18 Idiopathic Intracranial Hypertension (Pseudotumor Cerebri)

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INTRODUCTION

Idiopathic intracranial hypertension (IIH) is a disorder of elevated intracranial pressure (ICP) without apparent inciting etiology. *Pseudotumor cerebri* (PTC) is also a commonly accepted term describing the same disorder. Many authors advocate limiting the definition of IIH to a truly idiopathic subset of PTC, as PTC encompasses a list of known nontumor conditions resulting in elevated ICP, including the following: cerebrospinal fluid (CSF) malabsorption, superior vena cava syndrome, elevated right heart pressure, venous sinus or jugular vein thrombosis, and others.[1,2] Additionally, neuroradiologists often prefer the term *PTC* over *IIH* because extracranial or radiographically occult secondary etiologies are not readily evident on routine brain imaging.[2] *Benign intracranial hypertension*, yet another frequently used term, should be avoided, since the disorder can result in serious clinical outcomes including vision loss.

IIH was first recognized by Heinrich Quincke in 1893[3] and Walker Dandy first proposed the diagnostic criteria in 1937.[4] Since then, multiple revised diagnostic criteria have been proposed and debated[1,5,6] in an effort to reflect the rapid evolution of advanced neuroimaging, especially magnetic resonance imaging (MRI). Before MRI, neuroimaging had a limited role to rule out intracranial masses prior to diagnostic lumbar puncture in cases of IIH. As with other primary idiopathic disorders, the diagnostic criteria and rationale remain largely clinical (Box 18.1). Hence the negative imaging findings as well as the constellation of positive clinical findings are of greater importance in diagnosis than any isolated positive imaging features.

IIH is most frequently reported in obese females of childbearing age. A review of cohort studies revealed that 57% to 100% of IIH patients are obese[7] and there is at least a two- to threefold increased prevalence in overweight females of reproductive age compared with the general population (1–3 in 100,000).[7-10] By contrast, IIH in the prepubertal pediatric population does not demonstrate strong associations with obesity or female sex.[11]

The most common presentation symptom of IIH is headache, which occurs in 90% to 94% of cases.[7,10] Other common symptoms of IIH include retro-ocular pain, transient vision obscuration, pulsatile tinnitus, photopsia, and diplopia. Although less common, visual loss occurs in approximately 30% of affected patients.[7,10] Papilledema and visual changes are the most common clinical examination findings of IIH (~40%). Although palsy is less frequent, patients can also present with abducens (CN 6) palsy (~10%).

Many IIH cases without visual changes are self-limiting or only require conservative management. Cases with mild visual symptoms or papilledema necessitate treatments such as acetazolamide, therapeutic lumbar puncture, or bariatric surgery. More invasive treatments are reserved for refractory cases or rapidly progressing vision loss and include optic nerve sheath fenestration (ONSF), venous sinus stenting, and ventriculoperitoneal shunt placement. As the exact pathophysiology of IIH remains elusive, these therapeutic measures yield varying degrees of success in different patient groups.

BOX 18.1 Criteria for Diagnosing Idiopathic Intracranial Hypertension

1. A diagnosis of IIH is definite if the patient fulfills criteria A through E. Otherwise a probable diagnosis can be suggested.
   - A. Papilledema.
   - B. Normal neurologic examination except for cranial nerve abnormalities.
   - C. Neuroimaging: normal brain parenchyma without hydrocephalus, mass, or structural lesion and no abnormal meningeal enhancement or venous sinus thrombosis on MRI/MRV or contrast-enhanced CT.
   - D. Normal CSF composition.
   - E. Lumbar puncture pressure above 25 cm H_2O (>23 cm H_2O in pediatric patients).
2. In the absence of papilledema, a diagnosis of IIH can be made if B through E are satisfied and, in addition, the patient has a unilateral or bilateral abducens nerve palsy.
3. In the absence of papilledema or sixth nerve palsy, a diagnosis of IIH can be suggested but not made if B through E are satisfied and, in addition, at least three of the following neuroimaging criteria are satisfied:
   - Empty sella
   - Flattening of the posterior aspect of the globes
   - Distention of the perioptic subarachnoid spaces with or without tortuous optic nerves
   - Transverse venous sinus stenosis

CSF, Cerebrospinal fluid; *CT,* computed tomography; *MRI/MRV,* magnetic resonance imaging/venography; *IIH,* idiopathic intracranial hypertension.
Adapted from Friedman DI, Liu GT, Digre KB. Revised diagnostic criteria for the pseudotumor cerebri syndrome in adults and children. Neurology. 2013;81:1159–1165.

