



Surgery for PDPH: Blebs and needle holes

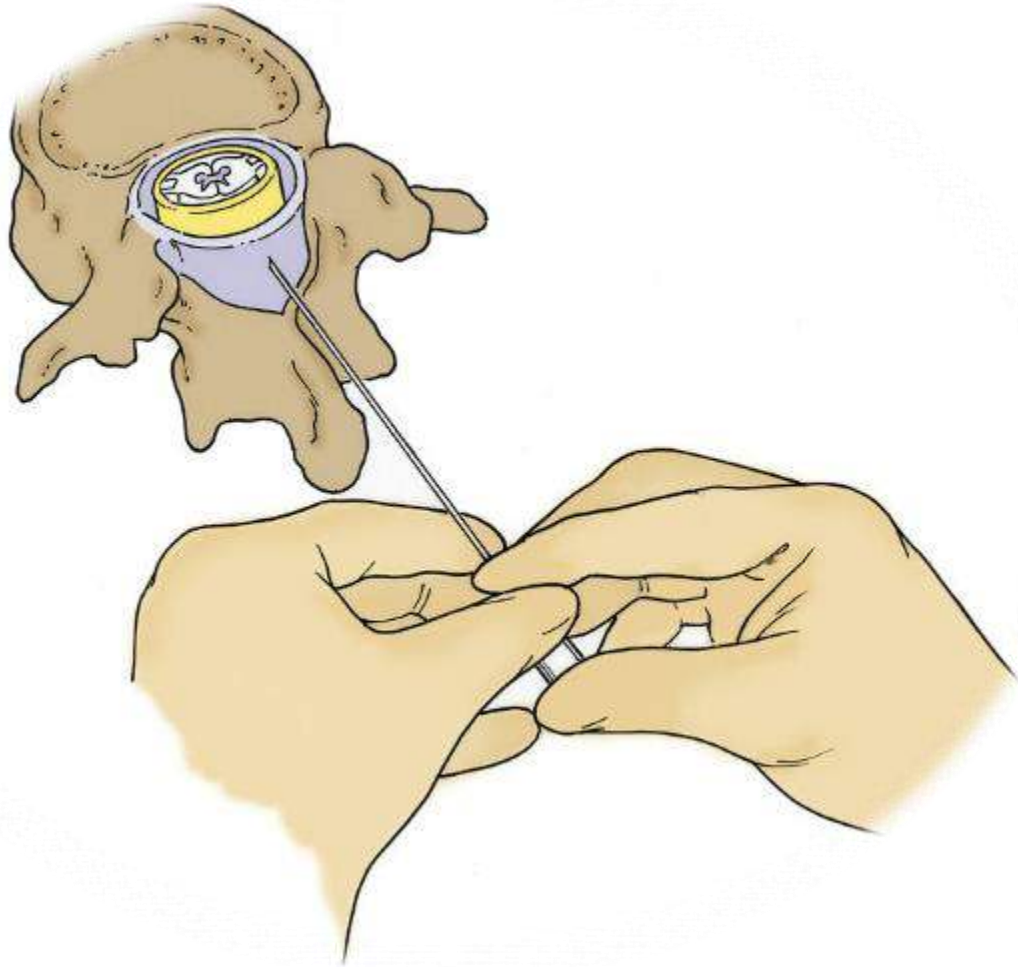
Prof. Dr. Jürgen Beck

Director Neurosurgery | Speaker Neurocenter | Chair CSF-Section EANS

Medical Center – University of Freiburg, Germany

Disclosures

Nothing to disclose



Post-dural puncture headache - PDPH

- within 5 days of a lumbar puncture
- remits spontaneously within 2 weeks
- remits upon blood patching

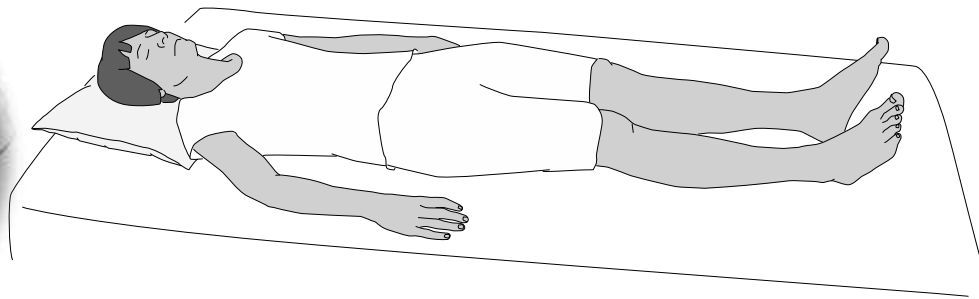


chronic PDPH

Post
Dural
Puncture
Headache

≠

Spontaneous
Intracranial
Hypotension



Symptoms of chronic post dural-puncture headache (cPDPH)

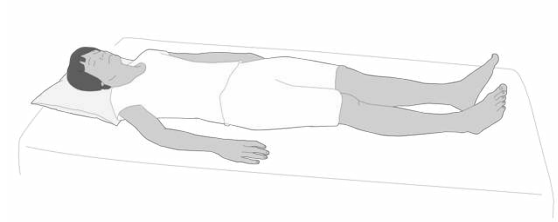


Pain

- Orthostatic Headaches 96%
- Neck Stiffness/Pain 64%
- Meningeal signs
 - Photophobia
 - Phonophobia

Sensory Symptoms

- Vestibulocochlear signs
 - Tinnitus 36%
 - Dizziness 46%
 - Equilibrium troubles
- Autonomic
 - Nausea 40%



Cognitive

- Brain Fog
- Reduced performance
- Chronic Fatigue

Emotional Related

- «Depression»
- Anxiety

Chronic PDPH – Benign ?

"I lost my job"

"My condition has completely changed my life"

"I lost 2 years of my life in social isolation"

"I lost my partner"

"I lost my joie-de-vivre"

"No restaurant, no cinema, no reading"



- Subdural hematoma **6%**
- Fatigue
- Loss of QOL
- Depression

Acute

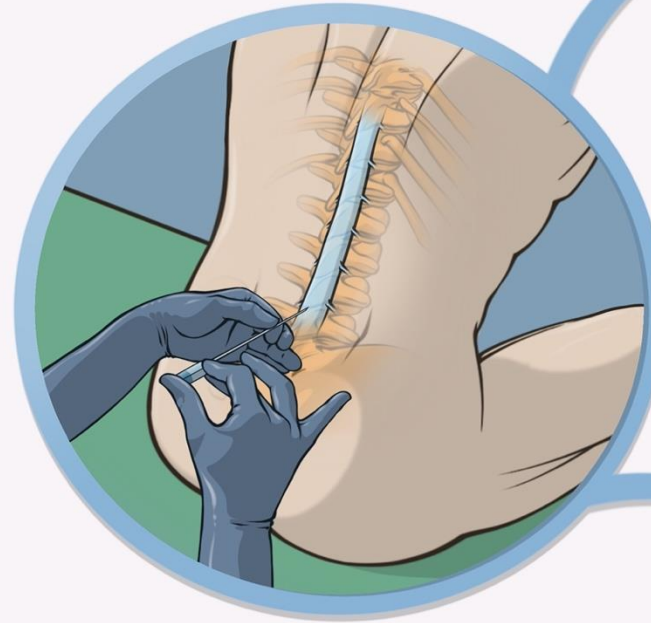
Chronic

Long Term

Lumbar Puncture

Chronic PDPH

- - 2023
- n = 61 patients
- Freiburg Neurosurgery



381 days on sick leave



5 doctors/institutions



31 days in acute hospital care

Kraus L, Fung C, El Rahal A, Beck J – Brain and Spine



Health-related quality of life, work ability and disability among individuals with persistent post-dural puncture headache

Ali Kapan^{1*} , Thomas Waldhör² , Tobias Schiffler¹ , Jürgen Beck³  and Christian Wöber^{4,5} 

Sick leave due to pDPH

3–6 Months	14 (7.8)
6–12 Months	43 (24.0)
Over 1 year	64 (35.8)
Over 2 years	6 (3.4)

Ability to be in an Upright Position

Not at all	29 (16.2)
Less than 1 h	50 (27.9)
2–4 h	29 (16.2)
Most of the day	16 (8.9)
Whole day	55 (30.7)

Ability to take care of children

Not at all	20 (23.3)
Under 1 h	23 (26.7)
2–4 h	17 (19.8)
4–6 h	15 (17.4)
Whole day	11 (12.8)

Full time work in same job = 12 %

Neurosurgical findings in cPDPH



N= 26
74%



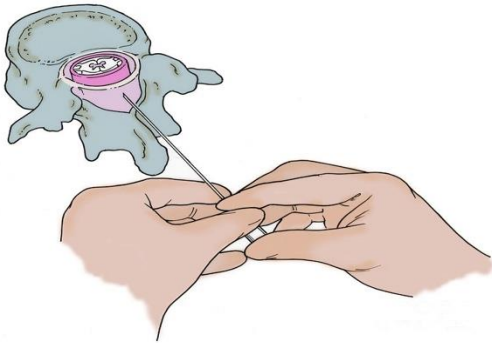
N= 8
24%

N= 34

Age (mean)

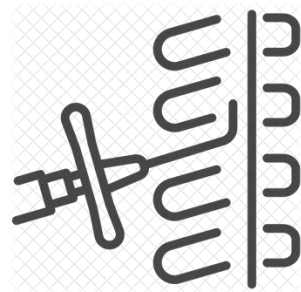
50.5 y.o (IQR 13)

Lumbar Puncture



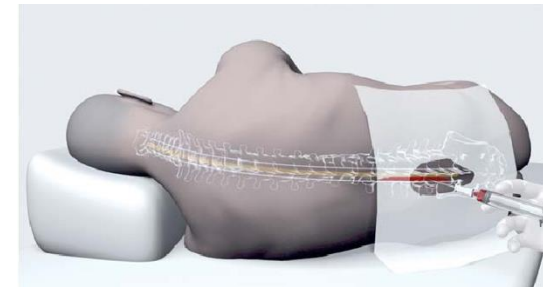
63%

PDA (accidental) or Spinal Anesthesia



27 %

EBP



(n) mean
patches = 3



EANS CEREBROSPINAL FLUID
SECTION

CSF-Center Freiburg



International Collaborations

Inselspital Bern, Switzerland
(Dorbocky, Piechowiak, Schankin, Raabe)

Lindenhofspital Bern, Switzerland
(Fung, Ulrich)

ETH Zuerich, Switzerland
(The Interface Group)

AKH, Vienna, Austria
(Kapan)

King's College, UK
(Carlton-Jones)

Cedars Sinai, CA, USA
(Schievink)

Stanford, CA, USA
(Carroll)



Neurosurgery & Neurology
J. Beck, K. Wolf, F. Volz,
L. Krismer, A. El Rahal, M. Shah

