.

^a A visual analog scale (VAS) was used to evaluate the headache; 0 = no headache and 10 = worst headache.

EPIDURAL BLOOD PATCH – PERSISTENT EFFECT

- Clot formation is the critically important second effect of the EBP
 - MRI studies show clot is largely resorbed by 7 hours with only thin and adherent clot to dura by 18 hours
- After initial injection, the blood coagulates, forming a fibrin-based clot
 - Clot adheres to the dural tear or defect, providing a more definitive and stable seal
 - Over subsequent days, fibroblasts invade the clot, transforming it into durable scar tissue, permanently sealing the leak in successful cases

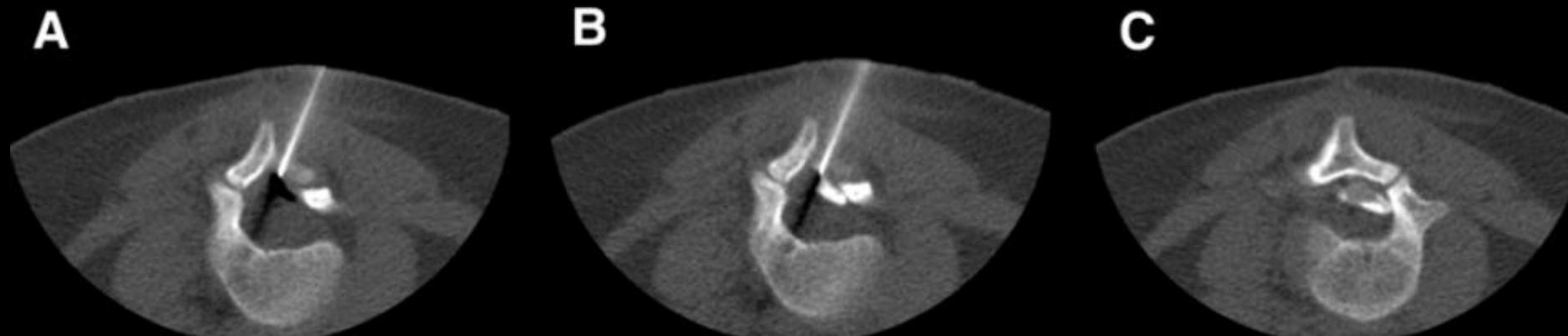
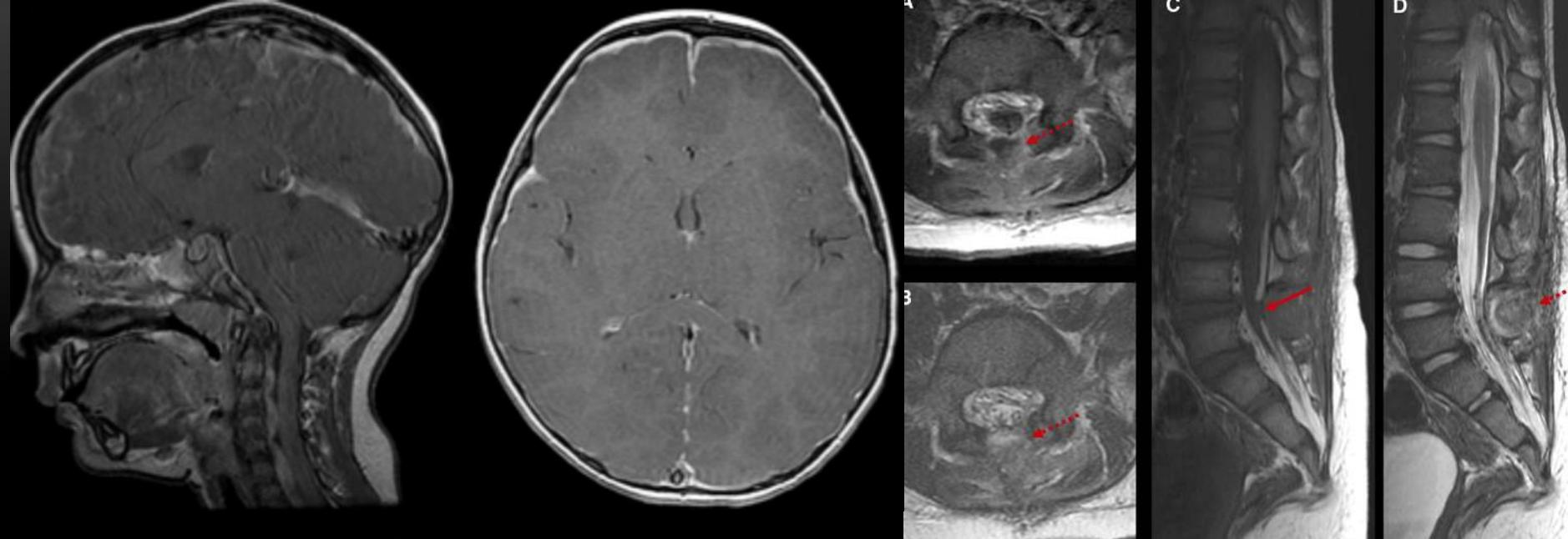
EFFICACY OF EBP IN PDPH

- For post dural puncture headache (PDPH), EBP is highly efficacious
 - Large series by Safa-Tisseront et al. of 504 patients reported 75% of complete success, 18% of partial success, and 7% of failure

Outcomes of epidural blood patches following iatrogenic causes (intracranial hypotension syndromes after lumbar punctures, perimedullary techniques, or surgery) or spontaneous intracranial hypotension (spontaneous intracranial hypotension).

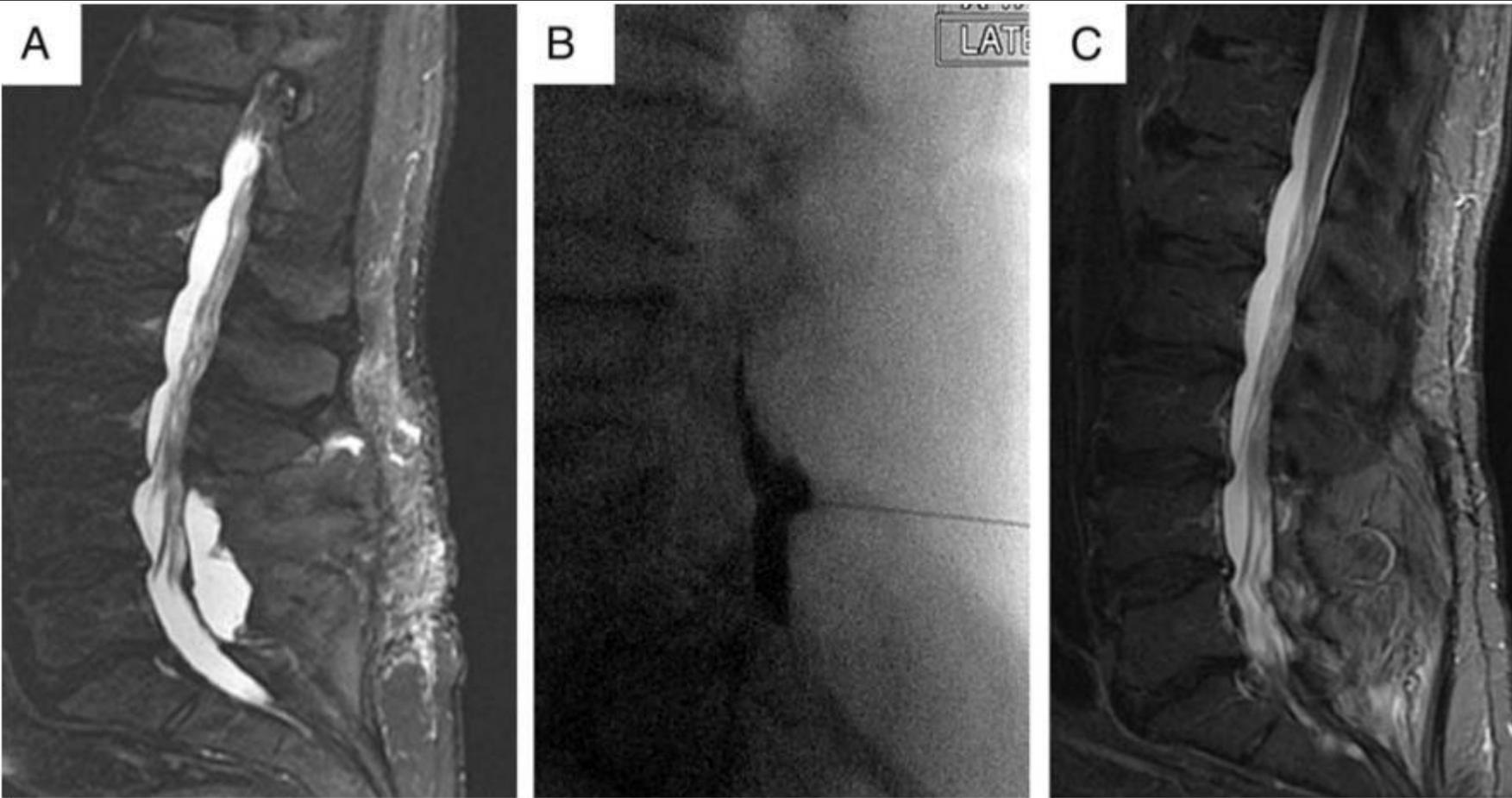
	Patients/ nb of EBP	Context	Total success Nb (%)	Partial success Nb (%)	Repeated EBP Nb (%)	Failure Nb (%)
Gormley [3]	6	Iatrogenic	6 (100)	0	0	0
Di Giovanni [5]	63	Iatrogenic	61 (96)	0	0	2 (4)
Van Kooten [38]	19/	Iatrogenic	16 (84)	3 (16)	NA	0
Kokki (children) [44]	129	Iatrogenic	115 (9)	NA	NA	14 (11)
Booth [45]	394/466	Iatrogenic	394 (100)	72 (18) patients required multiples EBP		
Safa-Tisseront [46]	504	Iatrogenic	387 (76)	93 (18)	NA	34 (7)
Vercauteren [160]	186	Iatrogenic	167 (90)	16 (8,5)	NA	3 (1,5)
Taivanen [166]	81/81	Iatrogenic	50 (61)	31 (39)	NA	?
Stride [217]	135	Iatrogenic	93(68)	23 (17)	7 (5)	19 (15)

3-YEAR-
OLD MALE
POST
TETHERED
CORD
RELEASE



Cornman-Homonoff J, Schweitzer A, Chazen JL. CT-guided epidural blood patch for treatment of CSF leak and pseudomeningocele following tethered cord release in a 3-year-old. Clin Imaging. 2016 Nov - Dec;40(6):1191-1194.

