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Common Errors in Forensic Pediatric Pathology

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Abstract



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Medicolegal autopsies in the pediatric age group occur with some frequency. Despite the time-honored and often quoted address by Professor Alan Moritz many years ago, which described mistakes in the forensic autopsy of adults, a comparable discussion of infants and children has not been forthcoming. In this review, ten categories of potential and actual errors are listed, some of which are similar to those given by Moritz. The smaller size of infants as well as their unique growth and development creates problems separate from those in adult autopsies and creates opportunities for mistakes in observation and interpretation. The thorough documentation of all findings, the gathering and proper storage of evidence, and the availability of essential materials (e.g., scene investigation data, complete medical records, all microscopic slides, total laboratory analyses-especially toxicology) help to preclude errors of both omission and commission.

A legend even in his own time, Professor Alan Moritz gave his famous ward Burdick Award Address entitled "Classical Mistakes in Forensic Pathology" at the 35th meeting of The American Society of Clinical Pathologists in October of 1956 (1). As profound and seminal today, >40 years later, as it was then, his discussion was confined to medicolegal postmortem examinations of adults.

As no compilation of such mistakes in infants is available, other than the admonitions contained in Ophoven's "Pitfalls of Forensic Pediatric Pathology" (2), it was thought appropriate to document some of the potential and actual errors noted in my cases, in reviews of others' cases, and the few reports in the literature.

Several categories of mistakes, involving scene investigation, photography, and laboratory workup, are superbly presented in Moritz's time-honored work (1). However, additional factors must be considered in pediatric cases; the smaller size and shape of infants place many findings, such as postmortem interval changes, at variance with those in adults. A few distinctive issues remain the sole preserve of infant autopsies (e.g., stillborn versus liveborn, growth chart analyses, "failure to thrive"), and proper forensic interpretations in these situations become crucial factors in medical diagnosis and legal adjudication.

DISCUSSION

Ten categories have been arbitrarily selected to create a framework and a process for this review. Each provides a note of caution, explicit or inferred, for the pathologist and investigator to be especially vigilant and thorough.

1. Incomplete or Absent Scene Investigation

A proper scene investigation requires examination of the "bed of death," including pillows, mattresses, and all materials present therein; this also includes toys, bottles, and related items in and on the crib. A recreation of the body position with a doll is often instructive, especially in cases of inverted suspension. Removal of all evidence, including the bed, sofa, or other contrivance, to the morgue for review can also be accomplished. An environmental analysis must be conducted with special reference to room temperature and heat sources. Standardized scene investigation forms now available nationwide should be used where feasible. Situations involving multiple infants, multiple children, and children with adults in one bed require additional reconstruction in the workup. Failure to appreciate the positions of the victim, other siblings, and parents, as well as the significance of bedding, clothing, pacifiers, and other paraphernalia, can result in misinterpretation and misdiagnosis, improper classification, and worse, a subsequent infant death by the same mechanism.

2. Inadequate or Insufficient Photography

When the infant remains at the death scene, the position of the body must be accurately documented and adequately photographed. This is seldom the case because resuscitation measures are usually performed at the scene, on the way

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to, and in the local emergency department. In any event, all details of the room and the bed, whether at home or in the day care center and whether found in a baby car seat, swing, playpen, or other circumstance, should be documented at the location and/or when submitted as evidence; video recording can be effectively used at the scene. Any and all "bruising" of the victim, including the "hand-print hyperemia" (i.e., "buttock slap") often described but occasionally misdiagnosed, must be accurately recorded. Petechial hemorrhages of the face, eyelids, or thoracic organs should be described and photographed; cases of lengthy survival after hospitalization require admission pictures to accurately document petechiae and other trauma. Complete photography of the entire external body surface will usually supplant an inadequate or incomplete verbal description. Failure to retain fatal child abuse victims for additional time to photograph "next-day bruising" (i.e., blood seeping through deeper tissues into the overlying skin) may result in the omission of unsuspected significant injuries.

