Int J Legal Med (2012) 126:385–390
DOI 10.1007/s00414-011-0651-9

ORIGINAL ARTICLE

Caput succedaneum and facial petechiae—birth-associated injuries in healthy newborns under forensic aspects

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Received: 20 June 2011 / Accepted: 16 November 2011 / Published online: 27 November 2011

Abstract In cases of suspected neonaticide, the results of a forensic autopsy might be important for conviction or acquittal. But autopsy findings in dead newborns are often unspecific and can rarely provide corroborative evidence of inflicted injury, as they are known to occur during normal birth as well. In our study, we examined 59 vaginally delivered, healthy newborns within the first 30 min after birth to know more about the prevalence and possible correlations of a caput succedaneum and facial petechiae. Caput succedaneum occurred in 33.9%, facial petechiae in 20.3%. As for the occurrence of caput succedaneum, statistically significant differences could be shown for the duration of delivery and the mother's parity. These correlations could not be shown for the occurrence of facial petechiae. Within the scope of our study, we could demonstrate that neither caput succedaneum nor facial petechiae are rare findings in healthy newborns. In the forensic investigation of suspected neonaticide, their potential significance can only be ascertained together with further investigations of the circumstances of death and a thorough forensic pathological autopsy.

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Keywords Caput succedaneum · Facial petechiae · Birth-associated injury · Neonaticide

Introduction

Forensic pathologists often face the problem that the circumstances of an incident are obscure. This is especially true in cases of suspected neonaticide, defined as the killing of a newborn within 24 h of its birth [1, 2]. In these cases, autopsy results might be of prime importance for conviction or acquittal. Vague stories given by a mother to explain different injuries (such as precipitate labor [3] or complications during delivery due to unassisted childbirth), unspecific injuries [4], and the mother's psychiatric conditions [5] make it difficult to clarify autopsy findings within the right context. Once the viability of the newborn is proven and reliable statements on the cause of death are made, it is the forensic pathologist's task to evaluate whether injury patterns can be aligned with the story given by the mother or if inconsistencies lead to the suspicion of neonaticide.

But which autopsy findings can substantiate this suspicion? Referring to Rauch [6] the most common methods of infanticide are smothering and strangulation, the latter being highly associated with facial petechiae [7–9]. The second most common cause of death is cerebral injury, with or without associated skull fracture [2]. Therefore facial petechial bleedings or the presence of a caput succedaneum, as a sign of pressure having been exerted on a newborns head, can be very important autopsy findings in cases of suspected neonaticide and possibly be helpful for investigators in providing further evidence. If one wants to use particular injury patterns and their characteristics to provide reliable statements on the course of events, it is of prime importance to know about their different possible origins and, of course,

their prevalence in the normal population. Caput succedaneum, associated with prolonged labor [10], is a frequently observed birth trauma that usually resolves within the first few days following birth [11]. Facial petechiae may occur in healthy infants for different reasons [12, 13]. There was no satisfying data related to the prevalence of these findings within the first minutes of life. Based on this precedent, we carried out this study to find out more about the prevalence of facial petechiae and caput succedaneum in healthy newborns within the first minutes after birth and their possible correlation with circumstances of delivery and/or maternal conditions.

Patients and methods

Between December 2009 and March 2010, together with a gynecologist, we examined 59 vaginally delivered newborns within the first 30 min after birth. All babies were born on the maternity ward of the Augustinian Sisters' Hospital in Cologne, Germany. We scrutinized each baby in terms of facial petechial spots and the presence of caput succedaneum.

Particular area of interest for petechial hemorrhages were the perioral and the retroauricular regions, the eyelids, and the lower conjunctivae. Ectropionizing of the eyelids was not performed at the newborns; thus, the upper conjunctiva could not be assessed. Localization, number of findings, and basic information concerning the mother and the baby as well as the circumstances of gravidity and delivery (see Box 1) were recorded.

Box 1. Additional information recorded for each case

Mother
Age
Number of former pregnancies
Complications during pregnancy
Newborn
Gestational age
Weight
Length
Head circumference
Delivery
Duration of expulsion period
Complications
Vaginal injuries
Technical support

The study had been approved beforehand by the ethics committee of the medical faculty of the University of Cologne (ref. number: 09–146) and informed written consent was obtained from the parents prior to examination.