EVOLUTION: OVERVIEW

As the name of IIH suggests, the etiology is still unknown despite many different proposals based on numerous clinical and scientific investigations. The common ground of these proposals is centered around the alteration of CSF hydrodynamics (Fig. 18.1). The association between obesity and IIH is intriguing, as successful weight loss after bariatric surgery was found to treat IIH effectively.[12] Interestingly, recent studies of long-term spaceflight astronauts demonstrate similar clinical and MRI findings of IIH.[13]

As can be observed from the diagnostic criteria listed in Box 18.1, several MRI features have been identified as signs of IIH[2,14]; they also serve as a basis of pathophysiologic proposals (Box 18.2). Findings such as a partially empty sella, posterior globe flattening, optic nerve head protrusion, optic nerve sheath distension (ONSD), optic nerve tortuosity/enhancement, and Meckel cave meningoceles occur in the orbits, sella turcica, and Meckel cave where the

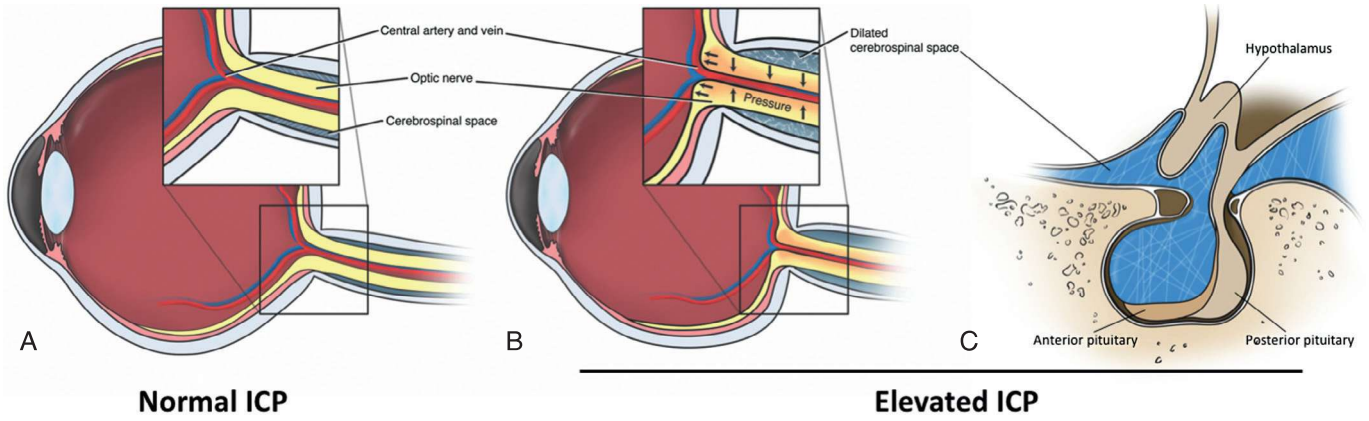

Figure 18.1. Increased intracranial pressure *(ICP)* is directly transmitted to extracranial cerebrospinal fluid (CSF) compartments such as the orbit (B) and sella turcica (C), where distension, remodeling, and damage to the supporting microscopic structures of arachnoid trabeculae can occur. Compared with the normal globe (A), increased CSF pressure (B) will exert upon optic nerve as well as the optic disc as the anterior aspect of the globe is exposed to atmospheric pressure. Similarly, within the sella turcica (C), where the pituitary gland is situated between two dural layers, increased CSF pressure depresses the diaphragmatic sellae, resulting in expansion and inferior herniation of the CSF space.

BOX 18.2 Imaging Findings in Idiopathic Intracranial Hypertension

Empty sella/partially empty sella
Posterior globe flattening
Optic nerve head protrusion
Optic nerve sheath distension
Optic nerve tortuosity/enhancement
Meckel cave meningoceles
Transverse sinus narrowing
Slit-like ventricles

intracranial CSF compartment can transmit its increased pressure to its extended extracranial compartment.[15] Microscopically, the CSF-containing subarachnoid space is suspended by the tensile forces of arachnoid trabeculae, which can be distended, remodeled, or damaged by increased CSF pressure,[16] as depicted in Fig. 18.2. A slit-like ventricle is a finding introduced by Dandy,[4] but its clinical utility has been questioned owing to its rare occurrence.[17] Distal transverse sinus narrowing is a frequently associated finding, perhaps resulting from extrinsic compression due to increased ICP. Some authors suggest that venous sinus stenosis may, in fact, be the inciting etiology of IIH; this view has served as the grounds to treat some refractory IIH cases with dural venous sinus stenting.[18]