Neuroradiology
H. Urbach, N. Lützen,
C. Zander, T. Demerath, H. Mast



Nuclear Medicine
P.T. Meyer & Team

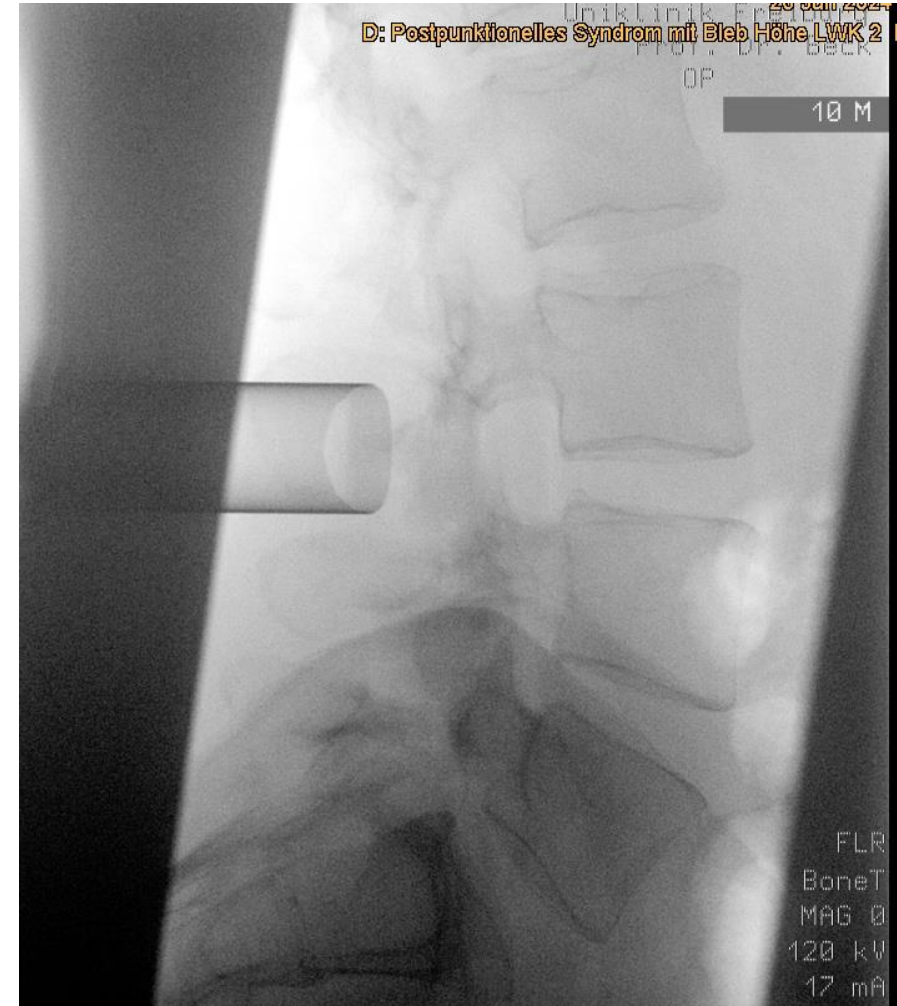
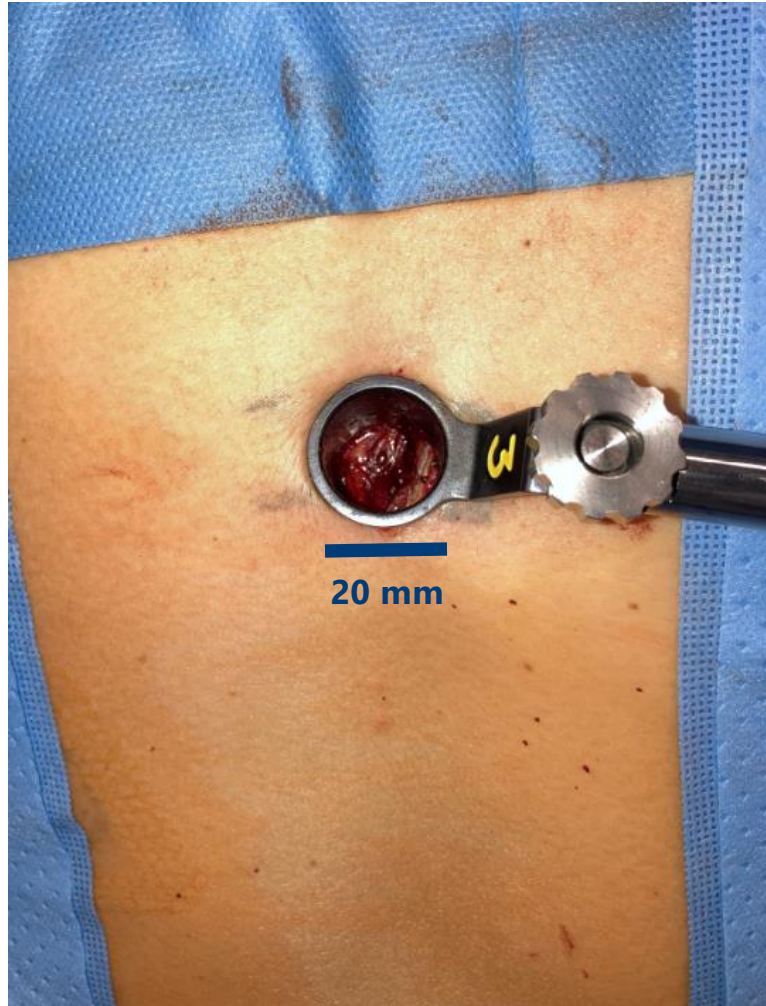
Anesthesiology
H. Bürkle & Team

Neuroophthalmology
W. Lagrèze & Team

Neuromedical AI Lab
T. Ball & Team

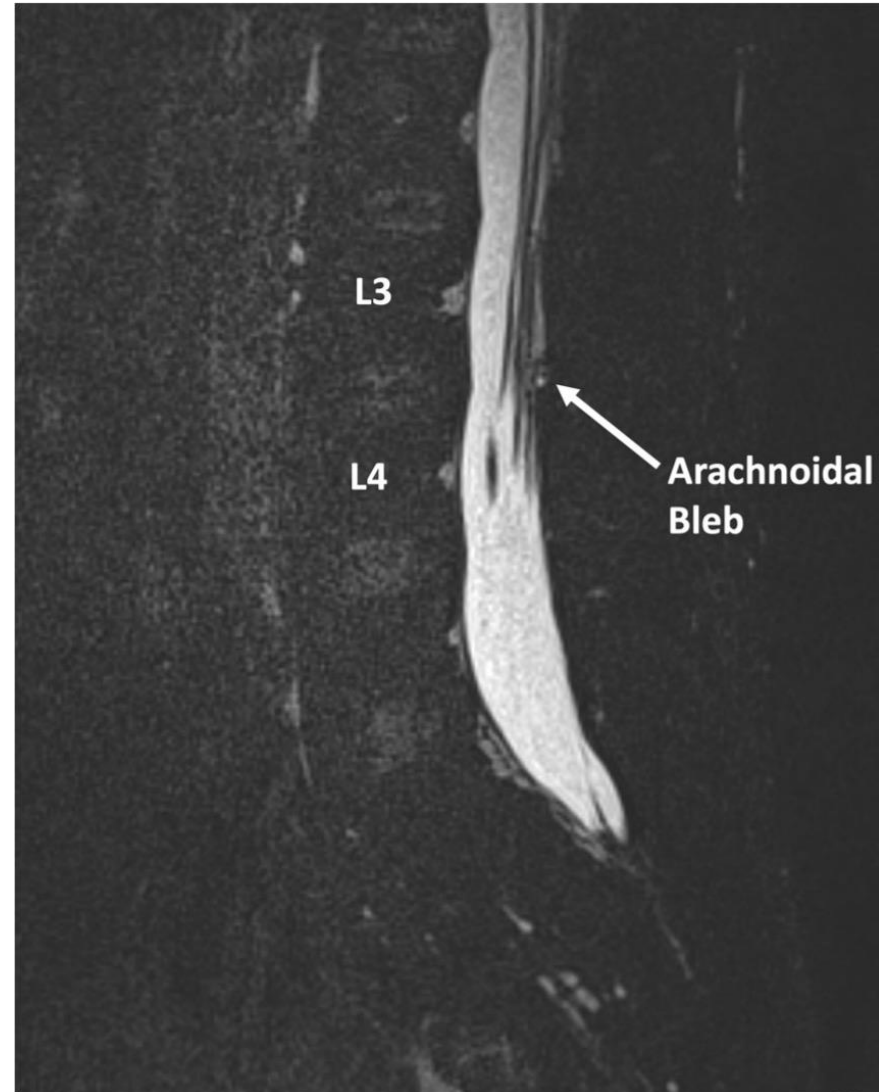
Medical Physics
M. Reisert & Team

MIS - Approach



Short duration PDPH

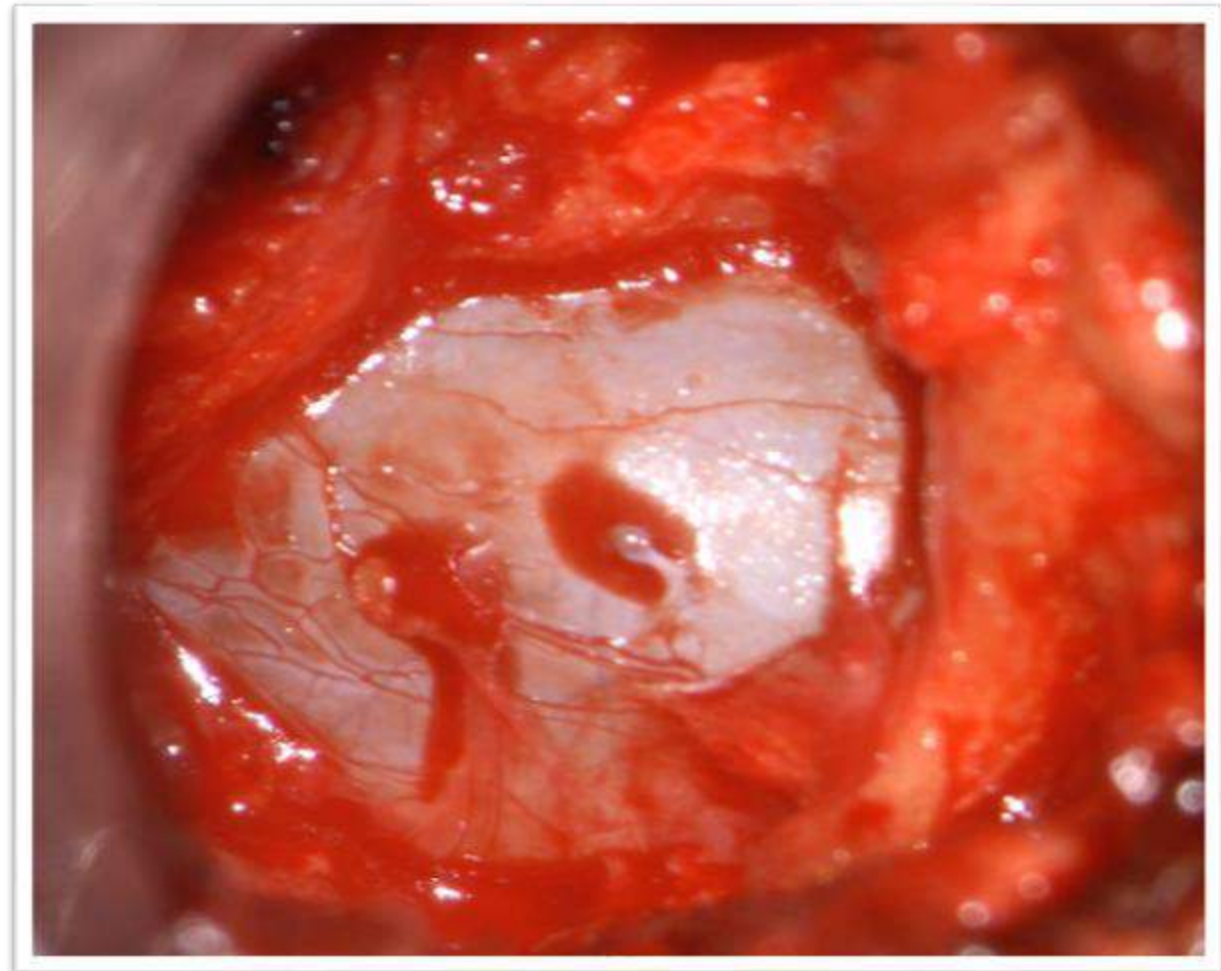
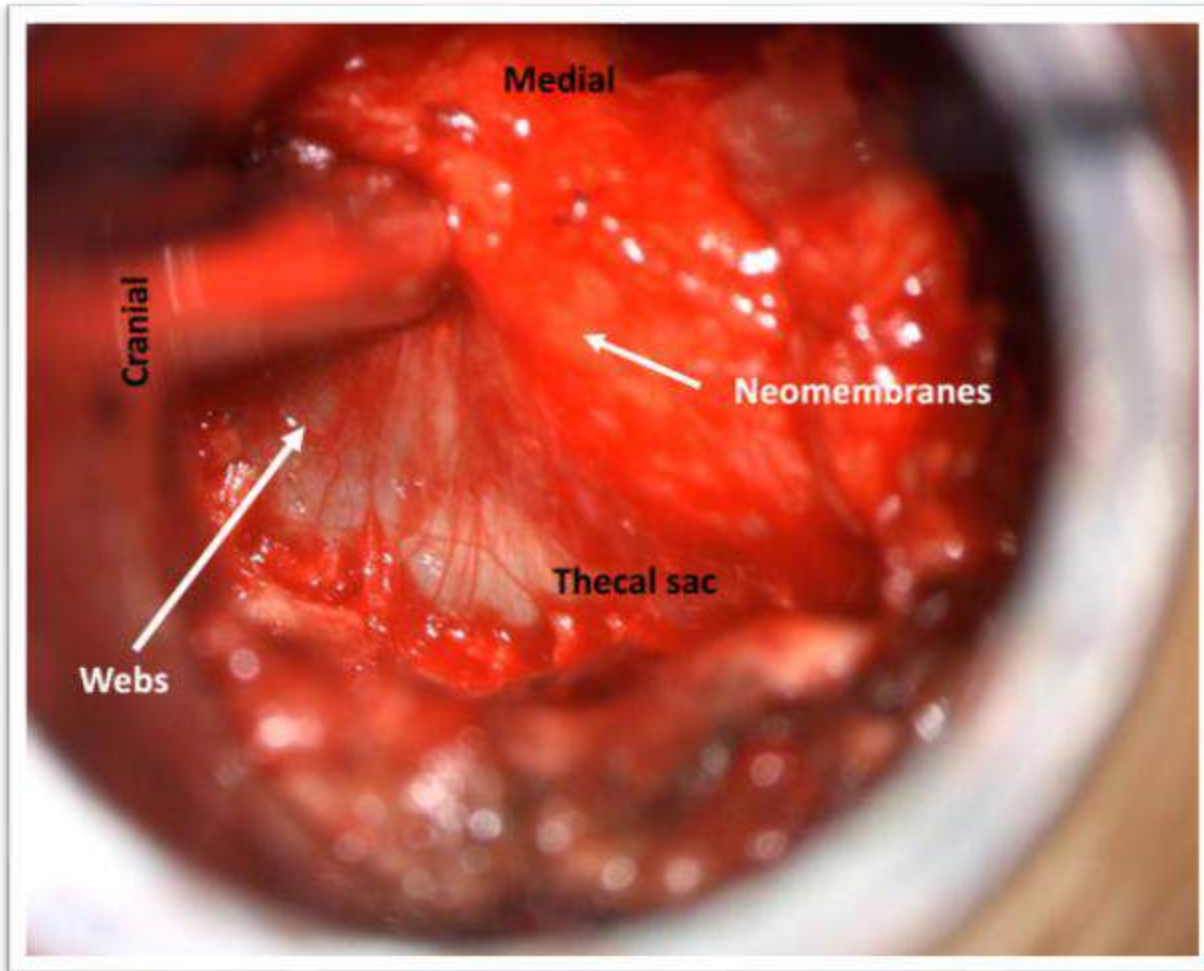
Arachnoid Bleb - Weeping Dura



