

Yield and clinical efficacy of funduscopic examinations performed in the pediatric emergency room

Anat Segev-Becker · Miki Har-Gil · Pinhas Fainmesser · Ehud L. Assia · Nathan Watemala

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Abstract Consultations by ophthalmologists to rule out papilledema are frequently requested by emergency room (ER) physicians. The clinical setting and optimal timing for examination are not well established, and the impact on patient management is unclear. We evaluated the yield of emergency funduscopic examinations, aiming at establishing the optimal timing and efficacy of the consultation. The medical records of all children aged 0–18 years referred for funduscopic examinations from the ER between June 2010 and May 2011 were reviewed. Of 19,772 ER visits, 1,920 (9.7 %) were seen by an ophthalmologist and 479 (2.4 %) to rule out papilledema. Headache (44.5 %) and head trauma (18.4 %) were the most common indications. Sixty percent of the 479 patients had been symptomatic for <24 h, all having normal eye exams. Only 6/479, with diverse etiologies, depicted papilledema. Among these six children, visual complaints associating with headache were statistically significant to suggest the presence of papilledema ($p=0.014$). Seventy-one

of the 479 children underwent neuroimaging studies despite normal funduscopic examinations. A single tumor case (medulloblastoma), symptomatic for weeks, had normal funduscopy. Conclusion: The vast majority of ER consultations to rule out papilledema show normal findings, particularly among children with signs and symptoms lasting for <24 h. The yield of funduscopy may be higher if visual disturbances are reported. If neuroimaging studies are considered, emergency room ophthalmological consultation is probably not warranted, except for young infants with neurological signs and symptoms in whom retinal hemorrhages suggestive of physical abuse must be ruled out.

Keywords Funduscopy · Children · Emergency department · Yield

Abbreviations

BIH	Benign intracranial hypertension
CNS	Central nervous system
ER	Emergency room
ICP	Intracranial pressure
LP	Lumbar puncture

Introduction

Papilledema (optic disc swelling) may be a manifestation of increased intracranial pressure (ICP) and is believed to develop within hours to several days from the onset of the disease [1, 10, 16, 17]. Nevertheless, this finding is not always present, and its absence may mislead the physician caring for a child with an intracranial lesion [1, 17]. In Israel, it is a common practice to refer children with a suspicion of increased ICP for an emergency room ophthalmological evaluation to evaluate for possible optic disc swelling. These

A. Segev-Becker
Pediatrics Department, Meir Medical Center, Tel Aviv University,
Kfar Saba, Israel

M. Har-Gil · N. Watemala
Child Development Center and Child Neurology Unit, Meir Medical
Center, Tel Aviv University, Kfar Saba, Israel

P. Fainmesser
Pediatric Emergency Department, Meir Medical Center, Tel Aviv
University, Kfar Saba, Israel

E. L. Assia
Ophthalmology Department, Meir Medical Center, Tel Aviv
University, Kfar Saba, Israel

N. Watemala (✉)
Child Development Center, Meir Medical Center, Tel Aviv
University, 59 Tchemichovsky St, Kfar Saba 44281, Israel
e-mail: nathan.watemala@clalit.org.il

patients are initially assessed by an ER physician prior to obtaining the ophthalmological consultation. ER physicians, in turn, are a major source of ophthalmological consultations on patients with different conditions, namely headache, head trauma, convulsions, and in some cases prior to obtaining a lumbar puncture (LP). It is the impression of the authors that many of these ophthalmological consultations are not clinically justified, particularly in cases that have been symptomatic for a short period of time. This practice represents a significant burden for the health system, both in terms of work load and expenses.

To the best of our knowledge, there are no reports on the clinical contribution of emergency room ophthalmological consultations referred by ER physicians to rule out papilledema in children with acute-onset neurological signs and symptoms. A major, unanswered question pertains to the timing of appearance of pediatric papilledema in relation to the onset of increased ICP. A few series on adult patients suggest that several days may elapse before papilledema is detected [6]. A study on 37 adult patients with acute intracranial bleeding showed that papilledema was not present for at least 72 h from the time of the insult [13]. Moreover, papilledema was detected in only 3.5 % of cases in a large series of adults with significant head trauma and not before 4 days from the time of injury [12].