EVOLUTION: IN GREATER DEPTH

One can presume that multiple positive imaging findings would present in a patient with more severe or advanced IIH. However, there is no proven quantitative or qualitative relationship between the severity of disease and particular imaging findings or an increased number of imaging findings. There is also no proven or suggested temporal progression of one imaging finding compared with others. Varying types or combinations of imaging findings may reflect the local anatomic architecture, the chronicity, and the degree of elevated pressure. Variable reversibility of MRI findings after treatment has also been reported.[19] A possible exception to this variability is optic nerve head protrusion (Fig. 18.3); some observational studies demonstrate that the absence of this finding appears to correlate with the absence of visual symptoms,[19,20] with a reported specificity as high as 100%.[2] Given the variability of imaging findings and the absence of quantitative relationship between them and clinical severity, different management strategies employed are usually dictated nearly exclusively by clinical symptoms.

MIMICS AND DIFFERENTIAL DIAGNOSIS

Any isolated imaging findings listed in Box 18.2 can be seen in normal, asymptomatic patients except for posterior optic nerve head protrusion. Isolated findings of posterior globe flattening can be seen in the rare setting of ocular hypotony. Venous sinus thrombosis can cause all of the imaging features of IIH and confound the diagnosis if venographic imaging such as computed tomographic venography (CTV) or magnetic resonance venography (MRV) is not performed with routine brain MR imaging.

Extracranial venous obstruction should be considered upon identification of neuroimaging findings of IIH if a clinically relevant history is present. Superior vena cava obstruction syndrome (Fig. 18.4), right heart failure, and abdominal compartmental syndrome are known causes of PTC due to secondarily increased ICP.

