



# Spontaneous Intracranial Hypotension: A Focus on Clinical Characteristics

ILC/SIH SYMPOSIUM

NOVEMBER 7, 2020

FARNAZ AMOOZEGAR, MD, MSC, FRCPC

CLINICAL ASSOCIATE PROFESSOR

DEPT CLINICAL NEUROSCIENCES

UNIVERSITY OF CALGARY & HOTCHKISS BRAIN INSTITUTE

# What is SIH

- ▶ SIH stands for spontaneous intracranial hypotension
- ▶ A condition where a leak occurs within the dura (the thick covering layers) at the level of the spine
- ▶ Synonymous with Spinal Cerebrospinal fluid (CSF) leak
- ▶ Different than cranial or sinonasal CSF leaks
- ▶ Although better recognized now than in the past, many health-care practitioners are still not aware of this condition
- ▶ For a number of reasons, SIH also remains difficult to diagnose and treat in many patients

# Epidemiology

- ▶ No major prospective/RCT studies
- ▶ Estimated annual incidence: 5 per 100,000
- ▶ The onset of symptoms of SIH is usually in the fourth to fifth decades of life
- ▶ Peak incidence around age 40 years
- ▶ SIH affects women more than men, ratio 1.5:1

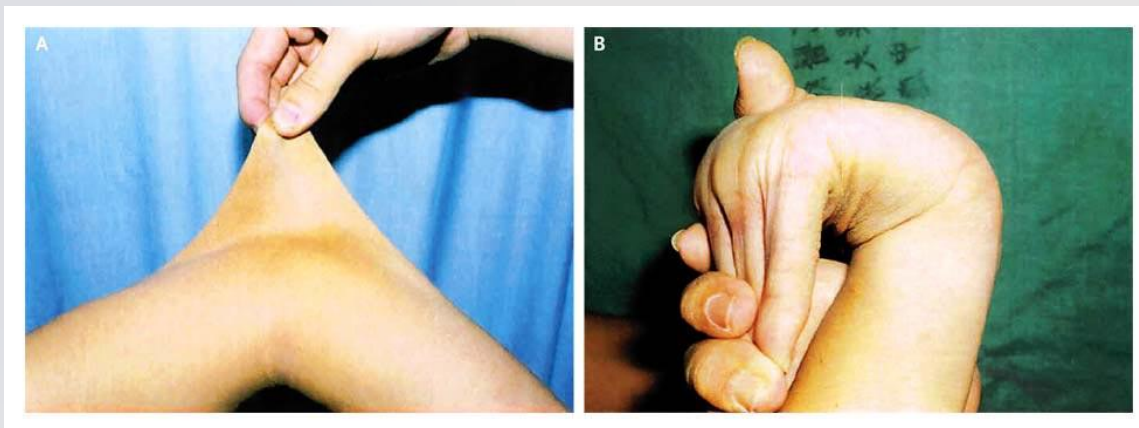
# Etiology & Pathogenesis



- ▶ SIH is caused by spontaneous spinal CSF leaks
- ▶ The exact cause of the leak remains unknown in the vast majority of patients; likely multifactorial
- ▶ Underlying fragility of the spinal meninges is suspected
- ▶ A history of a traumatic event can be elicited in about one third of patients, suggesting mechanical factors as well

# Etiology & Pathogenesis

- ▶ An inherited connective tissue disorder can play a role in the development of CSF leaks
- ▶ Marfan syndrome, Ehlers-Danlos syndrome (type II), and autosomal dominant polycystic kidney disease are the most common
- ▶ Familial SIH has been described



# Etiology & Pathogenesis

- ▶ Some patients are found to have osseous spinal pathology
- ▶ Most commonly, degenerative disk disease with osteophytes found piercing the dura
- ▶ Occasionally, congenital bony spurs
- ▶ Dural abnormalities: dural holes or rents, meningeal diverticula, or even absence of dura

# Current Understanding of SIH pathogenesis

- ▶ Believed that the symptoms are related to loss of intracranial CSF volume, rather than strictly a reduction in pressure
- ▶ Many patients with SIH exhibit normal opening pressures
- ▶ The CSF volume loss is felt to occur by three major etiologies in the spine:
  - Leaks secondary to dural weakness in the area of the nerve root sleeves/meningeal diverticula
  - Ventral dural tears associated with degenerative disc disease/osteophytes/disc herniations
  - CSF-venous fistulas

# ICHD-III Diagnostic Criteria for SIH

- A. Any headache fulfilling criterion B to D
- B. Low CSF pressure (<60 mm CSF) and/or evidence of CSF leakage on imaging
- C. Headache has developed in temporal relation to the low CSF pressure or CSF leakage, or has led to its discovery
- D. Not better accounted for by another ICHD-3 diagnosis

Cephalalgia. 33(9)629-808.



