Idiopathic Intracranial Hypertension

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Current Treatment Options in Neurology 1999, **1:**74–81
Current Science Inc. ISSN 1092-8480

Opinion statement

A thorough assessment of vision with special attention to formal visual field testing is the cornerstone to decision making in idiopathic intracranial hypertension. After the diagnosis of idiopathic intracranial hypertension has been established, vision should be thoroughly assessed. If there is no visual loss, the patient can be followed carefully. In patients with symptoms and only a few signs (*eg*, mild blind-spot enlargement), acetazolamide, 1 to 2 g, or another diuretic should be initiated. In patients with progressive visual loss in whom maximal diuretic therapy fails and in those who on initial evaluation have significant recent visual loss that does not respond to maximal diuretic therapy, optic nerve sheath decompression or lumbar peritoneal shunting should be carried out. With all treatments, weight loss should be encouraged. All patients should be evaluated regularly with visual field testing.

Introduction

Idiopathic intracranial hypertension (IIH) occurs especially in obese women of reproductive age. It occurs in 3 of 100,000 nonobese individuals but in 20 of 100,000 obese individuals [1, Class IIa]. IIH is accompanied by symptoms (headache, transient visual obscurations) and signs (papilledema, sixth nerve palsy) of increased intracranial pressure without other localized findings. Papilledema characterizes the condition, and visual loss is a major complication in up to one third of cases [2•, Class IIIa2]. This disorder has been known by several terms over the years including *benign intracranial hypertension* and *pseudotumor cerebri*, but IIH is the preferred term [3•, Class IIIc]. The diagnosis is made according to the modified Dandy criteria (Table 1). It is crucial that these criteria be applied because many conditions, including venous sinus thrombosis, may mimic IIH and alter treatment. The pathogenesis remains obscure, but obesity is associated in up to 90% of cases [4•, Class IIIa1; 5••, Class IIa; 6•, Class IIb].

Evaluation of patients in whom IIH is suspected should begin with a careful history, which may point to a secondary cause of intracranial pressure (Table 2). An imaging procedure should be performed in all patients, preferably a magnetic resonance imaging scan with venography, to exclude secondary causes, especially venous thrombosis. All patients should undergo a lumbar puncture to document an elevated opening pressure and to ensure that cerebrospinal fluid (CSF) is normal. Because loss of vision is a major complication, all patients require measurement of visual acuity, formal visual field testing using automated or kinetic perimetry, and careful evaluation of the optic disks. Additive risk factors for visual loss in IIH include systemic hypertension or hypotension, anemia, and elevated intraocular pressure [4•, Class IIIa1; 5••, Class IIa]. The neurologist should establish a working relationship with an ophthalmologist or a neuro-ophthalmologist to assess and follow the effects of the disease on

Table 1. Modified Dandy criteria

Signs and symptoms of increased intracranial pressure (papilledema or headache)
No localizing findings on neurologic examination (except abducens nerve palsy)
Normal neuroimaging with no evidence of venous obstructive disease
Increased intracranial pressure as measured by lumbar puncture
Normal cerebrospinal fluid constituents
Awake and alert patient
No other cause of increased intracranial pressure

Table 2. Symptomatic causes of intracranial hypertension

Space-occupying intracranial lesions
Venous hypertension
Dural sinus thrombosis
Arteriovenous malformations and dural fistulas
Congestive heart failure/congenital heart disease
Pulmonary hypoventilation
Jugular vein or vena cava obstruction
Idiopathic thrombocytopenic purpura
Iron-deficiency anemia
Gammopathies
Chronic uremia
Endocrine disorders
Treated hypothyroidism in children
Alimentation of deprivational dwarfism
Hypoparathyroidism
Addison's disease
Hydrocephalus
Toxins
Chlordecone
Heavy metals: lead, arsenic
Hypervitaminosis A
Nalidixic acid
Danazol
Lithium
Amiodarone
Tetracycline or minocyclin
Nitrofurantoin
Infectious disease
Meningitis: viral (coxsackievirus B), bacterial, fungal
Brucellosis
Lyme disease
Guillain-Barré syndrome
Parasites: malaria, sandfly fever, trypanosomiasis
Torulosis
Neurocystercercosis
Syphilis
Sarcoid

the patient's visual acuity and fields, because these are the principal determinants that will guide treatment options [3•, Class IIIc]. Peripheral visual field loss generally precedes loss of acuity and is detected by formal perimetry with much higher sensitivity than bedside confrontation techniques.

