

Virtopsy

Postmortem Imaging of Laryngeal Foreign Bodies

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• **Context.**—Death from *corpora aliena* in the larynx is a well-known entity in forensic pathology. The correct diagnosis of this cause of death is difficult without an autopsy, and misdiagnoses by external examination alone are common.

Objective.—To determine the postmortem usefulness of modern imaging techniques in the diagnosis of foreign bodies in the larynx, multislice computed tomography, magnetic resonance imaging, and postmortem full-body computed tomography–angiography were performed.

Design.—Three decedents with a suspected foreign body in the larynx underwent the 3 different imaging techniques before medicolegal autopsy.

Fatalities from foreign bodies in the larynx are reported frequently in middle-aged and elderly people.^{1–4} This age group is rapidly growing in Western society, and the importance of accidental deaths from choking on food might increase. In the United States, choking is the fourth leading cause of death from unintentional injury.⁵ Typically, in these types of fatalities, the victim collapses immediately while eating. The diagnosis of bolus death is difficult because the sudden nature and led to the vivid description Café-Corony Syndrome⁶ because the sudden cause of death is mostly misinterpreted as acute cardiac—or coronary—failure. The cause of death is mainly a food bolus in the larynx. These bolus fatalities are still rare in daily forensic practice.^{1,4,7,8}

Risk factors for this cause of death include neurologic and psychiatric diseases, old age, poor dentition, local malformation, local tumors, and intoxication from alcohol and drugs.^{1,2,4,9–13} In the early years of medicolegal investigation, it was assumed that death occurred due to asphyxia, but today, it is known that many cases are reflexogenic.^{1,4,14} In addition, deaths in scurrile situations are reported in case reports.^{15–18}

Results.—Multislice computed tomography has a high diagnostic value in the noninvasive localization of a foreign body and abnormalities in the larynx. The differentiation between neoplasm or soft foreign bodies (eg, food) is possible, but difficult, by unenhanced multislice computed tomography. By magnetic resonance imaging, the discrimination of the soft tissue structures and soft foreign bodies is much easier. In addition to the postmortem multislice computed tomography, the combination with postmortem angiography will increase the diagnostic value.

Conclusions.—Postmortem, cross-sectional imaging methods are highly valuable procedures for the noninvasive detection of *corpora aliena* in the larynx. (*Arch Pathol Lab Med.* 2009;133:806–810)

Modern imaging techniques like multislice computed tomography (MSCT) and magnetic resonance imaging (MRI) allow the medical specialist in clinical radiology to localize foreign bodies—even if these are not radiopaque—and to perform virtual bronchoscopies or gastroscopies.^{19–21} With the postmortem use of modern imaging techniques, small hemorrhages in the laryngeal muscles are assessable without any dissection,²² but investigation of bolus fatalities by postmortem MSCT or MRI are still unreported.

MATERIALS AND METHODS

Three decedents with a suspected foreign body in the larynx were delivered to the Institute of Forensic Medicine, University of Bern, Switzerland, for medicolegal autopsy. A detailed history of the incidents is given in the case reports below.

Before autopsy in all 3 cases postmortem cross-sectional imaging was executed on a 6-row multislice computed tomography scanner (Emotion 6, Siemens Medical Solutions, Erlangen, Germany). Image reconstruction was carried out in a slice thickness of 1.25 mm with an increment of half the slice thickness and in a soft tissue and a bone-weighted kernel. In the first case, an additional MRI of the neck was performed (GE 1.5T Signa Echo-speed Horizon, General Electric Medical Systems, Milwaukee, Wis) in T1 and T2 weighted sequences. In a third case, a postmortem full-body computed tomography–angiography was carried out. For this angiography, access to the arterial and venous system was gained by preparation of the left femoral vessels. Using a pressure-controlled, modified heart-lung machine (HL20, Maquet, Hirrlingen, Germany), the body was perfused antegrade by the arterial system and retrograde by the venous system. As a contrast agent, a 10:1 mixture of PEG (PEG 200, Schaefer and Schlaepfer AG, Rothrist, Switzerland) and Imagopaque 300 (GE Healthcare Diagnostic Imaging, Slough, United Kingdom) was used.