3. Improper Postmortem Interval Assessment

The small size and shape of infants "accelerates" the process of rigor mortis; the infant decedent can become completely rigid in only a few hours. Similarly, the smaller body of the infant can quickly become quite cold or warm in response to its environment. The onset of rigor mortis can be markedly delayed in cases of malnutrition as a result of diminished muscle mass. Care should be given to document any abnormal lividity patterns, especially when facial pallor, indicating pressure, has occurred. Vomitus and froth around the face should be recorded prior to any cleaning process. Failure to appreciate postmortem rectal changes resulting in erroneous diagnoses of sexual abuse is, unfortunately, not uncommon, and utmost care must be exercised in making these interpretations (3).

4. Inadequate or Incomplete Medical Records

Pregnancy and birth records should be secured from the local health facility and physicians. Any state of prematurity should be accurately documented. "well-baby" records, including growth charts, must be reviewed. A prolonged neonatal stay should be recorded and any apnea monitor records obtained. It is important to check eating and other habits during the 24 hours before death, including whether and how any medications may have been administered. Even experimental studies (e.g., cardiac lability changes during sucking) may identify an infant with a weakened heart and reveal a potential mechanism of death (4). Failure to carefully review such records may jeopardize an otherwise proper workup and result in a misdiagnosis.

5. Incomplete Preautopsy Study

Infant diagrams should be employed in every case, and all body measurements, including circumferences, should be duly recorded. Clothing and other personal effects (e.g., bottles) should be photographed and retained; it may be prudent to use Keto-Diastix (Miles Inc., Elkhart, IN, U.S.A.) to check a wet diaper for glucose and ketones. It is essential to examine the various orifices such as ears, genitals, and buttocks as part of the routine external evaluation. The lips, gums, and oral cavity should be carefully examined, especially for foreign material. The condition of the skin with documentation of any rashes and other markings should be listed. "Patterned" injuries (e.g., blunt, thermal, electrical) should be carefully measured and accurately documented by description, diagram, and photography. Prior to autopsy, a complete radiographic survey must be performed, and comparison to any antemortem radiographs should be made. Discrepancies can arise with inadvertent omissions; for example, in a recent case, failure to include the vertex of the skull on hospital radiographs showed a linear, nondepressed fracture on postmortem radiologic examination.

6. Inadequate Gross Autopsy Examination

The upper respiratory tract, including the salivary glands, middle ears, epiglottis, and tonsils, must be completely examined for indications of subtle or overt infectious processes. Petechial hemorrhages over the thoracic organs should be described and photographed; in some instances, their absence could suggest suffocation (5). In cases of suspected abuse, the brain, spinal cord, eyes, and genital organs must be reviewed; swabs of orifices should be routinely

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obtained at the outset of the examination. In cases of malnutrition, a complete gastrointestinal survey must exclude conditions such as volvulus and intussusception, other congenital abnormalities (e.g., Meckel's diverticulum, pyloric stenosis), and infectious diseases. The thickness of the abdominal fat should be measured. Full documentation (i.e., weight, volume, color, odor, and consistency) of gastric and intestinal contents must be performed, with all material retained from each portion of bowel. Extreme care must be used when describing "food" and interpreting the "stage of digestion." Failure to follow these procedures could severely jeopardize the correct diagnostic criteria for homicidal starvation.

7. Incomplete Microscopic Examination

All specimens of the major organs and tissues, including the gastrointestinal tract, should be histologically examined. Fat stains of frozen liver is an acceptable but not confirmatory screening method for congenital fatty acid and enzyme deficiencies. Subsequent diagnosis of congenital defects can be enhanced by deep-freezing skeletal muscle, heart, liver, and kidney and by retaining skin in proper fixatives. Iron stains should be employed on all wounds whether old or recent; some abdominal and other injuries may be of various ages as a result of repetitive trauma. Failure to submit each and every organ and tissue, some in multiple sections (e.g., lungs), for a thorough microscopic examination (including ageing) may cause the examiner to overlook a significant finding and miss the correct diagnosis. Likewise, interpreting distended alveoli (i.e., "air in the lungs") as evidence of live birth can not be substantiated without other supportive investigative data.