# Clinical Presentation

- ▶ Prototypical & most common manifestation of SIH is an orthostatic headache
- ▶ Can occur within seconds to minutes of taking an upright position (but can be hours)
- ▶ Headache improves or resolves after lying down, usually within 30 minutes
- ▶ Headache is usually holocephalic & diffuse, but may be localized to one region of the head or asymmetric
- ▶ Headache quality can vary

# Clinical Presentation

- ▶ Initial onset of headache in majority of patients is gradual or subacute
- ▶ Headache severity varies from mild to severe
- ▶ Exact cause of headache is unknown
- ▶ May be related to downward displacement of the brain due to loss of CSF buoyancy, causing traction of pain-sensitive structures
- ▶ Compensatory dilation of pain-sensitive intracranial venous structures may also play a role

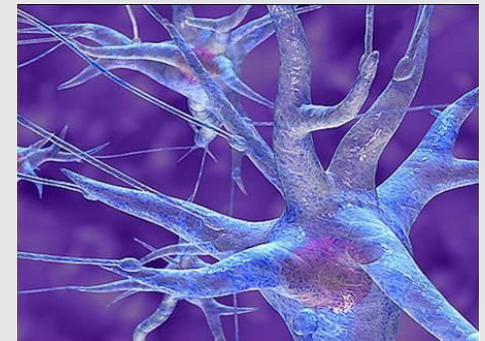
# Clinical Presentation



- ▶ An orthostatic headache can become less prominent or even disappear over time
- ▶ Rarely, the reverse pattern may occur
- ▶ There are also patients with no postural component to their headache
- ▶ Other headache patterns: exertional headaches, headaches at the end of the day, or even paradoxical headaches
- ▶ Think of SIH in patients with a New Daily persistent Headache

# Clinical Presentation

- ▶ Other relatively common symptoms of SIH include:
  - ▶ Posterior neck pain or stiffness
  - ▶ Nausea and vomiting
- ▶ Up to 25% of patients may have:
  - ▶ Change of hearing (echoing, under water)
  - ▶ Tinnitus
  - ▶ Disturbed sense of balance
- ▶ Rarely, patients can also have:
  - ▶ Visual blurring, VF defects, diplopia
  - ▶ Facial numbness or facial pain, facial weakness or spasm
  - ▶ Parkinsonism, ataxia, dementia



# Evaluations

## ▶ Imaging

- CT Brain
- MRI
  - Brain
  - Spine
- Radionuclide Cisternogram
- Myelogram
  - CT
  - MR
- Digital subtraction imaging

## ▶ Other

- CSF
  - Profile
  - OP

# CSF

- ▶ OP < 60mm H<sub>2</sub>O
- ▶ Lymphocytic pleocytosis
  - ▶ < 50 cells
- ▶ Normal or Increased protein
  - ▶ Up to 100mg/dl
  - ▶ Rare up to 1g/dl
- ▶ Xanthochromia



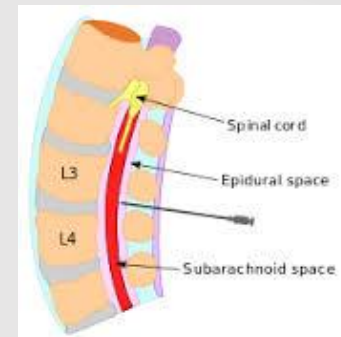
# Treatment

- ▶ Conservative:
  - ▶ Bed rest
  - ▶ Oral or IV hydration
  - ▶ Caffeine
- ▶ Steroids
- ▶ Epidural blood patch
- ▶ Fibrin glue injection
- ▶ Surgical repair



