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Pediatric medicolegal autopsy in France: A forensic histopathological approach

Clémence Delteil[a,b,*], Lucile Tuchtan[a,b], Julia Torrents[a], Caroline Capuani[a,b], Marie-Dominique Piercecchi-Marti[a,b]

[a] Institut Médico-Légal, Hôpital de la Timone, 264 rue St-Pierre, 13005 Marseille Cedex 5, France
[b] Aix Marseille Univ, CNRS, EFS, ADES, Marseille, France

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ABSTRACT

The aim of postmortem medicolegal examination in pediatric death is primarily to establish the circumstances and causes of death and to exclude child abuse. In France, pediatric death is systematically documented by medicolegal or medical autopsy. In case of medicolegal autopsy, the complementary examinations, requested and financed by justice, are rarely limited to a histopathological examination. However in medical autopsies other tools are available to the pathologist as toxicology, biochemistry and molecular biology. The purpose of this article is to evaluate the efficacy of forensic histopathology in pediatric forensic autopsies. We analyze the main causes of pediatric death in a forensic context. Between 2004 and 2015, 157 infant deaths were identified in Marseille university hospital. The forensic histopathology and autopsy reports of all 157 cases were available for systematic review. Medical or surgical causes represented 41,3% of deaths in our center, accidental causes 8.1% and child abuse 28,8%. The definitive diagnosis was made at autopsy in 30% of cases and at histopathological examination in 70% highlighting that forensic histopathology is an indispensable tool in pediatric medicolegal autopsies. Significant histological abnormalities may be detected in selected organs such as the brain, lungs, heart, liver, adrenal glands and kidneys in spite of macroscopically normal appearances. This justifies systematic sampling of all organs. Despite the implementation of the French sudden infant death protocol which recommends medical autopsies, too many pediatric autopsies are carried out in a medicolegal context. 30% of the cases remain without diagnosis at the end of the autopsy and histological examination. This number could be reduced by the contribution of others laboratory investigation.

1. Introduction

In France and most European countries, deaths of children under one year of age passed below the threshold of 10 deaths per 1000 children around the year 1980.[1] Infant death has now become a rare and/or accidental phenomenon in all developed countries. According to INSEE (the French National Institute of Statistics and Economic Studies) the child mortality rate was 3.8 per 1000 live births in 2016. However, there are marked social and geographical inequalities in mortality at birth and during the first year of life in France.[2] The aim of postmortem medicolegal examination in pediatric death is primarily to establish the circumstances and causes of death and to exclude child maltreatment.[3,4]

In France, child death is systematically documented by autopsy. Since 2007, the recommendations of the French High Authority for Health[5] define the context in which autopsy should be performed: medicolegal autopsy or medical autopsy/hospital autopsy. The spectrum of pediatric diseases is wide, ranging from common to extremely rare diseases, and due to the absence of a history, most deaths remain suspicious and lead to forensic analysis.

Lesions occurring in the perinatal period and infancy encompass the entire field of pathology associating traumatic, inflammatory, vascular, neoplastic and metabolic conditions. Pediatric histopathology is a unique discipline and these lesions are often expressed differently from those of the same condition in adults. Comprehensive histopathological screening is important especially for investigating the mode and process of death, as well as contributory factors including predispositions and complications, rather than for determining the initiating cause of death. Lesions arising in the neonatal period or early childhood may go unnoticed during pediatric consultations and may be discovered later sometimes in the context of suspected child abuse or other circumstances of forensic importance.[6,7] Forensic pathologists need to be

* Corresponding author. Institut Médico-Légal, Hôpital de la Timone, 264 rue St-Pierre, 13005 Marseille Cedex 5, France.
E-mail address: clemence.delteil@ap-hm.fr (C. Delteil).

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aware of these considerations so that proper interpretations can be made.

In France, in case of medicolegal autopsy, the complementary examinations are requested by the magistrate and financed by justice without forensic pathologist's discretion or suggestion. In this context, histopathological examination is often the only examination requested by the magistrate. Major laboratory sections including toxicology, biochemistry, microbiology and molecular biology are more rarely demanded by the courts. Although in medical autopsy, all of the laboratory exams are available to the pathologist.

The purpose of this article is to evaluate the efficacy of forensic histopathology in pediatric forensic autopsies, highlighting the histopathological lesions frequently observed. We analyze the main causes of pediatric death in a forensic context.

2. Materiel and methods

We conducted a retrospective review from January 1, 2004, to December 31, 2015. The eligible population included all infants and young children up to 2 years of age and underwent a forensic autopsy and pathological examination by our physicians, and whose histopathology and autopsy reports were available for systematic review. All cases were anonymized.

All the autopsy were standardized according to the French protocol defined by the French High Authority for Health.[5] Specimens required for histology were fixed for at least 72–96 h in 10% buffered formalin before cutting. Hematoxylin, eosin and saffron (HES) staining was performed for all sections. Furthermore, other staining methods or immunochemistry was applied.