Initial treatment includes facilitation of weight loss, diuretic use, and symptomatic treatment of headache. If visual fields or acuity worsens, surgical treatment is indicated [3•, Class IIIc; 4•, Class IIIa1; 7, Class IIIc; 8, Class IIIa2]. Weight loss has been shown to bring about remission and is encouraged in all obese patients [9••, Class III]. Diuretics have been the mainstay of medical therapy for IIH. Acetazolamide is a carbonic anhydrase inhibitor that is thought to work in part by reducing CSF production [10, Class IIIa1]. Other carbonic anhydrase inhibitors, such as methazolamide, can be employed when acetazolamide is not tolerated [3•,7, Class IIIc; 11, Class III]. Loop diuretics, such as furosemide, have also been used [12, Class IIIb2]; Schoeman [12, Class IIIb2] suggests combining acetazolamide and furosemide. Digoxin [13, Class IIIa2] and glycerol [14, Class IIIa2] have been used sporadically.

Oral steroids (*eg*, prednisone) have been advocated in patients with acute or rapidly progressive visual loss [8, Class IIIa2; 15, Class IIIb]. Steroid withdrawal, however, has been associated with the onset of IIH [7, Class IIIc] Furthermore, chronic steroid use causes weight gain, fluid retention, and increased intraocular pressure, all of which might exacerbate the disease.

Lumbar punctures lower intracranial pressure acutely [16, Class IIIa2], but frequent procedures as a means of therapy are usually not well tolerated. Serial lumbar punctures, however, may temporize while surgery is being planned.

Medical treatment of headache provides symptomati relief. Symptomatic treatment of headache is often not satisfactory unless the underlying condition is adequately controlled [17, Class IIIa2]. No studies have compared pain remedies in IIH. Nonsteroidal anti-inflammatory agents (*eg*, naproxen sodium), β-blockers (*eg*, propranolol, nadolol), calcium-channel blockers (*eg*, verapamil), antidepressants (*eg*, imipramine, nortriptyline, desipramine), and anticonvulsants (*eg*, divalproex sodium) have all been recommended by some authorities [17, Class IIIa2]. Tricyclic antidepressants and divalproex sodium should be used with caution in IIH, however, because they are associated with increase in appetite and weight gain. Analgesics such as acetaminophen or aspirin and seritoninergic compounds like isometheptene, ergotamine, and sumatriptan are occasionally effective.

Optic nerve sheath decompression (ONSD) through fenestration is probably the procedure of choice when vision is threatened. It was first described by deWecker in 1872 and has since been described in detail in the literature [18, Class IIIc; 19-22, Class IIIa2]. The approach may be through the medial [21, Class IIIa2] or lateral [22, Class IIIa2] orbit and is conducted by ophthalmic surgeons. Decompression is thought to work chiefly by providing an alternative outflow path for CSF. Complications include arterial occlusion with blindness and injury to the ciliary ganglion with resultant dysfunction of accommodation and pupillary constriction.

Lumbar peritoneal shunt can also reduce intracranial pressure and prevent visual loss [23•, Class IIIa2; 24,25, Class IIIa2]. This procedure is performed by neurosurgeons. It is generally safe but is most commonly complicated by spontaneous obstruction requiring reoperation. Headaches are frequently better controlled with the LP

shunt than with ONSD but may become a problem if excessive CSF drainage results in intracranial hypotension.

Subtemporal decompression was once in favor to treat IIH but has been replaced by less invasive, less risky surgical techniques [26•, Class IIIc].

Bariatric surgery has been proposed to encourage weight loss in IIH. Although this approach may help expedite remission of the condition [27•, Class IIIa2], its benefits develop too slowly to address visual loss.

