H13 Retinal Hemorrhages and Spinal Nerve Root Hemorrhages in Pediatric Resuscitated Near-Drownings: Recognizing Ischemia-Reperfusion Injuries

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Learning Overview: The goal of this presentation is to demonstrate the extent of reperfusion injuries in the eyes, spinal cord, and central nervous system in two pediatric cases of resuscitated, near-drowning events with prolonged resuscitative efforts.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by showing how retinal hemorrhages and spinal nerve root hemorrhages are due to hypoxia-ischemia reperfusion injury and are not specific for inflicted trauma.

A complete and thorough autopsy is critical in a subset of accidental pediatric deaths where circumstances are uncertain. Reported here are two resuscitated, near-drowning events in young children who developed fatal hypoxic-ischemic brain injury with herniation, retinal hemorrhages, spinal cord ischemia, and spinal nerve root necrosis and/or hemorrhage. This presentation highlights the necessity of performing a meticulous examination in near-drowning events, including a fundal examination, brain examination, and spinal cord examination to include both nerve roots and dorsal root ganglia.

The first case is a 4-year-old girl who was found submerged in a residential pool at her grandmother's house after being seen one to two minutes prior. Her uncle pulled her from the pool and immediately began cardiopulmonary resuscitation. Emergency Medical Services (EMS) arrived and intubated her prior to her bradycardia and subsequent cardiac arrest with pulseless electrical activity. Resuscitation was performed for approximately one hour prior to the return of spontaneous circulation. Pupils at the time were fixed and dilated, and the child was transferred to a tertiary center where a head Computed Tomography (CT) scan showed diffuse cerebral edema. A CT scan of the chest and abdomen showed sternal fractures (secondary to resuscitation), pulmonary edema, and diffuse dilation of the small bowel. Her condition continued to decline, and she was pronounced brain dead two days after the immersion incident.

The second case is a 7-year-old boy who was found fully submerged in a community pool after being seen playing approximately three to four minutes prior. Video footage later showed the boy jumping in the pool and playing prior to falling beneath the surface of the pool. EMS arrived to find the boy pulseless and performed resuscitative measures for at least 30 minutes prior to the return of spontaneous circulation. On arrival to a tertiary care center, his pupils were asymmetrically dilated and non-reactive. A head CT scan showed diffuse cerebral edema and hypoxic ischemic injury. A CT scan of the chest showed acute non-displaced, bilateral rib fractures (consistent with resuscitation) and lung changes suggestive of aspiration and pulmonary edema. Two brain death examinations were performed prior to pronouncement of death approximately 3.5 days after the near-drowning. Permission was granted for organ procurement.

Autopsy findings for both cases showed diffuse cerebral edema, bilateral aspiration pneumonia, and softening of the spinal cord. The younger child also had bilateral optic nerve sheath hemorrhages. Postmortem monocular indirect ophthalmoscopy revealed retinal hemorrhages in varying numbers, with the younger child having bilateral retinal hemorrhages (10-15 right eye, 50 left eye) and the older having a single hemorrhage. Histologically, the spinal cord and brain of both showed hypoxic-ischemic changes, accompanied by hemorrhage in the lumbar cord of the older child. Sampled spinal nerve roots showed perineural and intraneural necrosis, with associated hemorrhage in the case of the older child. No additional injuries were identified that caused or contributed to the deaths.

Near-drownings with prolonged downtimes and subsequent resuscitation lead to diffuse hypoxic injury of the brain and spinal cord. While no antemortem fundal examinations were performed during the hospitalization, postmortem fundal examination revealed retinal hemorrhages not clinically expected. Meticulous examination of the spinal cord also showed each child had nerve root ischemic changes and hemorrhage, thought by some authors to be specific for a shaking mechanism of injury. These cases highlight the importance of fundal examination and spinal cord examination in the resuscitated pediatric population to detail the extent of the ischemia-reperfusion injuries throughout the nervous system.

Retinal Hemorrhages, Spinal Nerve Root Hemorrhages, Hypoxia-Ischemia