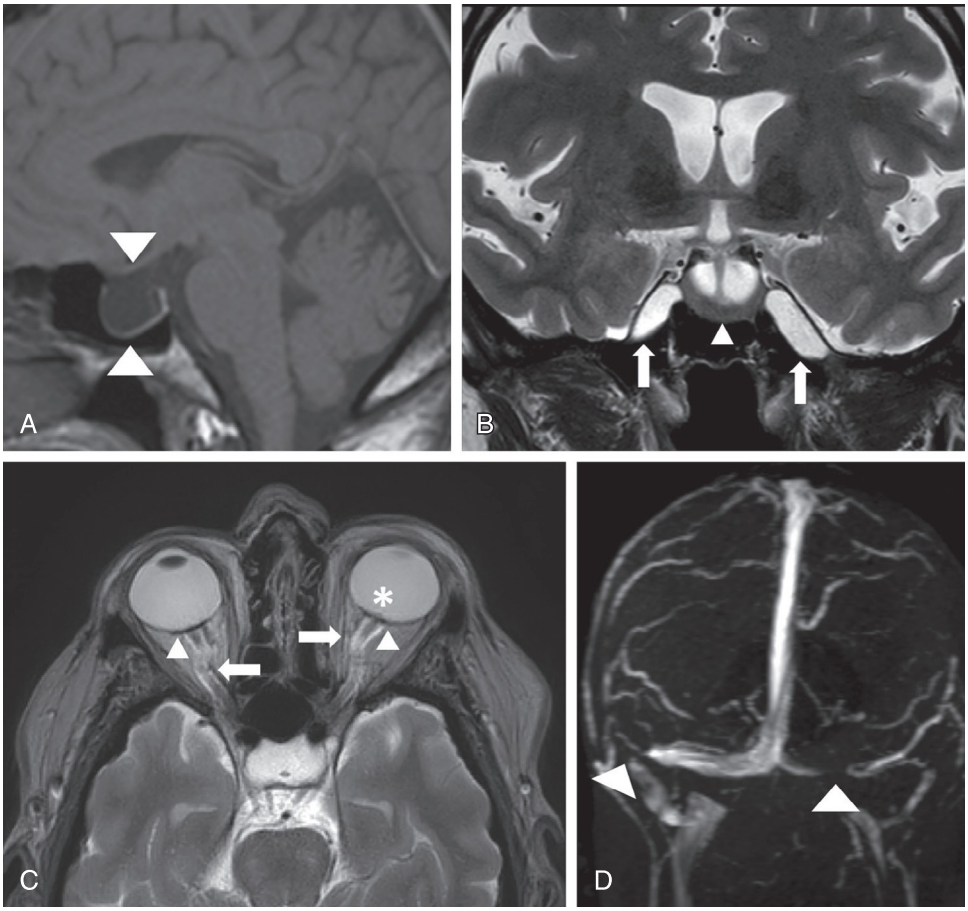

Figure 18.2. Typical magnetic resonance imaging (MRI) findings of idiopathic intracranial hypertension (IIH). (A) A T1-weighted sagittal image demonstrates a partially empty sella turcica with a flattened pituitary gland *(arrowheads)*. (B) A T2-weighted coronal image shows a partially empty sella *(arrowhead)* as well as enlarged bilateral Meckel caves due to meningoceles filled with cerebrospinal fluid *(arrows)*. (C) A T2-weighted axial image demonstrates bilateral posterior globe flattening *(arrowheads)*, optic nerve sheath distension, optic nerve tortuosity *(arrows)*, and optic nerve head protrusion into the posterior globe *(asterisk)*. (D) A time-of-flight MR venogram of a patient with IIH demonstrates narrowed right distal transverse/proximal sigmoid sinuses and severe narrowing at left mid–transverse sinus *(arrowheads)*.

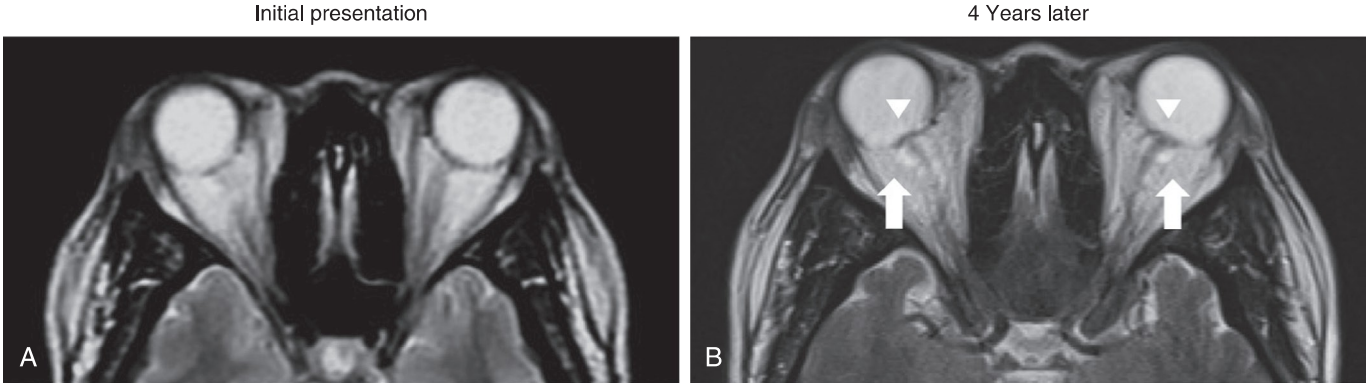

Figure 18.3. Longitudinal evolution of magnetic resonance imaging findings of idiopathic intracranial hypertension. (A) A T2-weighted axial image of a middle-aged female patient reveals normal-appearing globes and optic nerves. (B) The patient presented with worsening symptoms 4 years later and developed optic nerve sheath distension *(arrows)* as well as optic nerve head protrusion *(arrowheads)*. *Continued*