Results

The median gestational age was 39 weeks (range from 36 to 42 weeks) and the median birth weight was 3,472 g (range from 2,650 to 4,435 g). The mother's median age was 32 years (range from 21 to 42 years). According to the prenatal care records, none of the parents suffered from coagulopathy. All examined babies were healthy according to the gynecologist's examination.

Of the 59 examined newborns, 15 (25.4%) exhibited a caput succedaneum only, 7 (11.9%) exhibited facial petechiae only, and 5 (8.5%) exhibited both facial petechiae and caput succedaneum (see Fig. 1). Altogether, a total number of 20 newborns (33.9%) showed caput succedaneum and 12 (20.3%) had facial petechiae of which 7 (58.3%) exhibited petechiae in more than one site.

Nine newborns exhibited petechiae on at least one eyelid, five on the lower conjunctiva, two retroauricular, two in the area of the forehead, and two perioral (Fig. 2). The number of petechiae of each newborn was recorded in three different groups (group 1, 1–3 single spots, $n=5$; group 2, up to 10 spots, $n=7$; and group 3, more than 10 petechial spots, $n=0$). None of the examined newborns showed extensive petechial hemorrhages in high density. In two cases an umbilical cord entanglement around the neck had occurred during childbirth. Both of the concerned newborns demonstrated up to 10 facial petechiae. In all cases where a caput succedaneum was present, it was located in the occipital region.

Since the total time of delivery was difficult to measure exactly, we recorded the duration of the expulsion period. The mean duration of this second stage of labor was 35.75 min (95% CI 27.93–43.75). In comparison, newborns without any of the aforementioned characteristics had a mean duration of 29.52 min (95% CI 18.87–40.16), those with facial petechiae 39.75 (95% CI 11.27–67.87), with caput succedaneum 44.23 min (95% CI 25.73–62.73), and those newborns with both types of lesions had the highest mean duration of the expulsion period with 47 min (95% CI 20.08–73.92). Looking at those with caput succedaneum in their entirety ($n=20$), the mean duration is significantly different from those without caput succedaneum (45.0 95% KI 31.17–58.83 vs. 31.37, 95% KI 21.78–40.95, $p=0.04$).

Furthermore, we divided all women ($n=59$) into two groups related to the number of former pregnancies. The first group included women with none or only one previous pregnancy ($n=47$). The second group consisted of those with more than one pregnancy in the past ($n=12$). In all the findings of caput succedaneum ($n=20$) in our study, 19 (95%) belonged to the first group, whereas only one was found in the second group ($p=0.04$; Fig. 3). None of these correlations could be shown for facial petechial hemorrhages.

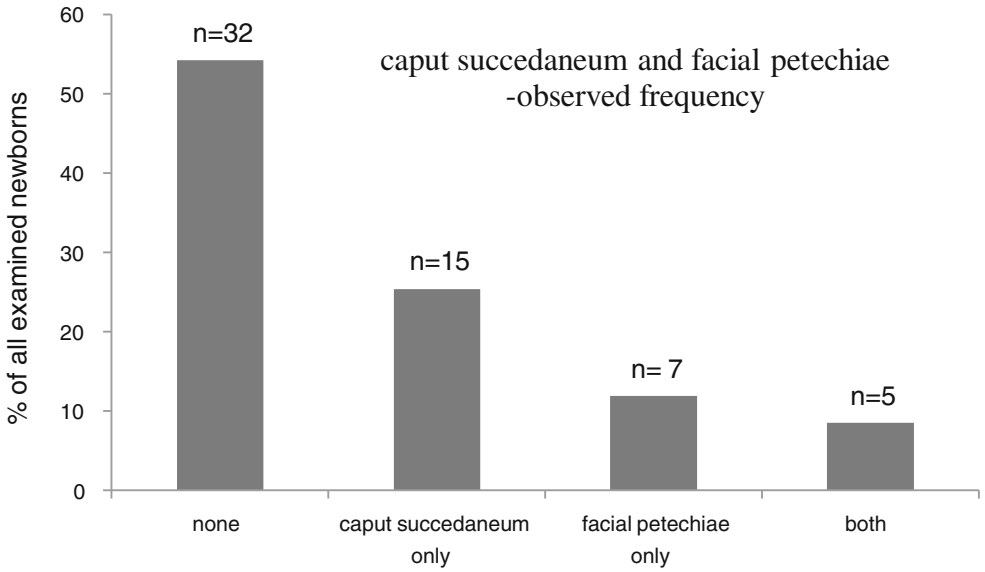

Fig. 1 Number of caput succedaneum and facial petechiae observed in our study and percentage of the total number of examined newborns (n=59)

