



Death by anaphylactic shock in an institution: an accident or negligence?

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Received: 15 February 2018 / Accepted: 29 August 2018
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Abstract

This is a description of a man, institutionalised for learning difficulties, known to have an allergy to seafood. After eating a pie, the patient quickly developed dyspnoea and vomiting. The staff at the institution administered epinephrine and called the emergency services. Despite cardiopulmonary resuscitation, the patient died shortly after being admitted to the emergency department of the University Hospitals of Geneva. In the light of the circumstances of the death and of a discrepancy between the information given to the police by the staff at the institution looking after the patient on the one hand, and the preliminary elements of the investigation on the other hand, it was suspected that there was failure in care of the patient and our institute was asked to carry out an autopsy. Basing on all the investigations carried out, the cause of death was anaphylactic reaction following the ingestion of seafood, contrary to what had been alleged by the staff at the home.

Keywords Anaphylaxis · Seafood · Death

Introduction

Food allergies are relatively common in the population [1]. A food allergy can manifest itself by way of severe reactions such as anaphylaxis, which can lead to death [2]. For this reason, it is essential that hospitals and homes take special precautions in order to avoid giving food that is likely to cause a reaction in a patient known for a specific food allergy. This is particularly the case for elderly patients and/or those with a handicap, who would not be able to determine whether the food they eat represents a danger for them. If, despite taking the necessary care, an allergic reaction causes the death of a patient in an institution, this death must be reported to the competent judicial authority, the latter being, in Geneva, the Public ministry or on its delegation, the police. The Public prosecutor will then instigate an investigation to determine the circumstances of the event, in particular whether criminal

liability is involved. The forensic physician will then surely be called to carry out an autopsy and any additional investigations to determine the precise cause of death.

Case report

A 64-year-old man, with a diagnosis of epilepsy, as well as learning difficulties since childhood as a result of meningitis, was also known for a specific food allergy to seafood. Because of his health problems, he had lived in an institution for many years. On the day of his death, just after the staff at the home served his meal, the patient presented with severe dyspnoea, and he complained about this to one of the educators. He also vomited and then promptly went into cardiorespiratory arrest. The staff on duty administered adrenaline to the patient and called the emergency services. The latter quickly attended to the patient, started cardiopulmonary resuscitation, administered adrenaline and tracheal aspiration, which brought up gastric contents. The patient was then transferred to a hospital (University Hospitals, Geneva), where clinicians found that he had a generalised skin rash, that he was in a coma (Glasgow coma scale 3/15), had fixed bilateral mydriasis, a pupillary reflex in the left eye only, and a lack of any other brainstem reflexes. Despite the administration of adrenaline, the patient remained haemodynamically unstable. Given the severity of

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the neurological prognosis, it was decided to withdraw treatment, with the consent of the patient's family, and the patient rapidly died after that. The relatives of the deceased were told that the death was caused by food going down the wrong way, and they did not question this, as such events had already occurred several times before.

A report was drawn up by the paramedics, which stated that the patient had accidentally been given a seafood pie, despite the patient's having a known seafood allergy, and that he quickly presented with dyspnoea after eating the said pie.

A death certificate was issued by the emergency physician at the hospital who declared the death, certifying death by natural causes. The family had made a request for cremation of the body, and according to the laws of the canton of Geneva, the Institute of Forensic Medicine instructed that the circumstances of the death be verified before authorising the cremation. It was then that we suspected that the death had in all likelihood occurred following an allergic reaction and informed the Public ministry, which ordered an autopsy.

The staff at the institution in which the patient resided was questioned by the police as to the circumstances of the event that led to the death of the patient. This institution was divided into apartments in which several residents resided. The information provided, for the patient in question, reported dependency for all everyday activities because of severe learning difficulties, with a history of allergy to seafood, which is why—although a seafood pie had been put on the menu of the day—a cheese pie had been served to the residents of this apartment, knowing that they sometimes swapped food between themselves. Apparently, this pie was served with a walnut salad. When asked more specifically about administration of the EpiPen® (adrenaline), the staff said they gave it without suspecting an allergic reaction, since the patient was suffering from dyspnoea. The staff at the institution stated they assumed that some food had gone down the wrong way (he had inhaled some food) given the vomiting that occurred quickly after ingesting the food.

However, the paramedics told the emergency doctors that the situation was presented to them by the staff of the institution as a suspected allergic reaction after eating a seafood pie.

Results of the forensic investigations

A medicolegal autopsy was performed 4 days after the death occurred.

The *macroscopic* examination showed a swelling of the larynx (Fig. 1), with haemorrhagic infiltrations, gastric content that had entered the oesophagus and the upper respiratory tract, as well as signs of resuscitation (namely costal and sternal fractures, traces of an injection in the upper limbs).