The aim of our study was to evaluate the yield and impact on patient management of ER-initiated ophthalmological consultations to rule out papilledema in a large series of pediatric patients. We paid particular attention to those children referred for acute neurological insults/manifestations in an attempt to establish the optimal time for a funduscopic examination, as the scarce literature available suggests that papilledema may not appear until several days from onset of signs and symptoms.

Methods

This study was approved by Meir Medical Center's Internal Review Board. The medical records of all children aged 0–18 years who were referred by ER physicians to evaluate for possible optic disc swelling between June 2010 and July 2011 were reviewed. Patients referred for acute eye trauma or infection and those with a former diagnosis of papilledema or increased ICP were excluded. Information obtained from the records included demographic data, reason for ER visit/community physician referral, type and duration of symptoms, associated (secondary) complaints, prior medical history, family history of neurological conditions, and physical and neurological findings.

The decision whether to refer a child for ophthalmology consultation was made by the pediatric resident with the consent of the senior pediatrician on duty. Regarding the ophthalmological consultation, patients were classified as

having normal or abnormal findings. All children were initially evaluated by a senior ophthalmology resident with experience in pediatric eye exams and, if optic disc edema was found or suspected, an attending ophthalmologist and/or a neuro-ophthalmologist examined the patient too. If abnormal, funduscopic results were recorded as papilledema, other retinal finding, normal variant (determined later by the neuro-ophthalmologist), and mixed findings. Neuroimaging studies, if obtained, were also noted, including study type and whether it yielded normal or abnormal findings. If abnormal, we sought clinical correlation with patient signs and symptoms. Finally, we recorded whether the patient was admitted based on the ophthalmological and/or neuroimaging findings, which diagnostic tests/procedures were performed during hospitalization, and the final diagnosis regarding the existence and the etiology of papilledema.

Statistical analysis Data was described as numbers and percentage for nominal variables and as mean values for continuous parameters. Comparisons for age between two groups were performed using unpaired *T* tests; for categorical variables, chi-square and Fisher exact test were utilized, each when appropriate. Results were considered significant when $p < 0.05$. All statistical analyses were performed using SPSS software (version 21.0.0, SPSS Inc. Chicago, IL, USA).

Results

During the year covered by our study, 19,772 children were seen in the ER. Of these, 1,920 (9.7 %) were referred by the ER physician for ophthalmological consultation, including 479 (2.4 %) to rule out papilledema. Sex distribution was similar (53 % males); mean patient age was 9.2 years (median 9 years).

Headache (44.5 % of 479 patients) represented the most common reason for ER visit, followed by head trauma (18.4 %), convulsion (10.2 %), and syncope and vomiting (5 % each). Three hundred seven of the 479 patients reported associated signs and symptoms, mostly vomiting in 153 (see Table 1). Sixty percent had been symptomatic for less than 24 h. Of these, 37 % for less than 6 h, 22 % for 6–24 h, and 16 % for 24–48 h.

Funduscopic examination by an ophthalmologist was successfully performed either by the senior ophthalmology resident of the senior (attending) ophthalmologist. The examination was normal in 96.5 % of the 479 children. Among the 17 patients with an initially abnormal result, papilledema was eventually confirmed in only six (1.2 % of all examinations): four had benign intracranial hypertension (BIH) (one asymptomatic), one had bacterial meningitis, and one child was lost to follow-up as his parents decided to obtain a second

Table 1 Clinical characteristics of 479 children referred for emergency ophthalmological consultation to rule out papilledema

Category	Total no.
Age	
0–5 years	144
5–10 years	110
10–15 years	121
>15 years	104
Gender	
Male	255
Female	224
Reason for referral to ER	
Headache	213
Head trauma	88
Seizure	49
Syncope	26
Vomiting	25
Other ¹	78
Duration of signs and symptoms	
<6 h	176
6–24 h	105
25–48 h	78
48–96 h	19
4 days–1 week	34
>1 week–1 month	32
>1 month–1 year	24
>1 year	6
Incidental finding/asympt.	5
Associated signs and symptoms	
None	172
Vomiting	153
Fever	96
Behavioral change	70
Visual disturbance	54
Headache	57
Funduscopy exam results	
Normal	462
Abnormal	17
Papilledema	6/17
Retinal hemorrhage	2/17
Normal variant	9/17

ophthalmological opinion elsewhere. Among the remaining 11 children, nine received a final diagnosis of normal variant by a neuro-ophthalmologist and two had retinal hemorrhages attributed to non-accidental trauma (Table 2). None of the 462 (out of 479) children in whom optic disc swelling was initially ruled out was eventually diagnosed with papilledema (no false-negative cases). Follow-up information for five of the six true papilledema patients was available: the infant with meningitis was successfully treated and fully recovered. All

four children with BIH received a several week course of acetazolamide and their papilledema resolved. They were asymptomatic at follow-up visits 13–27 months later. Data on the patient whose parents opted for further care elsewhere are not available.