In total, 9 women suffered from first-degree perineal tear, 12 from second degree, 3 from third degree. Ten women had mediolateral episiotomy (Fig. 4). These vaginal injuries had no influence on the absence or presence of caput succedaneum or the occurrence of petechiae according to our data.

Discussion

Reviewing the current English and German literature on neonaticide, we found extensive information on the psychological characteristics of the perpetrators [1, 5, 14–16], their motives, means [15, 17], prevalence, and legal considerations of neonaticide [14, 16, 17]. Our study was conducted to find out more about the prevalence and the possible correlations of maternal circumstances with caput succedaneum and facial petechiae in healthy newborns, as these autopsy findings might significantly help in providing corroborative evidence of neonaticide.

Sauvageau et al. describes the utility of caput succedaneum in the forensic investigations [18], pointing out that this edema in and under the fetal scalp [19], which is usually seen as an indicator for prolonged labor [10], can be helpful in analyzing the circumstances of delivery. The results of our study confirm this assumption, as newborns with caput succedaneum had a significant higher mean duration of the expulsion period than those with no injury. Furthermore, we found a correlation between the number of previous pregnancies and the presence of a caput succedaneum (p=0.04). Our study indicates that women with more

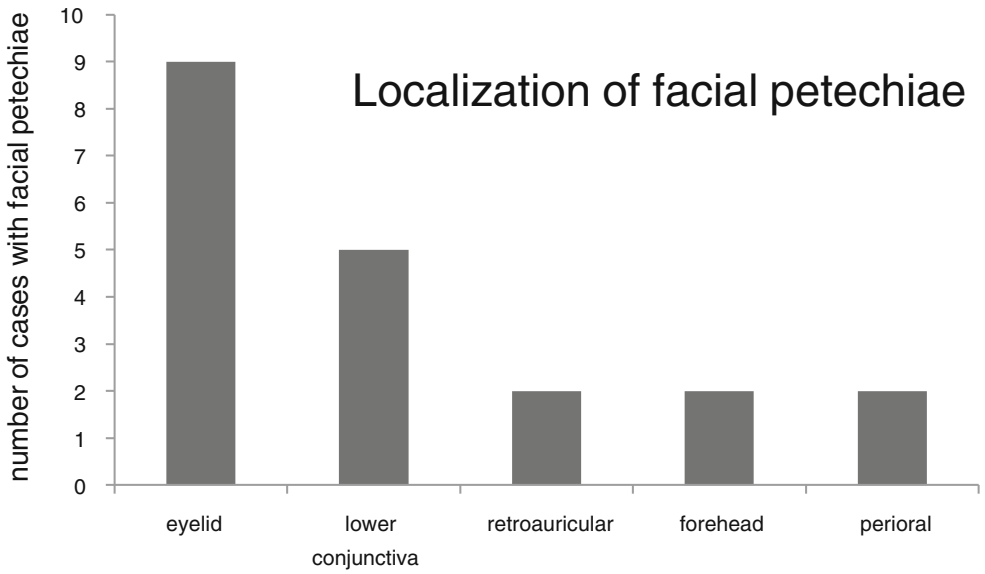

Fig. 2 Distribution of facial petechiae according to the localization. A total number of 12 newborns (20.3%, n=59) presented facial petechiae of which 7 exhibited petechiae in more than one site