El Rahal A, Beck J et al.

Under review

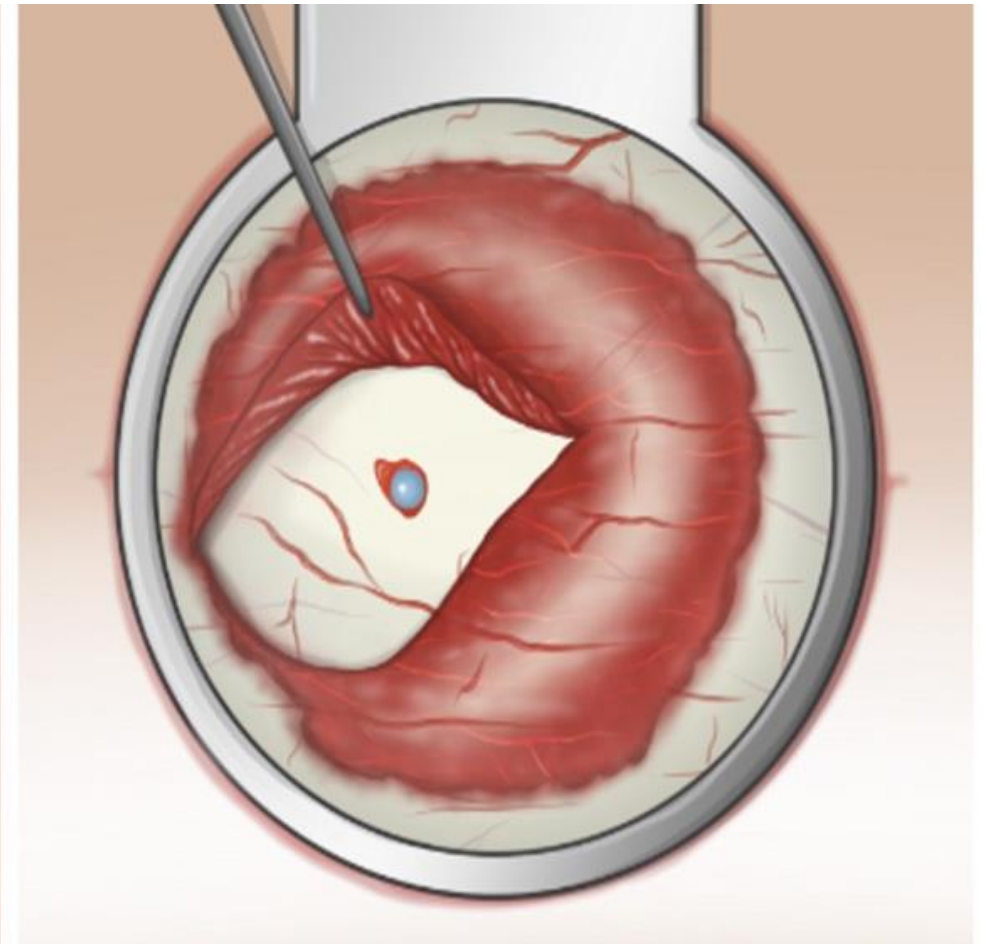
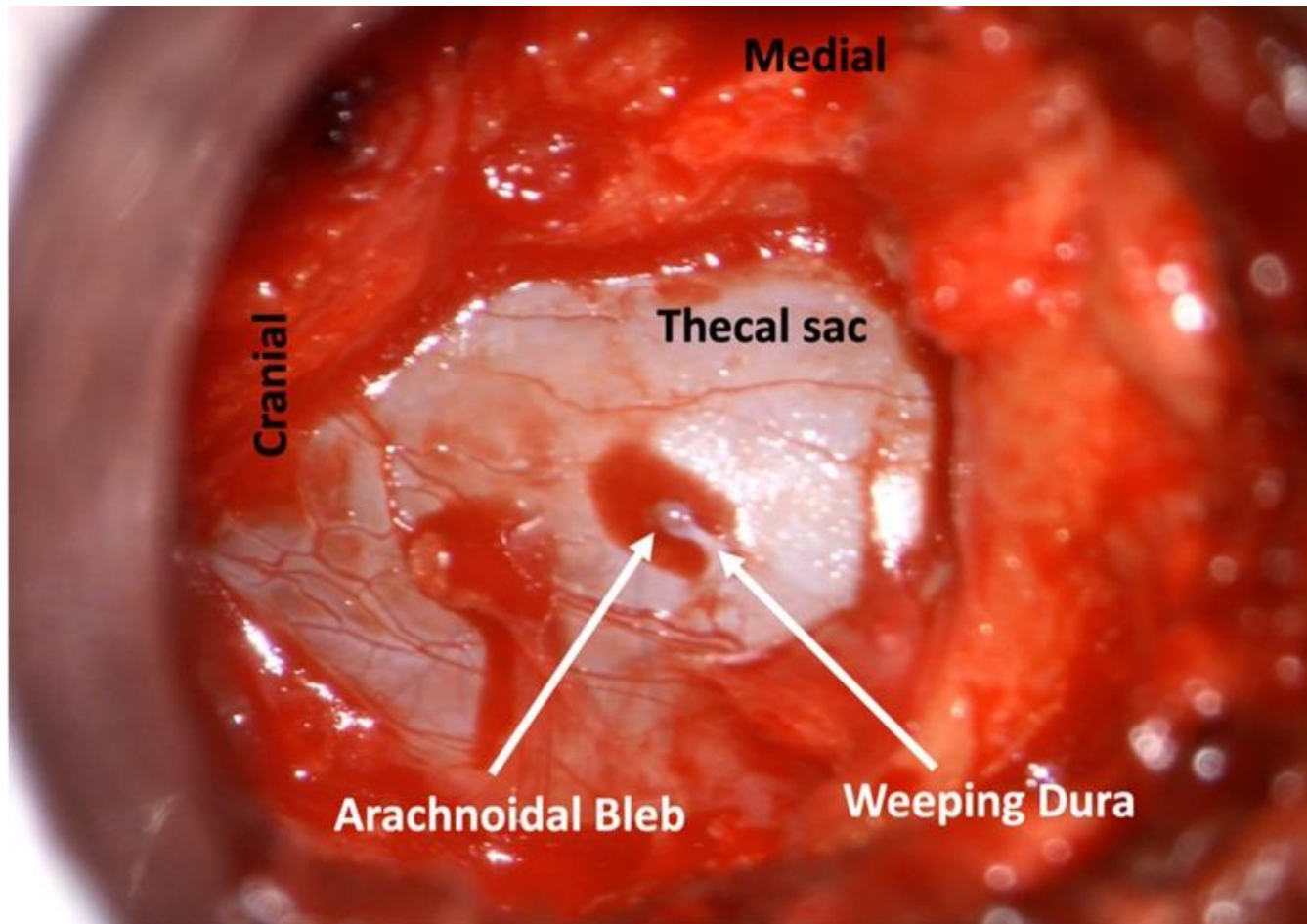
Arachnoid Bleb - Weeping Dura



El Rahal A, Beck J et al.