No primary symptom was shown to be statistically significant among the six children with proven papilledema. Nevertheless, among secondary signs and symptoms reported, blurred vision was significant ($p=0.014$). Moreover, none of the six patients had been symptomatic for less than 24 h. Two had complaints for 24–48 h (one with fever and vomiting eventually diagnosed with meningitis and one with headache and paresthesias with a final diagnosis of BIH). Three patients had been symptomatic for more than 4 days, and in one case, the optic disc swelling was incidentally found during a routine eye examination.

Neuroimaging studies were obtained in 71 of the 479 children, all of whom had normal funduscopy findings. The indications for the study were similar to those leading to ophthalmological consultation. Fifty-five percent had been symptomatic for less than 24 h, similarly to the proportion of patients sent for funduscopy with less than 1 day of complaints. Only one child among the 479 was diagnosed with a brain tumor (medulloblastoma); papilledema was absent in this case.

Discussion

Papilledema (optic disc swelling) is usually the consequence of increased intracranial pressure and is believed to develop within hours to weeks from the onset of disease [3]. Fear of missing an intracranial tumor as the cause of papilledema leads pediatric ER physicians to request emergency ophthalmological consultations in children with a variety of neurological symptoms, findings, and conditions. In fact, papilledema appears to be relatively uncommon at the time of diagnosis of a brain neoplasm. A recent meta-analysis of over 4,000 pediatric CNS tumors reported the presence of disc swelling in only 13 % of all patients, although specific tumor locations such as the posterior fossa depicted papilledema in up to one third of cases [16].

As a sign of sudden or acute-onset rise in ICP, papilledema may not be reliable. This has been demonstrated in cases of ventriculoperitoneal shunt failure in children in whom, although ICP rises quickly, papilledema is uncommonly seen at presentation [10]. As previously stated, in adult patients, papilledema seems to develop only after several days in cases of traumatic intracranial hemorrhage [13], although one series on both children and adults with severe head trauma, particularly among those with Glasgow Coma Scale 11–15 (severe CNS involvement), detected papilledema within hours of injury in all 11 cases that did not survive the injury [5]. In our patients, head trauma was the second most common

Table 2 Characteristics of the six papilledema cases

Patient	Age (years)	Reason for referral	Duration of signs and symptoms	Associated signs and symptoms	Final diagnosis
1	16.3	Headache	1 week	Vomiting and blurred vision	Benign intracranial hypertension
2	4.8	Community ophthalmology consult	Incidental finding		Benign intracranial hypertension asymptomatic
3	10.5	Visual disturbance	6 months	Blurred vision and behavioral change	Lost to follow-up
4	16.8	Headache	1 week	Blurred vision	Benign intracranial hypertension
5	5.6	Headache	2.5 days	Fever, vomiting, and behavioral change	Meningococcal meningitis
6	17.4	Headache	3 days	Vomiting and bilateral legs parenthesis	Benign intracranial hypertension

indication for a consultation. All cases had sustained minor head injury and none depicted papilledema.

In our series, acute and subacute headaches were the most common reason to obtain an ophthalmological consultation. Papilledema was absent in all children who had been symptomatic for less than 24 h, irrespective of the etiology of the ache. In fact, abrupt onset headaches in children are most commonly associated with extracranial or systemic conditions such as upper respiratory infection, sinusitis, and systemic infections or are related to chronic, nonlife-threatening neurological condition such as migraine [2]. Serious intracranial conditions in this setting are uncommon, and when present, usually are accompanied by other neurological manifestations besides headache [2, 7]. Hence, the need for an emergency ophthalmological consultation to rule out papilledema in a child with isolated acute headache and normal neurological examination is quite questionable.

