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ORIGINAL PAPER

Pseudopapilledema and association with idiopathic intracranial hypertension

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Abstract
Purpose Diagnosing idiopathic intracranial hypertension (IIH), or pseudotumor cerebri, can be challenging in children. Diagnosis is based on lumbar puncture, opening pressures, and appearance of the optic disk. Misdiagnosis of papilledema, a typical finding, may lead to unnecessary treatments and procedures. We report 52 children over a 6-year period to better identify the true incidence of pseudopapilledema and other factors that may confound the diagnosis of IIH.
Methods A retrospective chart review approved by the Institutional Review Board was performed. Fifty-two children under the age of 21 referred to us based on suspected IIH or papilledema from 2007 to 2013 are included in this study. Patients were assessed by a pediatric ophthalmologist and a neurosurgeon.
Results Fifty-two children were initially diagnosed with IIH and/or papilledema; 26 diagnoses were revised to pseudopapilledema after pediatric ophthalmological review. Out of those 26 patients with pseudopapilledema, 14 had undergone lumbar punctures, 19 had MRIs, 9 had CTs, and 12 were taking medications—these medications were discontinued upon revision of the diagnoses. The difference in the CSF opening pressure between children diagnosed with true IIH (32.7 cm H_2O) and children diagnosed with pseudopapilledema (24.7 cm H_2O) was statistically significant.
Conclusions IIH diagnosis is heavily reliant on the appearance of the optic disk. Pediatric ophthalmological assessment is essential to carefully examine the optic disk and prevent further unnecessary investigation and treatments. Close communication between pediatricians, ophthalmologists, and neurosurgeons can avoid invasive procedures for children who do have pseudopapilledema, and not IIH or associated papilledema.

Keywords Pseudopapilledema · Idiopathic intracranial hypertension · Papilledema · Pseudotumor cerebri · Optic nerve drusen

Introduction

Idiopathic intracranial hypertension (IIH), also called pseudotumor cerebri, is defined as increased intracranial pressure without a space-occupying lesion or evidence of hydrocephalus, a normal cerebrospinal fluid composition, normal cranial imaging results, and elevated appearance of the optic disks [1]. Clinical presentation in children for IIH includes various combinations of headache, vomiting, and/or visual disturbances. Papilledema, swelling of the optic disk secondary to elevated intracranial pressure, is often found with an otherwise normal neurological examination [2]. Diagnosis of IIH is greatly based on the appearance of the optic disk. Diagnosis can be established by showing cerebrospinal fluid (CSF) of normal composition with raised CSF pressure without the presence of an intracranial mass lesion [3]. Treatment includes medications for months or even years, multiple

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lumbar punctures, and/or surgery, in order to prevent visual failure, a risk associated with IIH [2]. However, the diagnosis can be incorrectly diagnosed. Furthermore, a diagnosis relying on CSF opening pressure measurements on lumbar punctures may not be accurate. We believe that a significant number of patients undergo unnecessary investigations and procedures for IIH due to a misdiagnosis of pseudopapilledema. Pseudopapilledema is an anomalous elevation of the optic disk accompanied by blurring of the disk margins. It is a benign variant of normal optic nerve development. We report 52 patients under the age of 21 referred to us over a 6-year period with suspected pseudotumor cerebri/IIH to better identify the true incidence of pseudopapilledema in this population and other factors that potentially confound the diagnosis of IIH.

Patients and methods

A retrospective chart review of all children under the age of 21 referred to us based on suspected IIH and/or papilledema over 6 years from 2007 to 2013 was carried out. After appropriate Institutional Review Board (IRB) approval, patients were identified by appropriate International Classification of Diseases (ICD) 10 codes. Age, gender, weight, height, initial clinical appearance, imaging, lumbar puncture information, diagnosis, treatment, and clinical outcome after treatment were obtained from patient records. Patients were assessed by a pediatric ophthalmologist and a neurosurgeon.

Statistics on the significance between the two groups were calculated using a Student's *t* test. *p* values under 0.05 were considered statistically significant.

Results

Between January 2007 and January 2013, 92 children between the ages 3–21 were referred to us with an initial diagnosis of suspected IIH and/or papilledema. Due to an insufficient amount of information or inadequate follow-up, we exclude 40 patients who were referred only on suspicion of papilledema due to abnormal optic nerves. A total of 52 children (median 12 years of age) were included in this study. Initial clinical and ophthalmological appearance presented before referral is shown in Table 1. After further tertiary ophthalmological review, 26 diagnoses (50 % of patients) were revised. Details of investigations performed and related data are shown in Table 2. Twenty-six children were finally diagnosed with IIH, and the other 26 children with pseudopapilledema.

