Spectrum of subdural fluid collections in spontaneous intracranial hypotension

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Object. Spontaneous intracranial hypotension is a noteworthy but commonly misdiagnosed cause of new daily persistent headaches. Subdural fluid collections are frequent radiographic findings, but they can be interpreted as primary rather than secondary pathological entities, and uncertainties exist regarding their optimal management. The authors therefore reviewed their experience with subdural fluid collections in 40 consecutive patients with spontaneous spinal cerebrospinal fluid (CSF) leaks and intracranial hypotension.

Methods. The mean age of the 26 female and 14 male patients was 43 years (range 13–72 years). Subdural fluid collections were present in 20 patients (50%); 12 of these patients (60%) had subdural hygromas alone, and eight (40%) had subacute to chronic subdural hematomas (SDHs) associated with significant mass effect. The subdural hygromas resolved within several days to weeks following treatment of the underlying CSF leak. Three patients with SDHs underwent evacuation of the hematoma prior to the establishment of the diagnosis of spontaneous intracranial hypotension, but the SDHs did not resolve until the underlying spinal CSF leak was treated. In the remaining five patients, the CSF leak was treated primarily and the SDHs resolved over a 1- to 3-month period without the need for evacuation.

Conclusions. Subdural fluid collections are common in spontaneous intracranial hypotension, varying in appearance from thin subdural hygromas to large SDHs associated with significant mass effect. These collections can be safely managed by directing treatment at the underlying CSF leak without the need for hematoma evacuation.

KEY WORDS • cerebrospinal fluid leak • headache • intracranial hypotension • subdural hematoma

Abbreviations used in this paper: CSF = cerebrospinal fluid; CT = computerized tomography; MR = magnetic resonance; SDH = subdural hematoma.

Fig. 1. A CT scan demonstrating subdural hygromas in a patient with spontaneous intracranial hypotension.
Subdural hematomas and intracranial hypotension

![Image](https://via.placeholder.com/150)

Fig. 2. A T₂-weighted MR image revealing subdural hygromas in a patient with spontaneous intracranial hypotension.

...ive patients with spontaneous CSF leaks and intracranial hypotension who had been referred to us for evaluation and treatment. The 26 female and 14 male patients had a mean age of 43 years (range 13–72 years). In 37 patients the presenting symptom was a positional headache. Cranial CT scans, MR images, or both were available for all patients and these studies were reviewed for features of intracranial hypotension. The presence of a spinal CSF leak was confirmed on CT myelography in all patients. Treatment consisted of bed rest, epidural blood patching, percutaneous placement of fibrin sealant, or surgical correction of the CSF leak. Follow up was complete in all patients, with a minimal follow up of 3 months from the time of the last treatment.

**Results**

Subdural fluid collections were present in 20 (50%) of 40 patients with spontaneous intracranial hypotension. The mean age of these 12 women and eight men was 42 years (range 28–56 years). Among these 20 patients, 12 (60%) had subdural hygromas only and eight (40%) had subacute to chronic SDHs associated with significant mass effect. No significant difference was found in age, sex, symptomatology, or location of the CSF leak among the different groups of patients.

The subdural hygromas were all thin, bilateral, symmetrical, and associated with no or only minimal mass effect (Figs. 1 and 2). The SDHs were unilateral in two patients and bilateral but asymmetrical in six patients (Fig. 3). The maximal thickness of the SDH ranged from 1 to 3 cm. The SDHs were heterogeneous in appearance with variable signal intensity and often accompanied by septations. In two of the patients with SDHs, initial MR imaging studies demonstrated small subdural hygromas, but spontaneous intracranial hypotension was not diagnosed and subsequent imaging revealed the development of SDHs even though the patients' headaches had improved.

Subdural hygromas resolved in all 12 patients within several days to weeks following successful treatment of the underlying CSF leak. Three patients with SDHs initially were treated elsewhere with burr hole drainage or craniotomy prior to establishing the diagnosis of spontaneous intracranial hypotension. In these three patients, the SDHs did not resolve.

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Fig. 3. Coronal T₁-weighted Gd-enhanced MR (A–D), axial fluid-attenuated inversion-recovery MR (E), axial T₂-weighted MR (F) images and CT scans (G and H) exhibiting SDHs (arrows) associated with significant mass effect in eight patients with spontaneous intracranial hypotension.
not resolve until the underlying CSF leak was treated (Fig. 4). In the remaining five patients with SDHs, the underlying CSF leak was treated primarily and the SDHs resolved over a 1- to 3-month period without the need for evacuation (Figs. 5 and 6). One of these patients underwent surgical repair of an extensive cervical CSF leak, and postoperative imaging studies revealed an increase in the SDHs with acute hemorrhage. Note, however, that the patient was asymptomatic, and the SDH subsequently resolved completely and without complication (Fig. 7).