EBP FOR POSTSURGICAL LEAK/PSEUDOMENINGOCELE?



➤ Key Points

- Blood patch injection can effectively treat symptomatic postoperative lumbosacral pseudomeningoceles and therefore represents a reasonable alternative to surgical re-exploration.
- In our study, 84% (16 of 19) of patients obtained lasting symptom improvement, with an average last known follow-up of 22.3 months after the last injection for successful patients.
- If possible, the pseudomeningocele should be aspirated and the cavity then injected with blood.
- Success is less likely when blood patches are performed after chronic pseudomeningocele development.

EFFICACY OF EBP IN SIH

- For SIH, efficacy is debatable and depends on leak type
 - D'Antona et al. (meta-analysis) reported that a single EBP was successful in 64%
 - Larger EBP appear more effective
 - Diaz et al. reported a failure rate of 52%, despite the use of large volumes (mean 36 mL)
 - However, complications may increase with larger volume
 - Wu et al. reported that a greater injected blood volume (>22.5 vs <22.5 mL) was associated with a higher success rate (67.9% vs 47.0%, $p=0.01$)
 - EBP also appears more effective for smaller SLEC <8 spinal levels

Diaz JH. Treatment outcomes in spontaneous intracranial hypotension: do epidural blood-patches stop the leaks? *Pain Pract* 2004;4:295–302.

D'Antona L, et al. Clinical presentation, investigation findings, and treatment outcomes of spontaneous intracranial hypotension syndrome: a systematic review and meta-analysis. *JAMA Neurol* 2021;78:329–37.

Wu JW, et al. Factors predicting response to the first epidural blood patch in spontaneous intracranial hypotension. *Brain* 2017;140:344–52.

JAMA Neurology 2021 META-ANALYSIS

- 144 articles evaluated in total
- *“the use of targeted EBPs gave similar success rates compared with nontargeted EBPs”*

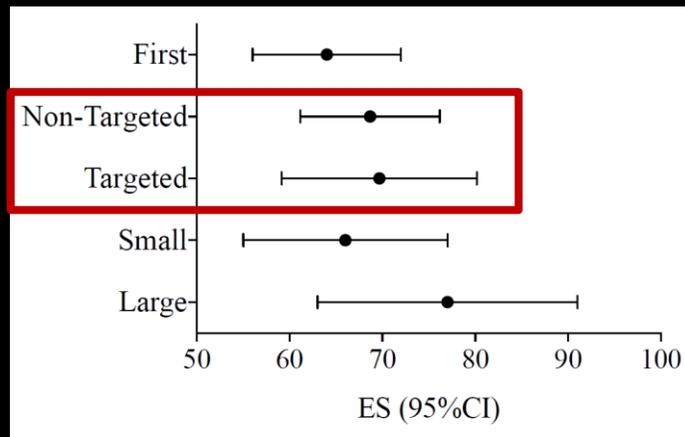


Table 2. Treatment of Spontaneous Intracranial Hypotension and Outcomes

Treatment ^a	Patients, No. (%)	Pooled estimates of proportions (95% CI)	I ²
Conservative treatment (17 articles, 748 patients)			
Effective	183 (24.5)	28 (18-37)	91.5
Ineffective	565 (75.5)	72 (63-82)	91.5
Type of conservative treatment			
Bed rest	658 (88.0)	NA	NA
Hydration	621 (83.0)	NA	NA
Analgesia	205 (27.4)	NA	NA
Steroids	30 (4.0)	NA	NA
Caffeine	2 (0.3)	NA	NA
EBP success rate			
First EBP (33 articles, 1758 patients)	1062 (60.4)	64 (56-72)	93.0
Nontargeted EBP (10 articles, 264 patients)	177 (67.1)	69 (61-76)	34.9
Targeted EBP (14 articles, 816 patients)	544 (66.7)	70 (59-80)	90.5
Small EBP, <20 mL (12 articles, 680 patients)	466 (68.5)	66 (55-77)	90.3
Large EBP, ≥20 mL (4 articles, 169 patients)	139 (82.3)	77 (63-91)	69.2

D’Antona L, et al. Clinical presentation, investigation findings, and treatment outcomes of spontaneous intracranial hypotension syndrome: a systematic review and meta-analysis. JAMA Neurol 2021;78:329–37.

2025 META-ANALYSIS

- 798 articles screened, 7 analyzed
- ***“Targeted and non-targeted EBP are both effective treatments for SIH. However, given the lack of statistical difference between the interventions, along with considerations such as the patient risk profiles, physician expertise, and avoidance of invasive imaging procedures, the analysis suggests that non-targeted EBP may be considered a viable initial approach, regardless of the identification of the leak.***

Study	Risk of bias domains							Overall
	D1	D2	D3	D4	D5	D6	D7	
Cho et al. (2011)	⊗	+	-	-	+	⊗	-	-
Lee et al. (2018)	⊗	+	-	-	+	-	+	+
Curie Ahn et al. (2019)	-	+	-	-	+	-	+	+
Lee et al. (2021)	-	+	+	-	-	⊗	-	-
Perthen et al. (2021)	+	-	+	+	-	+	-	+
Gomez et al. (2024)	-	-	+	+	⊗	⊗	-	-
Lee et al. (2024)	-	-	+	⊗	-	⊗	-	⊗

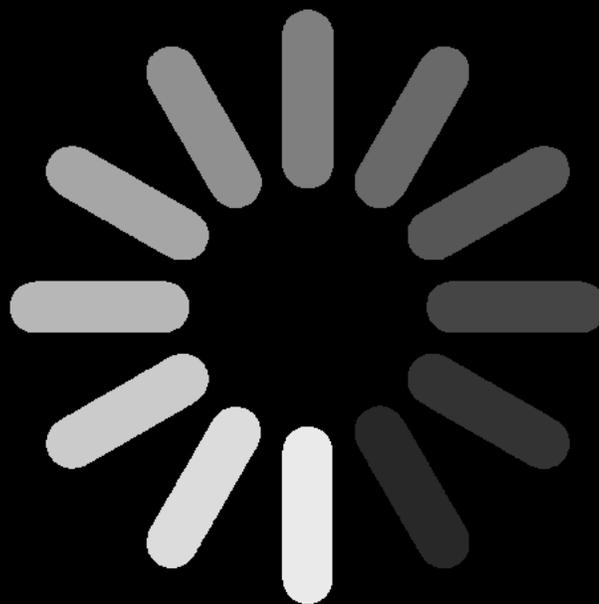
Domains:
 D1: Bias due to confounding.
 D2: Bias due to selection of participants.
 D3: Bias in classification of interventions.
 D4: Bias due to deviations from intended interventions.
 D5: Bias due to missing data.
 D6: Bias in measurement of outcomes.
 D7: Bias in selection of the reported result.

Judgement
 ⊗ Serious
 - Moderate
 + Low

EFFICACY OF EBP

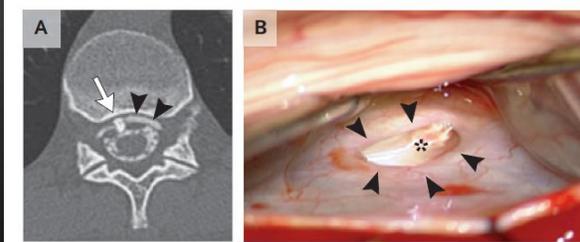
- Couch et al. propose at least two non-targeted lumbar or low thoracic EBP and to perform targeted EBP only in case of failure
- Conversely, Kim et al. propose that myelography and targeted EBP should be the first choice in all patients
- “A valid therapeutic option for the treatment of thoracic or cervical tears may be to start with one or lumbar EBPs”

RANDOMIZED CONTROLLED DATA FOR TARGETED EBP

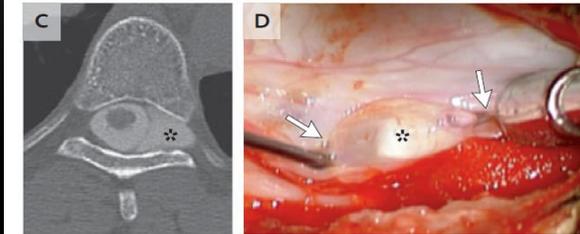


DATA FOR TARGETED EBP

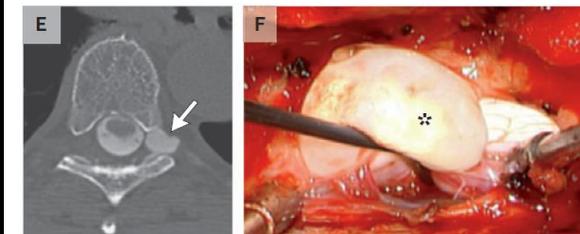
- Heterogeneous patient populations, type I-IV leaks
- Heterogeneous treatment location and EBP volume
- Blood vs. fibrin
- Reports pre-2014 do not include CSF-venous fistula
- Should guidance differ in the community vs. CSF leak center?



