

outpatient facility or small hospital with limited resources.

PATHOLOGY

Introduction

The National Association of Medical Examiners (NAME) and the AAP endorse universal forensic autopsies for all unexplained infant deaths.⁴⁹⁰ All unexpected pediatric deaths are investigated by a medicolegal death investigation system consisting of a mixture of physician medical examiners and lay coroners spread over approximately 2000 autonomous jurisdictions; autopsies are usually performed by forensic pathologists certified by the American Board of Pathology.⁴⁹¹ Forensic pathologists routinely serve as panel members on regional child death/fatality review committees.^{492–494}

The medicolegal autopsy aims to understand the cause, manner, and mechanism of death, each of which has a specific connotation when used in this context.^{495–497} The *cause* of death refers to the injury or disease process that initiated the lethal sequence of events (eg, traumatic head injury) while the *manner* considers the circumstances.⁴⁹⁵ The *mechanism* of death refers to the terminal pathophysiologic derangement that ended in death (eg, seizure, hypoxic-ischemic encephalopathy, cardiac arrhythmia, etc) and is usually not etiologically specific.⁴⁹⁸

The potential causes of sudden unexpected death in early childhood are numerous and span a spectrum from rare natural diseases to inflicted injuries. To accurately catalog the cause of pediatric demise, death investigation is a dynamic and comprehensive process that integrates patho-anatomic findings at autopsy with available history, imaging data, circumstances of the death, and the results of ancillary studies that include but are not limited to histology, toxicology, microbiology, metabolic, and molecular studies, among others.^{499,500}

As mentioned earlier in this report, the literature on physical findings was derived primarily from the clinical literature of non-fatal AHT cases. Epidemiologic and clinical features of fatal AHT cases are discussed in the section below.

Autopsy in Suspected AHT

Although as many as one-third of AHT cases have a lethal outcome and require an autopsy, determination of the cause of death may be challenging, because a history of trauma is often not easily forthcoming and external signs of injury may be subtle or absent.^{500,501} Published reports and guidelines from professional societies assist forensic pathologists in the investigation and certification of sudden pediatric death.^{490,502–506} The National Association of Medical Examiners currently has no formal recommendations for suspected head trauma in infants and young children, the

2014 position paper having sunsetted per the society's routine 5-year limitation policy; however, this resource is still informally referenced by many pathologists for guidance on autopsy procedures, interpretation, and documentation of findings.^{500,501,507}

An autopsy in suspected AHT is, thus, a specific and large independent dataset with core data elements that include digital photography, radiologic skeletal survey comprising full-body plain radiography, with comprehensive external and internal examination, and ancillary studies to document injury and exclude significant natural disease.⁵⁰⁰ These findings are interpreted in the context of history from medical records and other agencies including law enforcement.^{500,508} A forum has addressed some of the challenges and controversies faced by forensic pathologists in the autopsy investigation and analysis of childhood death.^{509–516}

Limitations of Autopsy Data

Autopsy data are an endpoint with published descriptions of AHT findings generally consisting of small descriptive series. These data are often limited by small sample sizes; incomplete and variable data; selection bias; small numbers of adequate controls; varied survival intervals; confounding variables, such as secondary changes from life-saving interventions instituted during life or artifacts of maintenance on artificial ventilation before death in children with hypoxic-ischemic brain injury; inconsistent inclusion of histopathologic descriptions; and noncontemporaneous methodology to assess axonal pathology in older series limiting comparisons across datasets.^{122,133,269,286,517–528}

Even though specialized autopsy techniques for examination of the central nervous system and related structures are described, some of these procedures require technical expertise and are variably implemented by forensic pathologists.^{529–535} In addition, AHT fatalities are typically investigated as discrete individual events, such that robust study designs including blinding are almost never feasible. The situation is further strained by an underresourced, understaffed, and nonstandardized death investigation system.^{536,537} Despite these limitations, autopsy observations continue to inform the pathobiology and classification of pathologic mechanisms of AHT and represent the bedrock of forensic investigation in sudden and unexplained childhood death.

The most common neuropathologic findings reported across AHT autopsy series include subdural hemorrhage (90%–100%), subarachnoid hemorrhage (60%–100%), RH (20%–100%), cerebral edema (28%–100%), global hypoxic-ischemic injury (37%–78%), traumatic axonal injury (less than 6%), and contusions (7%–67%).^{109,122,133,269,501,517–520,522,523,527,538–542} It should be noted that these broad ranges are derived primarily from small qualitative studies, many of which had low numbers