Retinal hemorrhages in patients with epidural hematomas

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PURPOSE To present a series of infants found to have sparse retinal hemorrhages associated with isolated epidural hematomas. None of these infants had other intracranial or subdural hemorrhages present.

METHODS Children less than 3 years of age admitted to an urban children's hospital between January 1998 and December 2002 with radiographic evidence of an isolated epidural hematoma at the time of presentation were eligible for this study.

RESULTS During the time period of the study, 15 children were admitted with traumatic epidural hematomas. Nine patients had an ophthalmologic examination, of which five had evidence of sparse retinal hemorrhages. All five patients with retinal hemorrhages were less than 8 months of age and all required surgical evacuation of the epidural hematomas. Of the five patients with retinal hemorrhages, four were unilateral, one was bilateral, and in all cases, the retinal hemorrhages were superficial, few in number, and confined to the posterior pole. There were no deep retinal or subretinal hemorrhages present. The institutional child protection team evaluated all five patients with retinal hemorrhages and each case was felt to be consistent with the history provided and no history of shaking was elicited.

CONCLUSIONS We found sparse retinal hemorrhages in five of nine patients who presented to our hospital with isolated epidural hematomas and who had had an ophthalmologic examination. All nine patients were evaluated by the institutional child protection team, who did not feel that there was sufficient evidence to be suspicious of nonaccidental trauma. (J AAPOS 2008;12: 177-180)

Epidural hematomas are a relatively uncommon complication of childhood head injury.[1,2] It has been well established that epidural hematomas may occur after relatively minor head trauma, such as brief linear contact forces that commonly occur in unintentional falls.[1-3] Retinal hemorrhages in infants and young children are findings most commonly associated with inflicted head injury and the association of retinal hemorrhages and child abuse is well established.[4-17] Accidental head injury can cause retinal hemorrhages,[18,19] although they are usually few in number and confined to the posterior pole. The exact etiology and pathophysiology of retinal hemorrhages in both accidental and nonaccidental trauma is the subject of debate in both the medical and legal literature. The finding of retinal hemorrhages in patients with isolated epidural hematomas has not been previously reported. In this article we describe infants with epidural hematomas as a result of accidental head trauma with associated sparse retinal hemorrhages.

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Methods

The medical records of children under 3 years of age who were diagnosed with epidural hematomas and admitted to the Children's Hospital of Philadelphia between January 1998 and December 2002 were reviewed retrospectively. These patients were identified from medical record codes for extradural hemorrhage according to the International Classification of Disease Clinical Modification, 9th revision. Subjects were included that had radiographic evidence of an epidural hematomas due to trauma on presentation to the hospital. Subjects were excluded if the epidural hematoma was the result of an intracranial disease process or associated with complications of prematurity. Charts were reviewed for clinical and historical features on presentation. This information included demographic data, the reported mechanism of injury, presenting signs and symptoms, time to presentation, Glascow Coma Scale[20] on presentation, associated injuries, laboratory studies, and the intervention required. The results of ophthalmologic examination, when performed, were extracted from the ophthalmology consultation record. All ophthalmology examinations were performed after surgical drainage of epidural hematomas. The study was reviewed and approved by the hospital's institutional review board and was Health Insurance Portability and Accountability Act compliant as per hospital institutional review board policy.

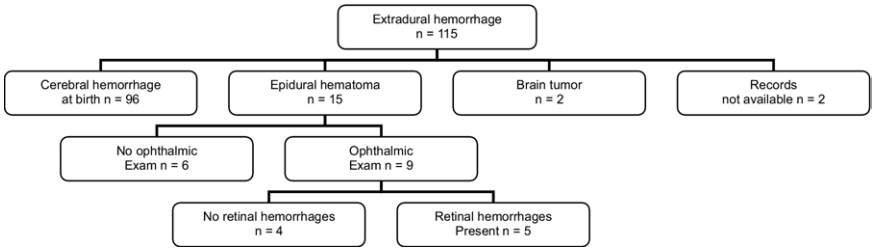

FIG 1. Summary of patients presenting with traumatic epidural hematomas.

Table 1. Group 1 patients with normal eye exams

Case	Age (months)	Mechanism	Time to presentation (hours)	GCS	Other injuries	Laboratory studies	Location of EDH	Surgical evacuation	Ophthalmic examination
1	6	Dropped onto linoleum floor	1	15	Soft tissue swelling, skull fracture	Normal coags	Left parietal	No	Normal
2	9	Fall with mother onto concrete	4	3	Soft tissue swelling	PT 27. PTT 160. Fibrinogen 41	Left parietal	Yes	Gaze preference
10	22	4ft fall onto concrete	2	15	Skull fracture	Normal	Left parietal	Yes (100cc)	Normal
13	7	Fall down stairs	6	15	Soft tissue swelling	Normal	Left parietal	Yes (150cc)	Normal

GCS, Glasgow Coma Scale[20]; *PT*, prothrombin time; *PTT*, partial thromboplastin time; *EDH*, epidural hematomas.