The *immunohistochemical* analyses of the lungs showed strong positivity for anti-tryptase (Fig. 2) and anti-CD117

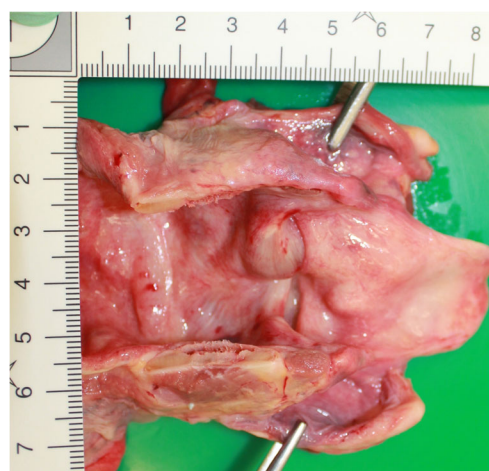


Fig. 1 Macrograph showing laryngeal oedema

(Fig. 3) antibodies, signalling the presence of very many activated mast cells.

Moreover, pagoda red staining performed in the spleen showed scattered eosinophilic reaction and diffused activated mast cells (Fig. 4).

The *clinical chemistry* analyses carried out on a serum sample taken ante-mortem at the hospital 2 hours before the death showed high serum tryptase levels (21.9 µg/L; standard, < 13.5), which suggests an allergic reaction. The analyses carried out on the serum ante-mortem and on the pericardial fluid taken during the autopsy showed high values (46.4 kU/l) of an antibody (IgE) that reacts to a fish/shellfish mix, and a non-significant value (< 0.35 kU/l) of an antibody specific to fish.

The results of toxicological analyses, performed on ante- and post-mortem samples (blood and urine) were negative for all substances tested for (alcohol, drugs and medication).

Additional investigations

In the light of the discrepancy between the information given to the police by the staff at the institution in which the events

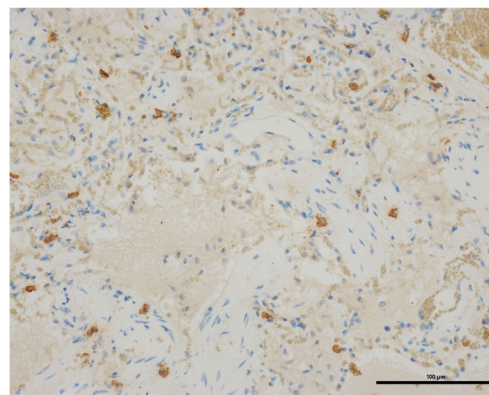


Fig. 2 A micrograph of a lung sample, showing many activated mast cells, stained in brown (anti-tryptase antibody, × 200)

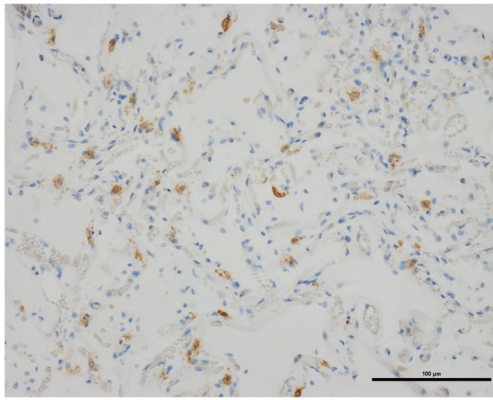


Fig. 3 Another micrograph of a lung sample, showing many activated mast cells, stained in brown (anti-CD 117 antibody, $\times 200$)

occurred and those from the paramedics, the Public prosecutor asked us to carry out additional investigations. So, we considered it pertinent to attempt to determine whether there was any seafood in the gastric contents taken during the autopsy and in the rest of the “cheese pie” confiscated by the police that was allegedly served to the patient and his co-tenants, according to the staff at the institution.

