Continuous Intracranial Pressure Monitoring: A Last Resort in Pseudotumor Cerebri

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In patients with pseudotumor cerebri, it is critical to intervene surgically if visual loss continues despite medical therapy (1). This sounds like a simple rule to follow, but in reality, the decision to recommend surgery can be fraught with uncertainty. The essential problem is that if one gives medical therapy a chance to work, it may not be possible to snatch the bacon from the fire. By the time it has become clear that a patient has not responded to pressure-lowering drugs or lost weight, irreversible visual loss may have already occurred (2). For this reason, it is crucial to monitor patients with great vigilance who suffer from acute or progressive visual loss, so that optic nerve damage does not go too far.

To monitor patients with pseudotumor cerebri is quite straightforward: check the visual acuity, obtain computer-assisted perimetry, and examine the fundi to assess the severity of papilledema (3–5). It is useful to sample the cerebrospinal fluid when the disease is diagnosed, to exclude other etiologies and to confirm that the intracranial pressure is elevated. However, it is rarely advisable or necessary to perform subsequent spinal taps on a regular basis. If the patient’s signs and symptoms are well controlled with medical therapy, then the intracranial pressure is moot. By the same token, if the patient is losing vision from papilledema, surgery is needed regardless of the intracranial pressure. There are, to be sure, exceptions to these principles. For instance, serial lumbar punctures to drain fluid may be a useful strategy in patients with tetracycline-induced intracranial hypertension. In such cases, the intracranial pressure returns to normal about a month or so after stopping the antibiotic, making it possible to avoid a shunt by using frequent lumbar punctures as a temporizing measure (6).

What about patients who are unreliable, unable to perform visual field examinations, or even to cooperate with visual acuity testing? In such cases, the clinician is forced to rely primarily on the appearance of the optic discs to judge whether the patient can be managed safely without surgery. This approach works well in most patients, but the rub comes if there is already significant optic atrophy. Dead or damaged nerves do not swell, at least not much. Patients can lose their remaining vision with little evidence of papilledema. This is a potential drawback of optic nerve sheath fenestration: disc edema is reduced, but the optic nerves remain exposed to high intracranial pressure. As a result, visual loss can sometimes progress after surgery, even though papilledema is nearly absent (7). For this reason, among a host of others, it is usually better to implant a shunt than to perform optic nerve sheath fenestration when surgical intervention is necessary (8–10).

Patients who have optic atrophy and perform unreliably on sensory tests pose a quandary. Dysplastic optic discs can also be difficult to evaluate. In such individuals, repeated measurement of the intracranial pressure may be the only dependable way to guide management. There is nothing else reliable to hang one’s hat on. Unfortunately, patients with pseudotumor cerebri are difficult to tap, prompting many neurologists to refer them for fluorescopy-guided lumbar puncture. Inaccurate measurements are common due to incorrect positioning, partial needle obstruction, fluid loss, or patient straining. For example, a Valsalva maneuver can increase the pressure from a mean of 146 mm water to a mean of 323 mm water (11).

Perhaps the biggest problem with lumbar puncture is that it captures a pressure reading at only one moment in time. Just like blood pressure, the intracranial pressure fluctuates widely, depending on posture and activity. Recall that lumbar subarachnoid pressure is equal to intracranial pressure only
when a subject is oriented with the craniospinal axis parallel to the ground. When a supine patient sits up, intracranial pressure falls (12). In a standing patient, average intracranial pressure at the vertex can actually drop below the atmospheric pressure (13,14). These facts explain the observation of Peeraully and Rosenberg (15) in this issue of the Journal that a lumbar puncture can sometimes yield a normal opening pressure in a patient with spontaneous intracranial hypotension. The probable explanation is that the intracranial pressure is indeed normal in the lateral decubitus position, but when the patient rises, it falls more than usual because of low cerebrospinal fluid volume. This accounts for the postural nature of the patient’s headache. The important lesson from their case is that if a patient has a typical history, and magnetic resonance findings consistent with spontaneous intracranial hypotension, one should not be deterred from the diagnosis by a normal pressure reading on a recumbent spinal tap (16,17).

