

SIDS AND ACCIDENTAL ASPHYXIA IN INFANCY. FORENSIC DIAGNOSIS.

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Abstract

Sudden infant death syndrome (SIDS) is defined as unexpected death of an infant in the first year of life that remains unexplained and etiologically undetermined after a thorough examination, including performance of a complete autopsy and review of the circumstances of death and the clinical history. The lack of underlying etiological cause for SIDS actually makes it a diagnosis of exclusion in most of the cases. Another diagnosis of exclusion in forensic practice is accidental asphyxia in infancy. Based on circumstances of the fatal outcome for an infant, the gross findings and additional examinations, at least an attempt of differentiation between the two causes of death should be performed in the interest of objectivity. We present three cases of accidental suffocation, all of them admitted in the Department of forensic medicine as unclear cases. In all of the cases the initial considerations were between SIDS and accidental suffocation.

For both SIDS and accidental suffocation the non compliance with safe sleep position and environment is crucial. To prevent such cases if preventable, especially accidental asphyxiations, it is of major importance the parents to be adequately instructed.

Key words: sudden infant death syndrome, accidental asphyxiation, infant death

Introduction. SIDS is defined as unexpected death of an infant in the first year of life, that remains unexplained and etiologically undetermined after a thorough examination, including performance of a complete autopsy and review of the circumstances of death and the clinical history. The onset of the fatal episode appears to occur during sleep [1]. The lack of underlying etiological cause for SIDS actually makes it a diagnosis of exclusion in most of the cases [2]. Sudden infant death syndrome (SIDS), as part of Sudden unexpected death in infancy constellation, continues to be a major contributor to mortality in the first year of life worldwide [3, 4]. In the time interval between the 1980s and 2000s there was an observation of SIDS cases decrease in countries with strong “Back to sleep” informative campaigns, promoting supine sleep position. Sleep position and other factors are being claimed as risk factors for SIDS. At the same time the underlying causes for SIDS are not fully understood [4]. GOLDWATER [1] suggests that underlying infection that remained undiagnosed might be considered a possible etiological factor in SIDS. The further explanation of this hypothesis is that male gender predominance, winter seasonality, a vulnerable host (prematurity, genetic predispositions, innate and adaptive immune response polymorphisms), pre-natal and post-natal exposure to smoke, low socioeconomic status and so forth, are circumstances and factors all fitting an infection model. There is also evidence suggesting that at least a subset of SIDS cases may result from a neuropathological mechanism [5].

To be precise, SIDS and Sudden intrauterine death (SIUD) might be attributed to multifactorial etiology factors, including congenital anomalies of the cardiac conduction system and the autonomic nervous system, respiratory rhythm generation and arousal from sleep [6]. These considerations give ground to the new common definition for the SIDS-SIUDS complex: “The sudden death of a fetus after the 25th gestational week or infant under 1 year of age which is unexpected by history and remains unexplained after a thorough case investigation, including examination of the death scene, performance of a general autopsy and examination of the fetal adnexa” [7]. The gross autopsy findings in SIDS cases are those of quickly occurring death with severe brain and lung edema and severe acute venous congestion [1]. Routine autopsy fails to disclose any cause of death in such cases and histopathological analysis of the cardiac conduction system and autonomic nervous system is required. Molecular autopsy should also be followed in this regard if possible [2].

Another diagnosis of exclusion in forensic practice is accidental asphyxia in infancy. Based on circumstances of the fatal outcome for an infant, the gross findings and additional examinations, at least an attempt of differentiation between the two causes of death should be performed in the name of objectivity.

Asphyxia is the generic term for mechanisms that cause a deficiency of the tissue oxygen supply [8]. There are four pathophysiological causes of asphyxia – reduced oxygen in the environment, reduced blood oxygenation, reduced car-