ACKNOWLEDGMENT

This work is supported in part by a grant from Research to Prevent Blindness, Inc., New York, NY, to the Department of Ophthalmology, University of Utah.

Treatment

Diet and lifestyle

- All patients should be encouraged to lose weight. Loss of 2.5 kg or more has been associated with improvement of papilledema and headache [9••, 11, 26•, Class IIIc].
- Excessive water intake should probably be avoided, because patients with IIH have been noted to develop peripheral edema.
- Salt restriction may be helpful.
- A rice diet was shown to be effective in one study [26•, Class IIIc].
- A tyramine-free diet reduced headache severity and improve the patient well-being in one study [28, Class III].
- IIH may resolve spontaneously. In an asymptomatic patient with normal vision, the neurologist may elect to treat it with weight loss alone.
- Initially, patients should be seen for evaluation of acuity testing, visual fields, and ophthalmoscopy at least monthly, depending on visual function. Thereafter, if vision is stable, visits every 2 to 3 months for 1 year generally suffice. If patients have stable symptoms and normal vision, visits every 6 to 12 months are recommended [4•, Class IIIa1; 11, Class III].

Pharmacologic treatment

Diuretics: carbonic anhydrase inhibitors

	Acetazolamide (Diamox; Storz/Lederle, St. Louis, MO) and methazolamide (Neptazane; Storz/Lederle, St. Louis, MO) are carbonic anhydrase inhibitors that work by reducing CSF production [29, Class IIIa1]. They may also directly reduce interstitial water content in the brain. Acetazolamide is generally started first.
Standard dosage	Starting dose of acetazolamide is 250 to 500 mg/day, increasing as tolerated to 1000 to 4000 mg in divided doses (bid to qid). The long-acting sequels are better tolerated and provide for less frequent dosing. Methazolamide is given in doses of 50 to 100 mg, bid or tid.
Contraindications	Allergy to the drug, severe hyponatremia or hypokalemia, marked kidney or liver disease, prior nephrolithiasis.
Main drug interactions	Use with high doses of aspirin can cause anorexia, lethargy, or coma. Use with topiramate may increase the risk of nephrolithiasis. They can also increase digoxin levels and lead to toxicity and can increase cyclosporine levels. These drugs increase lithium excretion.
Main side effects	Gastrointestinal upset, tingling of the extremities and perioral region, systemic acidosis, anorexia, renal stone formation (15% to 36%) [30, Class IIIb; 31, Class III], metallic taste, nausea, vomiting, and aplastic anemia.
Special points	Renal ultrasound has been suggested by a few authors when patients are on acetazolamide longer than 6 months [32, Class IIIc]. Improved responses with the combination of acetazolamide and furosemide have been described in children [12, Class IIIb2]. Use in pregnancy has not been established; these are rated as category C drugs

Cost effectiveness The generic form of acetazolamide in 250-mg tablets is least expensive at $0.28 per tablet. This formulation needs to be given tid to qid, for a daily cost of $0.84 to $1.12. Sequel formulation of acetazolamide (500-mg capsules) acts longer an is somewhat better tolerated but is more expensive.

Diuretics: furosemide

Furosemide (Lasix; Hoechst Marion Roussel, Kansas City, MO) has been helpful in some patients [3•, Class IIIc; 4•, Class IIIa1].

Standard dosage 20 to 80 mg daily in adults; 1 mg/kg in children.

Contraindications Allergy to the drug, anuria, hepatic coma, severe hypokalemia, hyponatremia, or hypovolemia.

Main drug interactions Furosemide increases nephrotoxicity and ototoxicity of aminoglycosides (*eg*, tobramycin, gentamicin). It reduces renal clearance of drugs like lithium and aspirin. Furosemide increases potassium loss from steroids. Use with digoxin can lead to toxicity.

Main side effects Hypokalemia, hypovolemia and hypotension, thrombocytopenia, hyperglycemia, hyperuricemia, pancreatitis, jaundice, and anorexia.

Special points One series in children described benefits of adding furosemide to acetazolamide in IIH [12, Class IIIb2]. Furosemide is a category C drug in pregnancy.