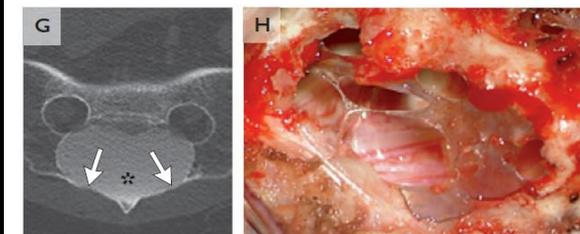
Ventral CSF Leak



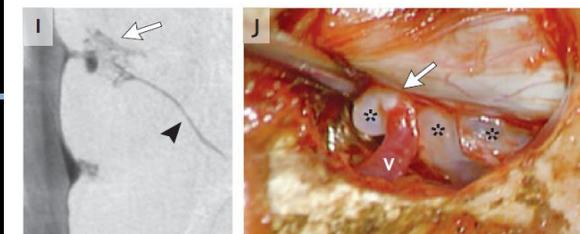
Lateral CSF Leak



Meningeal Diverticulum

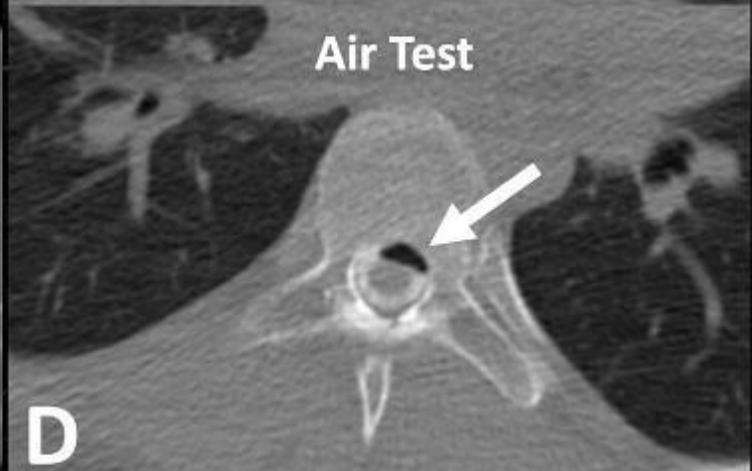
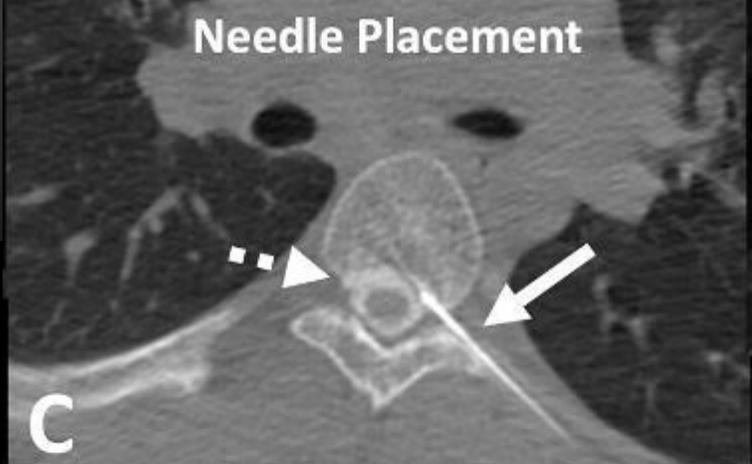
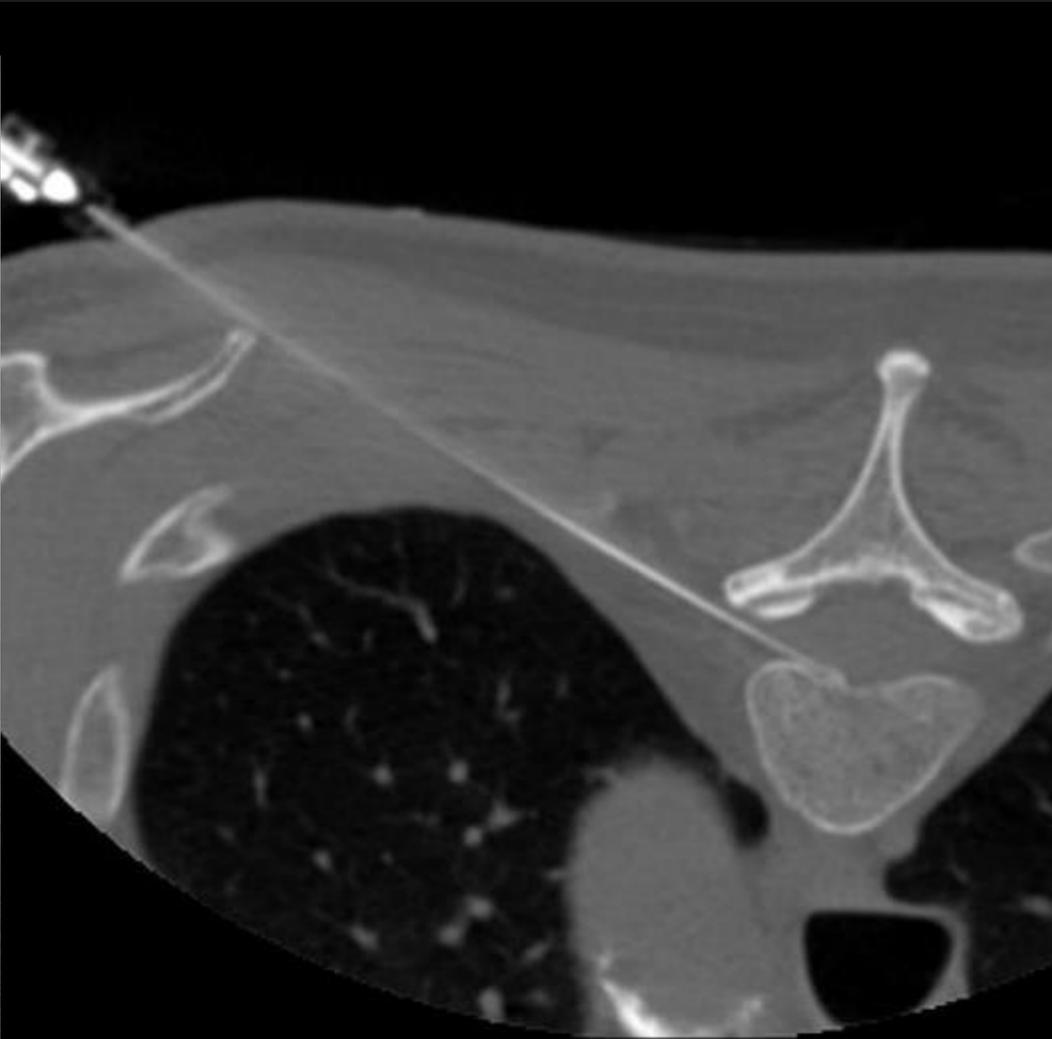
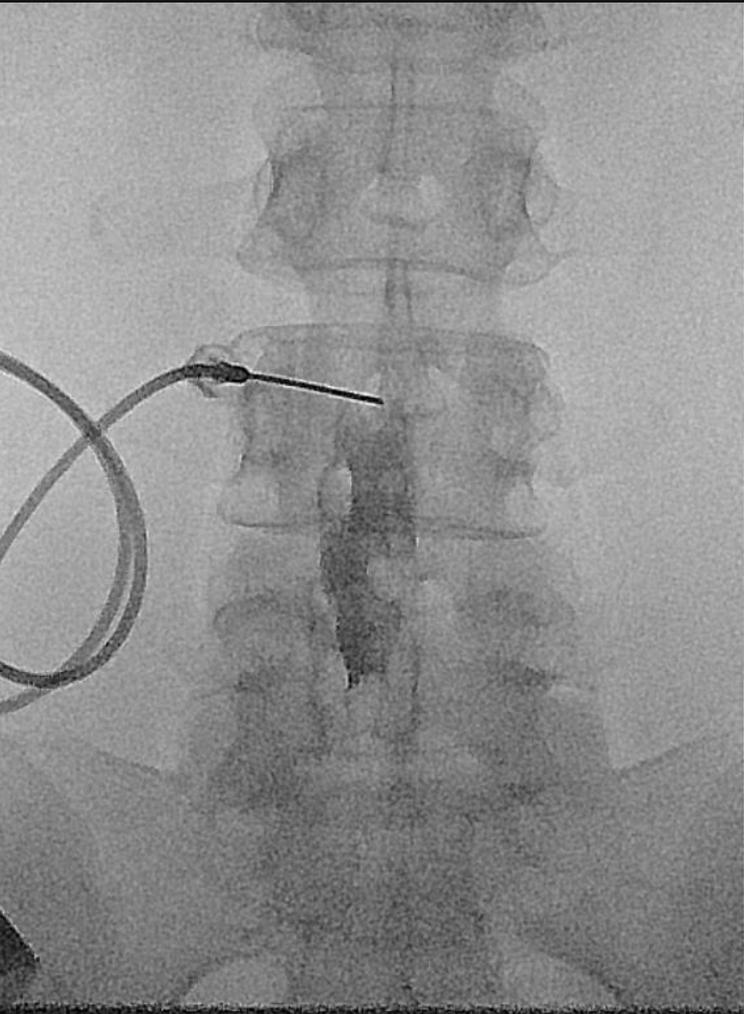