The limitations and pitfalls of spinal tap measurements can be overcome by performing continuous measurement of intracranial pressure with a device placed in the brain through a small burr hole in the skull. This procedure is often carried out in critically ill patients in the neurointensive care unit who are suffering from severe head trauma, meningitis, subarachnoid hemorrhage, stroke, or encephalopathy (18). In this issue, Trobe et al (19) describe their experience with continuous intracranial pressure monitoring in 10 patients with presumed pseudotumor cerebri. Should the indications for this procedure be expanded to include elective monitoring in alert, nonacute patients for the purpose of establishing the diagnosis of pseudotumor cerebri or guiding management?

In the Trobe study, pressure was monitored with the Codman MicroSensor system. It uses a transducer with a strain gauge at the tip, which is implanted in the frontal white matter about a centimeter below the cortical surface. It generates a voltage, proportional to intracranial pressure, which is transmitted electrically via a cable to a monitor that displays and records the data. The procedure is quite safe: in nearly 1000 patients implanted with the Codman sensor, Koskinen and Olivcrona (20) reported “no infection or hemorrhagic complication of clinical significance caused by the monitoring device.” Nonetheless, the literature records a 2%-5% infection rate in patients undergoing invasive intracranial pressure monitoring (21–23).

Continuous intracranial pressure monitoring is relatively safe, but is it necessary in pseudotumor cerebri? Trobe et al resorted to continuous monitoring in a selected cohort of patients who fit the profile described above: unreliable visual function testing, anomalous or atrophic discs, and inconsistent pressure data from lumbar puncture. In 7 of 10 cases, continuous monitoring proved that the intracranial pressure was normal. The authors point out that these patients were spared “unnecessary invasive surgical options.” However, by the time one has drilled a hole in the skull and inserted a probe into the brain, one has performed several key elements of a ventriculoperitoneal shunt. No doubt, continuous monitoring is less invasive, but it is still a surgical procedure.

The most puzzling aspect of the study by Trobe et al, evident on reviewing the clinical features summarized in their Table 1, is that the range of pressure readings obtained by continuous monitoring was lower than the pressure measured by lumbar puncture in every single case. This is especially surprising when one considers that continuous monitoring captures spikes in pressure that occur occasionally over the course of 24 hours, whereas the spinal tap reflects a single random time point. No information was provided about the posture of the patients or their activity level during continuous monitoring. As mentioned earlier, intracranial pressure tends to be lower than lumbar pressure if the head is elevated. However, this effect cannot explain the magnitude of the discrepancies reported here.

Case 1 appears to have been a malingerer, with a spurious lumbar pressure measured under fluoroscopy. She was the only obese patient in the series who fit the profile of pseudotumor cerebri. Cases 6 and 9 had optic disc drusen, with falsely elevated pressures recorded on multiple occasions by lumbar puncture. Case 3 had a lumbar puncture performed elsewhere. Case 5 had a lumbar puncture a year before continuous pressure monitoring, so the elevated reading was too stale to be useful. These cases underscore the difficulty and importance of obtaining an accurate opening pressure by lumbar puncture. If you are not standing there watching the procedure, regard the data with a baleful eye.

Cases 7 and 8 underwent continuous pressure monitoring to investigate possible shunt failure or to test for shunt dependency. This is a very useful application of continuous pressure monitoring because intermittent shunt failure can be hard to recognize (24). Pressure can rise for a few hours, producing headache but no objective clinical signs, such as papilledema. The only practical way to catch these transient episodes is with continuous pressure monitoring. We have also used continuous pressure monitoring in the rare situation of a patient with optic atrophy who reports progressive visual loss despite prior shunting.

Ultimately, the decision to shunt a patient with pseudotumor cerebri is made by the neurosurgeon, with the consent of the patient. The dilemma is that few neurosurgeons are comfortable with the evaluation of visual function or the examination of the ocular fundi. There is a temptation, potentially, to seek the tangible numerical data provided by continuous intracranial pressure monitoring (25). This procedure, however, is usually not necessary. In most patients, one can determine whether a shunt is required by listening to the patient’s symptoms, testing the vision, and assessing the severity of papilledema. Nonetheless, in a subset of patients, who represent the most challenging cases, Trobe et al have shown that continuous intracranial pressure monitoring may be valuable as a last resort.
REFERENCES