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Chronic abuse of hairspray by inhalation and sudden death of a 20-year-old woman

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Abstract: Severe morphological findings due to long-term and excessive inhalation of hairspray are rarely described. We present the case of a 20-year-old woman who was found lifeless in her room unexpected. She was known for inhalating hairspray since the age of fourteen, consuming up to 10 hairspray cans per day prior to death. Histological investigations showed lungs with fibrosing alveolitis and an increased number of macrophages but rare foreign body reaction (so called „hairspray-lung") although foreign material was present. Surprisingly there were also numerous conidiae found in the lungs. Independent from the pathological findings in the lungs, myocardium presents a focal myocarditis with single cell necrosis and a lympho-monocytic infiltration as cause of death.

Key Words: hairspray-lung, chronic abuse, pulmonary mycosis, myocarditis.

The number of case reports concerning clinical and morphological findings due to or in context of the inhalation of hairspray are scant [1-4]. Excessive inhalation of hairspray has been reported to lead to fibrosing lympho-monocytic alveolitis, sometimes with granulomatous reaction, an increased number of macrophages and multinucleated giant cells of the foreign body type [1-5]. These findings are meanwhile well-known as a so-called "hairspray-lung" but are not necessarily lethal. Severe changes with interstitial fibrosis, inflammation and lung emphysema may lead to hypertrophy especially of the right heart ventricle and to sudden death due to right heart failure. Up to now direct toxic effects on the heart muscles have not been described and in cases of sudden death, toxicological investigations do not reveal substances and concentrations able to explain sudden death. In cases without any history of hairspray abuse, the spectrum of histomorphological findings is an important parameter providing useful informations.

Based on these findings further toxicological investigations and inspection of the death scene as well as the history of the deceased person can be initiated.

CASE REPORT

A 20-year-old woman (body weight: 56 kg, body-length: 154 cm) was found lifeless in her room lying in an „embryo-like" position. Immediately initiated resuscitation failed. Relatives reported she inhaled deodorant and hairspray since the age of fourteen, at last 10 cans a day and either by spraying directly into the mouth or possibly using a plastic box. There were no other pre-existing diseases reported by the relatives.

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MATERIALS AND METHODS

We performed an autopsy, ordered by the prosecutor and collected samples from the body (e.g. blood from the heart, gastric content, urine and bile). Tissue samples from brain, liver, lungs and kidneys for toxicological investigations were taken and kept in so-called headspace vials. These samples were investigated using gas chromatography and mass spectrometry and compared to a sample of the hairspray primarily inhaled by the young woman. Moreover, tissue samples from all internal organs were taken for conventional-histological investigations. After fungal growth was shown in tissue section samples, fungal colonies from both lungs were cultured on agar plates. After separation of yeast-like colonies, sequence analysis of the ITS region 1 and 2 of the fungal rDNA with the primers ITS1 (5'-TCCGTAGGTGAACCTGCGG-3') and ITS4 (5'-TCCTCCGCTTATTGATATGC-3') was done for species identification [6].

RESULTS

Macroscopically, the autopsy revealed no cause of death. There were no rough injuries, no grip-signs in the skin of the arms, no so-called defence injuries. The heart muscle showed a conspicuous quality and pattern. There was plenty of mucus in the bronchi. The lymph nodes and the spleen were augmented. The brain and the lungs were edematous (weight of the brain: 1293 g; weight of the lungs: left 629 g, right 723 g). Congestion of inner organs was seen as well as a full bladder and cysts of ovaries.

Histological investigations showed a multitude of macrophages and infiltrations with lymphocytes in the interstitium of the lungs as well as in the alveoli suggesting a chronic alveolitis, as already described in cases of "hairspray-lung". Moreover, a congestion of blood and an emphysema was found. Beside these findings, there was amorphous foreign material in the alveoli (Fig. 1). Furthermore, numerous fungal filaments and conidiae

