First Annual Cedars-Sinai Intracranial Hypotension Symposium - October 14, 2017: Developments in Surgical Approaches

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Spontaneous intracranial hypotension
November 1991
My first patient

Memre L. DOS: 11-24-1991

22 year-old woman

6 week history of orthostatic headaches

CT brain: “normal”

CT-myelogram: single thoracic nerve root cyst

Treatment: surgery

Outcome: complete recovery, no recurrence (follow-up: 23 years)
Spontaneous Intracranial Hypotension
October 2017

❓ Routine practice?
Spontaneous intracranial hypotension
Cedars-Sinai Medical Center (1-1-2001 to 6-30-2017)

- Approximately 1450 patients evaluated

977 patients met ICHD-III criteria:
- CSF leak on spinal imaging
- Brain MRI with sagging/meningeal enhancement/SDH
- Opening pressure less than 6.0

First 107 patients evaluated: 89 (83%) met ICHD-III criteria
Last 107 patients evaluated: 26 (24%) met ICHD-III criteria
Diagnostic evaluation

Towards a “non-invasive” diagnostic work up
i.e., no spinal tap and minimizing ionizing radiation

**MRI or CT brain**

MRI spine/MRMyelography
Epidural blood patching
Percutaneous fibrin glue placement
Surgery
Advances in surgical treatment for SIH

- Understanding the anatomy of CSF leaks
  Through – advances in imaging
  advances in imaging
  advances in imaging
  intraoperative observations

- Developments of novel treatments
Advances in treatment of SIH

- 1953 Epidural blood patch (Nosik, JAMA 1955)
- 2001 High volume epidural blood patching (Louy, Schievink – not published)
- 2003 Percutaneous glue (Schievink, Maya, Moser: J Neurosurg 2004)
- 2003 Dynamic CT-myelography (Luetmer, Mokri: AJNR 2003)
- 2003 False localizing leaks @ C1-2 (Schievink, Maya, Moser: J Neurosurg 2004)
- 2008 Digital subtraction myelography (Hoxworth, Patel, Bosch: AJNR 2009)
- 2010 False localizing leaks @ CTJx (Schievink, Maya, Moser: Neurology 2015)
- 2013 CSF-venous fistulas (Schievink, Moser, Maya: Neurology 2014)
Cause of intracranial hypotension is

- **Spinal CSF leak**

- **Pooling of CSF**
  - Inadequate CSF production?
  - Rapid CSF absorption?

- ? CSF rhinorrhea–otorrhoea?

NEVER

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Lack of causal association between spontaneous intracranial hypotension and cranial cerebrospinal fluid leaks

Clinical article

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Misfortunes in spontaneous intracranial hypotension
Detection of CSF Leak

- MRI/MR-myelography
- Radionuclide Cisternography
- CT-Myelography/Digital Subtraction Myelography (DSM)
- Intrathecal gado-enhanced MRI
Classification of Spontaneous Spinal CSF Leaks (n=568)

- Type 1: Dural tear
- Type 2: Arachnoid cyst
- Type 3: CSF-venous fistula
- Type 4: Indeterminate
Type 1 CSF leak
n=151 (26.6%)

- 1 a = ventral leak 145 (96%)
- 1 b = postero-lateral leak 6 (4%)
Type 1a
Type 1 CSF leak

- Surgery in 125/145 (86%) patients with type 1a CSF leak
- Surgery in 5/6 (83%) patients with type 1b CSF leak
Type 2 CSF leak
\[ n = 240 \ (42.3\%) \]

- 2a = simple meningeal diverticulum \[ n = 218 \ (91\%) \]
- 2b = complex meningeal diverticulum/
  dural ectasia \[ n = 22 \ (9\%) \]
Type 2 CSF leak

- Surgery in 110/218 (51%) patients with type 2a CSF leak
- Surgery in 9/22 (41%) patients with type 2b CSF leak
Type 3 CSF leak