Therefore, we commissioned a private laboratory to perform *genetic analyses* using sequencing (16S rRNA) to detect the presence of seafood, on the one hand, in the gastric contents, and, on the other hand, in the remainder of the pie served to the tenants, which was confiscated by the authorities. This method, used by J. Brzezinski [3], was designed to detect the presence of crustacean DNA in food products and to determine the species source of the DNA. Both analyses came back positive. This laboratory then carried out an analysis to determine whether the same seafood was found in both substrates, but this analysis did not give the expected result (seafood was not successfully detected in the pie, because the sample had deteriorated significantly). For reasons of efficiency, no other analyses were carried out by another laboratory, since the

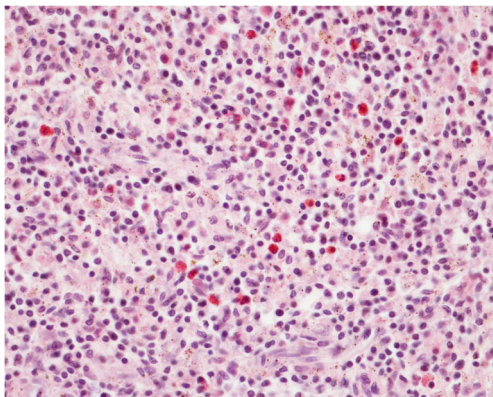


Fig. 4 A micrograph of a spleen sample, showing scattered eosinophilic reaction and diffuse activated mast cells, both stained in red (pagoda red, $\times 400$)

elements available to the Public prosecutor were deemed sufficient for this investigation.

Discussion

Under the laws of the canton of Geneva, before a body can be cremated following a death certificate, a second verification must be carried out by a forensic physician of the CURML (University Center of Legal Medicine Lausanne-Geneva), who will then issue, if appropriate, an authorization for cremation (art. 3A, Geneva law on cemeteries). This approach prevents the irreparable destruction of evidence required for the courts in the case of a death being certified incorrectly by a doctor as being due to natural causes.

In the case we are dealing with here, this approach helped to identify a situation with unclear circumstances of death, and which required additional forensic and judicial investigations.

Food allergies are common, affect 3.5 to 4% of the world's population [2], and the trend is on the up [4]; the specific allergy to crustaceans is well known and concerns 0.5 to 2.5% of the world's population [5]. All classes of molluscs (gastropods, bivalves, cephalopods etc.) and crustaceans (decapods, stomatopods, barnacles, ...) are concerned. The symptoms of such allergies can vary from a simple rash to an anaphylactic reaction, i.e. systemic, and are likely to cause death. Mucocutaneous involvement is more common in the paediatric population, whereas anaphylaxis is more prevalent in adults [6]. One talks of a true food allergy when the reaction is mediated by immunoglobulin E (IgE), with degranulation of mast cells, basophils infiltration and the release of histamine and other vasoactive substances. It is not necessary to ingest the food responsible for the reaction: simple contact with the skin or inhalation can trigger the allergic reaction. The only effective means of prevention is strict avoidance of the allergen.

A study [7] carried out in New Zealand on 18 cases (20 years) of deaths related to anaphylactic shock demonstrated the presence of aspecific signs at autopsy, such as laryngeal oedema, oedema and lung congestion, cerebral hypoxia and oedema of the skin, depending on the case. The serum tryptases analysed in 15 cases were significantly high in 8 cases, i.e. higher than 20 µg/L. In this study, the authors stated that a typical clinical history and high levels of serum tryptase (> 20 µg/L) are important tools for establishing diagnosis of the cause of death if anaphylaxis is suspected.

In the case we describe, similar results were found, namely the presence of a laryngeal oedema, serum tryptase of 21.9 µg/L (standard, < 13.5 µg/L), high specific IgE for crustaceans, as well as highly positive immunohistochemical results for the lungs, signifying the presence of a large number of activated mast cells.

Furthermore, the presence of crustaceans in the gastric contents, identified by way of RNA genetic analysis, proved to be an important element, too. It was not possible to assure the presence of the same crustacean in both substrates. As mentioned by Santaclara and colleagues [8], in a lot of seafood products, the assignation to a particular species based on morphological traits is not possible, because it is removed in the transformation process.

Finally, from the point of view of the criminal investigation, the presence of crustaceans identified by the same method in the cheese pie was a determining factor, which led to the allegations of the staff at the institution in charge of the victim being questioned, based on scientific evidence. Indeed, it turned out that the residents of the apartment occupied by the victim had been given a seafood pie and not a cheese pie, as indicated to the police by the employees of the home.

The person responsible for this error could not be identified despite the investigation by the Public ministry, so a *nolle prosequi* has been issued.

Conclusions

The constitution of scientific evidence is an essential element during judicial investigations following a death. The challenge of the forensic physician is to set up or identify the means likely to meet legal requirements and expectations. In this case, the autopsy results and the additional investigations performed (immunohistochemistry, ante- and post-mortem clinical chemistry and genetic analyses) helped to confirm the

presence of an anaphylactic reaction and to identify the responsible agent in spite of diverging anamnestic results.

The analysis of this case shows how important it is for forensic physicians to have enough experience and knowledge not only about anatomopathology but also in a broad panel of scientific fields. Also, an optimal resolution of forensic cases can only be performed by a multidisciplinary team.

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