



Research paper

An autopsy approach to bolus deaths

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ABSTRACT

Background: The term “bolus death” or “cafe coronary” refers to a misplaced larynx or laryngeal inlet by foreign bodies, in most cases by unchewed pieces of food such as meat, sausage, or fruit. The pathophysiological mechanism of death is still debatable – sudden reflex cardiac arrests and asphyxial suffocations are implicated. In particular, children, alcoholics, and persons with brain-related damages belong to this risk group. A defective dentition is also associated with the risk of bolus deaths.

Aim: The aim of the study was to supplement existing literature by evaluating cases of bolus deaths and determining the most likely mechanism of death in a large autopsy sample.

Material: Among 31,647 autopsies, 59 cases of cafe coronary syndrome were identified and evaluated: 38 male adults and 21 female adults between the ages of 26 and 89 years.

Methods: A retrospective analysis of autopsies performed in the Institutes of Forensic Medicine in Rostock (1990–2014) and Munich (1990–1999) was conducted. Autopsy findings, circumstances of death, police investigations, preexisting conditions, dentition, and toxicological investigations were recorded. Then, based on the presence or absence of selected findings and surrounding circumstances, conclusions on the mechanism of death were drawn.

Results: In eighty-six percent (86%), boluses of meat and sausage or meat-like chunks were observed. Of the forty-nine victims, 22 (42%) had elevated blood alcohol levels (>0.5‰) with blood alcohol concentration (BAC) levels of >0.73‰ to <3.99‰. Of the nonalcoholized decedents, 63% had neurological disorders and 11% had preexisting cardiac conditions.

Conclusions: Detecting potential bolus events upon autopsy and the resulting mechanism of nonnatural deaths are of great importance. Therefore, the medical history, resuscitation protocol, and detailed description of the scene of death are essential. Upon autopsy, the type and position as well as size and weight of the bolus and dental status of the victims should be documented in a standardized manner. Additional toxicological investigations are necessary.

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1. Introduction

Legend has it that the Greek poet Sophocles choked to death on a grape lodged in his larynx in 400 BC. In German specialist literature, the term *bolus death* (the Greek word “bolus” means lump or clod) was first established in the early 20th century. In 1908, Puppe defined suffocation from oversized food pulp as *cafe coronary*.¹ This was soon followed by descriptions of anatomic landmarks for the bolus as a foreign object located in front of the laryngeal inlet, above or under the glottis, or protruding into the laryngeal inlet at

the positioned epiglottis. In the following years, the definition of cafe coronary was extended and characterized as a mechanism where death occurred due to obstruction of the laryngeal entrance via wedging of solid pieces of food and other foreign particles. In 1913, Kolisko offered the term “laryngeal shock” (indicating a vagus death) as a pathophysiological alternative.²

The exact pathomechanism has been a matter of debate in specialist literature for decades and continues to be so. A theoretical distinction is made between asphyxial suffocation due to an airway displacement and the impossibility of expectorating or regurgitating the foreign body, but also a reflective cardiac death *inter alia* by irritating the upper laryngeal nerve. It is likely to be a combination of both processes.^{3–5} Functional central nervous system (CNS) restrictions due to diseases, intake of medication, previous brain damage, a defective dental status, or alcoholization increase

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the risks of a lethal outcome.

The present study aims to supplement the existing literature, based on the evaluation of 59 deaths out of 31,647 autopsies due to café coronary. Here, the most likely mechanism of death is proposed according to the selected criteria.

Relevant information about when and where the person was found and witnesses' statements about the incident were taken from police investigations. The following aspects were investigated:

- Have characteristic symptoms been observed (dyspnea, livid discoloration of the facial skin, convulsions, coughing, choking, spitting, or regurgitation)?
- Can statements on the period of agony be provided? Was there any report of sudden lifelessness or a prolonged struggle before death?
- Is there evidence of an imminent food intake?

2. Material and methods

Among all postmortem examinations performed at the Institutes of Forensic Medicine at the Ludwig Maximilians University in Munich (1990–1999) and the University Medical Center in Rostock (1990–2013), cases of “café coronary” were identified. Cases with ambiguous autopsy findings were not taken into account. The evaluation also included police investigation files regarding the circumstances of death. Information about medical history, age, and gender but also the position, quality, and size of the bolus and the dental status were taken from autopsy reports. Morphological findings such as asphyxial signs (facial cyanosis, petechiae of the facial skin/conjunctivae, or Tardieu spots), pulmonary emphysema, and/or pulmonary edema were evaluated. If available, concomitant cardiac and neurological diseases, blood alcohol level, and drug test results were also taken into account.

