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The Eyes of Child Abuse Victims: Autopsy Findings

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ABSTRACT: The authors studied 77 pairs of eyes removed from children who had died of suspected child abuse. Forty-seven of the cases had retinal hemorrhages. Those showing retinal hemorrhages were younger children and had fewer other stigmata of child abuse. Hemorrhages are more likely to occur in cases where the child was shaken or swung than in those with severe direct head trauma. The authors recommend that examination of the eyes be included in the autopsies of all small children who died without an obvious cause of death. Experience in both processing and reading of ocular material is necessary for reliable results.

KEYWORDS: pathology and biology, child abuse, eyes, hemorrhage

Since child abuse was first recognized as a common pediatric problem, many types of injuries have been reported, and the eyes are often involved. Friendly [1] and Jensen et al. [2] found the incidence of eye involvement to be approximately 40% in children hospitalized for child abuse. The identification of child abuse injuries is increasingly important, not only in the United States, but also in England, France, Germany, and Japan.

Present-day training of emergency medical personnel has led most to be conscious of child abuse and to look for the classic signs of old fractures, bruises, and other visible injuries of varying age. A major problem in recognition of cases of "the shaken baby" type of abuse is the lack of these common signs of external injury. In 1974, Caffey [3] associated shaking-type abuse with a particular kind of ocular injury, involving retinal hemorrhages. A number of studies have been done since that time on these retinal hemorrhages, relating them to a "whiplash" type of injury.

These injuries can be very serious, although not as often fatal as direct head injuries. Jacobi [4] found that 22 shaken babies had a mean age of 6 months. Three died after injury, and others were found to have epilepsy, retardation, and visual loss, including blindness. Of 19 other children showing skull impact injuries, the mean age was 13 months. There was major brain damage and 10 died immediately.

The majority of the reports of shaken infants have been of single or small numbers of

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cases which were seen clinically and found to have retinal hemorrhages. Rao et al. [5] studied 14 sets of eyes in child abuse autopsies. We have continued and added to this previous study.

Materials

At the Los Angeles Chief Medical Examiner-Coroner's office, most cases of infants and small children have the eyes removed at autopsy and referred to the pathology laboratory at the Doheny Eye Institute in Los Angeles. In the period 1984-1989, over 180 sets of eyes were studied. (These include some of the same 14 eyes that Rao et al. [5] reviewed.) Both eyes were taken in all cases. The specimens were formalin fixed, imbedded in paraffin, cut horizontally, and stained with hematoxylin and eosin and Prussian blue stain for iron.

Findings

Seventy-seven cases were identified with either retinal hemorrhages or a history or findings suggestive of child abuse. Forty-seven of these cases had retinal hemorrhages. The retinal hemorrhages varied from massive bleeding, involving all layers and almost the entire retina (Fig. 1), to those showing only a few blood cells in one or two areas of the retina in only one layer (Fig. 2). In the cases with severe hemorrhage, the hemorrhages are obvious in the gross specimen as well as in microscopic sections (Fig. 3). In only one case was iron staining found in the retina and here no fresh hemorrhages were seen.

Four of the cases with retinal hemorrhage did not have an adequate optic nerve section included, but 39 of the other 43 showed subdural hemorrhage in the optic nerve (Fig. 4).

The cases were analyzed for sex and racial distribution (Tables 1 and 2). There were slightly more males than females and the racial distribution shows the largest number to