diovascular oxygen transfer, and interference with cellular oxygen absorption [9]. According to the forensic classification, the mechanisms of asphyxia might include mechanical causes, such as strangulation, aspiration of foreign bodies or boluses, drowning, traumatic asphyxia, or constriction; changes in breathable air, leading to oxygen concentration reduction; positional asphyxia [10]. Sleep-related infant mortality, part of which is accidental suffocation of newborns, has fallen dramatically since the first public health prevention campaigns in the 1990s that focused on safe infant sleep and care practices including advising the parents to avoid the prone infant sleep position and presence of any soft objects surrounding the baby. The prone sleeping position and any object that might cover the head, and especially the face of an infant, might lead to obstruction of the nose and mouth and accidental asphyxia due to unintentional suffocation [11]. Most unintentional suffocation deaths are amongst children under 1-year-old. Children younger than 1-year-old cannot yet walk, and their injuries are mainly due to the negligence or abuse of their parents. The highest prevalence of unintentional suffocation is in the first few months of life, when babies are not able to turn around when sleeping [12]. It is now well known that there is a strong connection between sleep environment that is not safe and accidental suffocation [9]. Safe sleep environment reduces the risk of infant suffocation deaths. Increased knowledge about the characteristics of suffocation deaths can help prevention strategies by targeting highest-risk groups. The American Academy of pediatrics guidelines for infant safe sleep include: supine sleep position, sleeping on a firm surface, room-sharing, but not bed-sharing, no soft objects and loose beddings near baby's sleeping area [13].

Petechial hemorrhages are the most common externally visible gross finding indicating or suggesting asphyxia. Petechial hemorrhages are caused by venous obstruction in continuous arterial flow. Such hemorrhages might also be caused by many other conditions such as asthma attacks, status epilepticus, coughing, vomiting, and cardiac massage. Therefore, their sole presence is not clear or definite evidence of asphyxia. However, when present in conjunction with other findings of asphyxia detected during the autopsy and information about circumstances of the death, petechial hemorrhages are useful for distinguishing asphyxia related deaths from SIDS [14].

We present three cases of accidental suffocation, all of them admitted in the Department of forensic medicine of Sofia as unclear cases. In all of the cases the initial considerations were between SIDS and accidental suffocation.

Materials and methods. Full forensic examination of the cadavers in all of the three cases was performed. The examination includes forensic autopsy with additional histological examination.

The autopsy in cases of infant death starts when at least minimal information for the circumstances of the fatal outcome is present to the forensic examiner. Such data is generally reported to the forensic expert by the investigation. Additional

information might be given by the relatives before or after the examination, but it is also important to avoid secondary victimization and re-victimization of the parents, suffering through their loss.

The forensic post mortem examination in cases of infant death includes external and internal examination of the cadaver. The initial stage of external examination starts at the death scene, if possible, and continues in the forensic departments. During the external examination the presence and development of postmortem changes are registered. External signs of violence are also noted. The internal examination includes observation and section of the cranial, thoracic and abdominal cavities. All the organ systems located in them are carefully grossly examined and every aberration is described. Samples for histological analyses are obtained and the latter are examined (if necessary, depending on the case).

The final conclusions were based on discussion of the findings and the information given to the forensic examiners by the investigation.

Results and cases presentation. For the year of 2021 in the Department of Forensic medicine in Sofia Medical University, 23 cadavers of children under the age of 18 were examined (from 1206 cadavers for the year). Seven of them are under the age of one year. From them, three were cases of accidental suffocation because of incorrect sleep position of the babies. In two of the three cases the parents claim that side sleeping position was strongly recommended by the pediatricians and they were following their advice. In all three cases the recommendations for safe sleep of a newborn were not complied with. All of the three cases were preventable.

First case. A 3-months old male baby was found dead at 8 a.m. The baby was delivered vaginally, the pregnancy was normal; the baby was born mature, on term. At 2.30–3.00 a.m. the father fed the baby with formula milk, the baby burped, and they both fell asleep. They were bed-sharing. The mother slept in another room with a 2-years old toddler. The baby was found lying on his front surface, facing the bed covering. By recommendations of the pediatrician was put to sleep on his side “in order not to aspirate”.

Second case. A 2-months old female baby was found dead at 8 a.m. There was no information about the pregnancy and the delivery. The baby was breastfed. The baby was found lying on her front surface, facing the bed covering (she was put on her side to sleep) by the mother, in the morning, at about 7 a.m. By recommendations of the pediatrician she was regularly put to sleep on her side “in order not to aspirate”.

Third case. A 1-month old female baby was found dead at 7 a.m. There was no data about the pregnancy and the delivery. The baby was breastfed. At 5 a.m. the mother fed the baby, as they were both lying in the bed. The mother fell asleep and woke up at 7 a.m. She found the baby dead lying partly on the side, partly on the front, against the bed-covering.

