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ROLLER COASTER RETINOPATHY: CASE REPORT OF SYMPTOMATIC BILATERAL INTRARETINAL HEMORRHAGES AFTER SHAKING INJURY IN AN OTHERWISE HEALTHY ADULT

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Purpose: Traumatic head injuries not involving the eye have been known to cause retinal injury through multiple mechanisms. Abusive head trauma remains the prototypical example. We propose to demonstrate the first case of bilateral multiple retinal hemorrhages in a young healthy adult related to riding multiple theme park roller coasters.

Methods: The patient was evaluated with a complete ophthalmic examination including dilated extended ophthalmoscopy, fluorescein angiography, optical coherence tomography, and fundus photography.

Results: The patient was found to have a bilateral symptomatic macular retinopathy characterized by multiple intraretinal hemorrhages. Given the lack of other systemic findings and negative medical workup, her signs and symptoms were thought to be attributed to the same day attendance of a theme park and riding of multiple roller coasters.

Conclusion: Theme park roller coasters, as well as other attractions, may affect the eye at the vitreoretinal interface. This type of acceleration–deceleration injury should be considered in the differential of an adolescent or adult patient with retinal hemorrhage in the absence of other pathologic processes to explain clinical findings.

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Traumatic head injuries, not directly involving the eye or its adnexa, have been known to cause ocular injury. Abusive head trauma, previously known as shaken baby syndrome, remains a prototypical example. Multiple pathological explanations have been put forth to explain the mechanisms behind these injuries. We present a case of a macular retinopathy that developed immediately after riding an amusement park roller coaster. To our knowledge, this is the first reported case of retinopathy occurring after an amusement park ride that is both symptomatic and bilateral.

Case Report

A 22-year-old woman presented with a complaint of "dark spots" of abrupt onset in her right eye after riding a roller coaster the day before. She reported riding multiple theme park rides the previous day, but became symptomatic after one specific roller coaster. Her ocular history included wearing contact lenses but otherwise was unremarkable. Medical history only revealed an active smoking history and oral contraceptive use.

On ophthalmologic examination, Snellen visual acuity was 20/20 in both eyes with a pinhole. Refraction was significant for mild myopic astigmatism. Slit lamp examination of the anterior segment was unremarkable. Dilated fundus examination showed multiple scattered intraretinal hemorrhages in both eyes concentrated in the posterior pole. In the right eye, the hemorrhages were noted to involve the parafoveal region (Figure 1). The peripheral

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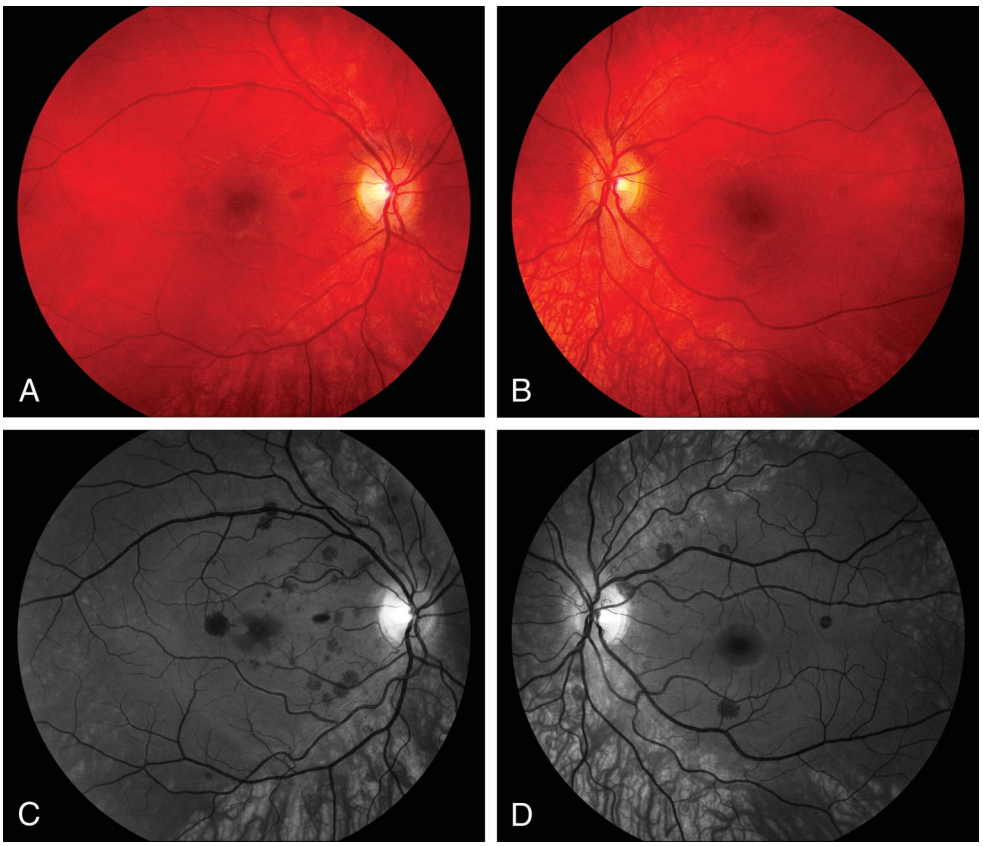