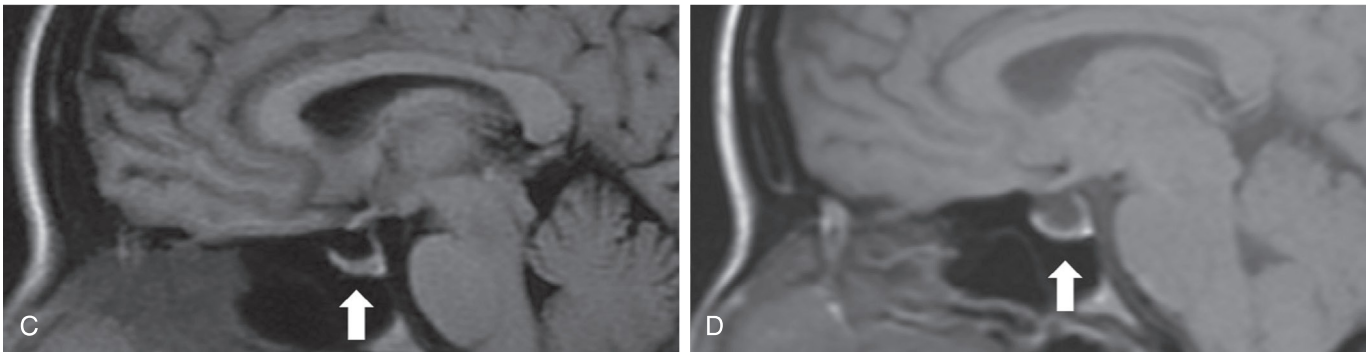

Figure 18.3., cont'd There is a mild partially empty sella with mild flattening of the pituitary gland on initial sagittal T1-weighted imaging (C, *arrow*). Four years later, there is progression with more pronounced flattening of the pituitary gland (D, *arrow*).

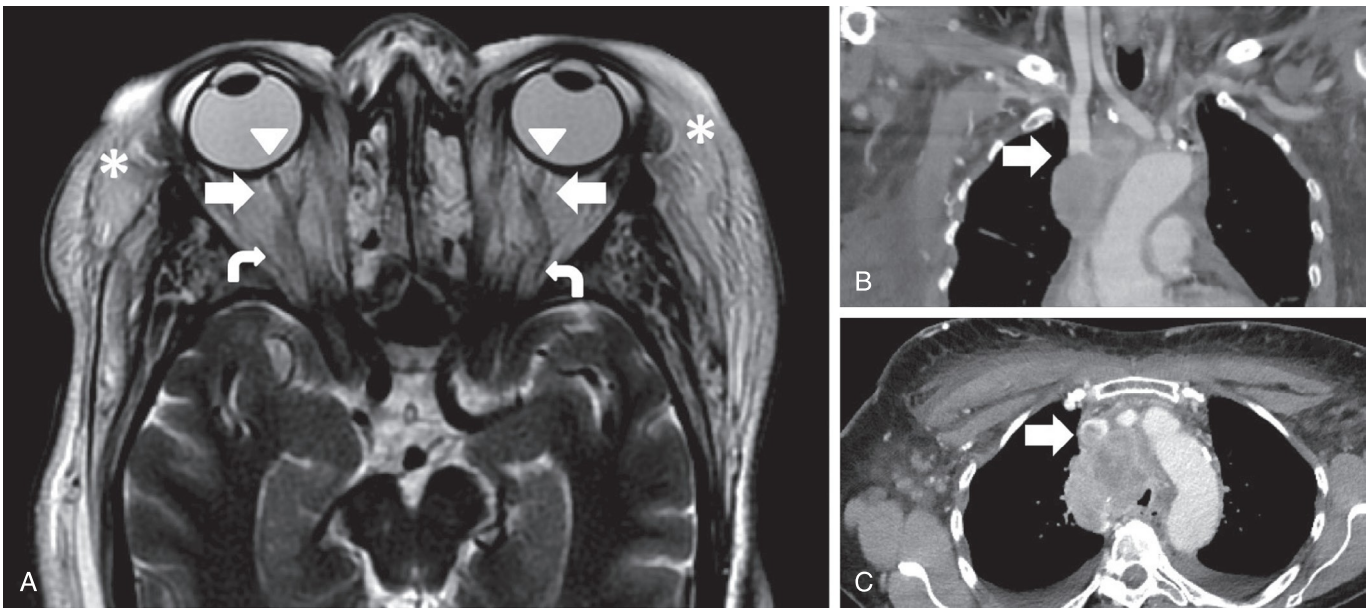

Figure 18.4. Superior vena cava (SVC) obstruction syndrome. Magnetic resonance findings of pseudotumor cerebri can result from extracranial venous obstruction. (A) A T2-weighted axial image demonstrates mild bilateral optic nerve sheath distension *(arrows)* with mild bilateral posterior globe flattening *(arrowheads)*. There are also additional findings including diffuse facial soft tissue swelling *(asterisks)*, dilated bilateral superior ophthalmic veins *(curved arrows)*, and bilateral globe proptosis. (B and C) Coronal and axial computed tomography images of the same patient reveal a large mediastinal mass invading and obstructing the SVC *(arrows)*.

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