Under review

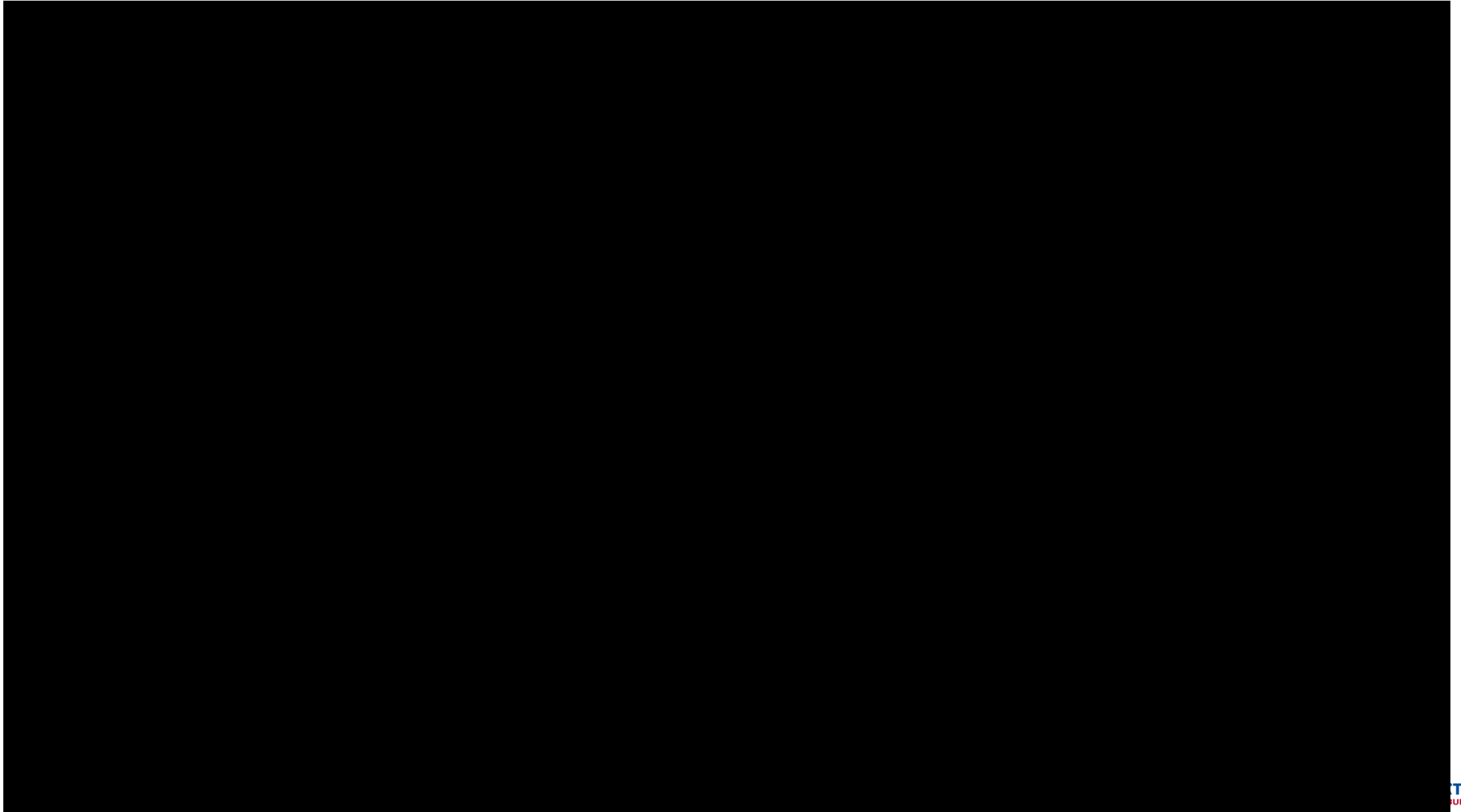
Web on a Bleb



El Rahal A, Beck J et al.

Under review

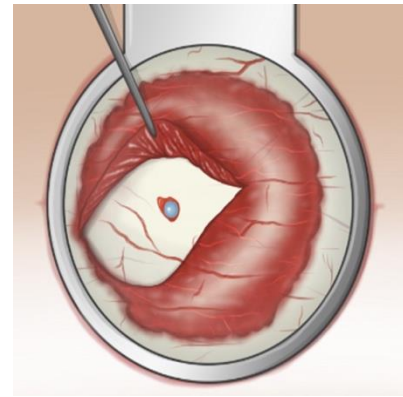
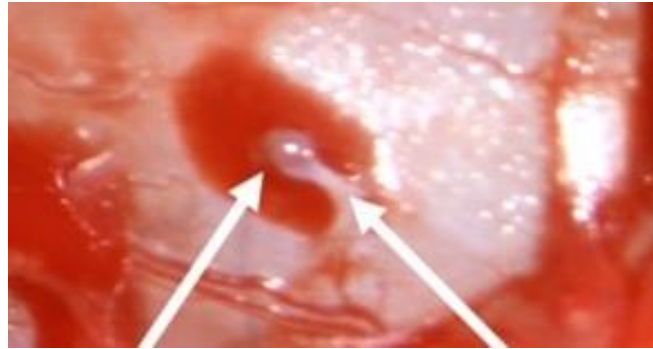
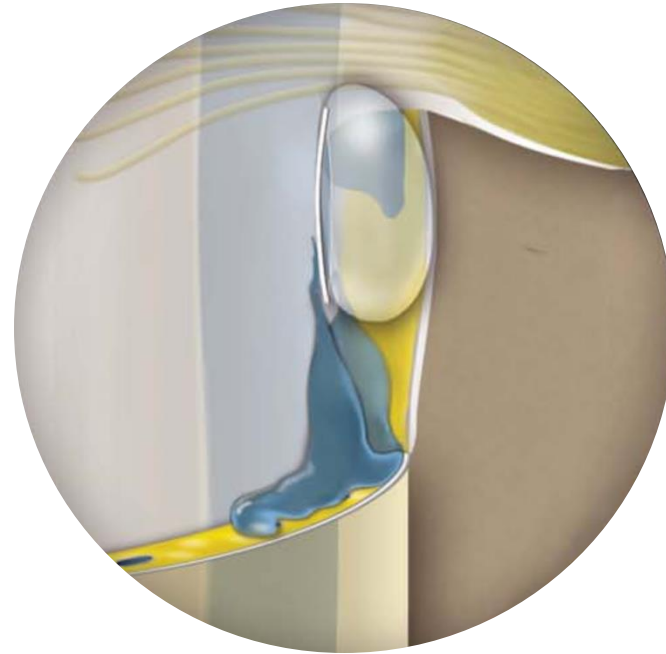
Web on a Bleb



Bleb reduction and Sandwich-Suture



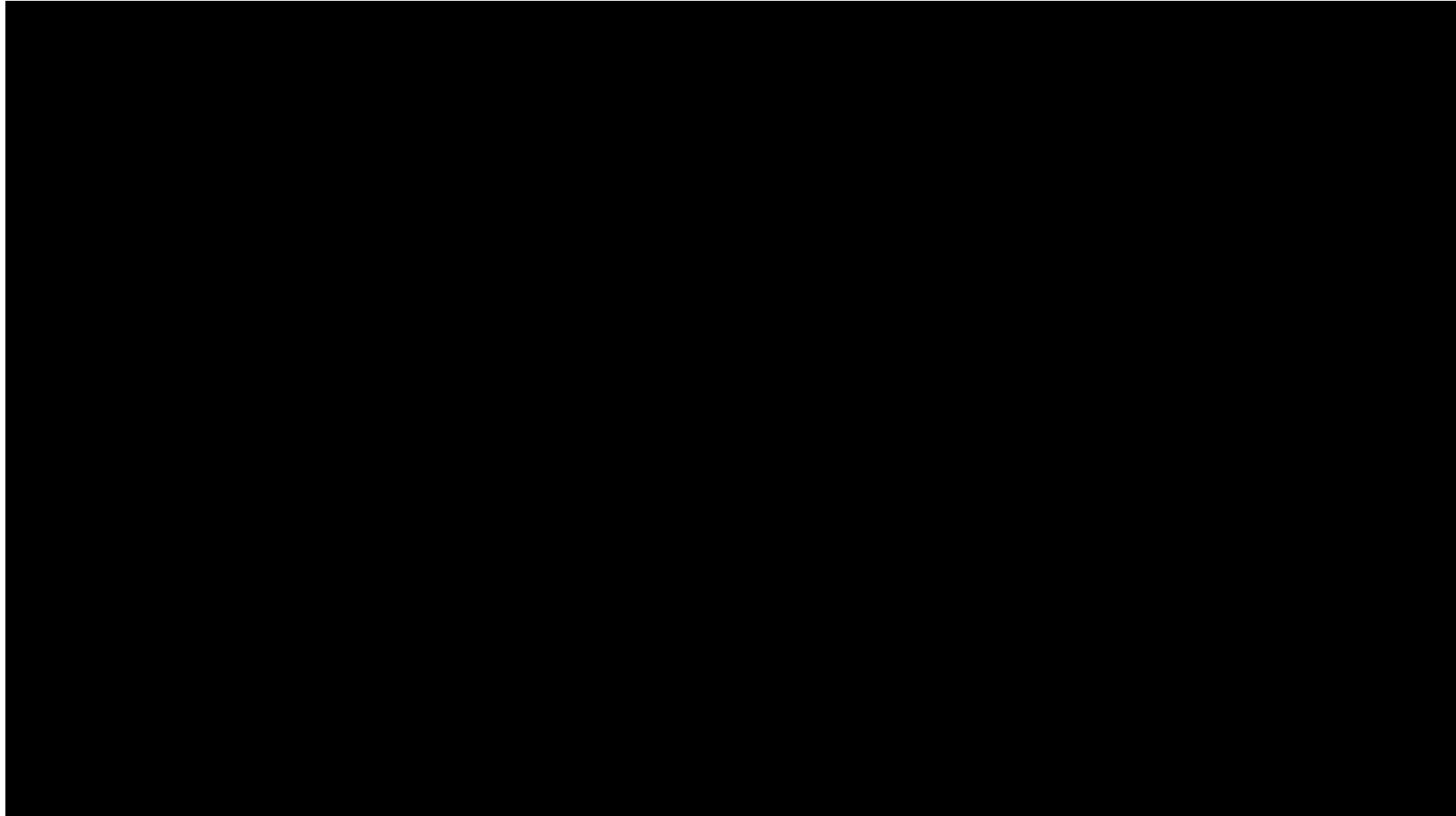
September 20, 2016
Beck et al. Neurology



El Rahal A, Beck J et al.