A board-certified radiologist performed the interpretation of

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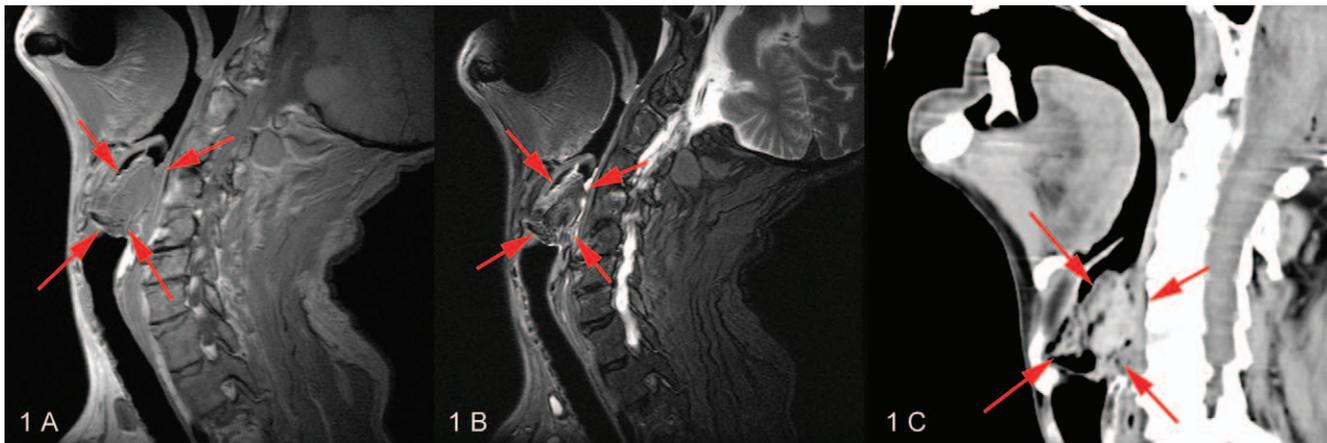


Figure 1. Sagittal cross sections on the midline of the neck. Corpus alienum in the larynx (red arrows). A, T1-weighted magnetic resonance imaging. B, T2-weighted magnetic resonance imaging. C, Multiplanar reformation of multislice computed tomography data.



the radiologic images, and the autopsies were performed by board-certified forensic pathologists. The responsible department of justice and the ethics committee of the University of Bern approved this study.

REPORT OF CASES

Case 1

A 70-year-old man had dinner in a restaurant. While eating a piece of meat, the man collapsed lifelessly. Resuscitation attempts were undertaken but remained unsuccessful. The man was declared dead at the incident scene. The deceased had a history of alcoholism with repeated falls. Furthermore, the man suffered from hypertension and—since a biking accident more than 25 years ago—from a skeletal deformation of the right leg. In addition, he had a history of minor cerebral strokes.

By order of the District Attorney of Bern, an autopsy was performed one day after the incident. Additionally, toxicologic screening, including alcohol, was demanded. One day after the incident, postmortem imaging by MSCT and MRI was carried out.

In the postmortem MSCT, as well as in the MRI scan, a foreign body in the larynx was clearly visible (Figure 1). In addition, the findings of cerebral atrophy and small stroke residues were detected by the imaging procedures. During the autopsy of the throat, a nonmasticated single piece of fried chicken ($4.5 \times 2 \times 2$ cm) was found in the larynx in between the epiglottis and the vocal cords. This piece of meat led to a nearly complete obstruction of the larynx (Figure 2). Because of the deep position in the larynx, this food bolus was not visible at external examination of the body.

The toxicologic screening did not show any sign of drug intoxication. However, the blood alcohol concentration was 0.61 g/L.

Case 2

A 90-year-old woman was fed her breakfast in a nursing home. The woman routinely ate 3 dried prunes and some yogurt. While being fed the first prune, the elderly woman choked and coughed, then she collapsed lifeless. The nurse performed the Heimlich maneuver without success. On manual inspection of the mouth, no food was palpable in the oral cavity or upper pharynx. The woman remained lifeless and died without any endotracheal intubation.

The deceased had a long-time history of Parkinson's disease.

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Figure 2. Autopsy photography: obstruction of the larynx by a piece of fried chicken after autopsy of the throat.