The mean body mass index (BMI) of the 26 children diagnosed with IIH was 31.01 kg/m^2. Complaints and symptoms included headaches and visual deficiencies, including blurred vision and reduced visual acuity (see Table 1). Among the children diagnosed with IIH, 92.3 % underwent lumbar

Table 1 Clinical and ophthalmological presentation and investigations before referral

	IIH	Pseudopapilledema
Headache	23	20
Visual loss	6	5
Visual deficit	16	13
Obesity	10	2
Medication	22	12
LP shunt	1	0
VP shunt	1	0
CT	8	9
MRI	23	19
USS	3	9
OND	1	8
LP	24	14

Initial clinical and ophthalmological appearance and investigations performed before ophthalmological referral is summarized in this table. A tertiary ophthalmological review can distinguish between pseudopapilledema and papilledema. Pseudopapilledema symptoms include anomalous surface vasculature, lack of obscuration of peripapillary vessels, and absent physiologic cup. Pseudopapilledema may be secondary to buried optic nerve drusen, which can be diagnosed by a B-scan ultrasonography of the optic nerve head

IIH idiopathic intracranial hypertension, *LP* lumboperitoneal shunt, *VP* ventriculoperitoneal shunt, *CT* computed tomography, *MRI* magnetic resonance imaging, *USS* ultrasound, *OND* optic nerve drusen, *LP* lumbar puncture

Table 2 Summary of data collected for children with IIH and pseudopapilledema

	IIH	Pseudopapilledema
Patients	26	26
Mean BMI	31.01 kg/m^2	22.78 kg/m^2
Mean LP CSF opening pressure	32.7 cm H_2O	24.7 cm H_2O
Range LP CSF opening pressure	19 to 60 cm H_2O	16 to 35 cm H_2O
Patients who underwent LP	24	14
Patients who had MRI	23	19
Patients who had CT	8	9
Patients on medication upon referral	22	12
Patients with papilledema	16	0
Patients with OND	0	9

Data from patients with IIH and patients with the revised diagnosis of pseudopapilledema is summarized in this table; 50 % of patients were misdiagnosed and had undergone unnecessary treatments or procedures

IIH idiopathic intracranial hypertension, *BMI* body mass index, *LP* lumbar puncture, *CSF* cerebrospinal fluid, *MRI* magnetic resonance imaging, *CT* computed tomography, *OND* optic nerve drusen

punctures (24 out of 26 children) to measure opening cerebrospinal fluid pressures, with a mean of 32.7 cm H_2O (range of 19–60 cm H_2O). Of the children diagnosed with IIH, 84.6 % (22 out of 26 children) was taking medication upon their initial diagnoses, including the carbonic anhydrase inhibitor Diamox (acetazolamide). Two patients (8 %) ultimately had ventriculoperitoneal shunts placed, and one patient (4 %) underwent optic nerve sheath fenestration.

Of the 52 children initially referred to us with suspected IIH, 26 children received revised diagnoses of pseudopapilledema (50 %) after further ophthalmological review at a tertiary care center. The mean BMI of the children with pseudopapilledema was 22.78 kg/m^2. Complaints and symptoms included headaches (20 out of 26 children) and visual deficiencies (18 out of 26 children; see Table 1). Among the children with pseudopapilledema, 53.8 % underwent lumbar punctures (14 out of 26 children) under the initial diagnoses of IIH, with a mean opening pressure of 24.7 cm H_2O (range of 16–35 cm H_2O); 73.1 % (19 out of 26 children) had a magnetic resonance imaging (MRI) done, and 34.6 % (9 out of 26 children) had a computed tomography (CT) done. Of the children diagnosed with pseudopapilledema, 46.1 % (12 out of 26 children) was taking medication under their misdiagnosis of IIH, including acetazolamide. Medications were discontinued when the diagnoses were revised. Through ophthalmological review, 34.6 % (9 out of 26 children) had a B-scan ultrasonography, which detected the presence of optical nerve drusen.

The difference in the CSF opening pressure between the children diagnosed with IIH (32.7 cm H_2O) and the children diagnosed with pseudopapilledema (24.7 cm H_2O) was statistically significant ($p<0.05$, Student's t test). The difference in the BMI between the two groups (31.01 kg/m^2 for those with IIH vs 22.78 kg/m^2 for those with pseudopapilledema) was also statistically significant ($p<0.05$, Student's t test).