8. Incomplete Laboratory Studies

All fluids and organs should be secured for complete toxicologic analyses, including antemortem specimens from the hospital and/or emergency department. Positive toxicologic data from parents, especially from the pregnant mother, require documentation. Bacteriology should be performed on the blood, spinal fluid, lung tissue, and when indicated, the intestinal contents and middle ears; tissue should be frozen if a virologic etiology is suspected. Spinal fluid and/or vitreous humor should be preserved for postmortem chemistry analysis; some toxicologic studies can also be performed with these specimens. Hair is now an acceptable specimen for toxicologic analysis and should be retained. Bone and/or muscle are specimens of choice for serology and potential DNA examinations. Failure to retain all specimens in an acceptable quantity, properly labeled and separately frozen in clean containers, may be a serious mistake; forgetting to check for subtle poisons (e.g., cyanide, carbon monoxide) could contribute to the wrong diagnosis and even result in an undetected homicide.

9. Failure to Document and Differentiate Artifacts

"Resuscitation injuries" occasionally seen following cardiopulmonary resuscitation procedures should be compared with those of antemortem blunt trauma; the latter shows vital reaction (6). However, pressure to lungs following resuscitation, in our experience, can rarely produce lacerations with hemothorax. All documented fractures and soft tissue injuries must be weighed against comparable resuscitative changes. Histochemical studies can assist in the timing of such "injuries." In any event, the doctor must review the emergency department and hospital records for confirmation of all procedures said to result in any changes observed. Failure to search for and find an independent, competent, producing cause of death (e.g., myocarditis) may cloud the pathologist's interpretation of any traumatic lesions discovered.

10. Failure to Give Appropriate Importance and Significance to Findings

Examination of multiple (i.e., 8-12) lung specimens usually can allow an infectious disease process (e.g., bronchiolitis, pneumonitis) to be differentiated from other noninflammatory changes of the lungs, including hyperaeration and atelectasis as well as other nonspecific changes; one or two random peripheral sections will not suffice. "Growth retardation" and/or "failure to thrive" versus malnutrition and starvation are difficult diagnostic problems, but thorough examination of the gastrointestinal tract as noted previously, the

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brain for possible congenital anomaly, prenatal or antemortem injury, enzymatic and biochemical surveys, complete records with growth charts, and a thorough history will usually allow noncriminal conditions to be differentiated from those that are deliberate. Failure to assess soft tissue hemorrhage by incisions into the skin, especially over the buttocks, back, and extremities, may result in the inability to confirm a diagnosis of child abuse. Epidural hematoma can be dramatic and diffuse, but in isolation it may be the result of a single inadvertent blow or fall and can be mistakenly labeled as nonaccidental injury. "Hyperthermia" may be present in certain infectious diseases as well as environmental conditions (i.e., child left in a closed car) and should always be suspected if supported by history, especially since little evidence of heat changes are observed pathologically; postanesthetic deaths may reveal a lack of enzyme as responsible for hyperpyrexia. Terminal aspiration must not be confused with agonal reflux, nor should it be necessarily interpreted as a mechanism of death; however, failure to "burp" a small infant and placing him or her face-down in a soft pillow can not only produce the phenomenon but might even suggest "neglect," and the pathologist or investigator must not forget to inquire along these lines.

CONCLUSIONS

Moritz goes on in his paper to discuss a series of "miscellaneous mistakes" and then reminds us of a common one which is just as important today: "talking too soon, too much, or to the wrong people" (1). This is equally detrimental in childhood death inquiries, especially when abuse or outright homicide has occurred and more than one family member and/or caretaker are suspects. Recent case investigations and subsequent trials with broad national and international coverage have suffered from such intense public scrutiny. The completed autopsy report and, as is often necessary, expert medical testimony in court should be all the "talking" that the pathologist provides.

When doubts persist about any equivocal finding or interpretation, one should obtain consultations with experts in pediatric pathology whose diagnostic acumen may be invaluable. Regular conferences of such specialists is one optimal way to help resolve such dilemmas.

Moritz (1) ends his paper with a commentary that is as true today as it was when first presented:

The almost complete exclusion from this discussion of the mistakes that are made in the interpretation of evidence has been deliberate. If evidence has been properly gathered and preserved, a mistake in interpretation may always be corrected. If the facts required for a correct interpretation are not preserved, the mistake is irreversible.

This cautionary tenet applies equally to infants as to adults and must be rigidly adhered to in any medicolegal death investigation.

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