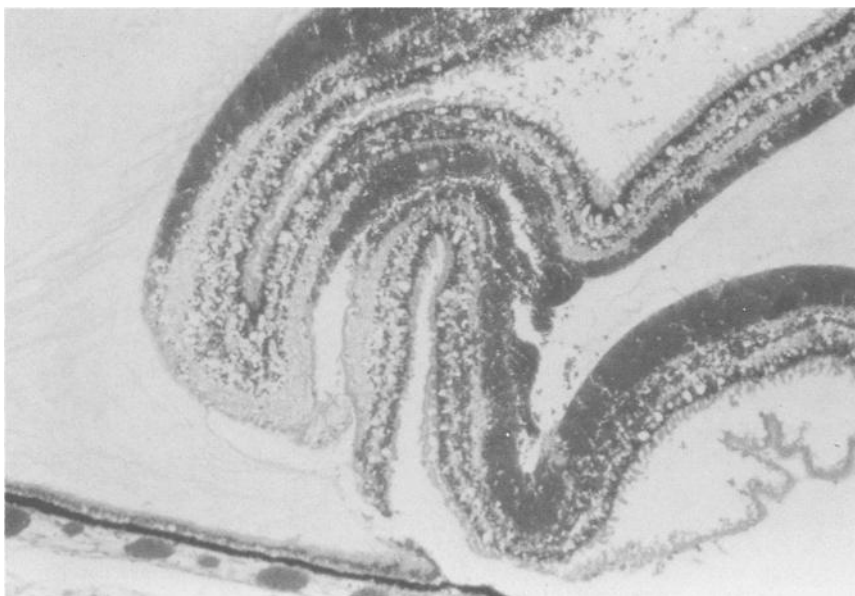


FIG. 1—Massive retinal bleeding, involving all layers of the retina.

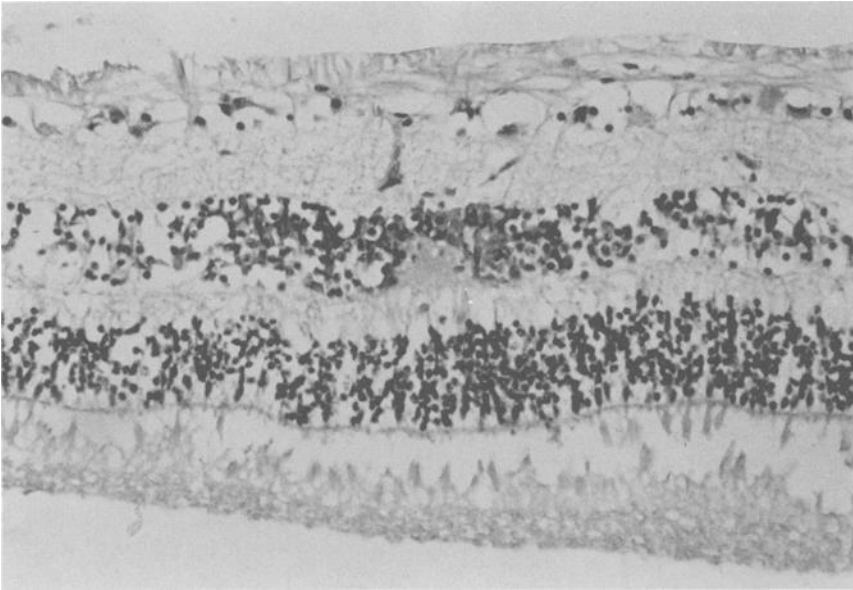


FIG. 2—Occasional, scattered hemorrhages in the retina.

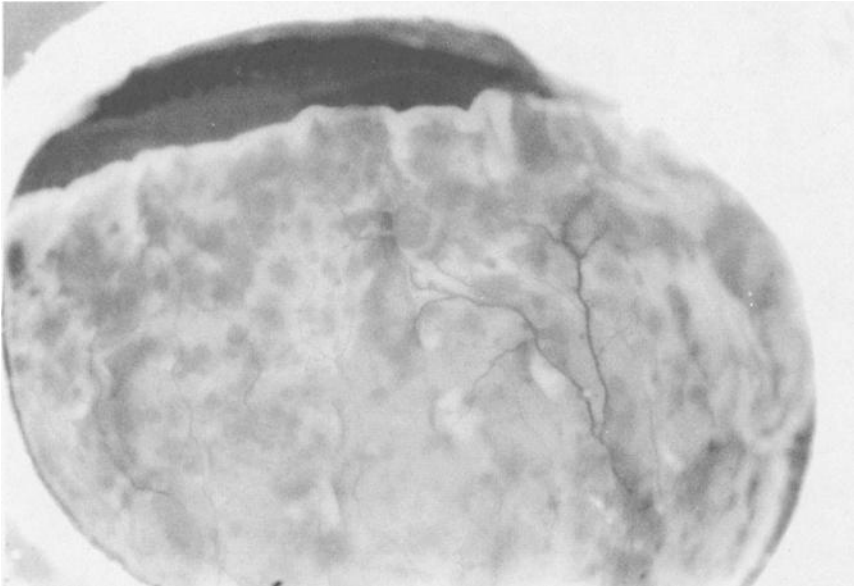


FIG. 3—Hemorrhage in a gross specimen.

be Caucasian, with nearly as many blacks, fewer Hispanics, and a marked underrepresentation of Orientals.

