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Sudden Unexpected Child Death Associated with Ingestion of Fluid Dish Detergent

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Summary. A case of sudden unexpected death of a 13-month-old child is reported. The immediate cause of death was aspiration of stomach contents. The autopsy and microscopical examinations revealed cerebral oedema, organ congestion and an increased number of neutrophils in germinal centres of mesenterial lymph nodes and spleen. The finding of ethanol and methanol (5.2 and 0.1‰) and of significant amounts of a surface-active agent (linear alkyl benzene sulphonate) in the stomach contents indicated consumption of a fluid dish detergent prior to death. The blood ethanol concentration was below 0.1‰ and urine ethanol and methanol concentrations were 0.28‰ and 0.04‰. The possibility that ethanol-containing detergents may trigger hypoglycemic attacks is discussed.

Key words: Sudden infant death, detergent – Fluid dish detergent

Zusammenfassung. Es wird über den unerwarteten, plötzlichen Tod eines 13 Monate alten Kindes berichtet. Die unmittelbare Todesursache war Aspiration von Mageninhalt. Autopsie und mikroskopische Untersuchung ergaben: Hirnödem, erhöhte Blutfülle in den Organen und eine gesteigerte Zahl von Neutrophilen in den germinalen Zentren der Mesenterial-Lymphknoten und der Milz. Im Mageninhalt wurden Äthanol (5,2‰) und Methanol (0,1‰) sowie bedeutende Mengen eines Oberflächen-aktiven Stoffes (lineare Alkylbenzolsulphonate) nachgewiesen, was auf das Trinken eines Geschirrspülmittels vor dem Tode hinweist. Die Blutalkoholkonzentration lag unter 0,1‰, Urin-Äthanol und -Methanol betrugen 0,28 bzw. 0,04‰. Es wird die Möglichkeit eines durch das Äthanol-haltige Detergens verursachten hypoglykämischen Schocks diskutiert.

Schlüsselwörter: Plötzlicher Kindstod, Detergentien – Spülmittel

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Introduction

Dish detergents are generally considered harmless. Statistics indicate that the ingestion of this type of household products is a common event [1], and according to our knowledge fatalities have not been reported. In this paper we present a case of a 13-month-old boy who died shortly after he had swallowed an unknown amount of a dish detergent that contained alcohol. Despite the fact that details of forensic interest remain unclear in this case, we have felt motivated to write this report due to a substantial lack of relevant information in similar cases.

Methods

The autopsy was performed 3 days after death and was completed with routine microscopical investigations. Before autopsy, the body was kept in the refrigerator of the mortuary at a temperature of about +4°C. Immediately after the body had been opened, urine and blood samples as well as stomach content and samples of liver and kidney tissue for routine toxicological investigations were taken. The samples were stored in chemically clean glass containers. To prevent fermentation, NaF (1%) was immediately added to samples of blood and urine. Ethanol and methanol were analysed by gas chromatography and mass-spectrometry. Liver samples were screened spectrophotometrically for barbiturates, carbamates and salicylic acid.

Case Report

A 13-month-old boy was found dead in his bed late in the evening. Autopsy showed abundant porridge-like stomach contents in the trachea and bronchi, cerebral oedema, pulmonary emphysema and organ congestion. The stomach mucosa was congested, but without visible injury. The stomach contained the same kind of porridge-like material as we found in the air passages. No foam or distinctive smell was noted. The mesenteric lymph nodes were enlarged and congested. Microscopical examination of the lungs demonstrated stomach contents in the bronchial stem and alveoli and acute interstitial emphysema but no other alterations. The mesenterial lymph nodes and the spleen exhibited congestion and oedematous germinal centres with some increase of neutrophiles. The leptomeninges, brain, heart, liver, pancreas, adrenals, kidneys and gastrointestinal mucosa showed no noteworthy microscopical alterations. Chemical analysis was positive for ethanol in urine (0.28‰), and in gastric contents (5.2‰). Trace amounts (< 0.1‰) were found in heart and in femoral vein blood. Also methanol was found in urine (< 0.1‰) and stomach contents (0.18‰) but could not be detected in blood samples. Barbiturates, carbamates or salicylic acid were not detected in liver tissue. These results were discussed with the parents, who brought ten different household items (detergents, shampoos and fluid-containing toys) to which the boy might have had access. Only one of them, a fluid dish washing detergent, contained major amounts (10%) of ethanol. The liquid also contained methanol (0.3%). The bottle was made of pliable plastic and equipped with a top that could be used as a teat (Fig. 1). The bottle-label was decorated with a small, stylized drawing, presenting a baby in diapers. It was considered possible that a 3-year-old sister could have assisted the boy in ingesting appreciable amounts of the detergent, since the two children, on the actual afternoon, had been playing beside the cupboard where the detergents were kept. Afterwards, the boy had been fed and put to bed. The manufacturer of the detergents requested a sample of the stomach contents, and found (the manufacturer's method) a surface-active agent known to be contained in their product[1].