N = 14 (2.5%)
Type 3 CSF leak

- Surgery in 12/14 (86%) patients with type 3 CSF leak
Type 4 CSF leak

N=163 (28.7%)
Type 4 CSF leak

Surgery in 23/163 (14%) patients with type 4 CSF leak
False localizing sign of C1–2 cerebrospinal fluid leak in spontaneous intracranial hypotension

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Object. Spontaneous intracranial hypotension due to a spinal cerebrospinal fluid (CSF) leak is an important cause of new daily persistent headaches. Spinal neuroimaging is important in the treatment of these patients, particularly when direct repair of the CSF leak is contemplated. Retrosinal C1–2 fluid collections may be noted on spinal imaging and these are generally believed to correspond to the site of the CSF leak. The authors undertook a study to determine the significance of these C1–2 fluid collections.

Methods. The patient population consisted of a consecutive group of 25 patients (18 female and seven male) who were evaluated for surgical repair of a spontaneous spinal CSF leak. The mean age of the 18 patients was 38 years (range 13–72 years). All patients underwent computerized tomography myelography. Three patients (12%) had extensive retrosinal C1–2 fluid collections; the mean age of this woman and these two men was 41 years (range 39–43 years). The actual site of the CSF leak was located at the lower cervical spine in these patients and did not correspond to the site of the retrosinal C1–2 fluid collection.

Conclusions. A retrosinal fluid collection at the C1–2 level does not necessarily indicate the site of the CSF leak in patients with spontaneous intracranial hypotension. This is an important consideration in the treatment of these patients because therapy may be inadvertently directed at this site.
C1-2 false localizing sign
Cervico-thoracic false localizing sign
C1-2 false localizing sign
Ventral spinal CSF leaks –
Digital subtraction myelography
Looking for a ventral CSF leak

- DSM
- DSM
- Dynamic CT-myelogram
- Bony spicule
Bony spicule as cause of type 1a ventral CSF leak

Cervical bone spur presenting with spontaneous intracranial hypotension

Case report

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Spontaneous intracranial hypotension due to a spinal cerebrospinal fluid (CSF) leak is a rare but increasingly recognized cause of postural headaches. The exact cause of these CSF leaks often remains unknown. The authors treated a 32-year-old man with a unique cause of spontaneous intracranial hypotension. He suffered an excruciating headache that was exacerbated by his being in an upright position. The results of four-vessel cerebral angiography were negative; however, magnetic resonance (MR) imaging of the brain revealed pachymeningeal enhancement and hindbrain herniation. A presumptive diagnosis of spontaneous intracranial hypotension was made. Myelography revealed extradural contrast material ventral to the cervical spinal cord as well as an unusual midline bone spur at C5–6. The patient’s symptoms did not resolve with the application of epidural blood patches, and he subsequently underwent an anterior approach to the C5–6 spur. After discectomy, a slender bone spur that had pierced the thecal sac was found. After its removal, the dural rent was closed using two interrupted prolene sutures. The patient was discharged home 2 days later. On follow up his symptoms had resolved, and on MR imaging the pachymeningeal enhancement had resolved and the cerebellar herniation had improved slightly.
Bony spicules in SIH

Pre-op

Post-op
Caveats in identification of bony spicule as source of ventral type 1a CSF leak

- Present in 82% of patients (91/111 patients)
- Multiple spicules – not always the largest
- Absorption of spicule over time
Not always the largest spicule
Absorption of spicule over time
Surgical Repair

- Suturing
- Muscle graft
- Clipping of cyst
- Fibrin glue/blood
- Gel foam

2017

20th century
Ventral leak – surgical repair
Arachnoid cysts – surgical repair
CSF–venous fistula – surgical repair
Surgery for spontaneous intracranial hypotension

Surgery - cyst + leak: 90% cure rate
  - cyst only: 75% cure rate
  - ventral/intradural: 95% cure rate
  - ventral/extradural: 25% cure rate
Risks of treatment