# Epidural Blood Patch (EBP)

- ▶ Instant relief in some
- ▶ Mechanism:
  1. Volume replacement
  2. Dural tamponade
  3. Restriction of CSF flow within epidural space → decrease CSF absorption
  4. Change in dural stiffness/resistance (long term)
- ▶ If poor response
  1. Repeat
  2. Higher volume patch (> 20 mL)
    - Need to wait 5 days in between





# Recommendations for CTD



- ▶ 2013 study at Cedars-Sinai: in 50 patients diagnosed with SIH, 9 had heritable CTDs, including Marfan syndrome, Ehlers-Danlos syndrome and others.
- ▶ In 7 of these patients, SIH was the first manifestation of their illness.
- ▶ The authors suggest that patients with SIH should be screened for connective tissue disorders and vascular abnormalities.
- ▶ If there are concerns based on this, the patient can then be referred to a medical geneticist

# Recommendations for Vascular Disorders

- ▶ Vascular abnormalities occur with higher frequency in patients with SIH as compared to controls.
- ▶ One study showed intracranial aneurysms in 9% of patients, as compared to 1% of controls (J Neurosurg. 2011; 115: 113-5).
- ▶ Patients with SIH should have intracranial vascular imaging at one point during their assessment, either with CTA or MRA.
- ▶ Those with an established connective tissue disorder, such as Marfan syndrome, should be screened further with MRA of the neck, chest, abdomen and pelvis, because they are at risk of large arterial aneurysms (Schievink & Deline, Curr Pain Headache Rep (2014) 18: 457)

# Clinical evaluation of CTDs in patients with SIH

*Adapted with permission from Reinstein et al, EJHG (2013) 21, 386-390*

## General:

Height: \_\_\_\_\_ Weight: \_\_\_\_\_  
Body Habitus (Marfanoid, slender, etc): \_\_\_\_\_  
Ethnic Background: \_\_\_\_\_  
Family History (Focused on joint, skin, eye, vascular abnormalities, sudden death): \_\_\_\_\_

## Pregnancy, development, and neonatal history:

Delivery type (e.g. NV, CS, aids): \_\_\_\_\_  
Presentation (cephalad): \_\_\_\_\_  
Gestational age (term, pre-term, post-term): \_\_\_\_\_  
 Pregnancy-associated maternal complications  
 Uterine rupture/cervical insufficiency during pregnancy/delivery  
 Delayed motor development/hypotonia

# Clinical evaluation of CTDs in patients with SIH

## **Signs for skin hyperextensibility and fragility:**

- Skin hyperextensibility/elasticity
- Easy bruising, ecchymoses
- Soft/thin/transparent skin
- Anal or uterine prolapse
- Surgical complications(postoperative hernias, wound dehiscence)
- Spontaneous pneumothorax
- Slow wound healing
- Widened, thin scars
- Stretch marks (unrelated to pregnancy)

# Clinical evaluation of CTDs in patients with SIH

## Joint hypermobility and complications:

- Joint dislocations
- Joint hypermobility      Beighton score: \_\_\_\_\_
- Degenerative joint disease
- Chronic joint and limb pain
- Scoliosis
- Flat Feet
- Spontaneous fractures

## Cardiovascular (history and echocardiography):

- Aortic or other arterial aneurysm, dissection or rupture (personal or family history of): \_\_\_\_\_
- Valvular disease, including mitral valve prolapse (on Echo)

# Clinical evaluation of CTDs in patients with SIH

## **Craniofacial:**

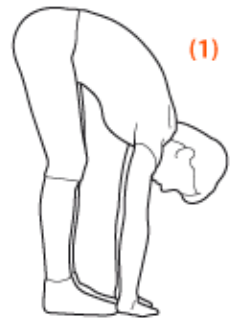

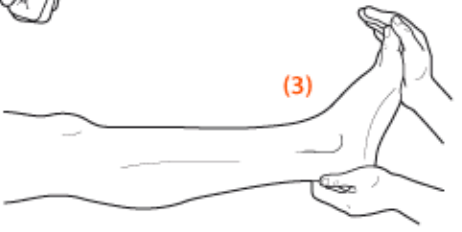

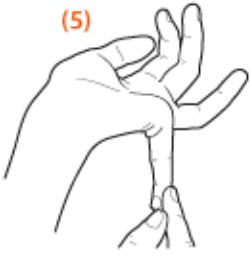
- Dental history of crowding/braces
- High-arched palate
- Single/bifid uvula
- Dysmorphic facial features
- Periodontal disease and age of onset \_\_\_\_\_