1 In the remaining stomach sample 0.043 g linear alkyl benzene sulphonate was detected. According to the manufacturer this indicates that about 1 ml detergent was contained in the stomach shortly before death

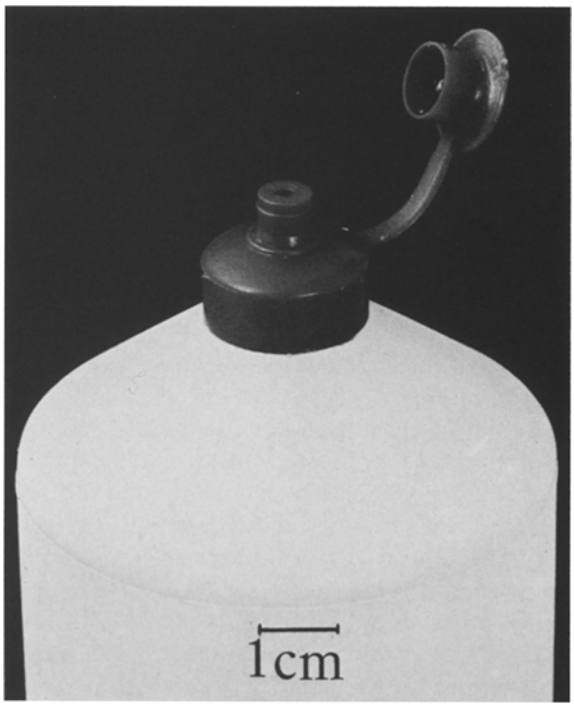

Fig. 1. Upper part of the detergent bottle. The top is made of bright red plastic, the bottle is made of pliable plastic

Unfortunately, the presence of the surface-active agent was never investigated in the other samples. The boy had previously been healthy. He was bottle-fed from 6 weeks of age. No apnoeic attacks had been noted.

Discussion

The direct cause of death in this case was aspiration of vomited stomach contents. The reason why the child aspirated is not clear, but the history supported by the chemical analysis suggests an involvement of the detergent. Pre- or post-mortal endogenous formation of ethanol in the gastric contents cannot be excluded (the child had been eating immediately before bedtime and no preservative had been added to this sample when taken for analysis), but the concentration of ethanol in urine indicates that the blood concentration approached 0.2‰ prior death [2]. The presence of about 1 ml dish detergent in the stomach contents, was also considered significant. This amount is believed to indicate a severalfold higher intake, as the major fraction of the detergent probably had passed into the intestine at the time of death.

The autopsy findings were nonspecific. The alterations in mesenterial lymph nodes and spleen may be interpreted as a slight acute inflammation or, possibly, as an effect of acute nonspecific chemical-induced irritation.

Ethanol inebriation is a generally accepted cause for aspiration of vomitus [3], but no signs of inebriation were reported in this case and the short time schedule indicates that the blood ethanol concentration hardly ever exceeded 0.2‰. It has recently been questioned whether children are more susceptible to ethanol intoxication than adults [4]. However, out of several causative factors we have considered the possibility that ethanol-induced hypoglycemia resulted in aspiration. The hypoglycemic effect may have lasted for hours, as even 1 mM (0.5‰) inhibits gluconeogenesis [5]. The need for gluconeogenesis, even with a full stomach, may relate to an ethanol-inhibited gastric motility [6] and low hepatic glycogen content in small children [7]. The reason to bring this mechanism into focus is recent reports on biotin deficiency among bottle-fed babies. It was speculated that biotin deficiency may lead to hypoglycemic attacks and death in young children [8]. Biotin deficiency, like ethanol, inhibits gluconeogenesis [9] and the child in question was bottle-fed. It thus seems possible that even very low concentrations of ethanol precipitated symptoms of biotin deficiency.

Detergents are often claimed to have a direct emetic effect, but in a series of reported cases vomiting shortly after intake occurred in 17% only [10]. How often vomiting is delayed several hours, as in our case, is not known. The detergent in question, like many others, has a pleasant smell but a bitter, repulsive and persistent taste. An overstimulation of taste receptors with consecutive attack of apnoea [11] in combination with the delayed emetic effect of the detergent could also be a causative factor of the fatal aspiration of stomach contents.

About 10–15 ml of the detergent would be required to explain the ethanol level in urine. With regard to its taste it is hardly conceivable that this amount was ingested without the active assistance of the older sister (cf. [12]). Under similar conditions—a 3-year-old girl playing "mama"—a seemingly harmless baby-powder became a fatal toxin when inhaled by a baby [13]. It might, thus, be worth noting that the softness of the bottle could have permitted the sister to forcefully squirt the detergent out of the bottle, and that the bottle's design with its teat-like top and drawing of a baby could have stimulated her to use it as a feeding bottle.

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