Results

A total of 115 patients with extradural hemorrhage were identified during the study period. Ninety-six patients had cerebral hemorrhage at birth and were excluded. Two patients who had brain tumors and associated epidural hematomas were excluded. Records were not available on two patients. Fifteen patients with traumatic epidural hematomas were identified and their ages ranged from 4 to 22 months. Of the 15 patients with epidural hematomas, 9 had dilated ophthalmologic examinations performed by staff ophthalmologists and the 6 remaining patients were excluded from further study. Four patients were found to have normal retinal examinations (group 1) and five patients were found to have retinal hemorrhages (group 2) (Figure 1). In group 1, the average age was 11 months (range, 6-22 months). In group 2, the average age was 6.2 months (range, 4-7 months).

The ophthalmologic examination findings included are outlined in Tables 1 and 2. The reported mechanism of injury was similar between the two groups with a history of a fall and linear contact force offered in each case. The time from presentation to medical care ranged from 1 to 6 hours in group 1 and from 2 to 12 hours in group 2. Group 2 had a lower mean Glascow Coma Scale[20] score on presentation (mean Glascow Coma Scale score, 8.2; range, 3-13) than group 1 (mean Glascow Coma Scale score, 12; range, 3-15). Peak systolic blood pressure measurements in group 1 ranged from 105 to 135 mm Hg and from 116 to 153 mm Hg in group 2.

Laboratory studies for coagulation abnormalities were obtained in all nine children who had ophthalmologic examination. One patient in group 1 had disseminated intravascular coagulation with prothrombin time of 27 seconds, partial thromboplastin time of 160 seconds, and fibrinogen of 41 mg/dl (normal, 172-471). The remainder of group 1 had normal coagulation studies. In group 2, one patient had mild disseminated intravascular coagulation (prothrombin time 14.4 seconds; partial thromboplastin time 60.2 seconds; fibrinogen, 71 mg/dl) and one patient had a slightly elevated prothrombin time at 15 seconds. The remainder of group 2 had normal coagulation studies. Of note, the location of the epidural hematoma was left parietal in all four patients in group 1 and was right parietal in four of five of patients in group 2. The institutional child protection team evaluated all five children with retinal hemorrhages and two of the four patients with normal eye examinations and in all cases the injury was deemed consistent with the history provided and no history of shaking was elicited.

Discussion

Retinal hemorrhages are an uncommon finding after unintentional pediatric trauma, but frequent in infants and young children who have sustained inflicted childhood neurotrauma or shaken baby syndrome.[4-19] The literature reviewing childhood epidural hematomas has reported that the trauma is usually the result of falls of less than 1 m.[1,2] A limited number of studies have reported ophthalmologic examination findings in patients with epidural hematomas,[4] none of which have reported retinal hemorrhages on ophthalmologic examination. This report is the first to note an association of retinal hemorrhages and isolated epidural hematomas in young children although all retinal hemorrhages found in these patients were superficial, few in number, and confined to the posterior pole, and no deep retinal or subretinal hemorrhages were

Table 2. Group 2 patients with retinal hemorrhages present

Case	Age (mo)	Mechanism	Time to presentation (hours)	GCS	Other injuries	Laboratory studies	Location of EDH	Surgical evacuation	Ophthalmic examination
5	7	Fall down steps in walker	12	5	Left parietal skull fracture	Normal	Left frontal	Yes	Intraretinal peripapillary hemorrhage OU
11	6	Fall off couch onto hardwood floor	5	7	Soft-tissue swelling	Normal	Right parietal	Yes	Single intraretinal hemorrhage OD
12	7	Dropped by sister	2	3	Soft-tissue swelling, temporal skull fracture	PT 14.4 PTT 60.2 Fibrinogen 71	Right parietal	Yes (150 ml)	Multiple (6-8) intraretinal white centered hemorrhages OD
14	7	Hit head on counter	5	13	Soft-tissue swelling, right ear bruise	PT 15.0 (11.1-13) PTT 31.4 (25-37.5)	Right parietal	Yes	Isolated preretinal hemorrhage and 4 intraretinal hemorrhages OD
15	4	Fall from bed to tile floor	9	13	Soft-tissue swelling, skull fracture	Normal	Right parietal	Yes	Isolated preretinal hemorrhage OS

GCS, Glasgow Coma Scale[20]; *PT*, prothrombin time; *PTT*, partial thromboplastin time; *OU*, both eyes; *OD*, right eye; *OS*, left eye; *EDH*, epidural hematomas.