Cost effectiveness Inexpensive in the generic form ($2.10 for 100 20-mg tablets).

Diuretics: chlorthalidone

Chlorthalidone was reported to be useful in one study [14, Class IIIa2]. It has not been thoroughly studied, however. It is not commonly used but can be employed in patients who do not tolerate other diuretics or in pregnant patients (being a category B drug).

Standard dosage One study suggested using 200 mg on alternate days [14, Class IIIa2]. Recommended dosage is 12.5 to 50 mg; or 2 mg/kg up to 120 mg/day.

Contraindications Renal failure with creatinine level greater than 2.5 mg/kg, anuria, allergy to sulfonamides.

Main drug interactions Severe hypotension can occur when combined with angiotensin-converting enzym inhibitors and other blood pressure medications, such as atenolol. It can cause hypercalcemia with concurrent use of calcium supplement. Like other diuretics caution must be used when taking with digoxin because of a potential drop of potassium level and possible development of arrhythmia. Concurrent use with steroids can potentiate potassium loss; use with lithium can increase lithium levels.

Main side effects Neutropenia, arrhythmia, hypokalemia, hypercalcemia, pancreatitis, and rash.

Special point Chlorthalidone is a category B drug in pregnancy

Cost effectiveness Inexpensive in generic form ($2.78 for 100 25-mg tablets).

Corticosteroids: prednisone (oral) or methylprednisolone (intravenous)

Steroids have been used to resolve symptoms and signs of IIH [24, Class IIIa2]. Recurrence is common with tapering of these drugs, however. In one series, all patients responded within 4 days, and steroids were stopped in 7 to 14 days. Long-term use of oral steroids (more than 2 months) increased complication rates. Patients who did not respond to steroids early did not respond at all.

Standard dosage 2 mg/kg/d given for 2 weeks, with tapering over an additional 2 weeks [32, Class IIIc]. Liu *et al*. [15, Class IIIb] recently treated patients with 250 mg of methylprednisolone administered intravenously qid for 5 days, with an oral taper beginning at 80 mg over 4 to 8 weeks. Steroids were given along with acetazolamide at traditional doses (500 mg bid).

Contraindications Use with caution in patients with diabetes.

Main drug interactions Can potentiate potassium loss with diuretic use

Main side effects Hyperglycemia, peptic ulcers, fluid retention, obesity, psychosis, increased intraocular pressure, anemia, leukocytosis, hypertension, hypercalcemia, adrenal suppression, lipid abnormalities, hypokalemia, pancreatitis, abdominal pain, acne, and osteoporosis

Special points Corticosteroids are a category C drug in pregnancy.

Cost effectiveness Inexpensive ($3.39 for 100 1-mg tablets).

Interventional procedure

Lumbar puncture and drainage

The aim of this procedure is to lower intracranial pressure immediately while surgical procedures are being planned or while medical therapy is being initiated. Serial lumbar punctures as sole therapy are not highly effective and are not well tolerated. Johnston *et al*. [24, Class IIIa2] treated 67 patients initially with serial lumbar punctures (mean, 9 punctures) and found that slightly less than 40% o patients improved. Frequent lumbar puncture seems to work best in patients with relatively lower CSF opening pressure (less than 300 mm H_2O) [24, Class IIIa2].

Standard procedur The patient is placed in a lateral decubitus position. The fourth or fifth lumbar interspace is entered with a small-gauge needle according to standard procedure. A manometer is used to measure pressure. Fluid is removed for cell, protein, glucose, and culture studies if indicated. Large volumes can be removed to reduce closing pressure to normal (less than 200 mm H_2O).

Contraindications Any cerebral mass lesion where reduction of lumbar pressure might result in shift of intracranial contents. Such a finding would rule out IIH, however. Cutaneous or subcutaneous infection at the proposed puncture site. Systemic anticoagulation therapy, severe thrombocytopenia, or other coagulopathy.

Complications Infection, pain, introduction of skin into the intraspinal compartment, hemorrhage, post–lumbar puncture headache.

Cost effectiveness Moderate cost (approximately $200 to $300 per treatment) but uncomfortable for the patient.