Dural Ectasia



CSF-Venous Fistula

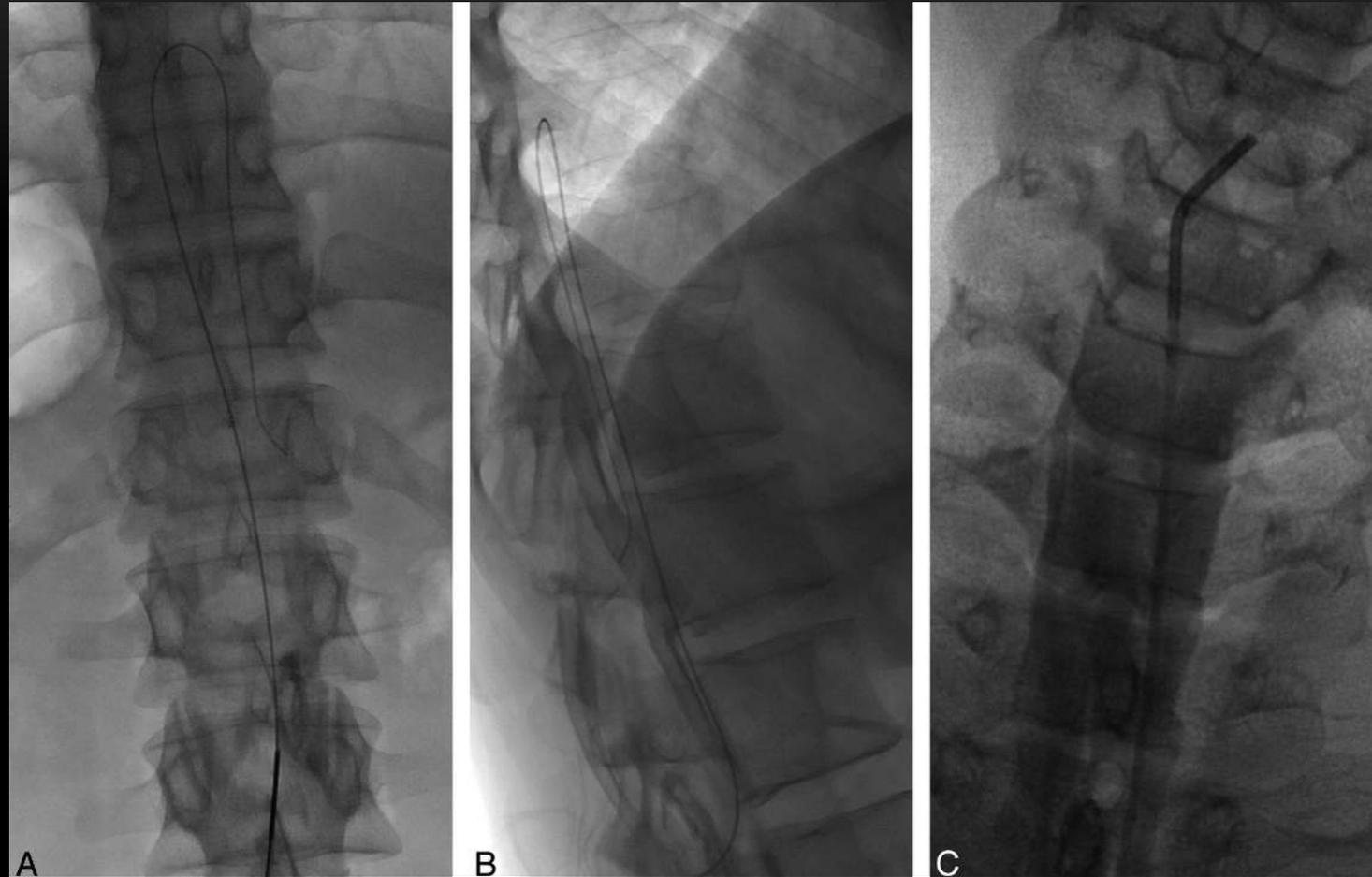
WHAT IS A TARGETED EBP?



Callen AL, et al. Efficacy of Traditional Epidural Patching versus Patching within Spinal Longitudinal Extradural Collections for Ventral Dural Cerebrospinal Fluid Leaks. Radiology. 2025 Mar;314(3):e242194.

CATHETER DIRECTED MULTILEVEL EPIDURAL BLOOD PATCH

- 19-gauge Tuohy inserted in lumbar region
- 0.035 glide wire inserted into epidural space and 4F catheter inserted over wire
- 38-70 mL epidural blood injected
- 89% patients improved including 80% of patients who failed prior targeted EBP or fibrin injection



NON-TARGETED EBP

- ✓ First line treatment of PDPH
- ✓ May result in clinical cure for SIH
 - Possible diagnostic/prognostic information?
- ✓ May obviate need for additional imaging with associated risks and radiation exposure
- ✓ Two meta-analyses show no benefit of targeted EBP over non-targeted
- ✓ Blood patch spreads over multiple levels
 - Linear relationship to EBP volume?



- Thank you for your attention!
- Questions?
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Controversies in SIH: *Non-Directed vs. Directed EBP*

Tim Amrhein, MD

Associate Professor of Neuroradiology

Director of Spine Intervention

Duke University Medical Center

Vice President, American Society of Spine Radiology

Disclosures

Dr. Amrhein:

- No relevant disclosures
- Fibrin glue: off label
- Medical Advisory Board: Spinal CSF Leak Foundation
- Siemens: speaker, research support

SIH: Treatment

Patching



Epidural Blood Patch: *Technical Considerations*

Non-Targeted



Targeted



Targeted EBP: *Spread*

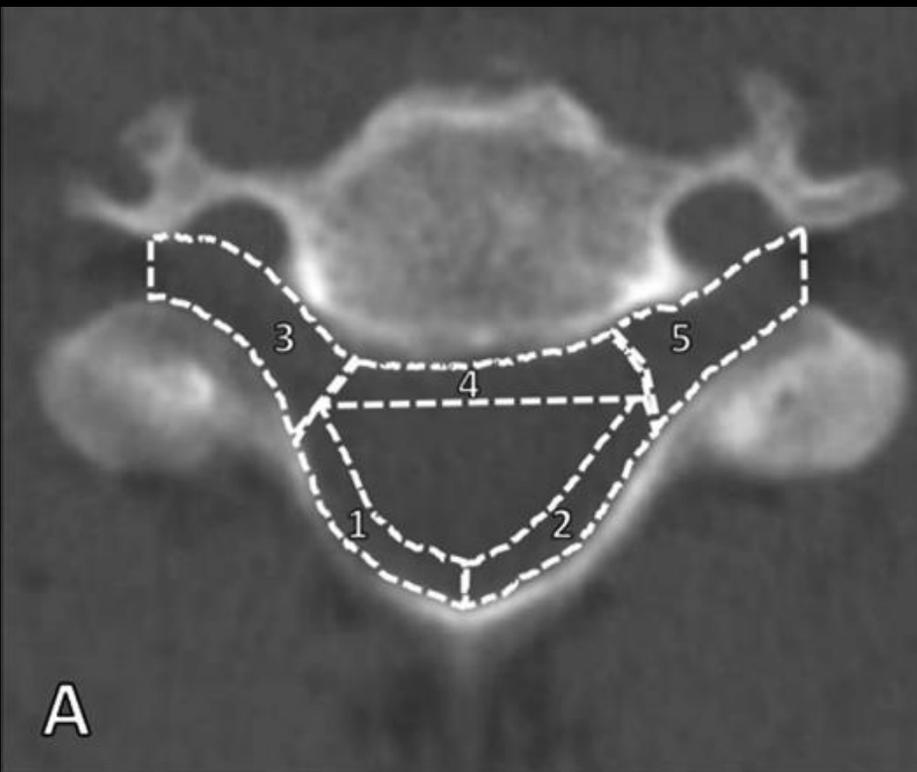
Non-Targeted



Targeted

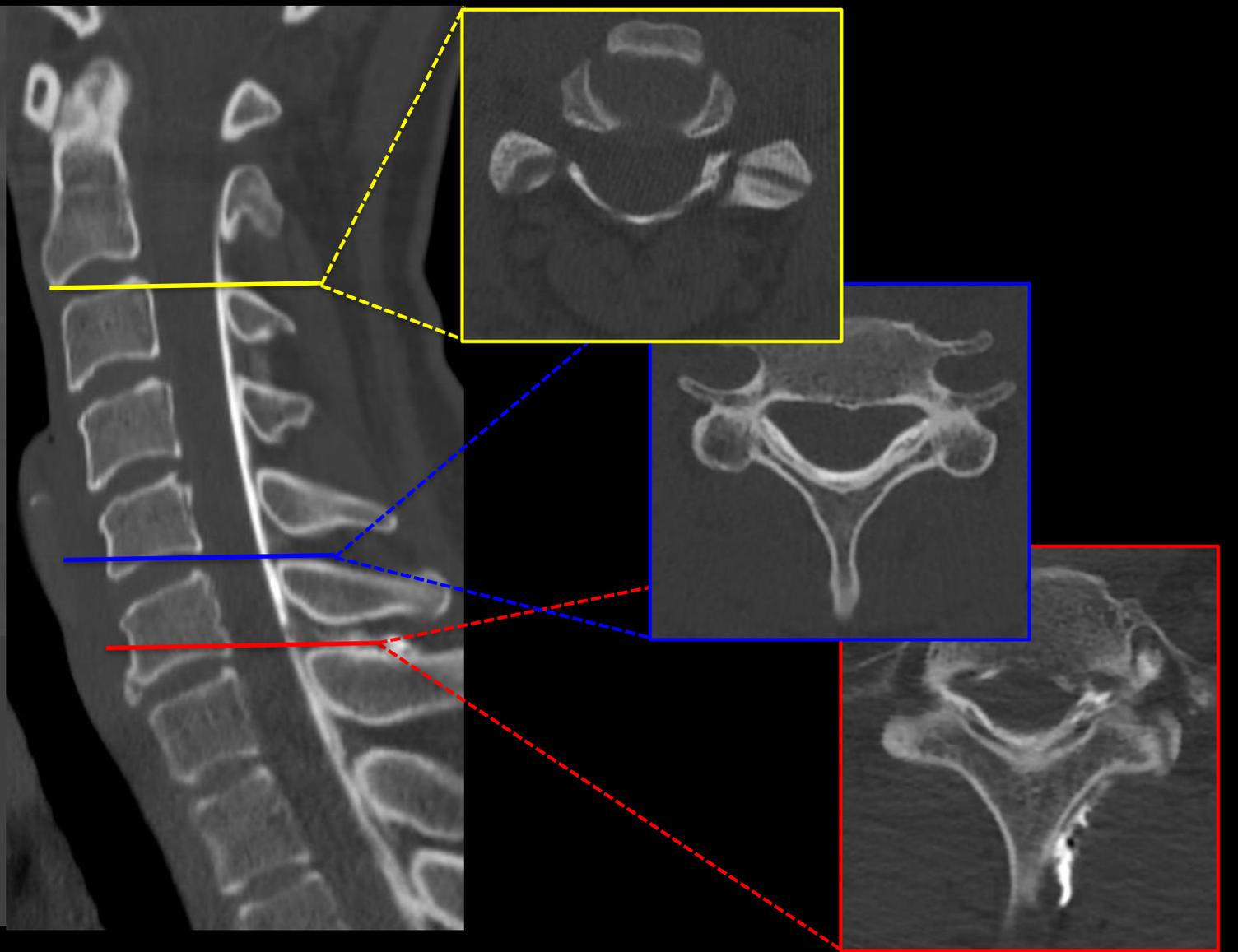


Epidural Spread



A

- 1=Ipsilateral Dorsal Epidural Space
- 2=Contralateral Dorsal Epidural Space
- 3=Ipsilateral Neuroforamen (ILNF)
- 4=Ventral Epidural Space (VES)
- 5=Contralateral Neuroforamen (CLNF)



CLNF
VES
ILNF

Results: *Spread Extent*

DES

Some Degree of Targeting MUST Be Necessary!