Twenty-four of our patients were referred to the ophthalmologist prior to obtaining an LP. One infant was diagnosed with meningococcal meningitis. In this case, the LP was obtained during the second day of signs and symptoms, and papilledema was detected before the diagnostic procedure. Hence, the time of onset of papilledema could not be established. The risk for brain tissue herniation following the acute “decompression” presumably caused by the LP is a reason for concern, prompting many ER physicians to obtain a head CT scan prior to performing the puncture [11]. On the other hand, the need for an eye specialist evaluation before the test in these patients has not been addressed in the literature. Although ICP is probably increased in most cases of acute purulent meningitis, papilledema at the time of meningitis diagnosis is likely a rare occurrence. An emergency funduscopic examination before an LP should probably be reserved for children with acute neurological deterioration or neurological signs suggestive of an impending herniation [11].

In this study, neuroimaging studies, particularly CT scans were obtained in 71 of the 479 children. All of these patients were also referred for a funduscopic examination before the CT. Funduscopic examination was normal in all (slightly over half of the children had been symptomatic for less than 24 h),

including one single child with medulloblastoma. It appears that in situations where an acute raise in ICP is suspected and potentially serious etiologies must be ruled out, emergency ophthalmological consultations may not be necessary if neuroimaging studies are obtained.

Regarding individuals with benign intracranial hypertension, we found that complaints about blurred vision do increase the chances of detecting papilledema. Nevertheless, as BIH is indeed a benign condition, the ophthalmological consultation may be postponed until after a brain scan has ruled out the presence of a space-occupying lesion.

The purpose of our study was to assess the yield of ER ophthalmological consultations to uncover papilledema in a variety of clinical settings. Our study population did not include children referred for an eye examination due to other indications such as eye trauma or infection who are in obvious need of an emergency ophthalmological assessment. We focused our attention on papilledema, as this indication represents a significant percentage of ER ophthalmology consultations; hence, our pretrial impression that many of these referrals yield negative results. Indeed, given our findings, it appears that the practice of obtaining an emergency ophthalmology evaluation for possible optic disc edema may in some situations be unwarranted, particularly among children who have been symptomatic for less than 24 h.

Nevertheless, young infants with neurological signs and symptoms should probably always be referred for an ER eye examination to rule out retinal hemorrhage suggestive of shaken baby syndrome. Indeed, retinal hemorrhage is much more likely to be detected by ophthalmologists who have the benefit of performing the eye examination after pupils have been dilated [14]. Studies have shown that retinal hemorrhages are highly suggestive of non-accidental head injury in infants, as opposed to traumatic head injury cases in whom retinal hemorrhages (RH) are rare on admission [15]. Moreover, CT scans may be normal at the time of ER evaluation in some cases of shaken baby syndrome [9]. Therefore, obtaining an ophthalmological consultation is mandatory in infants presenting with sudden unexplained encephalopathy [8], seizures, or respiratory difficulties/apnea [4]. Among our

479 patients, we detected two infants with RH: a fully alert 5-week-old male brought by his parents after having reportedly fallen from his brother's arms (normal CT scan). A previous head injury, purportedly from another fall was also reported; the second patient was a 3-month-old female referred for seizures (CT showing subdural hematoma). The first of these two infants certainly emphasizes the need for a high index of suspicion inasmuch as the baby appeared alert on admission.

Conclusion

Based on the common practice of referring pediatric ER patients with a variety of neurological complaints for emergency ophthalmological evaluation to rule out papilledema, we assessed the yield of these consultations in detecting optic disc swelling, paying special attention to the duration of signs and symptoms prior to the ER visit. We found that the yield of these consultations was very low, and regardless of the reason for referral to the pediatric ER, no cases of papilledema were detected among children with signs and symptoms lasting for less than 24 h. Visual complaints, usually associated with benign intracranial hypertension, were statistically associated with papilledema. Among patients referred for CT scans, we noticed an excellent correlation between a normal scan and absence of papilledema, suggesting that if a CT scan is being considered in children without visual complaints, there may be no need for an emergency ophthalmological evaluation. Nevertheless, young infants with neurological signs and symptoms should probably always be referred for an ER eye examination to rule out retinal hemorrhage suggestive of shaken baby syndrome.

Conflict of interest The authors have no conflicts of interest.

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