Therapeutic possibilities in Intracranial Hypotension (IH) by CSF leak and the relationship with the radiological brain and spinal findings

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Learning objectives

Review the diagnostic approach of Intracranial Hypotension (HI) by fistula of cerebrospinal fluid (CSF), taking into account the imaging findings and evaluate different treatment options, according to each clinical case.
Background

Persistent headache by IH is a syndrome with serious neurological sequelae. It is an important cause of headache in young and middle aged individuals but it is often misdiagnosis.

We retrospectively reviewed data, medical history and imaging of five patients in our hospital, 3 men and 2 women, age range between 27 and 54 years, who were admitted for suspected intracranial hypotension by licuoral fistula between May 2007 and September 2011.

All patients underwent, initial cranial CT without intravenous contrast enhancement (GE 64-detector rows) by disabling orthostatic headache. Patients with suspecting HI, were admitted and did underwent brain and spinal MRI (Philips 1.5 Tesla), performing TSE sequences T1, T2, PD, FLAIR and T1 with intravenous contrast enhancement (gadolinium).

When there were signs of licuoral fistula on MRI, the study of patient was completed with mieloCT. The puncture fluoroscopy-guided was performed in the lumbar region, the pressure of CSF was measured and 6 cc was extracted for analysis when was possible; then until 10 cc of water-soluble iodinated contrast media (Optiray) was injected and the table of patient was tilted, then when contrast media agent reaches cervical region, allow visualize the spinal cord, to determine the presence of contrast extravasation or presence of fistula and find their location.

We used the diagnostic criteria of HI by CSF fistula proposed by Schievink et al (AJNR May 2008), which includes clinical and radiological criteria.

We considered two treatment options: the first, recommending bed rest, oral hydration abundant, paracetamol and caffeine.
All the patients had persistent orthostatic headache, which did not improve with conventional analgesic treatment, with nausea and vomiting, without any other symptoms or neurological signs on physical examination.

Two patients didn´t have any pathologies in their medical history. One patient suffered a severe head injury in childhood, that required surgery by multiple brain hematomas, another patient had undergone lumbar puncture in last two weeks, but his headache had started before to the puncture and the last patient had a history of the epidural anesthesia three weeks before.

Two of the five patients had normal cranial CT and the other three had frontal and parietooccipital subdural collections left (Fig. 1 on page 6). In two of the three showed the presence of effacement of the basal cisterns, as a sign of downward transtentorial herniation (Fig. 2 on page 6).

The main findings of MRI were: diffuse dural thickening in both convexities, tentorium and falx, which showed enhancement with intravenous contrast medium administration, without involvement of the leptomeninges (Fig. 3 on page 7). In two patients this thickening extended into the spinal canal. In one of the patients was identified discrete posterior parietal dural hyperintensity on T1 suggesting minimal hemorrhagic transformation subdural collection.

Dural venous engorgement was visualized in one patient (Fig. 4 on page 8) and 2 had effacement of the cisterns of protuberance and descent of the cerebellar tonsils (Fig. 5 on page 9). Ballooning was identified only in the pituitary gland in one case.

In the three patients, spine MRI showed dural thickening and epidural CSF collections in the lumbar, dorsal and cervical level. (Fig. 6 on page 10). One patient had paraspinal and retroperitoneal collections and another had bilateral pleural effusion, in both cases the presence of CSF leakage through the dural fistula was viewed (Fig. 7 on page 11). We didn´t identify meningeal diverticula or syringomyelia in any case.

CT myelography was performed in 3 patients, finding extravasation of contrast medium subdural and epidural space as indirect sign of fistula (Fig. 8 on page 12) and the fistula was identified in two of them, one in dorsal region (Fig. 9 on page 13) and lumbar another location.

Myelo-CT wasn't performed in two patients because the headache was associated to lumbar puncture and they improved with conservative treatment.