Zone	Mean #levels spread (SD)
VES	1.6 (1.6)
CLNF	3.6 (1.8)
ILNF	4.3 (1.7)
DES	5.5 (1.2)

Zone	Mean #levels CRANIAL spread (SD)
VES	0.6 (1.1)
CLNF	1.9 (1.4)
ILNF	2.1 (1.3)
DES	3.0 (1)

Results: *Spread to VES*

Spread VES at level of injection: 43.4% (36 of 83)

$p < 0.0001$

Spread VES other than level of injection: 19.5% (97 of 498)

Targeted EBP: *Radiation Dose*

Targeted EBP: Radiation Dose

- ALARA Principle
 - Totally agree!
- SIH: Disability

SIH: Disability

October 10, 2023 RESEARCH ARTICLE **Neurology**

Quality of Life in Patients with Confirmed and Suspected Spinal CSF Leaks

 Victor Liaw,  Morgan McCreary,  Deborah I Friedman

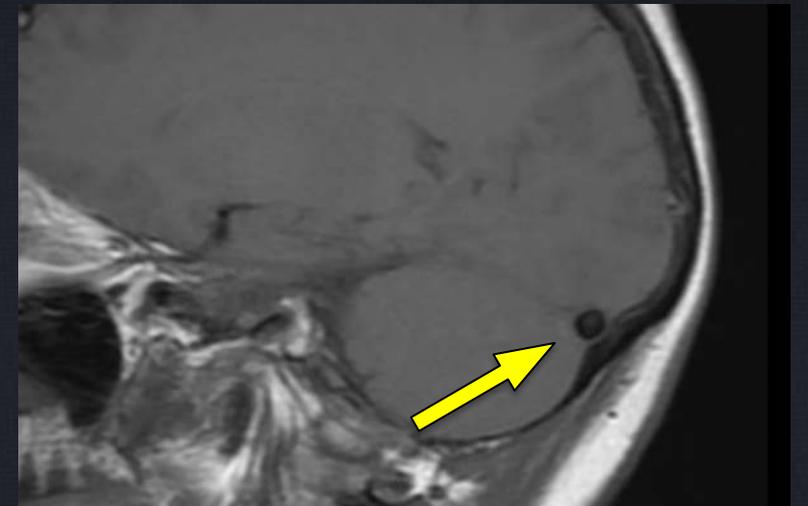
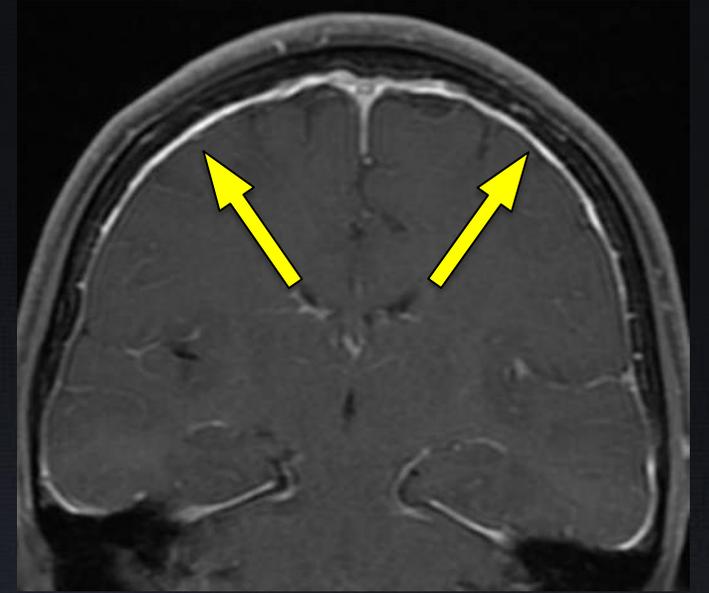
- HIT-6: 74.5% most severe HA category
- SF-36 (QoL/GenHealth): worse than MS pts
- PHQ-9 (Depression): ~50% moderate or worse
- FACIT-Sp-12 (Chronic Illness/Spiritual Well Being): worse AIDS and cancer pts
- C-SSRS (Suicide): 64% endorsed wishing they were dead

Targeted EBP: Radiation Dose

- ALARA Principle
 - Totally agree!
- SIH: Disability
 - QALYs: quality-adjusted life years
 - Need to balance theoretical minimal risk of stochastic effects with QOL

Typical Duke Patient

- 55 y/o F orthostatic HA, tinnitus, blurred vision, imbalance, neck pain, brain fog
- Significant disability for years



Typical Duke Patient

Pre-Duke Imaging Exams

- CTM total spine 10/10/19
- CTM total spine 6/12/20
- DSM 10/6/20
- CTM total spine 10/6/20
- CTM total spine 1/22/21
- DSM 9/3/21
- CTM total spine 9/3/21
- DSM 11/12/21
- MRI spine with IT Gd 4/27/22
- CTM total spine 4/27/22

****Six non-targeted EBPs across 3 hospital systems****

Typical Duke Patient

Pre-Duke Imaging Exams

The Best Way To Reduce Radiation Dose is to Find the Leak, Fix the Leak, and Limit the Number of Exams!

– DSM 10/6/20

– CTM total spine 10/6/20

– CTM total spine 1/22/21

– DSM 11/12/21

– MRI spine with IT Gd 4/27/22

– CTM total spine 4/27/22

****Six non-targeted EBPs across 3 hospital systems****

Targeted EBP: *Evidence*

NEUROLOGY

NEUROLOGY 2001;57:1921–1923

The efficacy of epidural blood patch in spontaneous CSF leaks

Drahomira Sencakova, MD; Bahram Mokri, MD; and Robyn L. McClelland, PhD

- Retrospective (case series)
 - chart review (12 years: 1986 - 1998)
- SIH Criteria: not specified
 - documented spontaneous CSF leaks
- Follow up: review of records / correspondence
 - range: 3 months to 11 years
 - outcome: subjective, not specified
- 54 patients with CSF leaks: 29 underwent EBP (10 – 20 mL blood)
 - 4 excluded: no follow up

NEUROLOGY

NEUROLOGY 2001;57:1921–1923

The efficacy of
epidural blood patch
in spontaneous CSF
leaks

Drahomira Sencakova, MD; Bahram Mokri, MD; and Robyn L. McClelland, PhD

- Results:
 - EBP at same level of leak (targeted) did better than EBP not at level of leak $p = 0.07$

	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
<i>Sencakova 2001</i>	25	Case series	R	Subj	T + NT?	B	NS	NS	68% (36% 1 st EBP) ↑ targeting (p=0.07)

Spontaneous intracranial hypotension

Efficacy of radiologic targeting vs blind blood patch

K.-I. Cho, MD* *Neurology*® 2011;76:1139-1144

- Retrospective (case series)
 - chart review (11 years)
- SIH Criteria: ICHD-2
- 56 SIH patients:
 - non-targeted (without imaging) or fluoro targeted EBP
 - blood only (9 – 20 mL)
 - decision to target physician preference

Spontaneous intracranial hypotension

Efficacy of radiologic targeting vs blind blood patch

K.-I. Cho, MD* *Neurology*® 2011;76:1139-1144

- Targeted EBP: 31 patients
- Non-targeted EBP: 25 patients
 - 19 lumbar
 - 6 upper thoracic
- Outcomes
 - subjective:
 - persistent symptoms requiring repeat EBP
 - resolved or minimal symptoms: no repeat EBP
 - determined via chart review
 - follow up: variable: 6 month – 5 years

Spontaneous intracranial hypotension

Efficacy of radiologic targeting vs blind blood patch

K.-I. Cho, MD* *Neurology*® 2011;76:1139-1144

- Results:
 - Targeted: 87.1% response rate
 - Non-targeted: 52% response rate ($p < 0.05$)
- Limitations:
 - CSF leak localization?