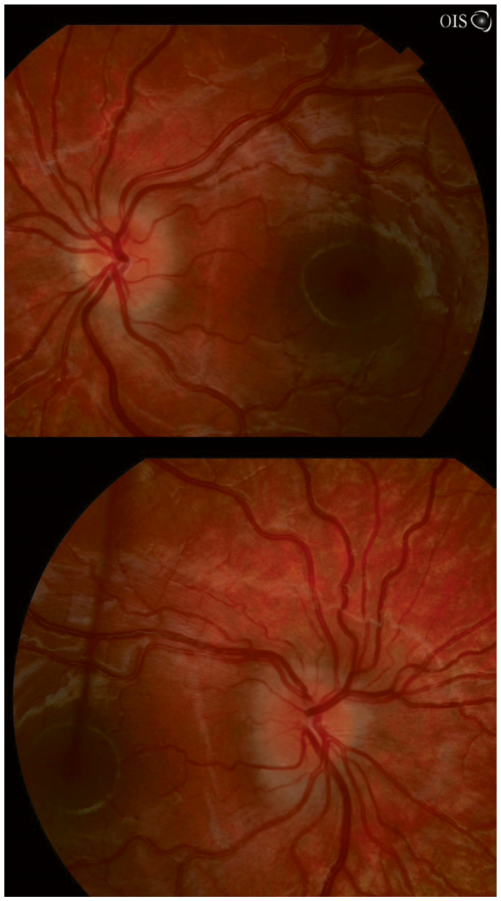

Fig. 1 RE and LE fundus photos of a 5-year-old girl with bilateral pseudopapilledema. Elevated optic disks with blurred margins, an absence of a central optic nerve cup, and anomalous emergence of retinal vessels from the center of the disk can be observed. No conspicuous buried optic nerve drusen are evident. Note the absence of signs of true papilledema

Discussion

Out of the 52 children, we saw with suspected IIH or papilledema over the 6-year period; about half (50.0 %) of the children were initially misdiagnosed with IIH. Our findings show that a tertiary ophthalmological review early in the process is important and can prevent unnecessary procedures and treatments.

Elevation of an optic disk may be papilledema (disk edema due to raised intracranial pressure (ICP) or pseudopapilledema). Papilledema is the swelling of the optic disk secondary to elevated intracranial pressure and is often associated with IIH. Pseudopapilledema is an anomalous elevation of the optic disk, and pseudopapilledema may be associated with optic nerve drusen, which are collections of mucoprotein visible as round excrescences within the optic disk. Figure 1 shows fundus photos of bilateral pseudopapilledema, without true papilledema. Patients were diagnosed with pseudopapilledema if there were anomalous surface vasculature, a lack of obscuration of peripapillary vessels, and absent physiologic cup. In addition, we found that 34.6 % of the children we saw who were misdiagnosed (9 out of 26 children) had pseudopapilledema secondary to optic nerve drusen (OND). Buried drusen can be particularly difficult to note, as the drusen may not be visible on the surface of the optic disk. In such circumstances, we suggest a thorough examination of the optic disk. A B-scan ultrasonography of the optic nerve head, a simple office-based test performed by an ophthalmologist, will aid in the diagnosis of OND and demonstrate the calcified drusen [4, 5].

Rarely, patients with OND develop visual field defects due to optic nerve drusen, especially in the second decade of life [2]. Visual acuity is not affected [6]. However, visual obscurations and visual loss due to optic atrophy does occur in patients with severe, chronic papilledema.

Expert ophthalmological review early on can avoid invasive lumbar puncture procedures involving pressure measurements. Diagnosis of IIH typically includes measuring the opening CSF pressure. Of the children we saw who were incorrectly diagnosed, 53.8 % underwent unnecessary lumbar punctures to measure the CSF opening pressure. Most were carried out under local anesthesia, but a number required sedation, thus exposing them to added potential risks. Furthermore, diagnosing based on the lumbar CSF opening pressure is not always reliable. This measurement can be affected by many factors, including age, posture, distress, current medications, or effects of anesthesia [7]. Ellis et al. found a 10 to 28 cm H_2O range in the CSF opening pressure in flexed lateral decubitus position in children [8]. Our findings show that the opening pressures in the group diagnosed without IIH were statistically lower than the opening pressures in the group diagnosed with IIH.

Imaging techniques are also important in the diagnosing process. B-scan ultrasonography can detect optic nerve drusen. High-resolution MRI can aid in the diagnosis of IIH. By definition, patients with IIH will have normal cranial imaging [1]. Of the children diagnosed with IIH, 95.7 % who had MRI (22 out of 23 children) resulted in a normal, unremarkable MRI. MRI and venography can be important in excluding other causes.

Our study has limitations. Our study is a single-center, retrospective before/after study, and our patients were not randomized. Other factors besides those we collected may have changed over time or affected our evaluation of the before and after periods.

At a minimum, we want to raise awareness of the difficulty and complexity of correctly diagnosing IIH. This study shows a significant number of children who were misdiagnosed and thus underwent unnecessary investigations and treatments.

Conclusion

Correct diagnosis of IIH can be complicated and difficult. We suggest a careful examination of the optic disk by an experienced ophthalmologist to prevent further unnecessary investigation and treatment. Close communication between pediatricians and ophthalmologists can help avoid invasive procedures for children who have pseudopapilledema and do not have IIH or true papilledema.

Statements An IRB application was submitted and approved; patients were identified by appropriate ICD 10 codes.

Conflict of interest The authors declare that they have no conflict of interest.

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