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Retinal Hemorrhage in an Infant After Cardiopulmonary Resuscitation

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Unexplained retinal hemorrhages in infants are usually indicative of child abuse. We present the case of an infant with retinal hemorrhages following cardiopulmonary resuscitation, who had not been abused. Cardiopulmonary resuscitation should be added to the list of causes of retinal hemorrhages in infants and children.
Key Words: Cardiopulmonary resuscitation—Child abuse—Retinal hemorrhage.

Ocular damage occurs frequently in battered children, with retinal hemorrhage being the most common ocular finding (1). Unexplained retinal hemorrhage in children, with or without fractures, has been considered to be strongly indicative of child abuse (2). Cardiopulmonary resuscitation has not been widely recognized or accepted as a cause of retinal hemorrhage (3). We present a case with retinal hemorrhage following cardiopulmonary resuscitation in an infant who had not been abused.

CASE REPORT

The patient was a 4-month-old Vietnamese infant boy who had suffered scalding water burns to his face, neck, hands, and back. The hot-water faucet had been turned on by a 2-year-old sibling while the mother was answering the telephone at the other end of their trailer. The water heater had been off for some time, but that morning the father had restarted the heater at a temperature setting of 160°F (71.2°C). The baby was brought to a local emergency room with second-degree burns, primarily of the head and neck, involving 15% of his total body surface area. He was crying and was not in respiratory distress. He received Demerol and i.v. fluids. After the first hour, ~12 ml of urine was produced. The baby was transferred by Life Flight to the Shriners Burns Institute in Galveston, Texas. The Life Flight nurse noted that the baby had an inflamed edematous oral airway with sloughing of the mucosa of the uvula. He was intubated with difficulty.

On arrival at the Shriners Burns Institute, he was in a critical condition; he was intubated and placed on 40% oxygen. He had cyanotic extremities and his vital signs were: temperature, 38.4°C; pulse, 240 beats/min, and blood pressure, 100/52 mm Hg. He then sustained a cardiac arrest. Sinus rhythm recovered after several rounds of cardiopulmonary resus-

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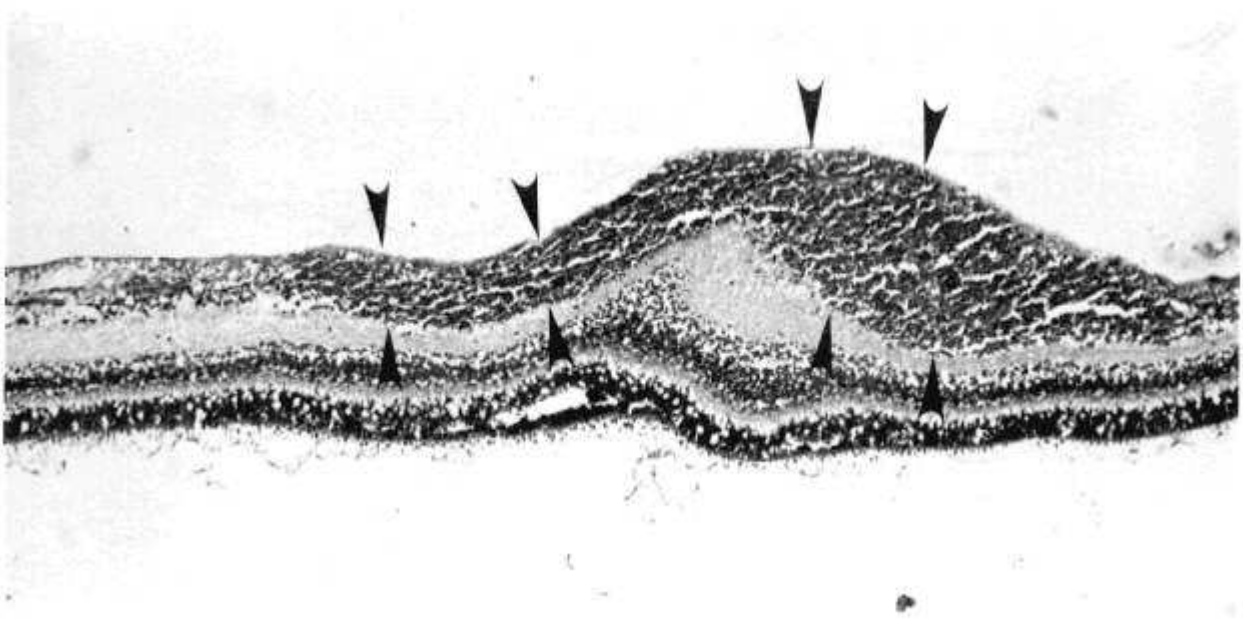

FIG. 1. The retina at the equator shows superficial hemorrhage covering the nerve fiber layer (arrowheads).

citation with the administration of bicarbonate, epinephrine, and atropine. By the second day, his blood pressure had fallen despite the administration of dopamine. Metabolic acidosis increased and was accompanied by bradycardia and labored breathing. Despite full resuscitative efforts with multiple rounds of epinephrine, calcium, atropine, and bicarbonate, the infant's blood pressure could not be sustained. After 45 min without electrical activity except with cardiac massage, resuscitation was stopped and the baby was pronounced dead—30 h after the burn injury.

At autopsy, second- and third-degree burns of the head and neck were present. The mucosa and submucosa of the posterior pharynx, valleculae, larynx, and entire tracheobronchial tree were necrotic. The bronchiolar mucosa was necrotic and filled with Gram-negative bacteria, fibrin, and polymorphonuclear leukocytes. There was marked edema of the brain with absence of subdural or subarachnoid hemorrhage. Microscopic examination of the eyeballs revealed several large patches of retinal hemorrhages situated in the nerve fiber layer in the equator and posterior pole of both eyes (Figs. 1 and 2). There was absence of subdural hemorrhage in the optic nerve sheaths, and no signs of disseminated intravascular coagulation in the choroidal circulation. The immediate cause of death was bronchopneumonia due to *Klebsiella aerugi-nosa*. Initially, the baby was suspected to have been a victim of physical abuse, but a home visit by a social worker verified the mother's statements.