The age distribution (Table 3) shows that those children under age one year had a much higher incidence of hemorrhage than did older children.

All cases without retinal hemorrhage showed a history or autopsy findings suggestive of child abuse, as this was the criterion on which they were chosen. Of the cases with

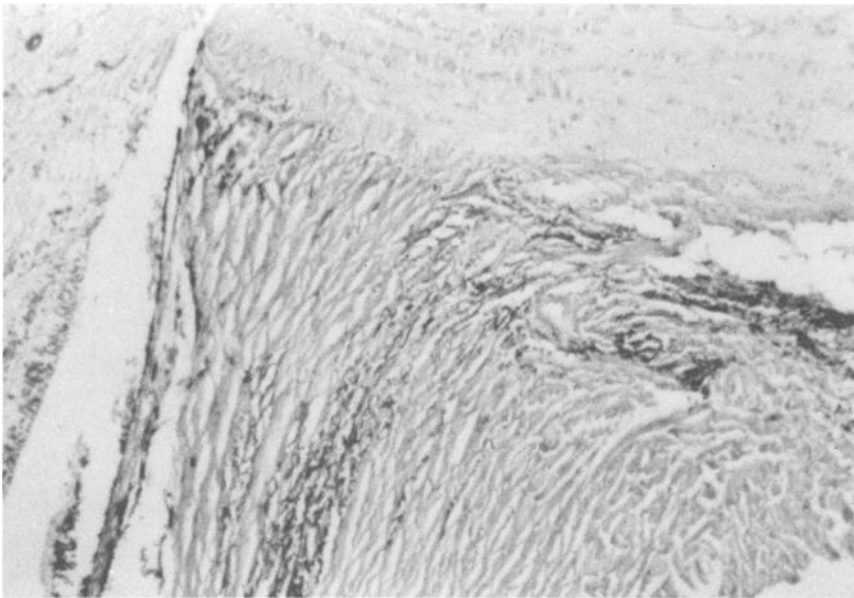


FIG. 4—Subdural hemorrhage in the optic nerve.

TABLE 1—Racial distribution of victims.

	With Hemorrhage	Without Hemorrhage
Black	18	10
Caucasian	18	15
Hispanic	10	5
Oriental	1	0

TABLE 2—Sex distribution of victims.

	With Hemorrhage	Without Hemorrhage
Male	27	15
Female	20	15

TABLE 3—Age distribution of victims.

	With Hemorrhage	Without Hemorrhage
Under 1 year	29	8
1 to 2 years	8	11
2+ years	10	11

retinal hemorrhage, 11 had a history of being shaken and 10 had histories consistent with head trauma, such as falling off a bed. It is often difficult to determine the cause of injury in suspected child abuse cases as the history is frequently unreliable.

Of the 47 cases with hemorrhage, only 23 (or 47%) showed external physical findings suggestive of child abuse. Of the 30 nonhemorrhagic cases, 25 (or 83%) showed evidence of such trauma. While these were selected by history or autopsy evidence of abuse, the marked difference still shows that the shaken child is less likely to have obvious evidence of abuse when seen by health workers.

Only 3 of the retinal hemorrhage cases had a definite history of causation not consistent with abuse. One was in an auto accident with severe head trauma, one died one week after a difficult forceps delivery, and the third had respiratory failure followed by resuscitation attempts with damaging chest compression.

There were many causes of death in those cases of our total series which were not included in the study, but the most common by far was sudden infant death syndrome (SIDS), with 40 cases. No SIDS case showed retinal hemorrhage or any other similar abnormality.

The individual responsible for the abuse is very difficult to determine as fear of prosecution leads to poor histories and denials, but adequate evidence was found in 17 of the 77 cases. Of these, the father was the abuser in 5, the mother in 4, a sitter in 2, the stepfather or mother's boyfriend in 3, and another relative in 3.