For the description of the most common pathological lesions, we excluded cases of abusive head trauma.

The following epidemiological data were collected: age, year of death, and gender. The principal macroscopic and microscopic lesions were also recorded, and the final diagnosis.

We differentiated the cases where the diagnosis could be made by autopsy alone from those requiring histopathological examination. The criteria for autopsy diagnosis of the cause of the death was for “infection” the presence of purulent secretion; for “surgical cause” any pathology that could have been treated by surgical procedure; for “prematurity” all postnatal complication related to birth before 37 weeks of amenorrhea, for “malformation” any congenital morphological alteration of an organ causing the death; for “fire” smoke soot covering the larynx, trachea and bronchi; for “drowning” the presence of fine white froth at the mouth, nose, air passage or lungs, voluminous water-logged lungs, the presence of water in the stomach; for “trauma” the presence of traumatic or hemorrhagic lesion causing the death; for “child abuse other than abusive head trauma” the presence of malnutrition, skin lesions or bones fractures of different age.

Simple statistical analyses were carried out in the form of percentages.

3. Results

Our institute has an average of 665 forensic autopsy cases per year, including 22 pediatric autopsies. We identified 215 infant and young children up to 2 years of age deaths from 2004 to 2015 who have undergone a forensic autopsy and histopathology: 55,3% of males, 43,7% of females, mean age: 9,2 months. Four primary causes of death were identified at the end of the autopsy and/or histopathological examination in this cohort (Table 1).

Fifty-eight (27%) of histopathological examinations related to abusive head trauma.

We retained 157 patients for descriptive histopathological analysis; 44.9% of girls and 55.1% of boys. The mean age was 11,2 months. The definitive diagnosis was made at autopsy in 30% of cases and at the histopathological examination in 70%. Isolated asphyxia and unknown causes of death were considered as uncertain cases.

Table 1
Causes of death.

Causes of death	Number (%)	Gender (Male/ Female)	Mean age (month)
Medical or surgical causes	89 (41,3%)	(47/42)	6,8
Infection	58 (27%)	(31/27)	12,8
Surgical cause	6 (2,7%)	(5/1)	12,1
Prematurity	16 (7,4%)	(6/10)	3,3
Malformation	6 (2,7%)	(3/3)	0,2
Metabolic disease	2 (1%)	(1/1)	2,6
Tumoral	1 (0,4%)	(1/0)	10,5
Accidental causes	16 (8.1%)	(10/6)	12,1
Fire	5 (2.7%)	(2/3)	13
Drowning	1 (0.4%)	(1/0)	8,6
Trauma (traffic accident, defenestration)	10 (4.6%)	(7/3)	13
Child abuse	62 (28,8%)	(39/29)	11,9
Child abuse other than abusive head trauma	4 (1,9%)	(2/2)	20
Abusive head trauma	58 (27%)	(33/25)	3,8
Uncertain causes	48 (22,3%)	(21/20)	6
Unknown	17 (7.9%)	(8/9)	5,5
Isolated asphyxia	31 (14,4%)	(18/13)	6,6

Centre nervous system examination

The brain was examined in 147 children (93.6%). A neurological cause explained 6% of deaths; the cause of death was made:

- purely on macroscopic examination in 4,7% of the deaths (acute meningitis, traumatic brain injury, leukemia, hemorrhagic or ischemic prenatal condition).
- purely on histology: none.

Macroscopic examination was normal in 49.6% of cases. The principal macroscopic lesions were edema, arachnoid anomaly (purulence, focal hemorrhage), ventricular dilatation, cystic destruction, traumatic lesions and neoplastic lesions (corpus callosum lipoma, choroid plexus papilloma).

However, microscopic examination can refine the diagnosis or understand the physiopathological mechanism at death. Meningitis was associated with cortical vein and sagittal sinus thrombosis in half of the case.

Non-specific microscopic lesions were found in 87% of cases and are summarized in Fig. 1.

The peri-ventricular area was the principal localization of chronic anoxia ischemia. Secondary lesions to prenatal ischemic or hemorrhagic conditions were ventricular dilatation with periventricular gliosis, leukomalacia, and cystic destruction of white matter.

The eyes were examined in 33 children and were all devoid of microscopic abnormality.

No cervical spinal cord examination was performed.

Heart examination

The heart was examined in 153 children (96.2%). Macroscopic and microscopic examination was normal, respectively, in 84.9% and 60% of cases. A cardiac pathology accounted for 7.4% of deaths: the cause of death was made:

- purely on macroscopic examination in 2,6% of deaths (cardiac malformation: valvulopathy, intra-ventricular communication);
-purely on histology in 1,9% of deaths (myocarditis: acute, chronic and eosinophilic inflammation, associated with myocardic necrosis).