## **Ophthalmologic:**

- Personal or family history of lens dislocation
- Detachment of retina
- Other vision abnormalities: \_\_\_\_\_
- Blue sclera

# Beighton score

- ▶ A simple system to quantify joint laxity & hypermobility
- ▶ Uses a 9 point system
- ▶ A higher score indicates more laxity
- ▶ Score above 6 indicates hypermobility

**The Beighton score**

Beighton's modification of the Carter and Wilkinson scoring system. Give yourself 1 point for each of the manoeuvres you can do, up to a maximum of 9 points.

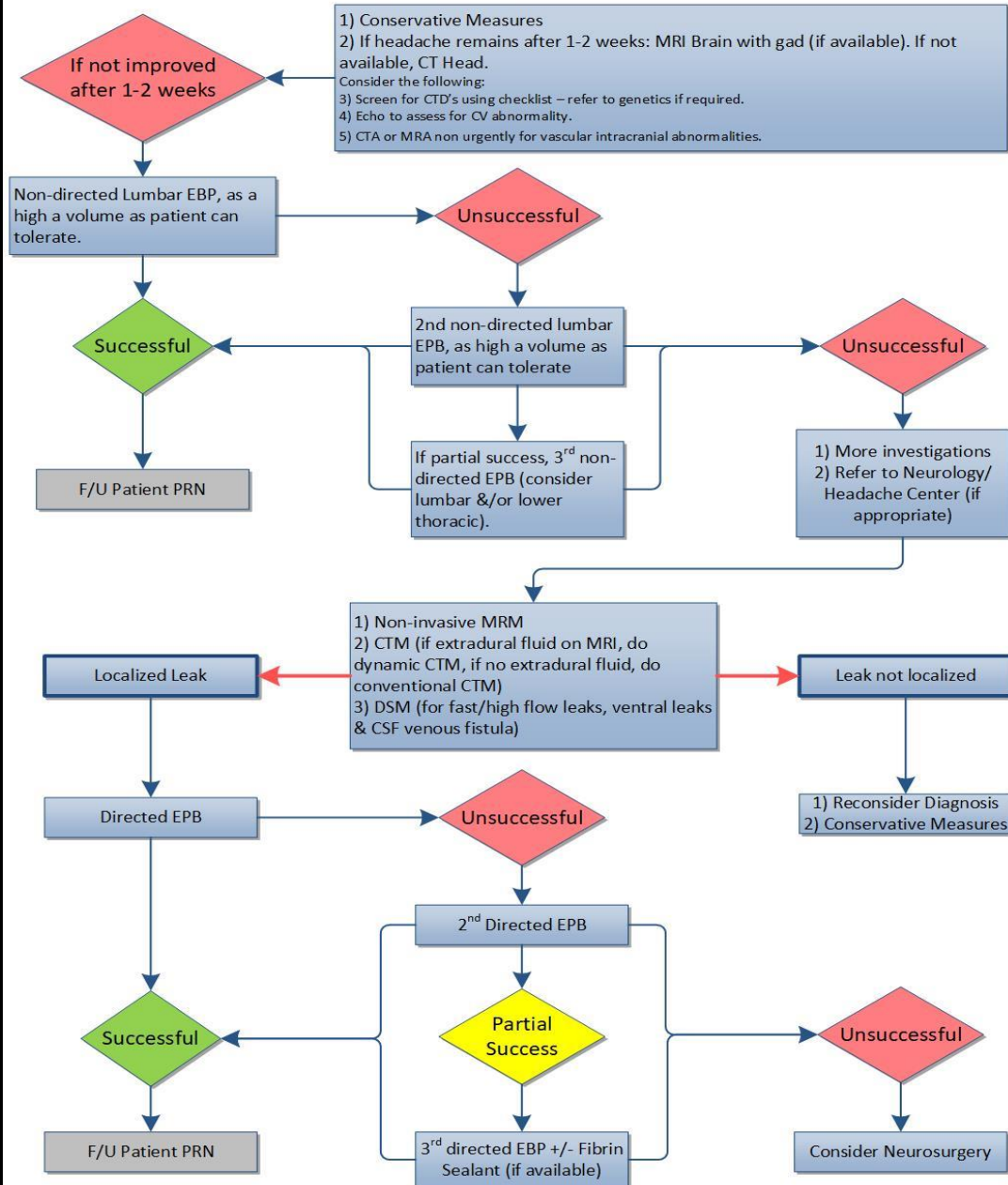
	SCORE	
	Left	Right
1. Can you put your hands flat on the floor with your knees straight? .....	1	
2. Can you bend your elbow backwards? .....	1	1
3. Can you bend your knee backwards? .....	1	1
4. Can you bend your thumb back on to the front of your forearm? .....	1	1
5. Can you bend your little finger up at 90° (right angles) to the back of your hand? ...	1	1
	9	