In all of the cases the autopsy revealed similar findings:

- The physical development of the babies was normal.
- The front of the faces and the bodies were hypostatic areas, discoloured by the presence of lividity, with paler areas where there was pressure against the underlying relatively soft surface (Fig. 1).
- Morphological signs of quickly occurring death were present – brain and lung edema, acute venous congestion, spot-like hemorrhages under the pleurae, both visceral and parietal, in the thymus, and under the epicard (Fig. 2A, B, C) atelectases and acute lung emphysema.



Fig. 1. Gross external examination. Location of the postmortem hypostasis on the dependent front surfaces of the cadaver

No gross findings pointing infectious diseases were observed.

Histological examination was performed. The slides were HE stained. No

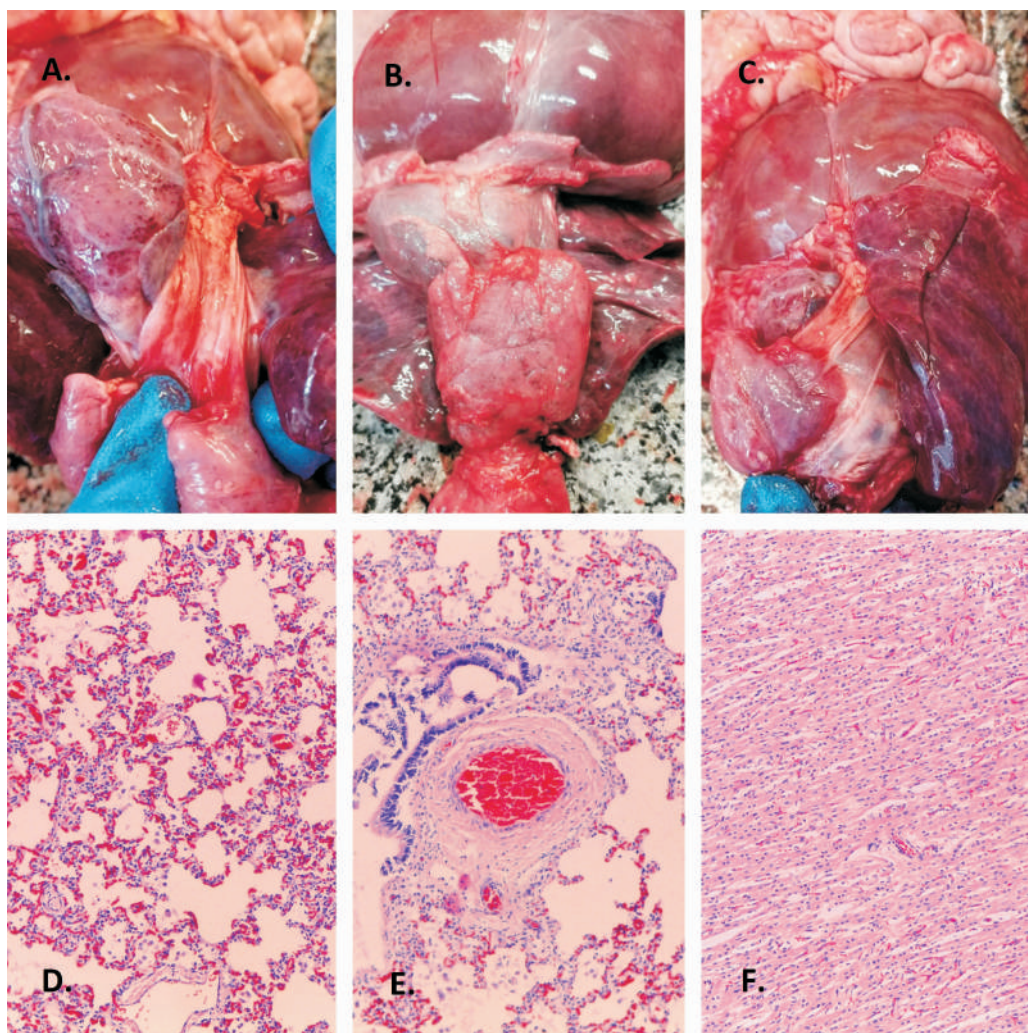


Fig. 2. Gross internal examination (A, B, C). Spot-like hemorrhages in the epicard (A), in the thymus (B), and under the visceral pleurae (C). Histological examination (D, E, F) – HE. Hemorrhages and congestion in lungs (D, E) and heart (F)

signs of inflammatory processes were discovered. There were acute circulatory changes which corresponded to the gross findings (Fig. 2D, E, F).