Surgery

- The purposes of surgery are to preserve vision and prevent further loss.

Lumbar peritoneal shunting

This procedure was introduced for the treatment of IIH by Jackson and Snodgrass in 1955. Both Weisberg [8, Class IIIa2] and Johnston *et al*. [24, Class IIIa2] treated all their patients successfully using this shunting procedure. Subsequent reports have confirmed its usefulness [23•,25,35•, Class IIIa2].

Standard procedur This neurosurgical procedure is usually performed with the patient under general anesthesia. Usually, a hemilaminectomy is performed before placing the catheter into the subarachnoid space and securing it to the dura. The free end is then passed through the subcutaneous fat around the trunk and into the peritoneum through a small muscle-splitting incision.

Contraindications Perilumbar infections, coagulopathy.

Complications Sciatica, intracranial hypotension due to overshunting, arachnoiditis, and subdural hematoma. The largest single complication is shunt failure. One series noted an average of 4.2 shunts required to treat IIH patients [23•, Class IIIa2].

Special points Careful follow-up is required because visual loss can follow shunt failure. In a large series of lumboperitoneal shunts (including four cases of IIH), children tolerated shunts less well and were more prone to failure [37, Class IIIa2].

Cost effectiveness Expensive. This is a surgical procedure that usually requires a hospital stay.

Optic nerve sheath decompression

	This procedure was introduced by DeWecker but did not become popular until the 1980s. It has been widely reported as being effective for visual loss associated with IIH [18, Class IIIc; 19-22,37,38, Class IIIa2].
Standard procedur	A standard lateral or medial orbitotomy is performed by an ophthalmic surgeon, usually with the patient under general anesthesia. Either several small slits or a window in the dura and arachnoid membranes of the optic nerve sheath is then placed. In most cases, a unilateral procedure is performed on the eye with the worst vision. In about half the cases, this is sufficient to reduce intracranial pressure, decompressing the fellow eye and alleviating headache.
Contraindications	Any contraindication to general anesthesia.
Complications	Central retinal artery occlusion, trauma to the optic nerve, corneal ulcer, hyphema, glaucoma, diplopia (from medial or lateral rectus injury), tonic pupil (especially from the lateral approach), orbital hemorrhage, and infection. Published complication rates range from 2% to 10% [18, Class IIIc; 39, Class IIIa2].
Special points	This procedure is generally accepted as the best choice in patients with impendin vision loss.
Cost effectiveness	High cost of a surgical procedure; reoperation on the same eye is seldom required. May be less expensive than LP shunt because it is most often an outpatient procedure.

Bariatric surgery

	This procedure is effective in reducing weight in severely obese patients with IIH. Following this type of surgery, opening pressures may be reduced, along with papilledema, headache, and pulsatile tinnitus [27•, Class IIIa2].
Standard procedur	Horizontal gastroplasty or vertical-banded gastroplasty, in which the bulk of the stomach is occluded, leaving a small pouch. Roux-en-Y gastrojejunostomy can also achieve this goal.
Contraindications	Patients who are poor risks for abdominal surgery or general anesthesia.
Complications	Gastrointestinal malabsorption, fat-soluble vitamin deficiencies, hypocalcemia, protein-calorie malnutrition, Wernicke's encephalopathy, stomal stenosis, gastrointestinal bleeding, incisional hernia, small bowel obstruction, dumping syndrome, and death (0.5%).
Special points	Reduces weight and brings about remission of IIH but works slowly. Thus, it is not appropriate as a form of urgent therapy.
Cost effectiveness	Very costly surgical procedure because of the required length of the hospital stay and invasiveness.

Emerging therapies

- Octreotide, a long-acting somatostatin analog, is a potent inhibitor of growth hormone. In one small series, it was reported to be beneficial in patients with IIH [40, Class IIIa2]. Dental caries, nausea, diarrhea, dizziness, and steatorrhea are side effects. The drug is classified as pregnancy class B. The cost is prohibitive.
- Hyperbaric oxygen was shown to be helpful in one patient [41, Class III].
- Sch 23390 is a serotonin receptor agonist that decreases CSF production in rats.

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