Discussion

Jacobi [4] has suggested that retinal bleeding follows subarachnoid bleeding due to shearing of bridging veins. Duhaine et al. [6] did testing with accelerometers and felt that shaking does not produce the angular acceleration required for this injury in the absence of impact. Gilkes and Mann [7] suggested two possible causes for the retinal hemorrhages. First, an acute rise in intracranial pressure may result in intracranial and retinal hemorrhages. The term "Terson's syndrome" [8], originally used for spontaneous occurrence, has been applied to other causes of this relationship. Second, hemorrhage might be due to a sudden rise in intrathoracic pressure from gripping the chest in shaking, producing the retinopathy first described by Purtscher (see Marr and Marr [9]). Evidence of retinal hemorrhage being caused by indirect force, probably leading to increased intrathoracic and intravascular pressure, was found in the experiments done by the U.S. Air Force with rocket-propelled sleds and also in supersonic escapes from aircraft [10]. Rao et al. [5] feel that hemorrhage is related to concussion. Concussion, however, is not always related to impact to the head itself. Whiplash injury may produce concussion by the wave of force being transmitted through the facial bones and orbit to produce an impact on the globe. The retina is particularly vulnerable as it impacts against the overlying choroid and sclera. Thus, there are several theories on the mechanism of the bleeding in cases of shaken infants.

The incidence of retinal hemorrhage in all child abuse cases decreases with advancing age. It is tempting to say that this is due to the increased strength of the child, particularly the neck muscles which could absorb the whip effect. It also may be simply that the older child is more difficult to shake and, therefore, he is more prone to actual impact injury. His bleeding is more likely to be associated with a skull fracture type of injury.

The fact that these injuries are more frequent in younger children also make the subjects less likely to have a history of previous child abuse or evidence of previous injuries. Thus it is possible that many cases are overlooked in the absence of retinal examination and CT scans for the intracranial hemorrhages associated with those in the eye.

In view of the difficulty in identifying these cases, it is important that the eyes be studied in all suspicious deaths. The lack of other injuries and signs suggesting child

abuse may lead to such cases being certified as SIDS. In comparing the history with the autopsy findings in our child abuse cases, a history suggestive of SIDS is common, as is one of falling from the bed or chair. Many of these cases have autopsy findings of healed fractures, ruptured spleens, anal or vaginal tears, multiple bruises, and three were noted to have human bite marks.

The eyes should be included in the autopsy examination of any unexplained death in childhood. Retinal hemorrhage is a very strong indication of shaking or head injury or both. These can be due to unintentional injuries, but retinal hemorrhage almost surely rules out the diagnosis of SIDS and is an indication for further investigation of the circumstances of death. Eisenbrey [11] has gone so far as to state that unexplained retinal hemorrhages in children under three without external evidence of head injury should be considered diagnostic of child abuse until proven otherwise.

Since some of the cases show only a very occasional small hemorrhage, adequate material is essential. Sectioning of the globes requires familiarity with ocular specimens. It takes an experienced technician to make a slide which can be read adequately, as ocular sections are easily collapsed or folded. A pathologist with experience in ocular pathology is needed to provide a reliable interpretation. If a coroner's laboratory does not have the necessary facilities, it is usually possible to make arrangements for the ophthalmic pathology laboratory at a nearby medical school to process questionable specimens.

Ludwig and Warman [12] and Greenwald [13] have emphasized the occurrence of the "shaken baby" syndrome in cases where the baby was shaken to produce respiration during a period of apnea. Kanter [14] confirmed this but found only one case with retinal hemorrhages in 45 children who had been resuscitated. Weedn et al. [15] have summarized the possible mechanisms in such cases. This points up the need for careful evaluation before a diagnosis of child abuse is made.

Summary

A series of 77 cases involving suspicion of child abuse or retinal hemorrhages or both has been reviewed. Retinal hemorrhage is most frequently found in younger infants who do not have the stigmata of child abuse.

It is thus extremely important to examine the eyes pathologically in inadequately explained childhood deaths. Retinal hemorrhage is an indicator of trauma, most commonly due to child abuse. Laboratory experience with ocular specimens is necessary for the most reliable evaluations. The factor of shaking in resuscitation attempts must be ruled out.

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