# Recommendations for Cardiac Disorders

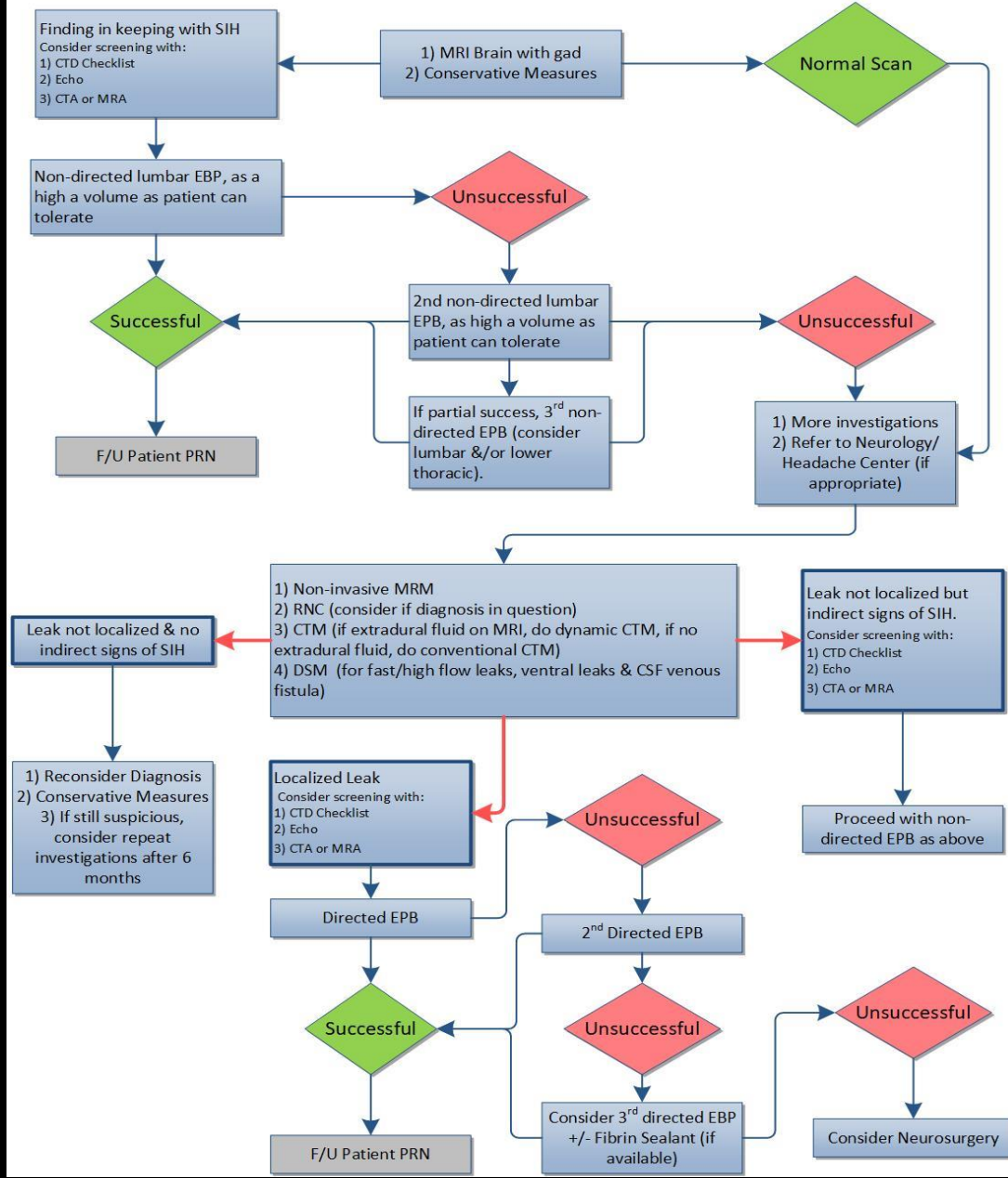
- ▶ An echocardiogram is also suggested to assess for valvular disease (such as mitral valve prolapse), and dilatation of the aortic root
- ▶ In a 2014 study, the rate of cardiovascular abnormalities detected for the same cohort of 50 SIH patients seen at Cedars-Sinai was 9/50 or 18%.
- ▶ 6 patients showed aortic root dilatation
- ▶ 3 showed valvular heart disease
- ▶ Only 2/9 patients had an underlying connective tissue disorder, indicating that cardiovascular pathology can occur even in patients with no known connective tissue disorders