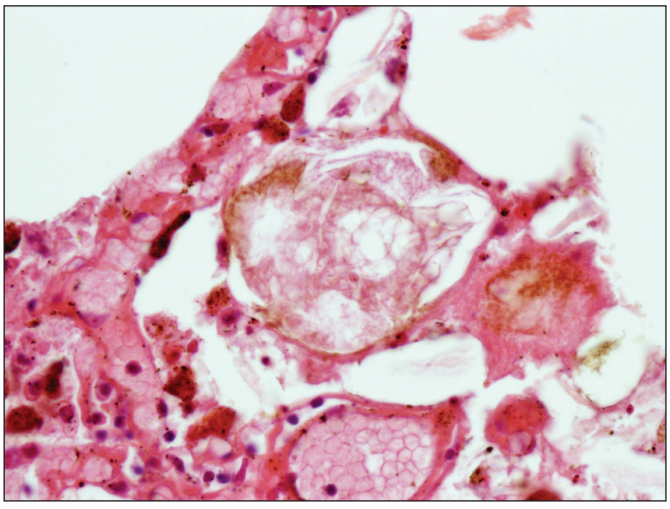

Figure 1. Amorphous foreign material in lung alveoli (HE x200).

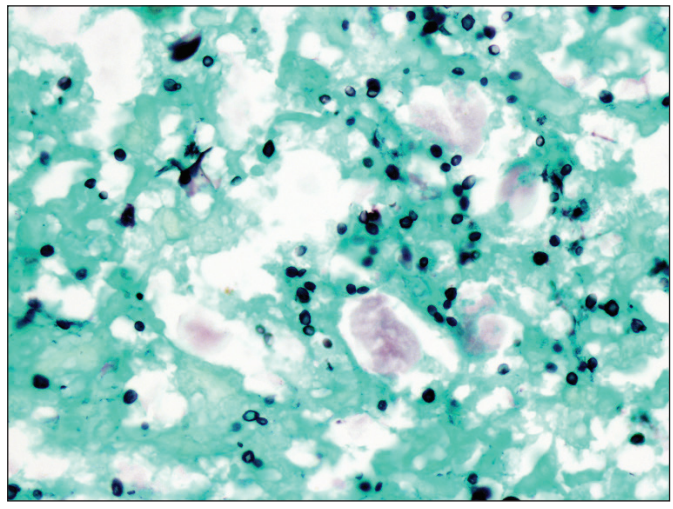

Figure 2. Numerous conidiae and single hyphae in the lungs (Grocott x400).

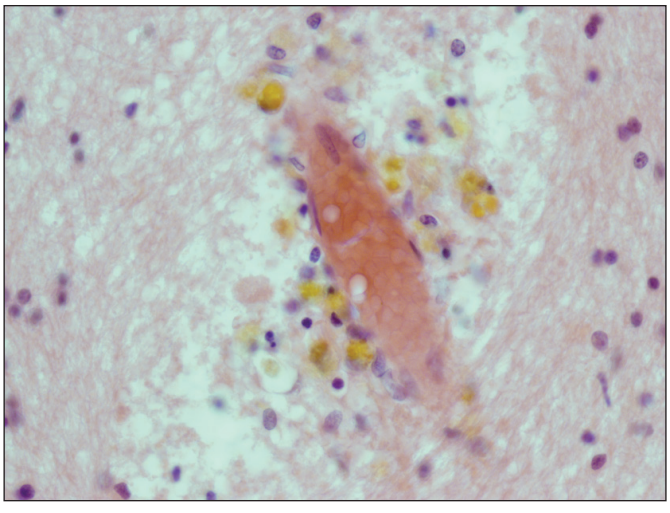

Figure 3. Congestion and perivascular defects with numerous lipophages in the brain (HE x400).

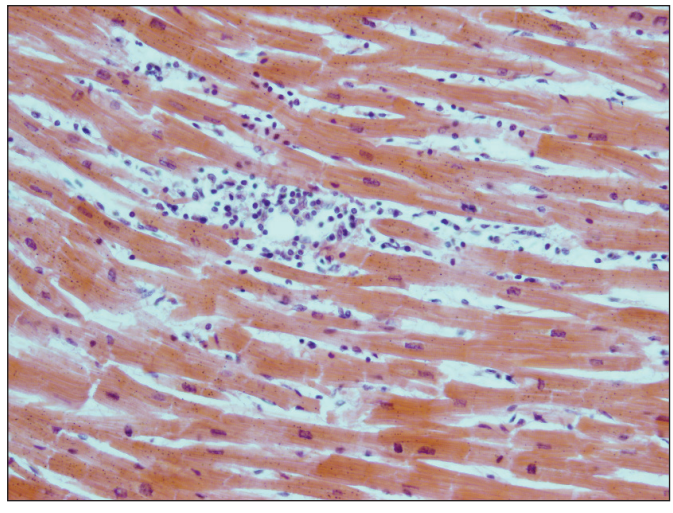

Figure 4. Myocarditis with focal and minimal diffuse lympho-monocytic infiltrates (HE x200).