Fig. 1. Color Fundus photographs of the right (**A**) and left eye (**B**). Red free fundus photograph of the right macula (**C**), showing multiple intraretinal hemorrhages with foveal involvement, and the left macula (**D**) showing multiple intraretinal hemorrhages sparing the fovea.

retina did not reveal any evidence of clinically appreciable changes. No posterior vitreous detachment was appreciated in either eye.

Optical coherence tomography showed perifoveal intraretinal hemorrhages in the right eye extending outward from the outer plexiform layer with disruption of the IS/OS junction. The foveal contour was otherwise unchanged and no intraretinal or subretinal fluid was noted. (Figure 2) Fluorescein angiography was remarkable only for blockage at the sites of hemorrhage.

The patient was lost to follow up; however, one month after her visit, she was contacted via telephone where she subjectively noted that her symptoms had resolved and vision had returned to baseline.

Discussion

The patient discussed in this case developed multiple scotomas in her right eye corresponding to the retinal hemorrhages noted on examination. She also had asymptomatic retinal hemorrhages in the left eye. There were no other neurologic deficits noted by the patient or seen on examination. There was no evidence of soft tissue injury or blunt head trauma. To our knowledge, there has been one other reported case of macular hemorrhage attributed to riding a roller coaster.[1] The case involved one isolated perifoveal hemorrhage in the right eye of a patient who reported a "wavy spot" in her vision after riding a roller coaster 13 times. There have been reports of neurological insults from roller coaster rides in the literature.[2,3] Other instances of macular hemorrhage have been reported in patients participating in high acceleration–deceleration activities such as bungee jumping.[4] The mechanism behind these injuries is similar in that they incorporate sudden changes in momentum without clinical evidence of impact to the head. The description of the trauma received by these patients is analogous to abusive head trauma (AHT) characterized by repetitive acceleration–deceleration forces with or without blunt impact to the head, which was originally described by Guthkelch and Caffey as shaken infant syndrome.[5,6] This often includes retinal hemorrhages, subdural hemorrhage, and encephalopathy. It is thought that the poor neck support and large heads of infants leads to whip-lash type injuries even in the absence of blunt trauma to the head.

Cases of adults with abusive head trauma or "shaken adult syndrome" meeting the original definition for infants have been reported in the literature. These cases involved severe repetitive shaking trauma and were associated with subdural and subarachnoid hemorrhage, often leading to death. One case of fatal adult abusive head trauma involved the interrogation of a 30-year-old