False localizing sign of C1–2 cerebrospinal fluid leak in spontaneous intracranial hypotension

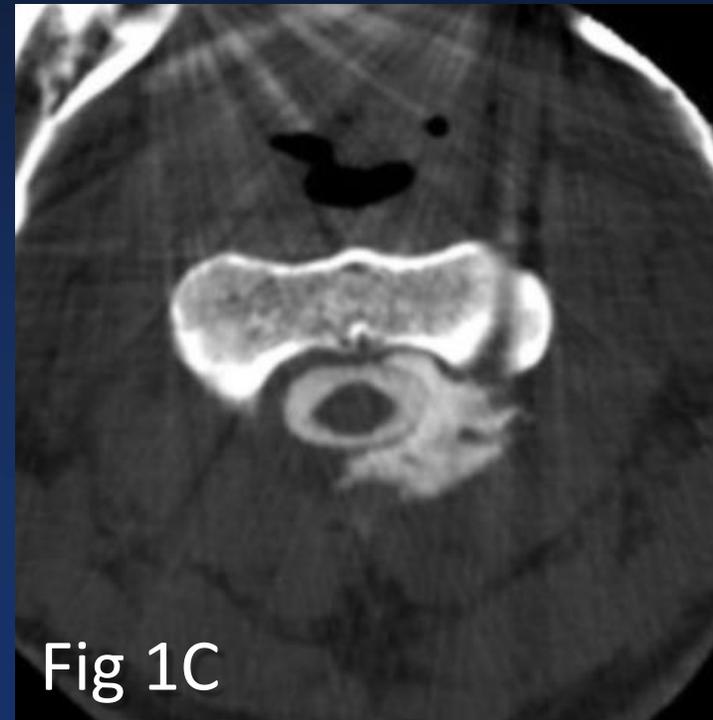
WOUTER I. SCHIEVINK, M.D., M. MARCEL MAYA, M.D., AND JAMES TOURJE, M.D.

J Neurosurg 100:639–644, 2004

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- Results:
 - Targeted: 87.1% response rate
 - Non-targeted: 52% response rate ($p < 0.05$)
- Limitations:
 - CSF leak localization?
 - Subtypes: non-targeted cases CVFs?
 - 6 non-targeted actually targeted?

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Targeted Epidural Blood Patch Treatment for Refractory Spontaneous Intracranial Hypotension in China

J Neurol Surg B 2018;79:217-223

Fei-Fang He^{1*} Li Li² Min-Jun Liu¹ Tai-Di Zhong¹ Qiao-Wei Zhang³ Xiang-Ming Fang⁴

- Retrospective (cohort)
 - chart review
- SIH Criteria: ICHD-2
 - all imaging positive for spinal CSF leak
- 165 SIH patients: targeted EBP: blood only
 - 87.8% (>75% symptom relief) after 1 EBP

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CSF leakage level	
Single	16 (9.7%)
Multiple	149 (90.3%)
Cervical	41 (20%)
Cervical-thoracic	131(63.9%)
Mid-lower thoracic	25(12.2%)
Lumbar	8 (4.8%)

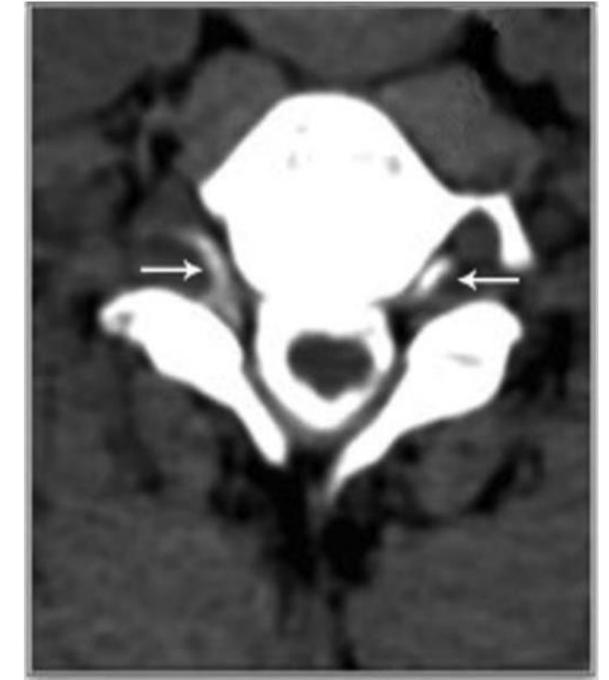


Fig. 4 Axial CTM with contrast demonstrating the presence of contrast in the epidural space at the cervicothoracic level (arrows). CTM, CT myelography.

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Wouter I. Schievink, MD
M. Marcel Maya, MD
Ray M. Chu, MD
Franklin G. Moser, MD,
MMM

False localizing sign of cervico-thoracic CSF leak in spontaneous intracranial hypotension

Neurology® 2015;84:2445-2448

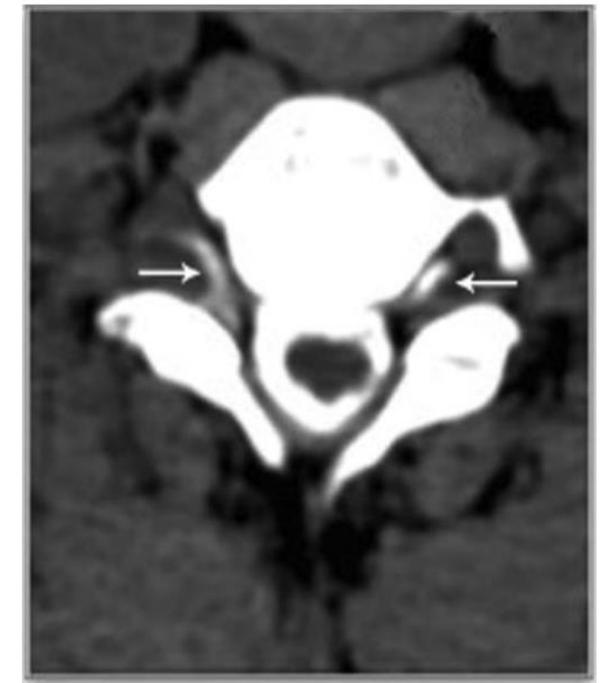
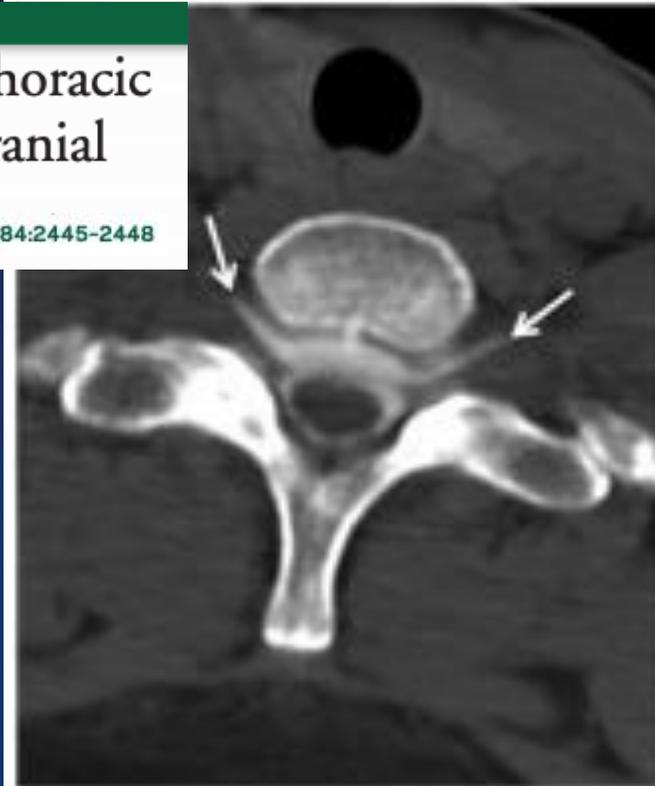


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Procedural predictors of epidural blood patch efficacy in spontaneous intracranial hypotension

Reg Anesth Pain Med
2019;**44**:212–220.

Gabriel L Pagani-Estévez,^{1,2} Jeremy K Cutsforth-Gregory,¹ Jonathan M Morris,³
Bahram Mokri,¹ David G Piepgras,⁴ William D Mauck,² Jason S Eldrige,²
James C Watson^{1,2}

- Retrospective (cohort)
 - 202 patients: 604 EBPs
- SIH Criteria: expert neurologist reporting
- Outcomes
 - efficacy: definition not specified
 - time points: ≥ 14 days, ≥ 3 months, ≥ 6 months
- Evaluated pt and procedure characteristics as predictors of EBP efficacy



Procedural predictors of epidural blood patch efficacy in spontaneous intracranial hypotension

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James C Watson^{1,2}

- Results:
 - Greater likelihood EBP efficacy:
 - larger volume patching material
 - multi-level patching
 - targeting: 8.4 (0.97-72), $p = 0.03$
 - Reduced likelihood EBP efficacy:
 - blood only
 - non-targeted lumbar or thoracic only

	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
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Targeted Epidural Blood Patch Injection Through a Mini-Open Approach for Treatment of Spontaneous Intracranial Hypotension

Tammam Abboud, MD*, Daniel Behme, MD*, Bawarjan Schatlo, MD*, Veit Rohde, MD*, Christian von der Brelie, MD*

- Retrospective (cohort)
 - 20 patients
 - 80% identified leak location
- Mini open interlaminar surgical approach:
 - Two epidural catheters: one above, one below, leak
 - Blood patch through catheters: mean 37.5 mL blood
- Outcomes
 - Significant improvement: 90%

	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
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Unveiling the superiority: single catheter multisite epidural blood patch for the treatment of spontaneous intracranial hypotension

Cunlong Kong¹ · Zuying Liu¹ · Lijun Fu¹ · Huilian Bu¹ · Xinxin Li¹ · Wenjie Liu¹ · Zhonghua Ma¹ · Xiao Wang² · Jingjing Yuan^{3,4} · Qingying Liu¹ · Xiaochong Fan^{1,4} · Wei Zhang^{3,4}

- Prospective (RCT)
 - 68 patients
 - Arms: Non-targeted (n=9), Targeted (n=17), Catheter Assisted (n=42)
- Response Rates:
 - 55.6% Non-targeted
 - 76.5% Targeted
 - 95% Catheter Assisted
- Note
 - Does not appear to categorize leak subtypes or use myelography for localization

	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
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<i>Kong 2025</i>	68	RCT	P	ICHD	T	B	VAS, HIT6	1 + 3 mos	76.5%T vs. 55.6%NT
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AJNR