Three of five patients received conservative treatment with good response. The other two patients who did not respond to initial treatment, were underwent lumbar epidural patch
of autologous blood at levels L2-L3 and L3-L4 with 5-10 cc, showing improvement of symptoms within 24 hours of treatment, without no complications (Fig. 10 on page 14).

All patients fulfilled the diagnostic criteria and had a good response to treatment, except one who was readmitted a month later by headache and epidural patch was necessary by persistent symptoms and positive findings in MRI as dural thickening, epidural collections spinal and pleural effusion unchanged.

MRI control were performed to 3 patients after 1 and 3 months (Fig. 11 on page 15, Fig. 12 on page 16) with persistent subdural collections to a lesser extent (Fig. 13 on page 17) and evidence of improvement or resolution of dural thickening.
**Fig. 1:** Initial cranial CT in axial plane in a 50-year-old man, showing bilateral hypodense subdural collections (arrows), without significant mass effect.

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**Fig. 2:** Cranial CT in axial plane in another patient showing bilateral subdural collections (arrows), discrete ventricular collapse and obliteration of the basal cisterns (arrowheads), as signs of HI.

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**Fig. 3:** Brain MR images with typical signs of intracranial hypotension. a. IV contrast T1 coronal plane, showing diffuse enhancement, nodular not the paquimeninges. b. FLAIR in coronal plane showing thickened pachymeninges.

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Fig. 4: Brain MRI, T1 sequence with IV contrast in mid-sagittal plane showing dural venous engorgement (long arrow) and the ballooning of the pituitary gland (short arrow) as signs of HI.

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Fig. 5: Brain MRI T1-weighted, mid-sagittal plane, showing signs of decline in cerebral HI: flattening of the pons against the clivus with effacement of the prepontine cistern (long arrow) and descent of the cerebellar tonsils (arrow short).

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**Fig. 6:** MRI brain and cervical contrast T1-weighted in mid-sagittal plane, which shows that the dural thickening (arrow), extends to the spinal canal.

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Fig. 7: MRI spinal myelography shows blurring of the boundaries of the spinal cord (long arrows), extensive paraspinal collections (short arrows) and pleural effusion (arrowheads) relative to CSF fistula as a cause of HI.

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Fig. 8: MyeloCT in sagittal plane shows contrast extravasation subdural and epidural space (arrows) as indirect sign of CSF fistula.

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Fig. 9: Myelo-CT in axial plane, which shows the location of the fistula the left anterior aspect of D9, as a cause of HI.

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Fig. 10: Axial and sagittal planes during patching lumbar epidural at the site of the CSF leak.

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Fig. 11: Brain MRI T1-weighted in coronal plane initial (a) and post-treatment (b), that show the reduction of subdural collections (short arrow) and disappearance of herniation of cerebellar tonsils (long arrows).

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Fig. 12: Cerebral MRI T2-weighted in axial planes, pre (a) and after (b) treatment, demonstrate resolution of subdural collection viewed on the initial study.

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Fig. 13: Brain MRI T1-weighted with IV contrast in sagittal plane, initial (a) and after (b) treatment with epidural patch, showing reduction of the descent of the cerebellar tonsils cerebellar (long arrow) with presence of prepontine cisterns and decreased venous engorgement (arrowheads) and resolution of ballooning of the pituitary (short arrow).

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Conclusion

Postural orthostatic headache is the most common symptom of HI and although this disease occurs more frequently after a lumbar puncture, there is also a type of spontaneous onset, caused by CSF leak, which has even come to associate with minimum prior trauma. Physical examination of these patients is usually normal and imaging studies are made by persistence of headache despite conventional treatment in the emergency room, as in the case of our patients.

The initial study usually is cranial CT, which rules out other diseases and can shows suggestive findings of IH as an increase in the subdural space by hypodense collection as most frequent finding. The collections are thin, unilateral or bilateral and are located on the cerebral convexity without significant mass effect. The other signs, obliteration of the basal cisterns and descent of the cerebellar tonsils, should be identified to support the diagnosis.