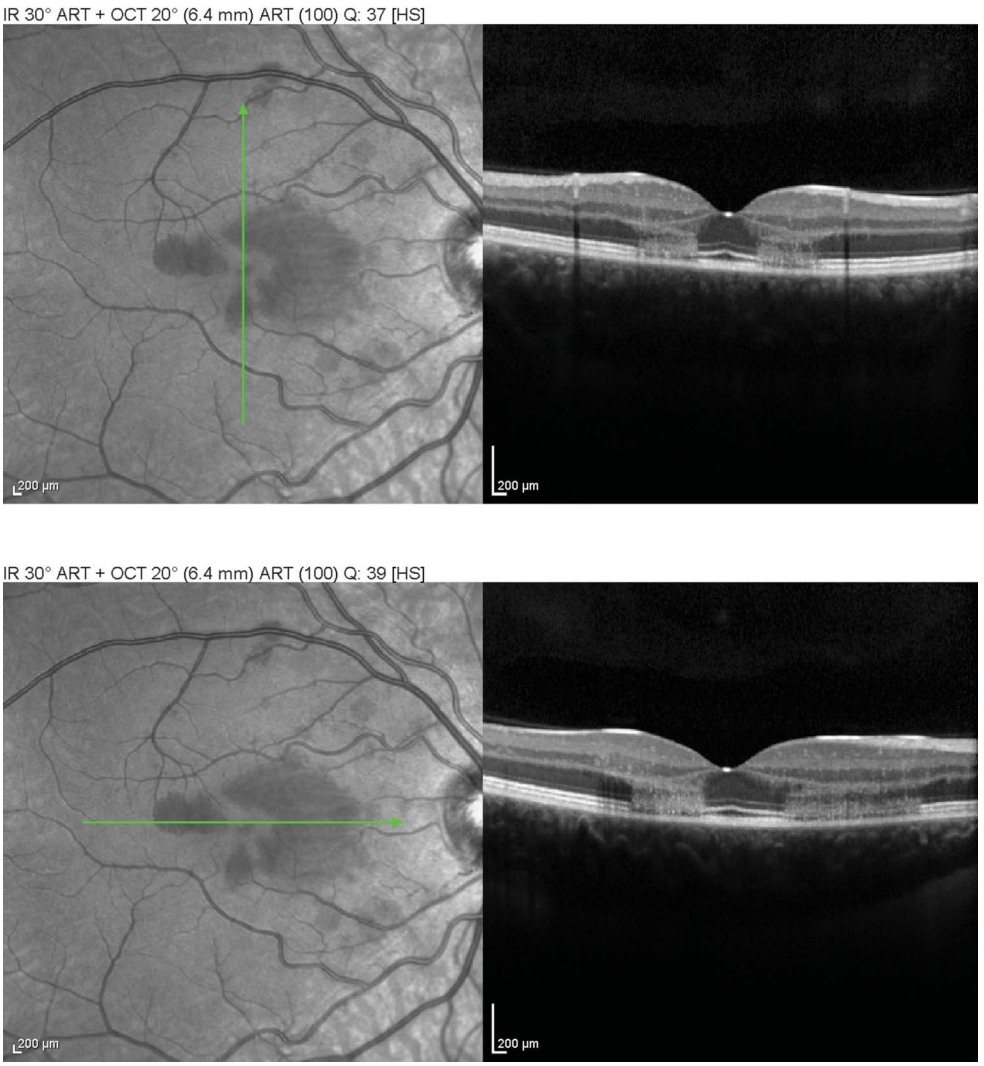

Fig. 2. Optical Coherence tomography of the right macula showed parafoveal intraretinal hemorrhages in the right eye extending outward from the outer plexiform layer with disruption of the IS/OS junction, consistent with what was seen on examination. No evidence of macular schisis.

man for 12 hours who was subjected to violent shaking. Autopsy showed cerebral edema and associated subdural and subarachnoid hemorrhage along with retinal hemorrhages in each eye. There was no evidence of blunt trauma to the head or neck.[7] Azari et al reported two cases of adult abusive head trauma where both victims were intoxicated and shaken by an assailant. Post-mortem analysis showed no evidence of trauma to the head but also revealed cerebral edema with associated subdural and subarachnoid hemorrhages.[8] These cases resemble that of Terson, in which they both involve some level of intracranial hemorrhage and the ophthalmic findings.

There are competing theories to explain the retinal hemorrhages seen in abusive head trauma, which are not mutually exclusive. First, a hydraulic mechanism proposes that shifts in the intracranial, intrathoracic and intrabdominal pressure along with changes in blood pressure are transmitted through the optic nerve sheath and result in retinal venous hypertension.[9] With more recent research, these theories have come into question and are generally less widely accepted.[10] A second, more accepted mechanism is related to vitreoretinal traction, which proposes that acceleration–deceleration forces result in mechanical disruption of the vitreous at the site of its strongest attachments, including the macula, optic nerve, blood vessels, and vitreous base.[8] The latter theory may explain the localization of the hemorrhages in our patient.

Abusive head trauma in children resembles the cases of adults mentioned above, where injuries were the result of violent shaking and trauma, without direct head trauma. Those adults were either intoxicated, frail, or victims to extreme levels of trauma. They were more likely to lose stability of their head resulting in

retinal hemorrhages resembling Tearson syndrome. Those patients eventually died because of causes related to their brain injury. In the case of our patient, she was not exposed to extreme levels of trauma and likely did not lose control of her head to the extent as that of the shaken adults described. We believe that her retinal findings are more related to the vitreoretinal-traction mechanism given that her hemorrhages are isolated to the areas of highest vitreoretinal attachment. The vitreoretinal interface of a young adult may more closely resemble that of a child with areas of strong adhesion and no posterior vitreous separation. She also endorsed no other neurologic findings and her fundus examination showed a normal optic nerve. Therefore, it is likely that the gravitational forces generated by the rollercoaster acted primarily on the vitreous rather than as a shaking mechanism of her head and neck.

Our case demonstrates that theme park rides may affect the eye and may lead to at least transient vision loss. However, whether these rides pose a true risk to ocular health is unclear. Additional prospective study may help elucidate the incidence of subclinical retinal hemorrhages in theme park patrons, comparable to the asymptomatic eye of our reported patient. A better understanding of the effects of rollercoaster rides may be of particular interest for patients who are monocular, are highly myopic, are anticoagulated, or have poor retinal vascular integrity (such as those with diabetic retinopathy, hypertensive retinopathy or collagen vascular disease).

Key words: roller coaster, trauma, retinopathy, retina, macular hemorrhage, shaken adult syndrome.

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