AJNR Am J Neuroradiol published online 20 June 2025

Outcomes of CT-Guided Targeted Epidural Patching For Lateral Dural Tears In Spontaneous Intracranial Hypotension: A Multicenter Retrospective Cohort Study

Andrew L. Callen, Daniel Montes, Debayan Bhaumik, Peter Lennarson, Mark D. Mamlouk, Niklas Lützen, Jürgen Beck, Horst Urbach, Daniel Scoffings, David Butteriss and Lalani Carlton Jones

- Retrospective (cohort)
 - 56 patients
 - Lateral dural tears only
 - CT guided targeted patching

- Response Rates:
 - 35.7% Complete resolution of symptoms
 - 48.2% Partial improvement
 - 16.2% No improvement

	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
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<i>Callen 2025</i>	56	Cohort	R	ICHHD	T	B, F, B+F	Subj	Variable	83.9% (35.7% Complete, 48.2% Partial)
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A two-level large-volume epidural blood patch protocol for spontaneous intracranial hypotension: retrospective analysis of risk and benefit

Ryan Martin¹, Charles Louy², Vijay Babu³, Yi Jiang⁴, Azita Far², Wouter Schievink⁵

Regional Anesthesia & Pain Medicine *Reg Anesth Pain Med* 2020;45:32–37

- Retrospective (cohort)
 - 94 patients, ICHD+ SIH
 - Two patches (non-targeted)
 - 1st: IL: T9/10 - T12/L1
 - 2nd: IL: L3/4 or L4/5
 - Mean blood volume: 43.2 ± 21.7 mL
 - 28.2% patients excluded (unknown outcomes)
- Success (no further treatment):
 - 28.7% after 1st procedure
 - 41.4% (total) after 2 procedures
 - 46.8% (total) after 3 procedures



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<i>Martin 2020</i>	94	Cohort	R	ICHHD	NT	B	Subj	NS	28.7% 1 st EBP 46.8% by 3 rd EBP
<i>Callen 2025</i>	56	Cohort	R	ICHHD	T	B, F, B+F	Subj	Variable	83.9% (35.7% Complete, 48.2% Partial)
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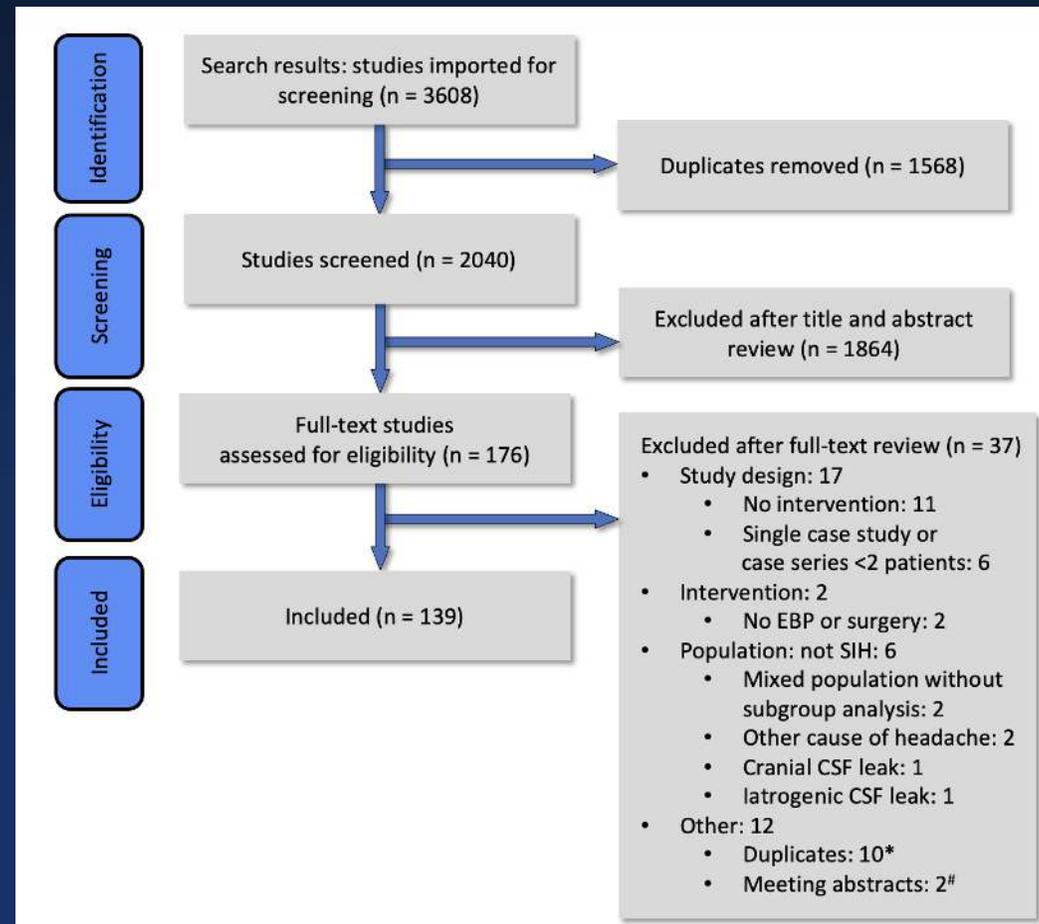
- Retrospective (cohort)
 - 51 patients: all SLEC+ (Type I or II)
 - Non-targeted EBP: L2/3, L3/4, or L4/5
- Response Rates:
 - 29% imaging success best case scenario: (71% persistent CSF leak)
 - 36% symptom improvement long term
 - 57% eventually required surgery

	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
<i>Martin 2020</i>	94	Cohort	R	ICHHD	NT	B	Subj	NS	28.7% 1 st EBP 46.8% by 3 rd EBP
<i>Callen 2025</i>	56	Cohort	R	ICHHD	T	B, F, B+F	Subj	Variable	83.9% (35.7% Complete, 48.2% Partial)
<i>Kong 2025</i>	68	RCT	P	ICHHD	T	B	VAS, HIT6	1 + 3 mos	76.5%T vs. 55.6%NT
<i>Abboud '24</i>	20	Cohort	R	Subj	T	B	Subj	3 mos	90%
<i>Pagani '19</i>	202	Cohort	R	Subj	T + NT	B, F, B+F	NS	3 mos	↑Efficacy: targeting
<i>He 2018</i>	165	Cohort	R	ICHHD	T	B	Subj	NS	88%
<i>Cho 2011</i>	56	Case series	R	ICHHD	T + NT	B	Subj	Variable	87.1%T vs. 52%NT (p<.05)
<i>Sencakova 2001</i>	25	Case series	R	Subj	T + NT?	B	NS	NS	68% (36% 1 st EBP) ↑ targeting (p=0.07)

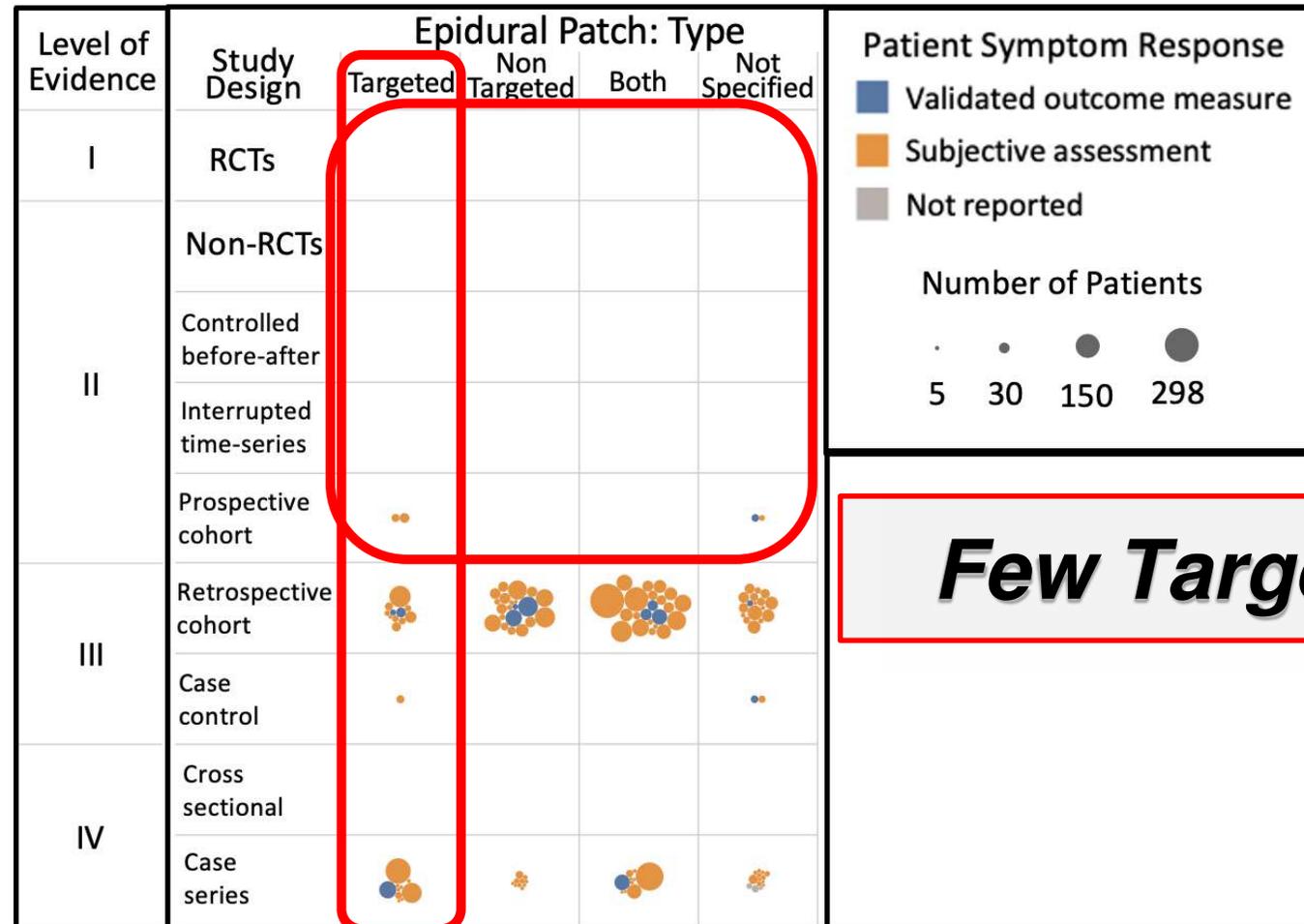
	<u>#Pts</u>	<u>Design</u>	<u>Prosp Retro</u>	<u>SIH Diag</u>	<u>Targeted or Non-T</u>	<u>Blood or Fibrin</u>	<u>Outcome Measure</u>	<u>Follow Up Timepoint</u>	<u>Result</u>
<i>Eike 2023</i>	51	Cohort	R	ICHHD	NT	B	Subj	NS	29% Imaging Success 36% Symptom Success
<i>Martin 2020</i>	94	Cohort	R	ICHHD	NT	B	Subj	NS	28.7% 1 st EBP 46.8% by 3 rd EBP
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Targeted vs. Non-Targeted EBP: *State of the Evidence*