DISCUSSION

In 1962, Kempe et al. coined the term "battered child syndrome" (4). Two years later, Kiffney described the ocular findings related to child abuse (5). Gilkes and Mann recognized that retinal hemorrhages were not always due to direct ocular trauma (6). Caffey described retinal hemorrhages in conjunction with the whiplash-shaking injury (7,8). The "whiplash-shaken infant" describes an infant with an acceleration injury producing subdural hematomas and retinal hemorrhages in the absence of external signs of trauma. On necropsy, Caffey found mild cortical contusions, subarachnoid hemorrhage, and laceration of the bridging cortical veins. Duhaime et al., using an experimental model for the measurement of angular acceleration, found that severe head injuries of the type commonly referred to as "shaking" injuries require impact to occur and that shaking alone is unlikely to cause the shaken-baby syndrome in otherwise normal babies (9). Hanigan et al. described three cases of child abuse with the "tin ear syndrome" (10). This syndrome described unilateral ear bruising, radiographic evidence of ipsilateral cerebral edema with obliteration of the basilar cisterns, and hemorrhagic retinopathy. Rotational acceleration produced by

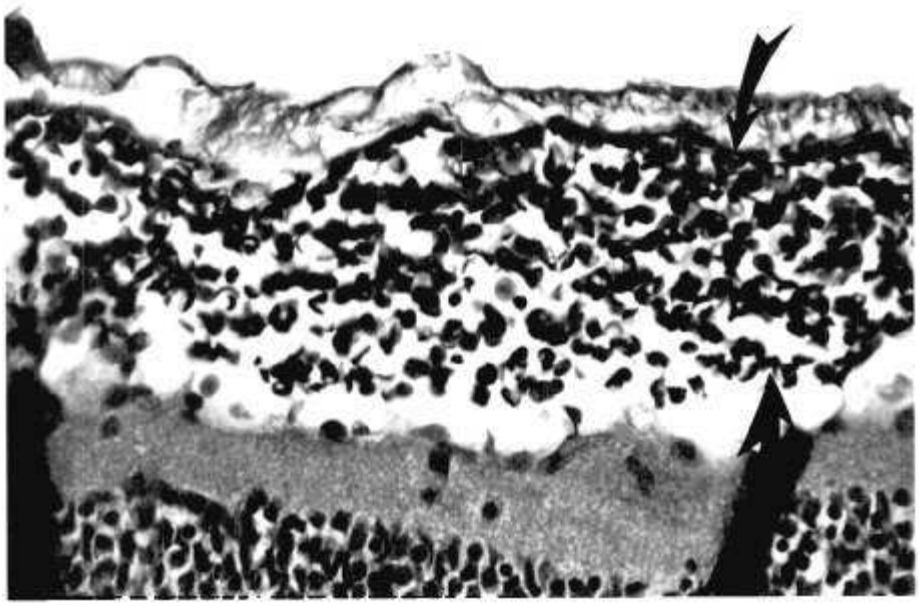

FIG. 2. Fresh superficial retinal hemorrhage (arrows) at the equator.

blunt trauma to the ear is thought to be sufficient to produce this syndrome (10). Approximately 40% of battered children have positive ocular findings (11–13). Permanent retinal damage may occur following extensive retinal hemorrhages in battered babies. The damage is due to the occurrence of traumatic retinoschisis as the inner and outer retinal layers are split apart by the hemorrhage (14).

Retinal hemorrhage is a frequent and key feature of abuse that should be sought in every case of suspected child abuse. Retinal hemorrhages occur in other conditions such as subacute bacterial endocarditis, leukemic leukostasis, thrombocytopenia, disseminated intravascular coagulopathy, and intracerebral arterial aneurysm (15). Retinal hemorrhages were found in 41% of newborns examined after spontaneous delivery (16,17). Perinatal retinal hemorrhages resolve in a period of a few weeks without long-term ocular sequelae (18). In 1910, Purtscher described a hemorrhagic retinopathy due to trauma distant from the orbit or cranium (19); the retinal vascular injury occurs secondary to increased hydrostatic pressure in the retinal venules as a result of increased intrathoracic pressures (20).

Retinal hemorrhages associated with spontaneous subdural or subarachnoid hemorrhages form the Terson syndrome (21); ~20% of patients with this syndrome have retinal hemorrhages (22,23). The retinal hemorrhage in Terson syndrome is attributed to sudden compression of the retinal venous drainage system by a dilated retrobulbar optic nerve sheath following effusion of cerebrospinal fluid in that region (21–23).

Retinal hemorrhages have been reported with cardiopulmonary resuscitation. Kirchner and Stein, in their study of a series of misdiagnosed abuse cases, mentioned an instance of retinal hemorrhage following cardiopulmonary resuscitation (24). Kanter examined the fundi of 45 children without prior history of trauma who had been resuscitated (25). Kanter found only one case with retinal hemorrhage. Cardiopulmonary resuscitation produces retinal hemorrhage, in a way similar to Purtscher's retinopathy, as a result of forceful increased intrathoracic pressure.

Retinal hemorrhage in early childhood commonly indicates physical child abuse. We have presented a case of retinal hemorrhage associated with cardiopulmonary resuscitation. A history of cardiopulmonary resuscitation should be included in the list of causes of retinal hemorrhages in children. □

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