# Typical SIH



# Atypical SIH



# Prognosis

- ▶ Recurrence: 10% (regardless of treatment)
- ▶ Good prognostic factors
  - ▶ Classical MRI changes
  - ▶ Focal CSF leak
- ▶ Poor prognostic factors:
  - ▶ Normal initial MRI
  - ▶ Diffuse multi-level CSF leak

# References

1. Schievink W et al. Surgical treatment of spontaneous spinal CSF leaks. *J Neurosurg.* 1998; 88: 243-246.
2. Schievink W. Spontaneous spinal CSF leaks and intracranial hypotension. *JAMA* 2006; 295(19) 2286-96
3. Inoue S, Hashizume K, Fujiwara A, Watanabe K, Furuya H. Case of cerebrospinal fluid hypovolemia possibly due to acceleration of cerebrospinal fluid absorption. Masui. 2008 Oct;57(10):1249-52.
4. Leep Hunderfund AN, Mokri B. Orthostatic headache without CSF leak. *Neurology.* 2008 Dec 2;71(23):1902-6.
5. Kong DS et al. Atypical spontaneous intracranial hypotension (SIH) with nonorthostatic headache. *Headache* 2008 Apr 48 (4) 641-2.
6. Street S. Spontaneous intracranial hypotension presenting to the ENT surgeon: case report. *J Laryngol Otol.* 2008 Oct 17: 1-3.
7. Walker L et al. Spontaneous intracranial hypotension masquerading as frontotemporal dementia. *Clinical Neuropsychol* 2008 Dec 22 (6) 1035-53.
8. Ohwaki K. Symptom predictors of cerebrospinal fluid leaks. *CJNS* 2008 Sept 35 (4) 452-7.
9. Schievink WI, Gordon OK and Tourje J. Connective tissue disorders with spontaneous spinal CSF leaks and intracranial hypotension: a prospective study. *Neurosurgery* 2004; 54: 65-70.
10. Lai TH. Subdural haematoma in patients with spontaneous intracranial hypotension *Cephalalgia* 2007. 27 (2) 133-8.
11. Schievink W et al. Misdiagnosis of spontaneous intracranial hypotension. *Arch Neurol*; 2003; 60: 1713-18.
12. Yamamoto M et al. Primary low CSF pressure associated with galactorrhea. *Intern Med.* 1993; 32: 228-31.
13. Inamo et al. A boy with growth disturbance caused by hypothalamic damage associated with intracranial hypotension syndrome following a motor vehicle accident: case report. *Endocr J.* 2008 Dec;55(6):1113-6.