Efficacy of EBP: Systematic Review and Evidence Map



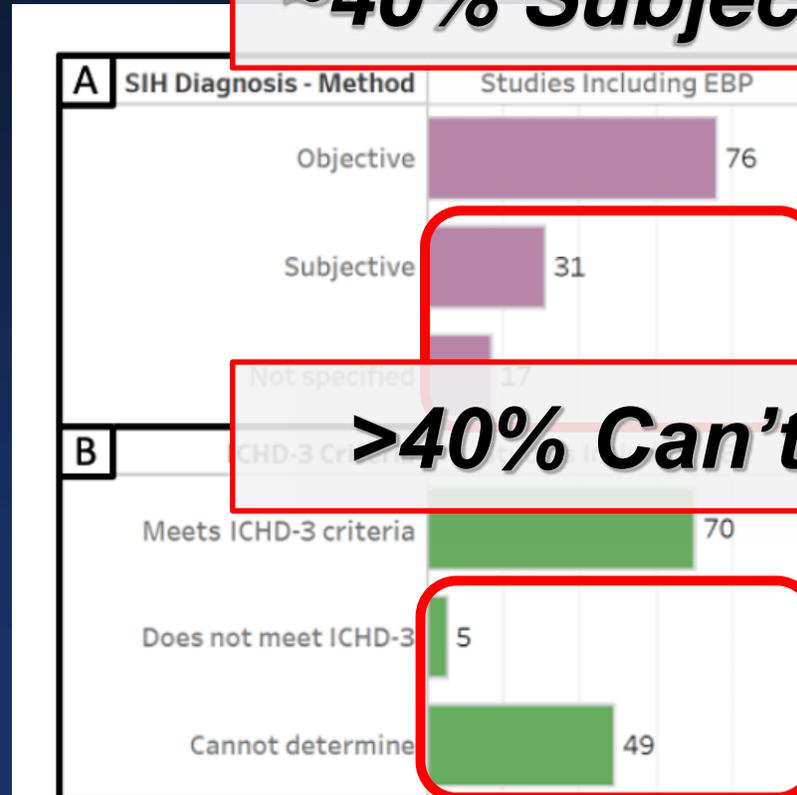
Epidural Patching: Patch Type



Few Targeted Studies

SIH Diagnosis

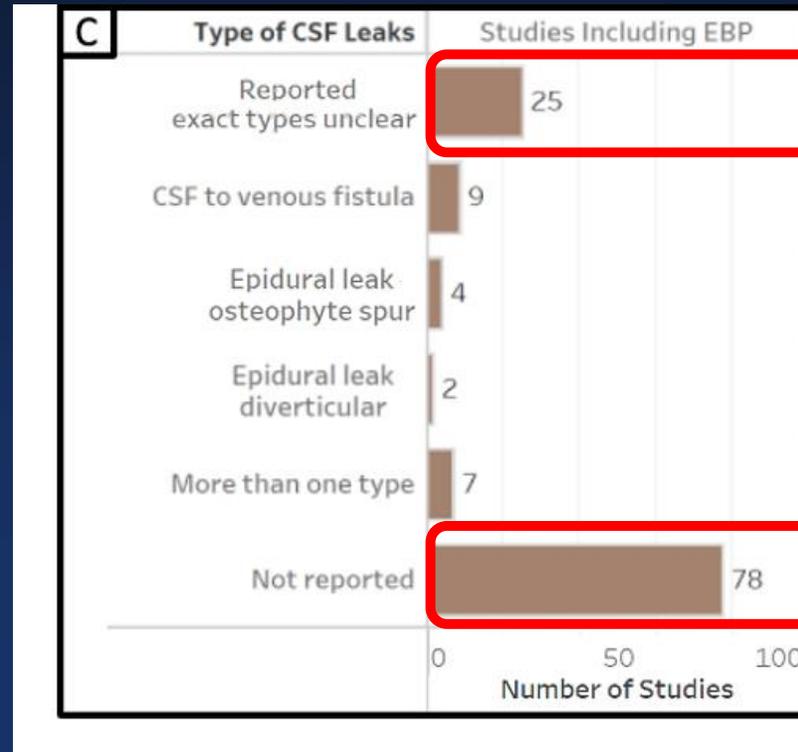
~40% Subjective or Not Specified



>40% Can't Determine ICHD-3

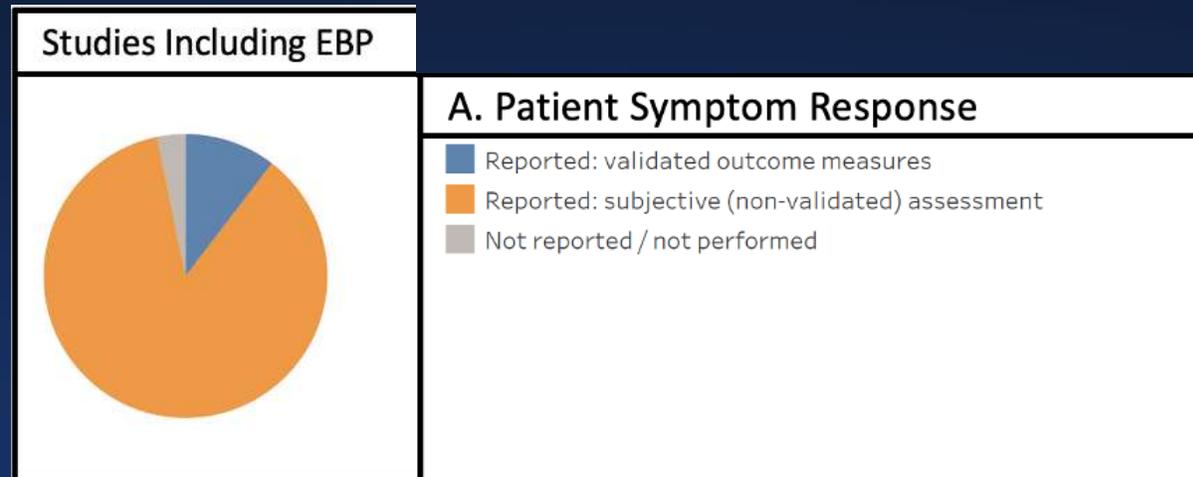
SIH Diagnosis: CSF Leaks

77.7% Did Not Report / Unclear



Outcome Measures: Symptoms

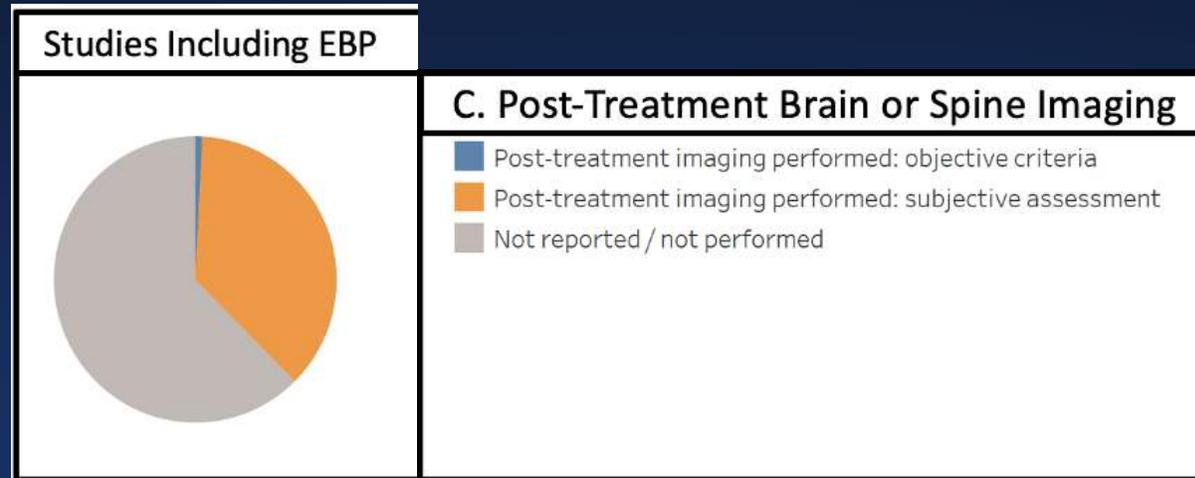
84.9% Subjective non-validated



Variable Time Points

Outcome Measures: Imaging

61.2% Not Reported



Only 2 Used Objective Outcome

The TARGET Trial



Application Number: 1 UG3 NS131531-01

Principal Investigator
AMRHEIN, TIMOTHY J

Most observational data suggest that both approaches (targeted versus non-targeted) are relatively effective



Thank You!

Tim Amrhein, MD

Associate Professor of Neuroradiology

Director of Spine Intervention

Duke University Medical Center

Vice President, American Society of Spine Radiology