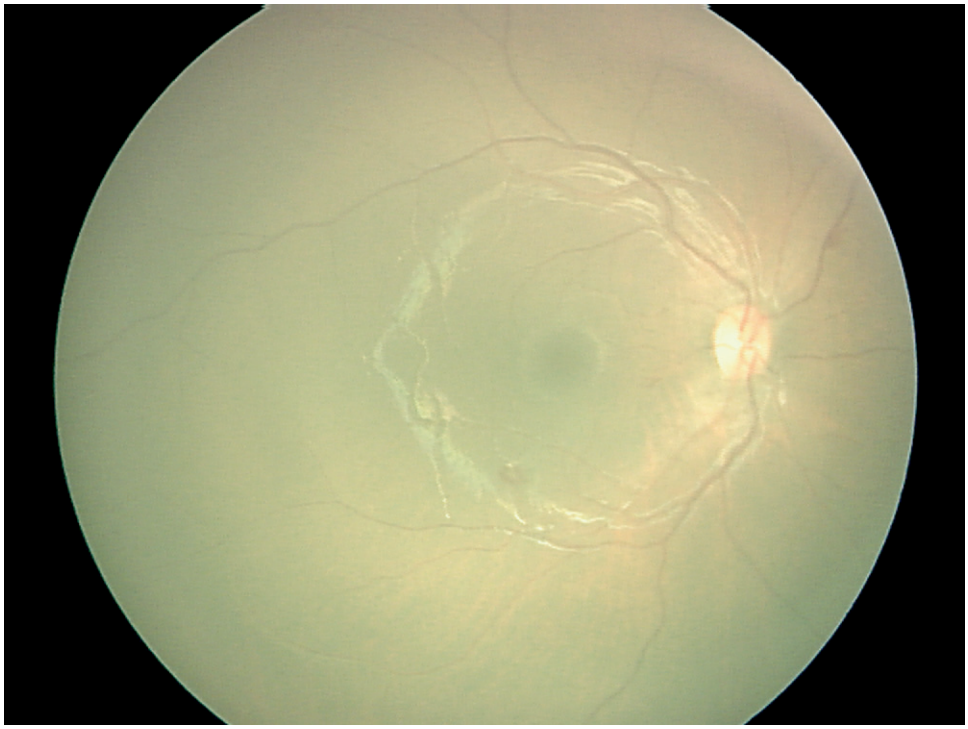

FIG 2. Fundus photograph of Patient 2, group 2, showing solitary intraretinal hemorrhage along the inferior arcade. The other fundus was normal.

noted in contrast to the severity of retinal hemorrhages commonly seen in shaken baby syndrome (Figure 2).

The pathophysiology of retinal hemorrhages in accidental and nonaccidental trauma continues to be debated in the literature and it is likely that there are multiple contributions to their etiology. Many theories as to the cause of retinal hemorrhages in shaken baby syndrome have been suggested.[21,22] These theories include increased venous pressure, with sudden rise of intracranial pressure, with passage of blood through the intracranial subarachinoid space. Another theory postulates that increased intracranial pressure due to cerebral edema and compressive subdural hemorrhage causes increased venous pressure and resultant obstruction in the retinal vasculature with rupture as the source of retinal hemorrhages. Sudden increases in chest or head pressure have been

hypothesized to be contributing factors as well. The body of literature suggests that it is the shaking itself, with resultant repetitive acceleration-deceleration forces that induce shearing forces at the vitreo-retinal interface, which is the primary factor in the generation of retinal hemorrhages seen in shaken baby syndrome. When a child is shaken, the vitreous is also shaken, which would cause shearing forces to be applied to the retina at points of firm attachment, which include the macula, retinal vessels, and peripheral retina.

There are a number of limitations of this study. We conducted a retrospective review of charts and therefore had no control over whether children had an ophthalmologic examination done as part of their care and in fact only 60% of the patients had a dilated ophthalmologic examination. In addition, because traumatic epidural hematoma is an uncommon injury in infants and toddlers, only a small number of patients were included in the review. Another possible limitation is that all of the ophthalmologic examinations were done after surgical evacuation of the epidural hematoma. It is possible that rapid changes in intracranial pressure may contribute to the development of retinal hemorrhages either at the time of the trauma or at the time of surgical decompression.

Because the traumatic forces associated with epidural hematoma are generally low, it is probably not the trauma itself that causes the retinal hemorrhage but rather a rapid change in intracranial pressure associated with epidural bleeding that leads to the development of retinal hemorrhages as retinal hemorrhages are generally not associated with mild accidental head trauma.[19]

Literature Search

A MEDLINE search covering the years 1902 to 2007 was done using the terms *retinal hemorraghes* and *epidural hematomas*.

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