3. Results

3.1. Frequencies of occurrence

Among 23,819 forensic autopsies performed at the Institute of Forensic Medicine in Munich between 1990 and 1999, 36 cases (0.16%) of bolus asphyxiation were observed. These cases include 24 male and 12 female victims aged 30–89 years (median 61 years).

Of 7828 forensic autopsies performed at the Institute of Forensic Medicine in Rostock between 1990 and 2014, 23 cases (0.29%) were diagnosed as “café coronary.” Of those, 14 were male and nine female, ranging in age from 26 to 91 years (median 60 years).

The overall sample provides 59 cases (38 men, 21 women) of bolus deaths among 31,647 forensic autopsies (0.18%) (Fig. 1). Adults aged 51–60 and >71 years were most commonly affected.

3.2. Nature of the bolus

In all 59 cases, the bolus was preserved and inspected. The nature of the predominant component was defined macroscopically (Table 1). The category “others” comprises undefined and chunky food.

3.3. Alcoholization

The blood alcohol concentration (BAC) was analyzed in 50 cases (85%), 28 (56%) of which showed no blood alcohol. One deceased person had a BAC <0.5‰. Twenty-one decedents (42%) had BAC levels considered to be relevant for the act of swallowing ranging

from 0.73‰ to 3.90‰. The arithmetic mean BAC level of these 21 victims was 2.3‰. Alcohol consumption was significantly less in women (male 19 cases, female two cases). The highest value was 3.42‰ for women and 3.90‰ for men. The gender distribution of the BAC levels is shown in Fig. 2.

The age distribution of persons affected by alcohol and their mean BAC values are shown in Fig. 3. The relevant alcohol concentrations (> 0.5‰) were found in the age group of 18–79 years among men.

3.4. Preexisting conditions and enabling factors

Five cases showed neither preexisting conditions nor signs of alcoholic influence. They could not be attributed to a concrete age group (36–78 years) or a specific gender (three male and two female decedents). Furthermore, the teeth conditions were not recorded for these cases.

Among the remaining 54 (91%) persons, both cardiac and neurological conditions as well as combinations thereof were found. In 27 cases (45%), morphological cardiac alterations such as cardiac hypertrophy, myocardial infarction scars, and middle- to high-grade coronary atherosclerosis were detected. Neuropathological alterations could be found in clinically documented neurological diseases, for example, infantile brain damage, Huntington's disease, paresis after stroke, ethyl toxic encephalopathies, and dementias. Furthermore, brain atrophy and hydrocephalus were subsumed, such that morphological changes were noted in a total of 36 cases (61%).

The age and gender distributions of cardiac and neuropathological findings are shown in Figs. 4 and 5.

There were 18 cases (30%) with clinical and medical history data concerning neurological conditions, as shown in Fig. 6.

Out of 29 nonrelevant alcoholized persons (see above), 22 (76%) had neurological abnormalities and 14 (48%) had cardiac abnormalities. In 10 cases (34%), the victims were exclusively affected neurologically, whereas two (7%) had cardiac conditions only. The previously mentioned five cases showed no preexisting conditions.

The distribution of preexisting conditions is listed in Table 2a.

The dental status was only recorded in 17 cases. In three cases (18%), an intact denture was noted. In eight cases (47%), irregular dentition or partial prosthesis was described. In six cases (35%), a full prosthesis was noted.

3.5. Death scene and witnesses

Of the 59 deceased persons, 28 were found dead alone; 13 (46%) of these deaths were clearly related to food intake. Twenty-two persons died in the presence of others. In 9 cases, there was no information.

Upon autopsy, 22 persons who died immediately due to food intake showed signs of suffocation such as petechiae, Tardieu spots, acute emphysema, or pulmonary edema. In seven cases, there were no findings. Witnesses' descriptions were categorized into “sudden collapse” and “turning blue” with following collapse and “vomiting/choking/coughing” according to the leading symptom. One case could not be assigned.

The testimonies and autopsy findings are presented in Table 2b.

Statements on the duration of agony can be estimated semi-quantitatively (“short” vs. “longer”). All cases of the “sudden collapse” category were associated with a short-term agony. The remaining heterogeneous group of cases had a long-term agony.

3.6. Autopsy findings

Morphological signs of suffocation such as petechiae and/or

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