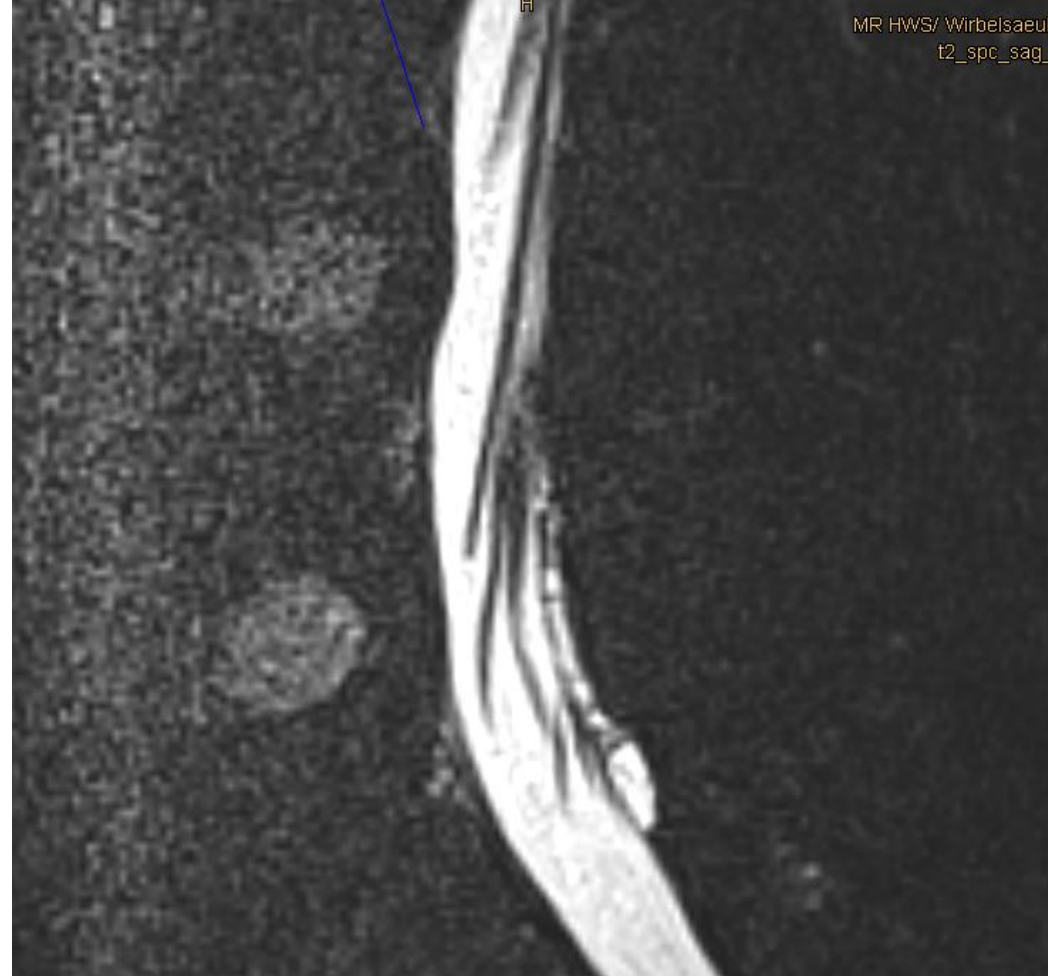
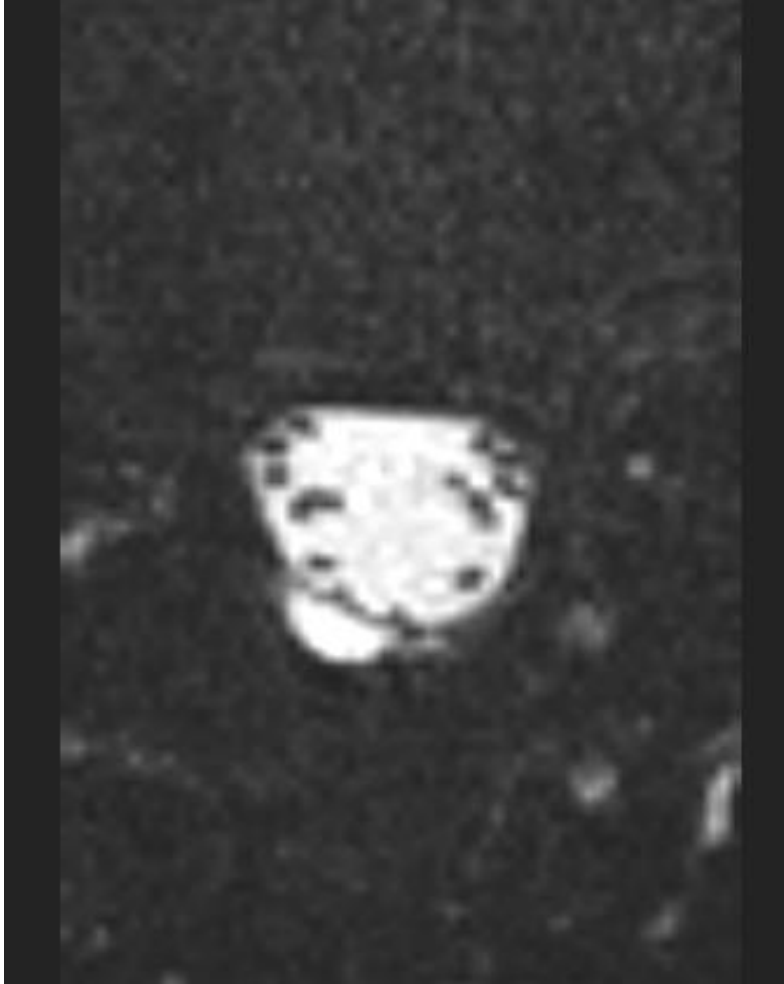
Under review