The results from the toxicological analyses were negative.

In all of the three cases the cause of death, based on the gross and histological findings, the results from the toxicological analyses and the data about the circumstances of the occurrence of the fatal outcome, was accidental suffocation. The main differential diagnosis in all of the cases was SIDS, which was excluded after establishing the information about the position of the babies and data by the investigation.

Discussion. The SIDS definition in use was established in 2004 in San Diego, California, and describes a sudden and unexpected death of an infant younger than 1 year, that takes place during sleep and remains without known cause after complete autopsy and analysis of patient history and circumstances of death. Other terms for this diagnosis are sudden death, crib death and unexpected infant death. During the 2004 meeting, experts including forensic pathologists, pediatricians and pediatric pathologists agreed on a classification that is still in use worldwide [15, 16]. There seems to be an overlap of the risk factors for SIDS and accidental asphyxiation. The main risk factors of both of them are pointed to be prone sleep position and all circumstances creating unsafe sleep environment. After massive campaigns of correct sleep position of newborns there is a stable tendency of decreasing of the cases of SIDS [17]. This fact together with the latest findings of genetic factors and central nervous system immaturity in the raphe nuclei positively connected with SIDS cases raises the logical question: Is there a chance of overlapping of diagnoses and misleading determination of SIDS as a cause of death in cases with risk factors more likely suggesting accidental suffocation? There should be at least an attempt in forensic practice to put the border between them. The gross and histological findings in both causes of death are pretty much the same. This means that deceased's history should be carefully obtained. In the authors' opinion if there is data of prone position of an infant, especially one that cannot turn around yet (in the first 3–4 months), there were soft covers and bed coverings, especially over the baby's face, if there are no positively established disruptions of the development of CNS, the case must be discussed as a probable accidental suffocation and SIDS should be a differential diagnosis. The gross examination of the cadaver might give grounds for such a conclusion if the following findings are present: lividity on the front side of the cadaver, especially over the face, with visible paler areas where pressed over the dependent surface; signs of severe edema and severe acute venous congestion. The prone position of a baby, especially when face is pressed over soft objects, like sheets, coverings, cushions, etc., creates a risk for obstruction of the external airways – the mouth and the nose of the baby. That is why the abovementioned position should be taken as a finding pointing to possible accidental asphyxia as a cause of death. During the development of the asphyxia process there might be moments of gasping and thus prolonging the agony. This gives the organism more time for development of circulatory disruptions observed post mortem as edema, acute venous congestion, and spot-like hemorrhages in multiple locations. In true cases of SIDS the cessation of respiration and circulation is due to a CNS mechanism, which means very quick, probably instantaneous fatal outcome. This is rather a suggestion, but in such cases there most probably will not be such findings pointing to prolonged agony. That is why the authors suggest that the type of the gross findings, including features of postmortem lividity in a combination with development of terminal circulatory disruptions, all together with the history

about the circumstances of the death and additional toxicological and histological examinations, might be helpful for differentiation between the two diagnoses. Both of them in the majority of cases are practically diagnoses of exclusion, so a higher probability for one or another can be at least achieved if no positive definite conclusion is possible.

Conclusion. For both SIDS and accidental suffocation the non compliance with safe sleep position and environment is crucial. To prevent such cases if possible, especially accidental asphyxiations, it is of major importance the parents to be adequately instructed. There should be mass informative campaigns about safe baby sleep. The pediatricians should be acquainted with the established good practices and knowledge, so they would give correct advice to the new parents and care-givers. In Bulgaria a tendency of advising the parents to put newborns on their side to sleep, continues to exist. This leads to high prevalence of asphyxia accidents which are preventable. In all of the cases of infant death, a death certificate should be issued only after thorough forensic or pathological examination, in accordance with the legislative requirements and regulations.

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