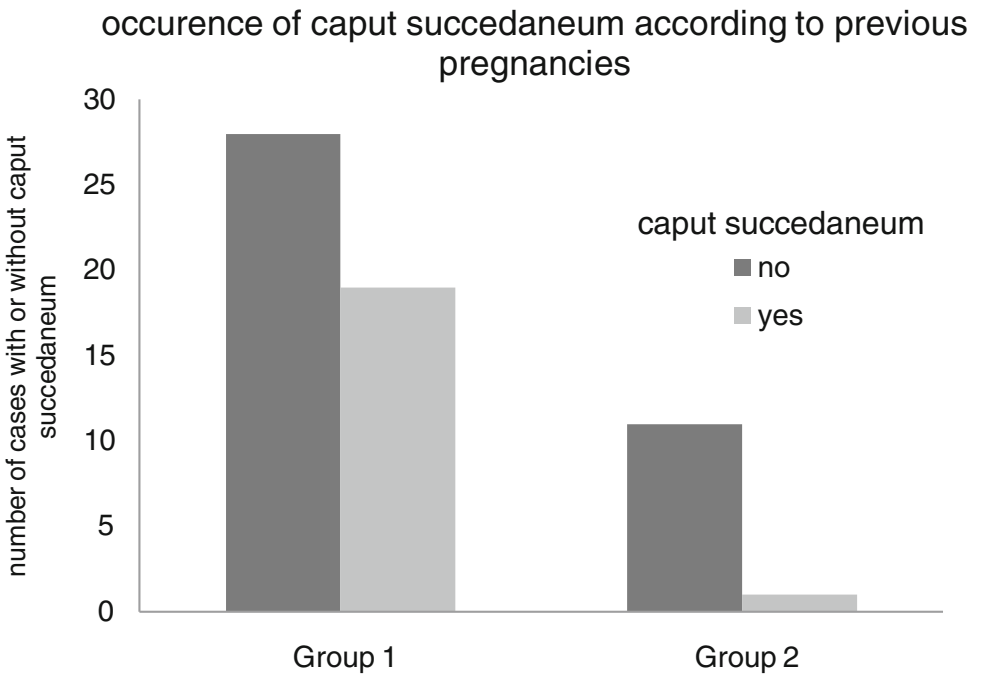

Fig. 3 Group 1, women with none or one previous pregnancy (n=47); Group 2, women with more than one previous pregnancy (n=12). In all the findings of caput succedaneum (n=20) in our study, 19 (95%) belonged to the first group, whereas only 1 was found in the second group (p=0.04)

than one former pregnancy are unlikely to deliver a newborn with such an anatomic finding. In this respect, a caput succedaneum can be a relevant autopsy finding regarding the length of birth.

Caput succedaneum, an edema of the presenting part, usually over the vertex [20] is a commonly known birth injury that usually does not need any treatment and is resolved within the first days of life [11]. Previous literature is lacking in detailed information about its prevalence. With a prevalence rate of 33.9% in our study, we could demonstrate that caput succedaneum is not a rare finding in healthy newborns, but besides the aforementioned, further correlations with other variables (i.e., birth weight, body length, or maternal vaginal injuries) could not be shown. Garcia et al. state that risk factors for caput succedaneum are the application of external