PDPH – multiple leak – clipping and 360° Patch

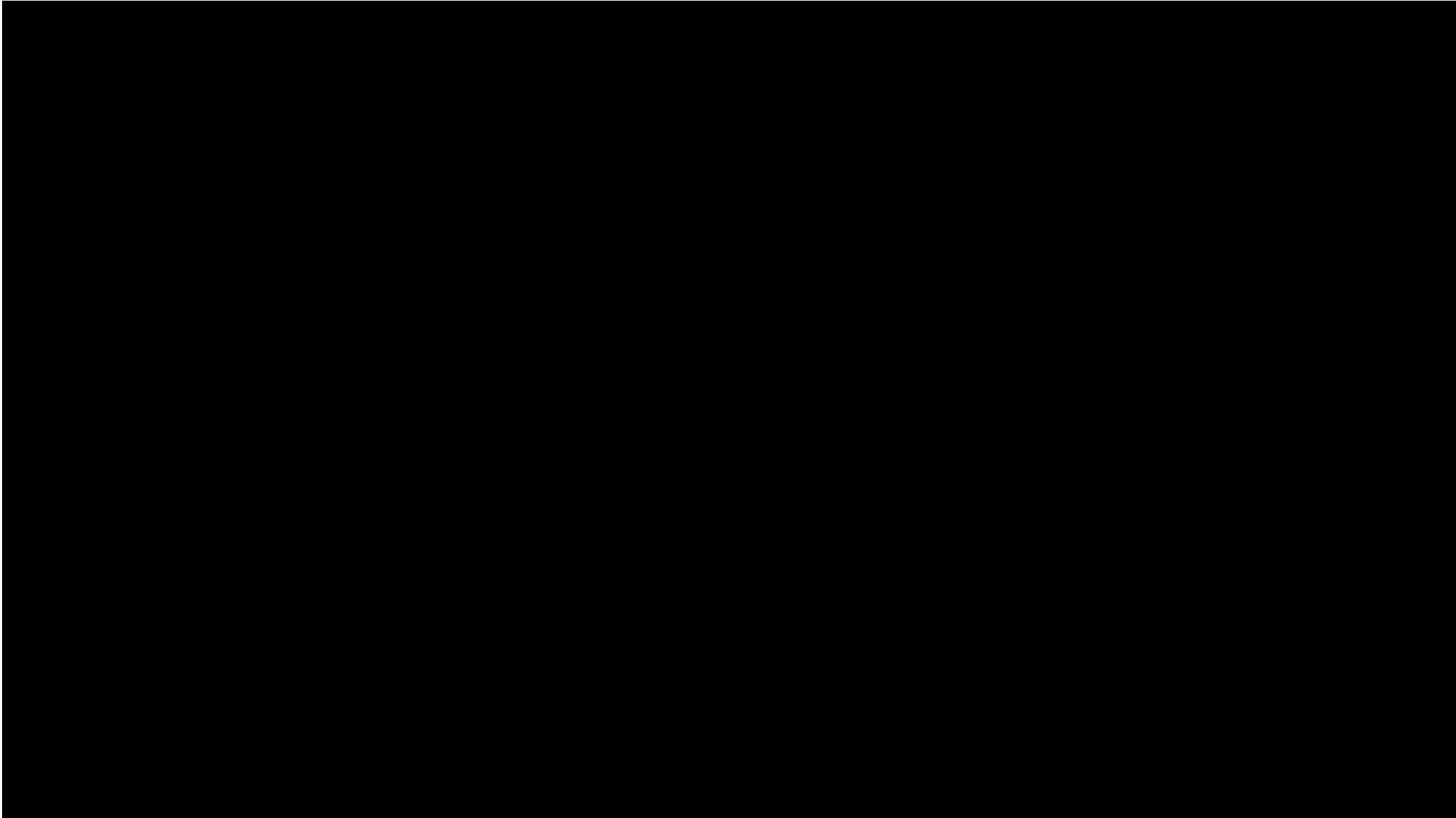


Long term PDPH

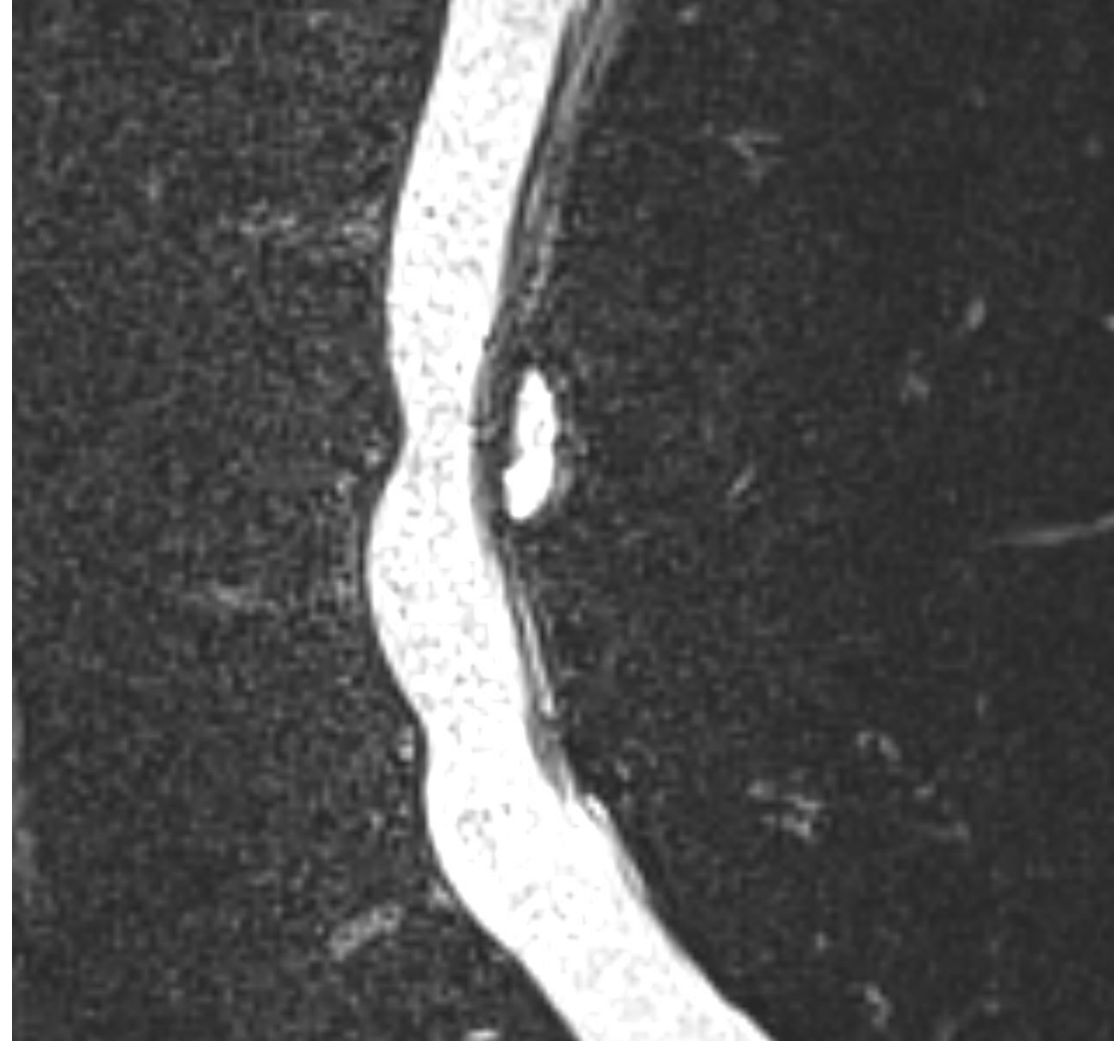
Complex L4-L5 PDPH



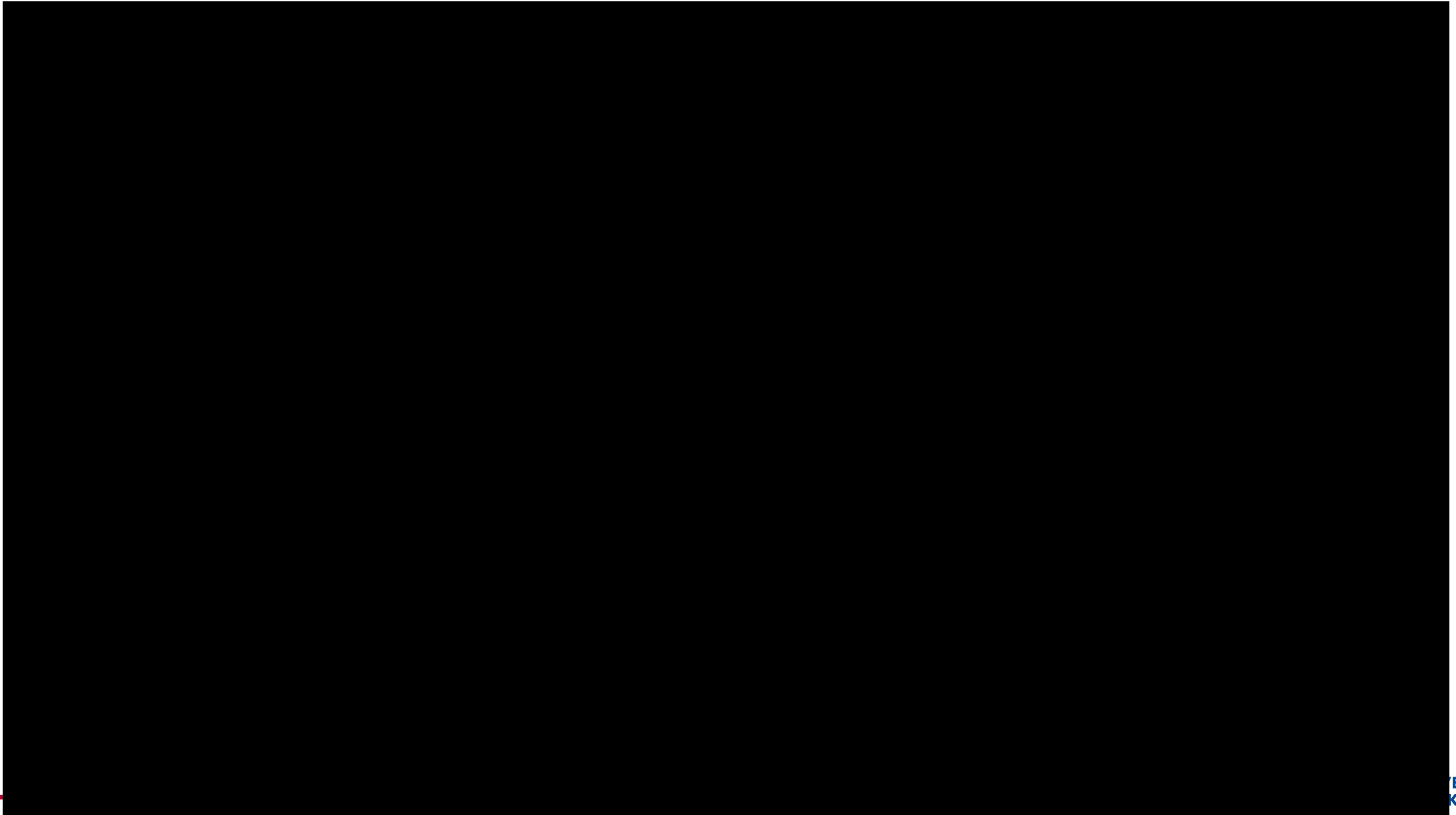
Chronic L4-L5 leak – extensive neo-membranes



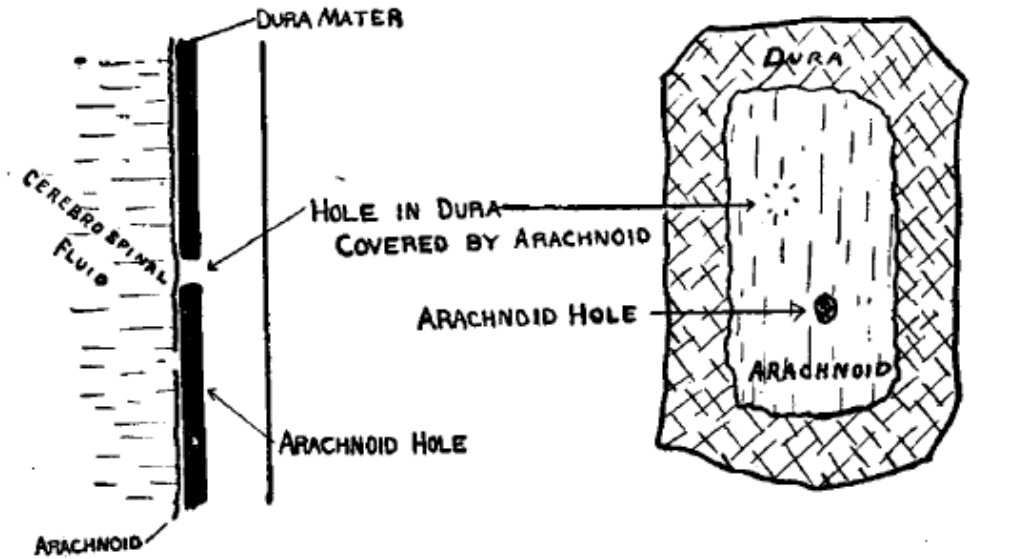
Chronic PDPH (20 years) - strangulated fascicles



Chronic PDPH (20 years long) - strangulated fascicles



Chronic PDPH – long story



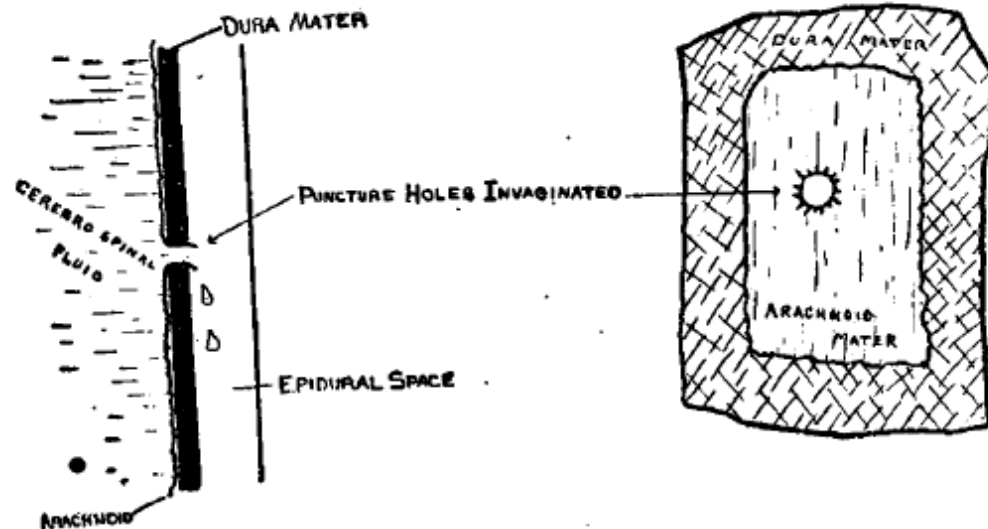
THE CAUSE OF LUMBAR PUNCTURE HEADACHE

RUSSELL G. MACROBERT, M.B. (TOR.)

Associate Physician, Neurological Institute

NEW YORK

JOUR. A. M. A.
MAY 11, 1918



CSF hypotension state?

*Smith et al 2019: „Risk of PDPH does not appear to be influenced by **opening pressure**, CSF pressure, volume or **pressure-volume-index**“*

Diagnostic?

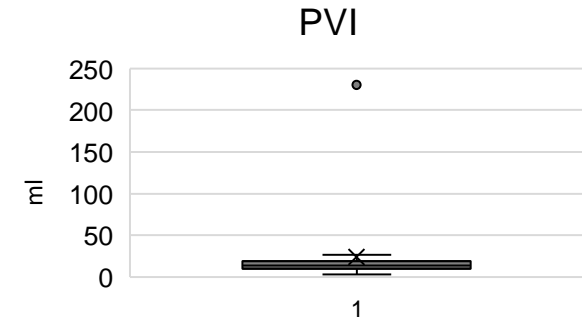
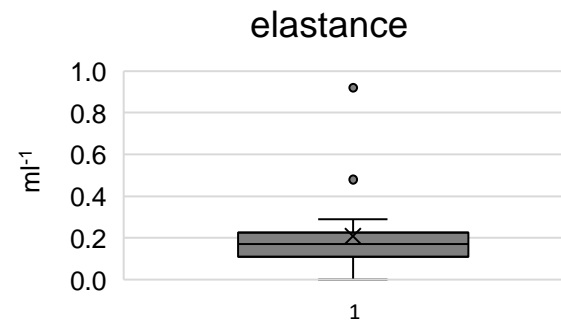
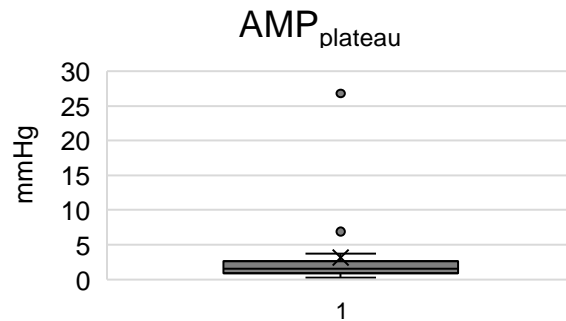
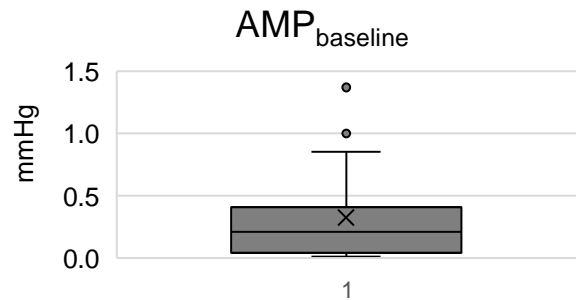
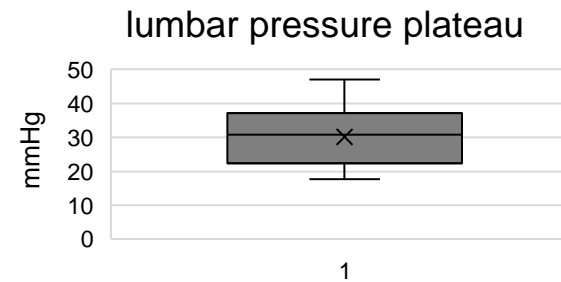
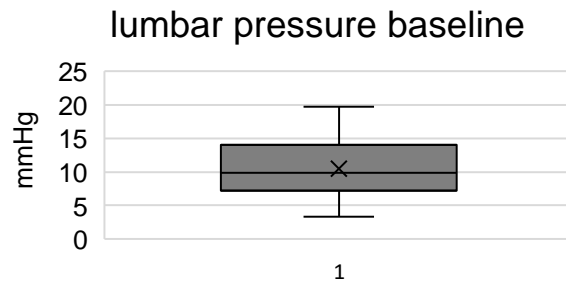
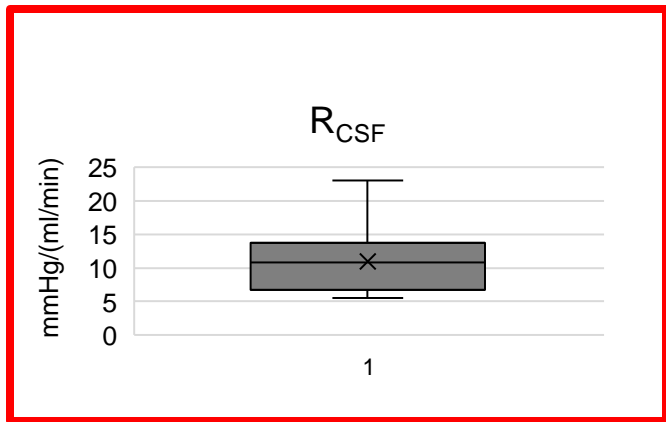
CSF dynamics?