14. Pleasure SJ et al. Spontaneous intracranial hypotension resulting in stupor caused by diencephalic compression. *Neurology* 1998; 50: 1854-57.
15. Liu YF et al. Burr hole drainage for complicated spontaneous intracranial hypotension syndrome. *Med Sci* 2008 Sep 24 (9) 498-502.
16. Schievink et al. Spontaneous spinal cerebrospinal fluid leak as a cause of coma after craniotomy for clipping of an unruptured intracranial aneurysm. *J Neurosurg* 2009 Mar;110(3):521-4.
17. Tosaka et al. Diffuse pachymeningeal hyperintensity and subdural effusion/hematoma detected by fluid-attenuated inversion recovery MR imaging in patients with spontaneous intracranial hypotension. *AJNR* 2008; 29; 1164-70.
18. Watanabe A et al. Diagnostic value of spinal MR imaging in spontaneous intracranial hypotension syndrome. *AJNS* 2009 Jan;30(1):147-51.
19. Halaç M. Is early bladder activity in radionuclide cisternography an indirect sign of spontaneous intracranial hypotension or sequence of lumbar puncture? *Clin Nuc Med* 2007 Nov; 32 (11) 850-3.
20. Schievink WI. Anaphylactic reactions to fibrin sealant injection for spontaneous spinal CSF leaks. *Neurol* 2008 Mar 11; 70 (11) 885-7.
21. Schievink WI. Cerebral venous thrombosis in spontaneous intracranial hypotension. *Headache* 2008 Dec; 48 (10) 1511-9.
22. Schievink WI et al. Treatment of spontaneous intracranial hypotension with percutaneous placement of fibrin sealant. Report of four cases. *J Neurosurg* 2004; 100:1098-1100.
23. Gladstone JP et al. Spontaneous CSF leak treated with percutaneous CT guided fibrin glue. *Neurology* 2005; 64: 1818-19.
24. Tan K et al. My headache does not get better when I lie down: spontaneous intracranial hypotension complicated by venous thrombosis. *Headache* 2008 Jan 48 (1) 149-52.

25. Ferrante E. Is it a rational choice to treat with lumbar epidural blood patch headache caused by spontaneous cervical CSF leak? *Cephalalgia* 2008; 28 (1) 99-100.
26. Hyun SH et al. Potential value of radionuclide cisternography in diagnosis and management of SIH. *Clinical neurology and neurosurgery* 110 (2008) 657-661.
27. Evans RW. Diagnostic testing and secondary causes of headache. *American Academy of Neurology Continuum series: Headache*. Volume 12, Number 6, Dec 2006: 220-221.
28. Mokri B. Headache associated with low CSF pressure. *Medlink Neurology*: [www.medlink.com](http://www.medlink.com). April 2006.
29. Mokri B. Expert commentary: role of surgery for the management of CSF leaks. *Cephalalgia* 2008; 28: 1357-1360.
30. Mokri B, & P.A. Low. Orthostatic headaches without CSF leak in postural tachycardia syndrome. *Neurology*. 2003 Oct 14; 61(7): 980-2.
31. Medscape CME. Spontaneous CSF Leaks: A review. *Neurosurg Focus* 9(1), 2000. American Association of Neurological Surgeons.
32. Ohwaki K, et al. Association between symptom duration and cerebrospinal fluid pressure, protein concentration, and number of cells in patients with intracranial hypotension. *Int J Neurosci*. 2009; 119(3): 307-14.
33. Schievink WI. Spontaneous Spinal Cerebrospinal Fluid Leaks. *Cephalalgia*. 2008; 28: 1347-1356.
34. Schwedt TJ & DW Dodick. Spontaneous Intracranial Hypotension. *Curr Pain Headache Rep*. 2007 Feb; 11(1): 56-61.
35. Headache Classification subcommittee of the International Headache Society. (2004). *The International Classification of Headache Disorders: 2<sup>nd</sup> Edition*. *Cephalalgia*, Suppl 1, 9-160.
36. Amoozegar F, Guglielmin D, Hu, W, Chan D, Becker, W. Spontaneous Intracranial Hypotension: Recommendations for Management. *Can J. Neurol Sci*. 2013; 40: 144-157.
37. Headache Classification committee of the International Headache Society (2013). *The International Classification of Headache Disorders: 3<sup>rd</sup> Edition (beta version)*. *Cephalalgia*. 33(9)629-808.