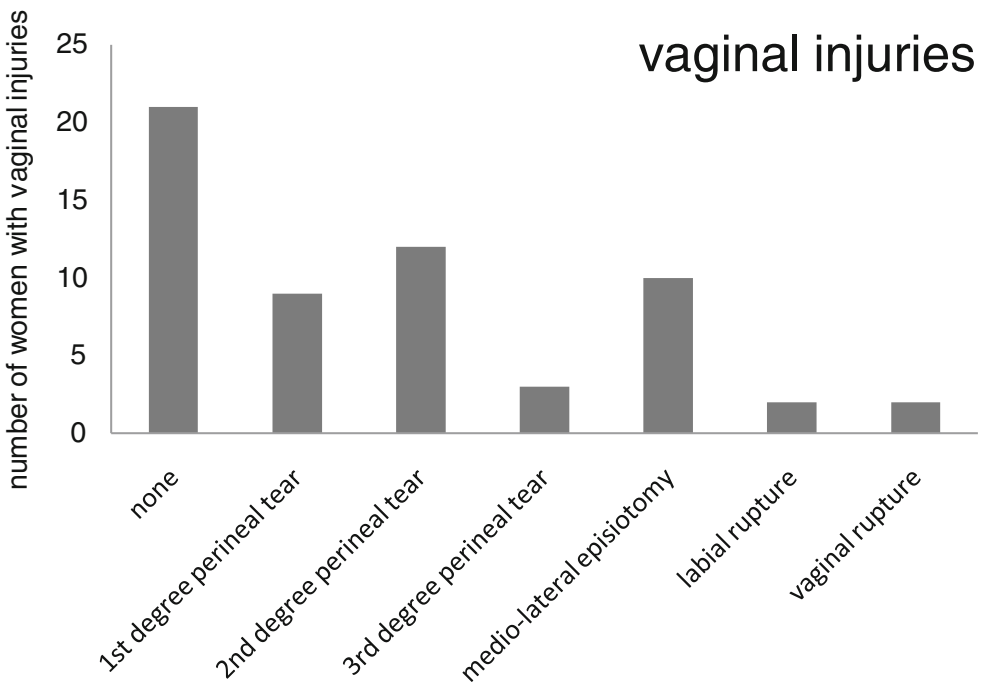

Fig. 4 Number and type of vaginal injuries and number of episiotomy among all women (n=59)

maneuvers during delivery and maternal age, <19 or >36 years [21]. Although caput succedaneum is believed to occur during labor, there are cases in which it was discovered in utero by ultrasound prior to delivery [19, 22]. Therefore, using caput succedaneum as a tool for forensic investigation remains difficult. Taken alone, it cannot provide conclusive forensic proof and should therefore always be interpreted in accordance with the elements of the scene and postnatal maternal behavior [18].

Unlike caput succedaneum, petechiae have always been findings of great interest for forensic pathologists [23, 24]. In the context of neonaticide, facial petechiae are mostly described in cases of asphyxial death [25–27] (i.e., strangulation, smothering, or the compression of thorax and upper airways). Their inconsistent occurrence in such cases [28–30], and their high prevalence in healthy newborns, that exhibit common birth-associated findings leads to an impairment of their significance in a forensic setting.

In our study, 20.3% of all newborns had facial petechiae. Literature research on the prevalence of facial petechiae in healthy infants revealed different accounts. Soheilifar et al. examined 500 infants and found that 10% had petechiae [13]; Downes et al. found even higher rates of 27.6% [31] but the results of both of these studies are not fully comparable to our data as they included infants up to the age of 12 months and recorded petechial spots on the whole body, not only facial ones. Eidam et al. (1988) examined 78 newborns on facial petechiae within 2 and 25 h after birth, quite similar to our study design and found that 28.2% had petechiae in the lower conjunctiva and even 48.7% presented petechiae on their eyelids [32]. These results cannot be supported by our study and we infer that the high rate of cord entanglements in this particular study (28% vs.3.4% in our study), the application of Credé's prophylaxis that is irritating to the conjunctivae (none of the newborns in our study received such prophylaxis) as well as the longer time span after birth (up to 25 h vs. 30 min in our study), in which other incidents (such as strong coughing or vomiting) [4, 14, 33] can cause petechial hemorrhages, are plausible reasons for the marked differences. We could not find reliable data in the literature concerning the timespan until which petechiae can be detected after birth. Kondo et al. [23] found petechial hemorrhages in the eyelid and/or the conjunctivae up to almost 2 days after inflicted violence. In our study, we did not measure this parameter.

Furthermore, Eidam et al. stated that the occurrence of facial petechiae correlates with a shorter total time of delivery. Within the scope of our study, this correlation could not be shown. A significant correlation of facial petechial spots with other maternal, birth, or newborn's circumstances could not be shown.

Conclusions

The present study shows that neither caput succedaneum nor facial petechiae are rare findings in vaginally delivered newborns, but their significance in a forensic investigation remains unclear. Since caput succedaneum is likely to occur in circumstances of prolonged, at least not in precipitate labor, its appearance might help forensic pathologists to clarify a neonate's birth history.

As for facial petechial spots, none of the examined newborns demonstrated them in mass amounts and therefore we think forensic pathologists should always consider birth trauma as an explanation—as long as they are not extensive—before interpreting them as evidence of inflicted asphyxia [34]. Nevertheless, if the circumstances are lacking in plausible explanations [12], the occurrence of facial petechiae in newborns should be treated suspicious [28] and lead to thorough investigation [35]. Taken alone, caput succedaneum and facial petechiae cannot provide corroborative evidence of neonaticide and should therefore always be interpreted together with a further investigation of the circumstances of death and a thorough forensic pathological autopsy [36].

Acknowledgments We would like to thank Ingrid Kaul from the Institute for Medical Statistics, Informatics and Epidemiology in Cologne for the support in data analysis.

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