G36 Association of Retinal Hemorrhages With Fatal Head Injuries in Infant Monkeys

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After attending this presentation, attendees will gain familiarity with the use of animal models for shaking injuries and appreciate the potential for further study of retinal hemorrhages using accidental head injuries in infant monkeys.

This presentation will impact the forensic science community by providing objective scientific data about the natural history of retinal hemorrhages, which will assist forensic pathologists, pediatricians, ophthalmologists, and emergency medicine physicians by offering a better understanding of the pathogenesis of retinal hemorrhages.

Published studies about the specificity of retinal hemorrhages for Abusive Head Trauma (Shaken Baby Syndrome) are controversial. A diagnosis of child abuse based on the presence, number and distribution of retinal hemorrhages has serious consequences, and thus deserves unbiased scientific investigation. Some authors claim that retinal hemorrhages are virtually pathognomonic of a shaking (acceleration-deceleration) injury, but for such a purportedly specific finding, this claim has never been scientifically proven. Many papers have been written on the subject; however, disproportionately few have had significant substantive value. To date, no reasonably scientific, reliable and ethical animal model for retinal hemorrhages has been identified. Consequently, an exhaustive list of situations and conditions in which retinal hemorrhages can be seen has not been established. Based on the experience of this institution, observational data suggests that retinal hemorrhages occur fairly commonly in the absence of shaking or other non-accidental injury. The goal of this study is to help elucidate these situations though the use of a natural animal model for retinal hemorrhages. This study is intended to serve as a pilot study to evaluate the possibility of using baby monkeys that have died as a result of trauma to demonstrate the presence of retinal hemorrhages in the absence of shaking.

Trauma is a well-documented cause of neonatal and infant mortality in certain non-human primate breeding colonies. One mechanism of trauma is related to changes in the carrying behavior of captive dams, including more frequent cradling of the infant monkeys. Cradling of the infants has resulted in an increased number of fatal accidental head injuries in these monkeys. The injury occurs when the mother's chest touches the ground as she jumps and lands, thus allowing the infant's head to hit the ground with significant force. Previously published necropsy data for infant squirrel monkeys (*Saimiri sciureus*) has revealed both open and closed skull fractures. No non-lethal or incidental skull fractures have been reported in any captive monkey populations. Unfortunately, none of these studies examined the eyes of the infant monkeys for the presence of retinal hemorrhages.

The heads of seventeen infant monkeys (*Callithrix jacchus* or *Saguinus oedipus*) who died from either trauma or natural disease were provided by the New England Primate Center following necropsy and selective histological examination (KGM). Information initially provided to the primary investigators (CHS, PEL, CAS, KAS and JHB) included the species, animal number and necropsy number. All monkey heads received CT scans (KAS, JHB) using the Siemens MicroCT [Resolution: Bin x 4 = .0732 (73 micron)] followed by pathological examination (CHS, PEL, CAS) including external examination, gross dissection and microscopic examination of the brains and eyes. Findings were digitally photographed including all brains and retinas. The examinations demonstrated eleven animals with apparent head injuries. Nine monkeys had skull fractures; five fractures were identified both radiographically and grossly, three fractures were only identified grossly and one fracture was only identified radiographically. Microscopically evident retinal hemorrhages were present in at least one eye in all specimens with skull fractures and were unilaterally present in one specimen without evidence of a head injury. Because of poor preservation, several of the retinas were fragmented, thus hindering interpretation. Following completion of the examinations, the age, date of birth, date of death, dam and sire numbers, type of postmortem examinations originally performed, postmortem interval, and cause of death for each animal was revealed. All animals were born and died in 2002, with a mean and median age of 1.88 and 2 days at death, respectively. The majority of animals (13/17) died or were euthanized (5) as a result of suspected parental neglect and inanition. Of the remainder, two died of infection, one was stillborn and one died of unspecified cause(s). Postmortem interval was less than twelve hours with the exception of the euthanatized animals, which were examined with in two hours. Based on the above information, this study demonstrates a possible association between skull fractures and retinal hemorrhages. Although more studies

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are necessary to identify a causal relationship between accidental head injuries and retinal hemorrhages, these results suggest that this type of animal model may be of use in studying retinal hemorrhages not associated with alleged shaking incidents.

Retinal Hemorrhages, Abusive Head Trauma, Animal Model

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