- Surgery (n=600):
  - 1% infection
  - 0.8% neurologic deficit
  - 2.7% pseudomeningocele
  - 0.8% presyrinx formation
Resection of transdural disc herniation and repair ventral tear
Ventral dural tear: sutures vs muscle repair
Ventral dural tear without CSF leak (Type 1a-)
Surgical solutions for the recalcitrant patient

- Lumbar dural reduction surgery
- Wearable epidural saline infusion catheter system
A Novel Technique for Treatment of Intractable Spontaneous Intracranial Hypotension: Lumbar Dural Reduction Surgery

Wouter I. Schievink, MD

Background and Objective.—Spontaneous intracranial hypotension has become a well-described cause of headache particularly among young and middle-aged individuals. Treatment of the underlying spinal cerebrospinal fluid (CSF) leak is effective in relieving symptoms in the vast majority of patients but symptoms may become refractory. The author describes a novel surgical technique to treat intractable spontaneous intracranial hypotension.

Methods.—A lumbar laminectomy is performed, a strip of dura is resected, and the dural defect is closed. The resulting decrease in lumbar CSF volume is believed to increase intracranial CSF volume and pressure.

Results.—The technique was utilized in a patient who suffered with intractable positional headaches because of a spinal CSF leak for 6 years in spite of numerous surgical and nonsurgical therapies. Significant improvement of symptoms was sustained during a 1-year period of follow-up.

Conclusion.—Dural reduction surgery may be considered in carefully selected patients with intracranial hypotension.

Key words: cerebrospinal fluid, headache, intracranial pressure, spinal cerebrospinal fluid leak, spinal dura

(Headache 2009;49:1047-1051)
Dural reduction surgery
Dural reduction surgery*

- N = 52
- 40 women and 12 men (most “without” SIH)
- Age: 21 – 72 years
- Good outcome: 31 (60%)
- Complications: Pseudomeningocele: 5 (10%)
  Suicide: 1 (2%)
  Infection/sepsis: 1 (2%)
Implantation of a wearable epidural spinal infusion system

A Wearable Epidural Catheter Infusion System for Patients With Intractable Spontaneous Intracranial Hypotension

Wouter I. Schievink, MD,* Howard L. Rosner, MD,† and Charles Loyd, MD, PhD‡

Background and Objectives: Spontaneous intracranial hypotension is an important cause of secondary headaches, and most patients respond well to epidural blood patching or direct repair of the underlying spinal cerebrospinal fluid leak. However, options are limited for those patients who have exhausted these traditional treatments, especially when spinal imaging is normal. We describe a wearable epidural catheter infusion system for patients with intractable spontaneous intracranial hypotension.

Methods: Six patients with intractable spontaneous intracranial hypotension (4 women and 2 men; mean age, 53 years; mean duration of symptoms, 50 months) underwent placement of a permanent indwelling spinal epidural catheter attached to an external infusion pump. The Migraine Disability Assessment questionnaire was used to assess the severity of the symptoms, before and during treatment.

Results: The infusion resulted in complete or near-complete symptom relief in 5 of 6 patients (Migraine Disability Assessment score decreased from grade IV to grade I or II). However, the epidural catheter infusion system was removed in 2 patients because of infection, in 1 patient because of delayed failure to provide adequate symptom control, and in 1 patient because of minimal symptom relief. Two patients reported excellent and sustained symptom relief over 27 and 36 months of follow-up.

Conclusions: This wearable epidural catheter infusion system showed promising efficacy results but the high rate of complications limits its use to a very select group of patients.

(Reg Anesth Pain Med 2015;40: 49–51)
Spinal epidural infusion system

- N = 12
- 7 women and 5 men (most “without” SIH)
- Age: 40 – 79 years
- Good outcome: 10 (83%)
- Complications:  
  - Infection: 2 (17%)
  - Hardware failure: 5 (42%)
Thank you

Save the Date!
Saturday October 14, 2017
Intracranial Hypotension Symposium

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