Resistance to CSF outflow in diagnosis of spontaneous CSF leakage

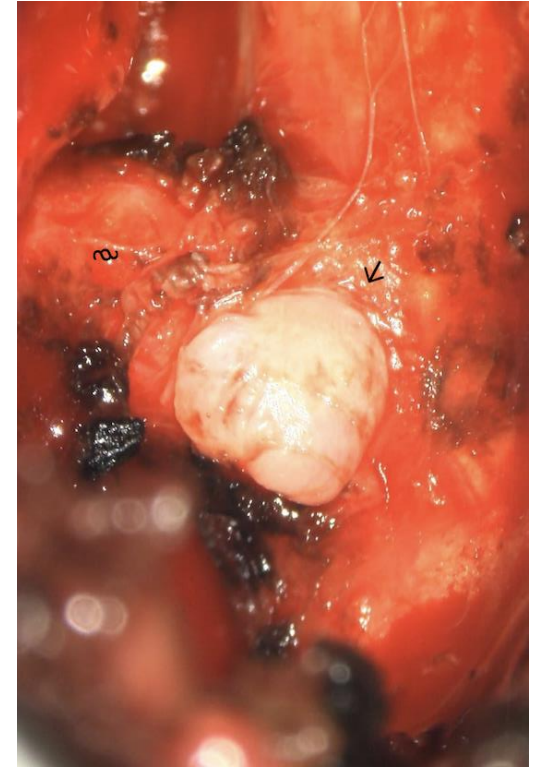
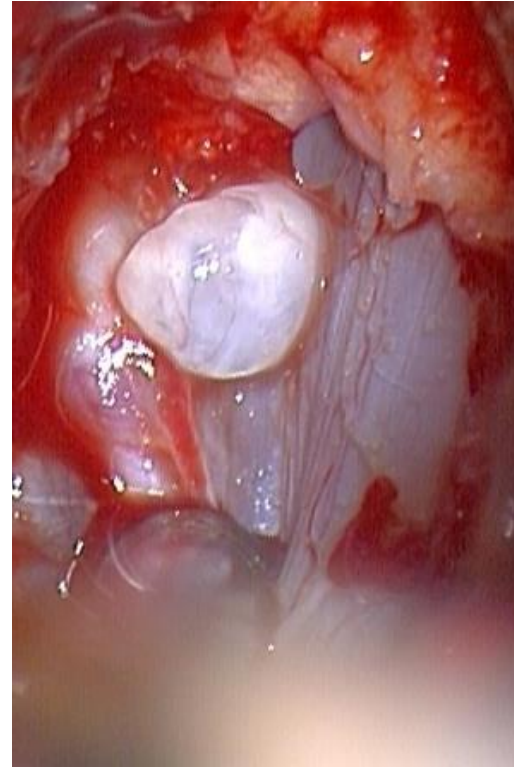
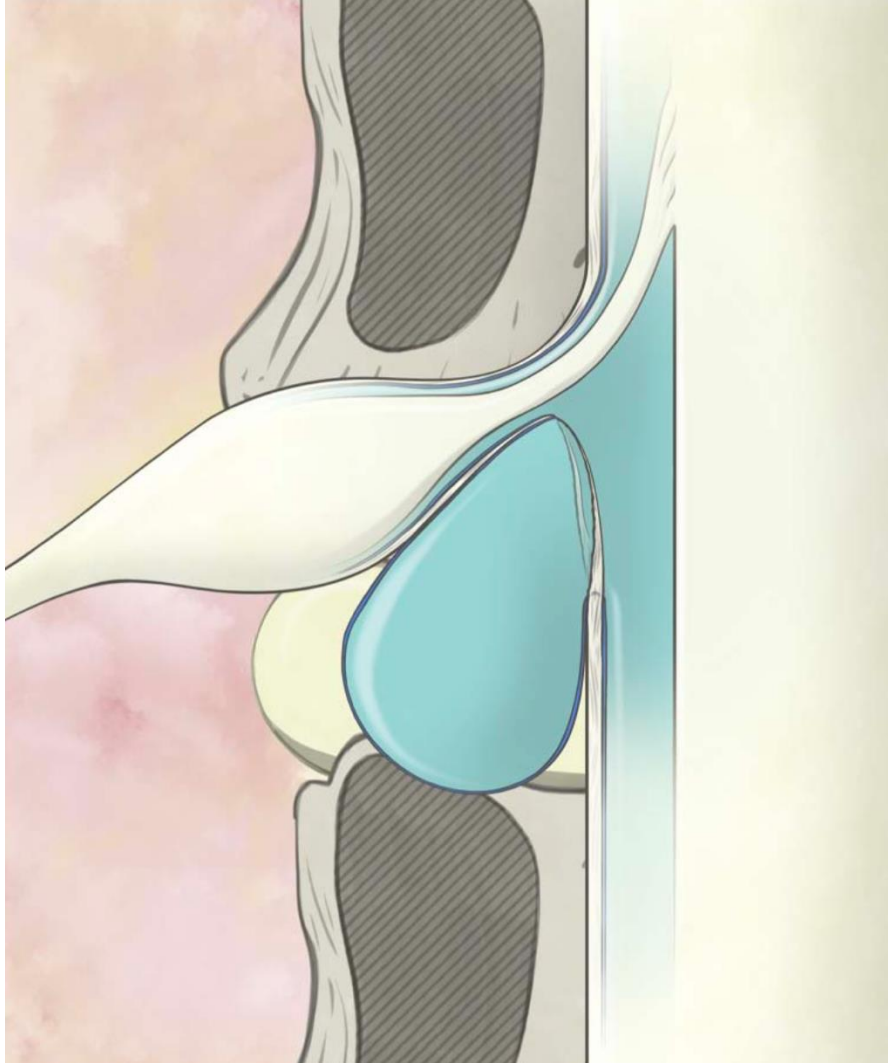


R_{CSF} is not related to chronic PDPH

Median R_{CSF} **10.77 mmHg/(ml/min)** IQR (6.79 - 13.78)



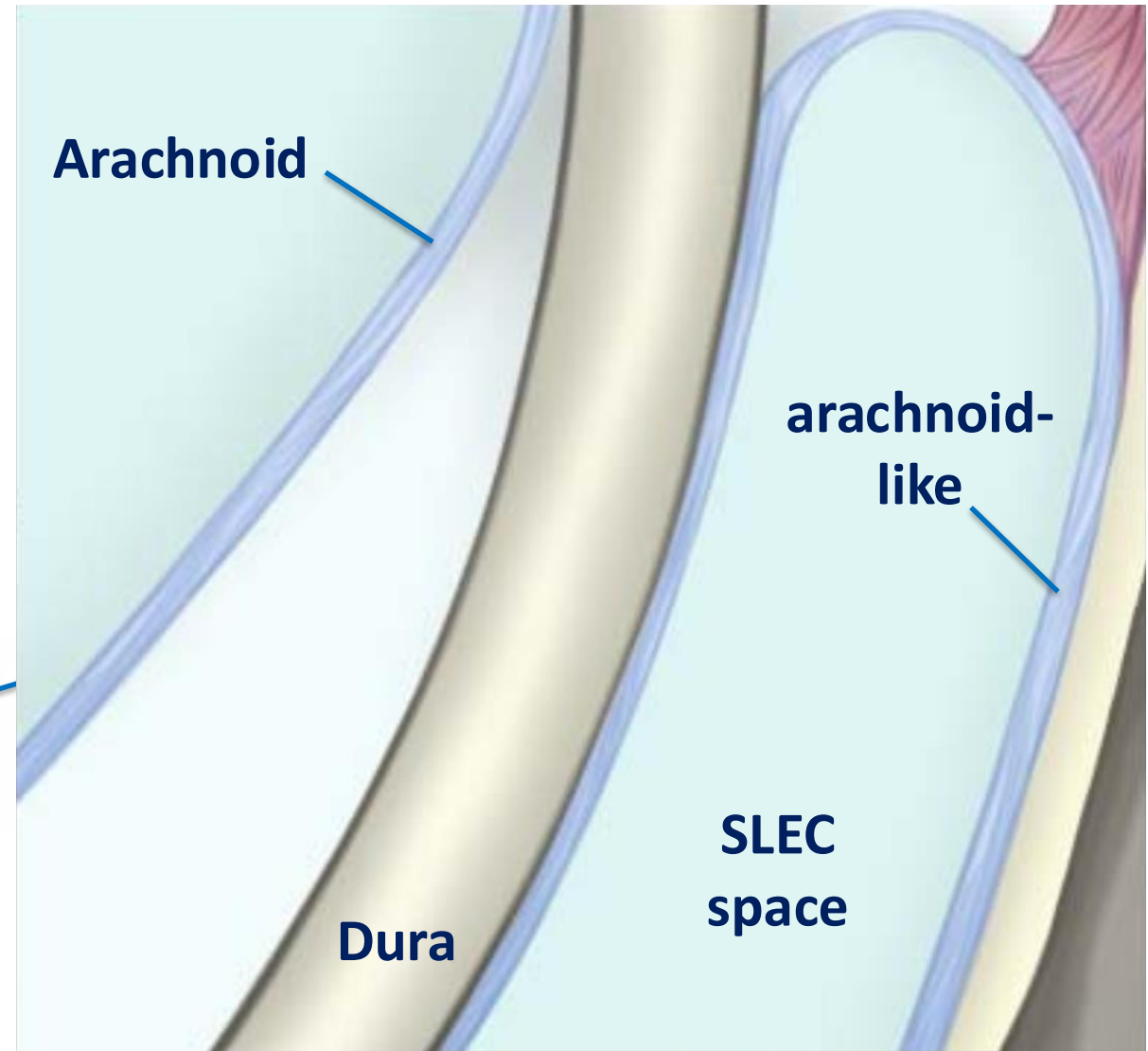
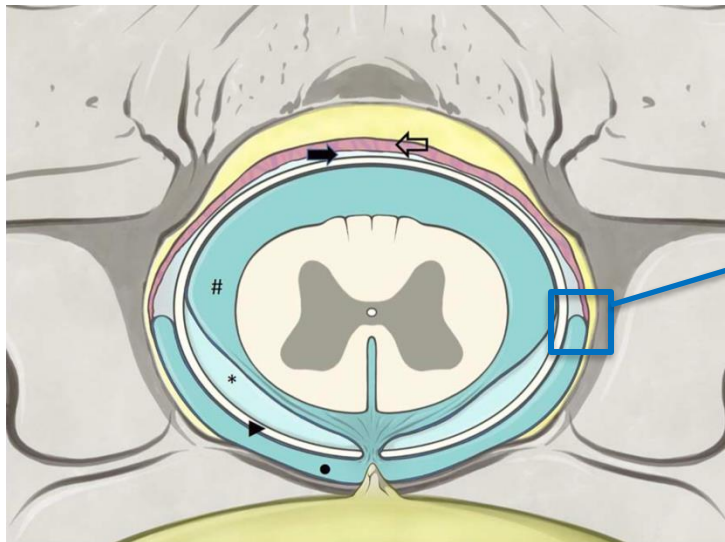
Microsurgical anatomy lateral membranes = arachnoid (diverticula)