were seen exclusively in lung tissue (Fig. 2). Additionally, the brain tissue did not only show edema and congestion but also defects near small vessels with macrophages located there as lipophages (Fig. 3). This finding, although its origin remains unclear, must also be taken into account as very unusual, when found in the brain of a 20-year-old woman. Histologically the myocardium presented interstitial fibrosis, single cell necrosis and primarily focal minimal diffuse lympho-monocytic infiltrations (Fig. 4). Toxicological investigations revealed promethazine in a therapeutic blood-concentration. All other tissues which have undergone toxicological investigations depicted a "fingerprint" of substances in extremely low concentrations and matching the chromatogram obtained from the primarily used hairspray. However, there was no toxicological finding explaining the sudden death.

By sequencing the ITS region of the ribosomal genes the yeast *Yarrowia lipolytica* is identified after growing on agar plates with samples from the lung. This yeast is rarely opportunistic pathogenic and it is suggested, that this fungus is counted to the normal human flora of the respiratory tract [7-8]. However, the histopathological findings of fungus growth in the lungs fits the microscopically appearance of *Yarrowia lipolytica* showing single cells, Blastoconidia and Pseudohyphae.

DISCUSSION

In forensic practice, cases of sudden death with unknown diseases prior to death are not unusual. Examples include undiagnosed fatal pleural empyema and other pathologies [9]. Nevertheless, case reports concerning diseases due to or in the context of inhaling deodorant and / or hairspray are rare. Unfortunately there was only little information concerning the family history and the medical history of the young woman. There was the suspicion that the young woman experienced domestic violence. Thus, the inhalation of hairspray perhaps can be regarded as a special form of self-injury, because there is a wide range of potential injury patterns beside the well-known scarring of the arms [10]. A fibrosing interstitial alveolitis and multinucleated foreign body cells are described as reaction to inhaled foreign material leading to the picture of a so called "hairspray-lung" [1-5, 11-12]. Because of the polymers in the hairspray solution, the ciliae of the respiratoric epithelium might have been glued together, subsequently the mucous could not be transported any longer and served as a sort of growth medium for the fungi allowing them to colonise the lung [13]. It should also be taken into account, that the same plastic box was used repeatedly for a longer period to inhale hairspray and that the wet milieu inside the plastic box probably supports growing of fungi. Although the corpse was kept at 4 °C immediately after the subject was found, even corpses kept at environmental temperature do not depict the amount of conidiae and fungi as seen in the young woman. Therefore this excessive growth of fungi in both lungs is ante-mortem a very unusual finding, especially concerning a very young woman. Additionally the perivascular accumulation of lipophages is an unusual finding as well, regarding the age of the victim. Although a causal relationship between the lethal lymphocytic myocarditis and the daily inhalation of hairspray cannot be proven beyond doubt, it should be considered, that cardiotropic viruses could have been inhaled together with the hairspray. However, in the scant literature describing hairspray inhalation there are no reports pointing to a higher incidence of a virus-induced myocarditis in cases of hairspray-inhalation.

Therefore the myocarditis should be considered as a random finding, although it is most probably cause of death. Only exclusion of a virus-induced myocarditis would allow a differentiation towards a toxic myocarditis which should still be considered. To the authors best knowledge, this is the first report of a „hairspray-lung" presenting a severe infiltration of the lungs with fungi, unusual defects and lipophages in the brain, altogether findings which have not been described with regard to a case of hairspray inhalation so far. The mycosis of the lungs was found by histological investigations and can be considered as a result of long term hairspray inhalation, a finding which should be attributed to the group of toxin-induced pathologies [14]. This once more underlines the sense and necessity to initiate conventional histological stainings including special stainings, not only to detect fungi in cases of suspected hairspray inhalation, but also in other cases to clarify cause of death [15].

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