Discussion
In our study, subdural fluid collections were common ra-

Fig. 4. Upper Left: Fluid-attenuated inversion-recovery MR image demonstrating bilateral SDHs (arrows) in a patient with spontaneous intracranial hypotension. Upper Center: A CT scan obtained following burr hole evacuation of the hematomas, displaying worsening of brain displacement with subdural air (arrows). Computerized tomography scans obtained after repeated surgery, revealing persistent subdural fluid collections 5 (arrows in upper right) and 10 days (arrows in lower left) postsurgery. Lower Right: Computerized tomography scan (lower right) obtained 1 week after surgical repair of the underlying spontaneous CSF leak, demonstrating resolution of the subdural fluid collections.

Fig. 5. Computerized tomography scans demonstrating an SDH (arrows in left) in a patient with spontaneous intracranial hypotension. One month following surgical repair of the underlying spontaneous CSF leak, the SDH was smaller (arrows in center) but not completely resolved until 2 months postoperatively (right).
diographic manifestations of spontaneous intracranial hypotension, occurring in 50% of patients. In previous studies, authors have reported subdural fluid collections in 10 to 80% of patients. In our study, 60% of subdural fluid collections were hygromas associated with no or minimal mass effect and 40% consisted of subacute to chronic SDHs associated with significant mass effect. In spontaneous intracranial hypotension, subdural hygromas are believed to be compensatory enlargement of the subdural/subarachnoid space due to the loss of CSF volume, whereas SDHs are probably caused by tearing of bridging veins or bleeding from enlarged veins in the subdural zone. The heterogeneous appearance of the SDHs and the presence of septations indicate that recurrent bleeding within the subdu-
ral space is common in untreated spontaneous intracranial hypotension. No correlation between the presence of subdural fluid collections and clinical features was observed in our study. In the two patients in whom SDHs developed from subdural hygromas while the underlying CSF leak was left untreated, symptoms actually improved. We postulate that the development of the SDHs corrected the abnormally low intracranial pressure or volume.3,9,26 Other authors, however, have reported significant clinical deterioration associated with the development of SDHs from hygromas.3 In those patients, the deterioration may have been due to progressive diencephalic herniation in the setting of brain sagging rather than the development of the SDHs.

Data from our study show that subdural fluid collections associated with spontaneous intracranial hypotension, including large SDHs associated with significant mass effect, can be safely managed by directing treatment at the underlying CSF leak without the need for a craniotomy or burr hole drainage. Resolution of the typical imaging features of spontaneous intracranial hypotension such as meningeal enhancement or brain sagging often can be demonstrated within days of successful treatment of the CSF leak and we found similar rapid resolution of subdural hygromas among patients in our study. For SDHs with mass effect, however, resolution was more protracted and lasted up to 3 months. In one of the patients in our study, the SDH increased in size immediately after surgery and we posit that this change was related to a relatively large loss of CSF volume intraoperatively. In none of the patients were the subdural fluid collections believed to be primarily responsible for the patient’s symptoms, and treatment of the underlying CSF leak was performed on an elective basis. Note, however, that treatment becomes more complex when a patient with spontaneous intracranial hypotension develops SDHs. For SDHs with mass effect, however, treatment becomes more complex when a patient with spontaneous intracranial hypotension becomes obtunded and SDHs with mass effect are demonstrated on radiographic examination. Good results following simple SDH evacuation have been reported,5 whereas other patients have only regained normal neurological functioning after intrathecal saline infusion or other specific treatment of the underlying CSF leak.3,13,16,30,23,23 Data in our study confirm that if SDHs are evacuated but spontaneous intracranial hypotension is not diagnosed and the underlying CSF leak is left untreated, the risk of persistent or recurrent SDHs is high.3,18

The most important step in recognizing underlying spontaneous intracranial hypotension in patients presenting with spontaneous subdural fluid collections is a high clinical index of suspicion. Clinically, important clues to a correct diagnosis are the absence of any significant head trauma or coagulopathy and, commonly, a history of positional headaches. Radiographically, characteristic features associated with intracranial hypotension include meningeal enhancement and brain sagging, consisting of downward displacement of the cerebellar tonsils, flattening of the pons against the clivus, and crowding of the optic chiasm. In most patients, these clinical and radiographic features allow the diagnosis to be made with confidence, whereas in others further spinal imaging is required to demonstrate evidence of the underlying CSF leak.

**Conclusions**

Subdural fluid collections are common in spontaneous intracranial hypotension, varying in appearance from thin subdural hygromas to large SDHs associated with significant mass effect. These subdural fluid collections can be safely managed by directing treatment at the underlying CSF leak without the need for hematoma evacuation.

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