Spinal CSF leak = tear in the dura

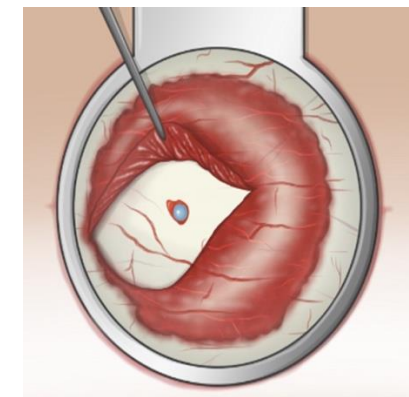
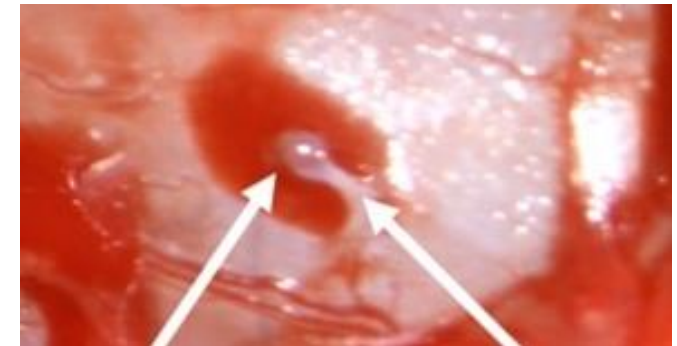
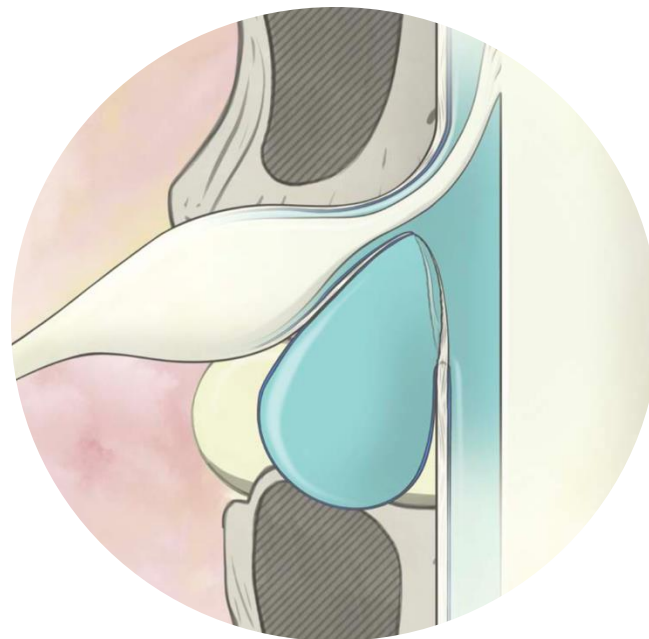
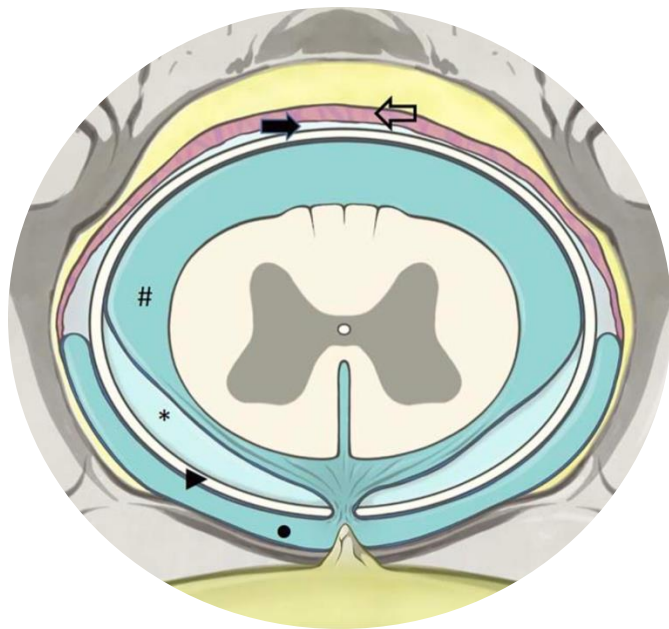
Häni et al. Operative Neurosurgery 2023

Microsurgical anatomy - lateral membranes



Distinct Pattern of Membrane Formation With Spinal Cerebrospinal Fluid Leaks in Spontaneous Intracranial Hypotension

Levin Häni, MD  **, Christian Fung, MD **, Amir El Rahal, MD [§], Florian Volz, MD ‡, Luisa Mona Kraus, MD ‡, Oliver Schnell, MD ‡, Roberto Ferrarese, PhD ‡, Daniel Erny, MD ^{||}, Marius Schwabenland, MD [§], Horst Urbach, MD [¶], Niklas Lützen, MD [¶], Jürgen Beck, MD ‡



... all about membranes

cPDPH Program – Freiburg CSF-Center

IMAGING

- Whole brain and **lumbar** spine MRI
- Heavily T2 spine MRI (Dinosaur sign, **arachnoidal bleb, epidural fluid**)
- Cine motion MRI-flow studies
- Dynamic myelogramms and Ga-CSF PET (optional)

CLINICAL SPECTRUM

- **The Freiburg SIH/pPDPH Inventory**
- Neuro-psychological Evaluation
- PROMs and smart watch health profile

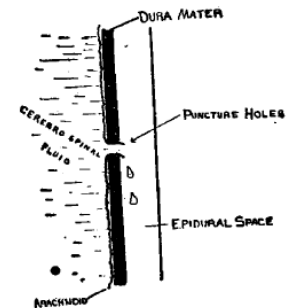
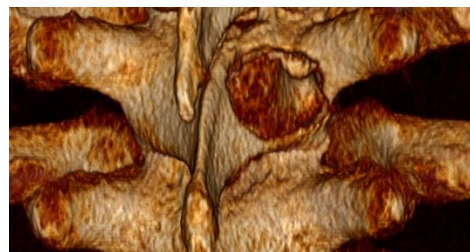
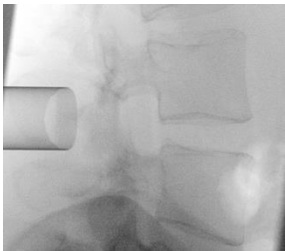
THERAPY

- Epidural blood patches
- Multilevel **minimal invasive surgical exploration**
- Long term follow-up and outcome evaluation
- Interdisciplinary multimodal pain treatment strategy



cPDPH Program – Surgery for PDPH – Freiburg CSF-Center

1. **Resect pathology** – neo membranes and pathological vessels
2. **Restore anatomy** – rebuild layers and augment dura
3. **Respect arachnoid** – key element to prevent CSF leaking / oozing



cPDPH Program – Freiburg CSF-Center

IMAGING

MRI:

Whole brain
Heavily T2 spine MRI
Dinosaur sign
Arachnoidal blep
Epidural fluid
Cine motion MRI

Optional

Dynamic myelogram
Ga-CSF PET

CLINICAL SPECTRUM

The Freiburg SIH/pPDPH Inventory

Neuro-psychological Evaluation

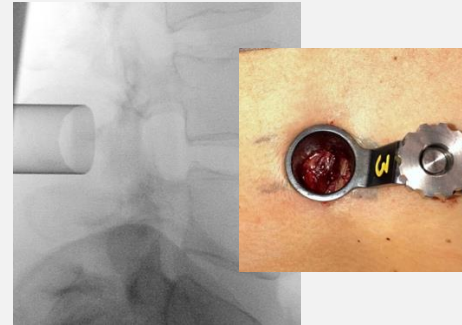
PROMs

Smart watch health profile

TARGETED TREATMENT

Epidural blood patches

Multilevel - MIS
Minimal invasive Surgical exploration



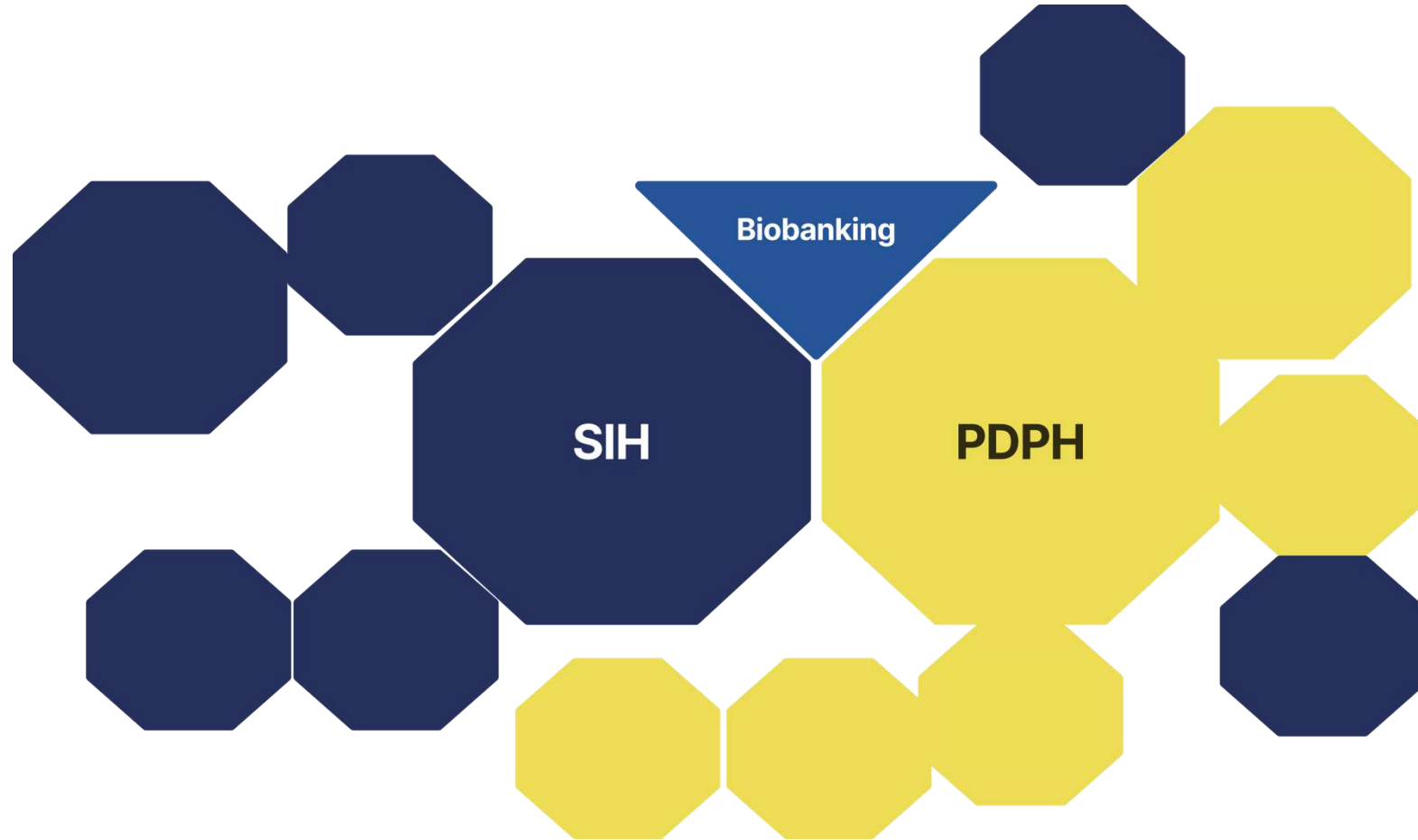
SUPPORTIVE TREATMENT

Interdisciplinary multimodal pain Treatment

PROMS
Outpatient visits

LONG-TERM FOLLOW-UP & OUTCOME EVALUATION

Freiburg Registry for spinal CSF Leaks - SEAL



Thank you



Freiburg im Breisgau

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CSF-Center Freiburg

Brain Health



**Craniospinal
CSF homeostasis**