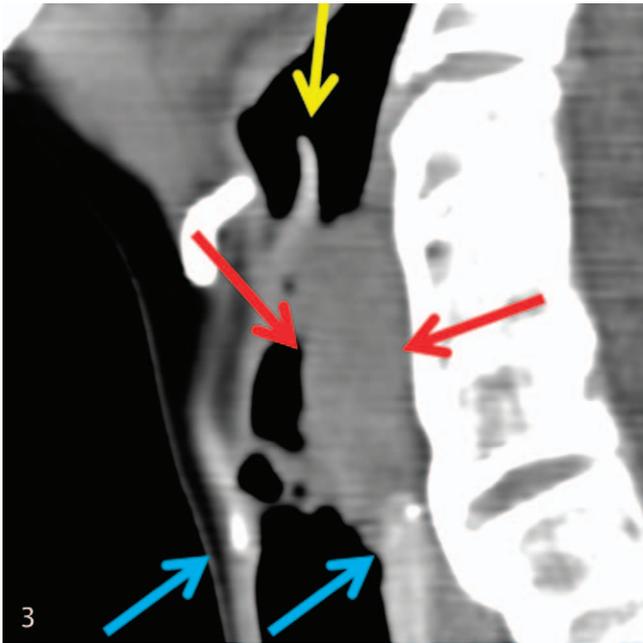


Figure 3. Sagittal multislice computed tomography cross section on the midline of the neck. Corpus alienum (red arrows) in the larynx between glottis (yellow arrow) and cricoid cartilage (blue arrows).

Autopsy was performed one day after the incident. Before autopsy, a full-body MSCT was obtained. In the postmortem imaging, a foreign body in the larynx was clearly visible (Figure 3). The trachea and the bronchi were free of any foreign material. In addition, the finding of a mild cerebral atrophy was detected by the imaging procedures. During the autopsy, a poorly masticated dried prune with yogurt was found in the larynx. This food bolus caused a complete obstruction of the larynx (Figure 4).

The toxicologic screening did not show any sign of drug intoxication. The blood alcohol concentration was 0.00 g/L.

Case 3

While having breakfast, a 60-year-old man with known dementia collapsed suddenly. The relatives started resuscitation, but the man was declared dead on arrival of the emergency forces without any further medical procedures. The last week before his death, the man suffered from a persistent coughing.

A medicolegal autopsy was performed one day after the incident. A full-body MSCT, including postmortem computed tomography–angiography, was performed directly before the autopsy. In the imaging, a laryngeal mass, causing a stenosis of the larynx, was visible with enhancement by the contrast agent. Inside the remaining lumen, foreign material was detectable (Figure 5). In addition, the finding of severe cerebral atrophy and clipping of the right medial cerebral artery were shown by the imaging procedures. During the autopsy, a primary laryngeal squamous cell carcinoma involving nearly the entire circumference of the larynx was detected. Soaked white bread was impacted in the remainder of the lumen, and no foreign material extended beneath this level (Figure 6). The diagnosis of Alzheimer’s dementia was proven by a board-certified neuropathologist.

The toxicologic screening did not show any sign of drug intoxication, and the blood alcohol concentration was 0.00 g/L.

COMMENT

If we trust the ancient Greek historians, one of the first-known bolus deaths is described more than 2400 years ago when Sophocles, at the age of 90, died from choking on a grape.²³ One of the major problems in bolus fatalities is the differentiation between accidental death by a foreign



Figure 4. Autopsy photograph: obstruction of the larynx by a dried prune with yogurt.

body in the larynx and a natural death from other causes, for example, sudden cardiac failure. By emergency services, the fatal accident is identified correctly in less than 10% of incidents.²⁴ The major diagnostic problem is the deep position of the bolus in the pharynx—making it often not detectable during the external examination.

Furthermore, the accusation of maltreatment from a medication overdose or inappropriately prepared food may emerge in hospitalized patients or elderly if they die while eating or getting fed.^{25,26} Choking or bolus death should be excluded in these cases, but the relatives often refuse an autopsy. By postmortem MSCT and/or MRI, it is possible to exclude or substantiate the accusation of maltreatment without an autopsy.

In some countries, the use of imaging techniques like computed tomography and MRI is becoming a routine

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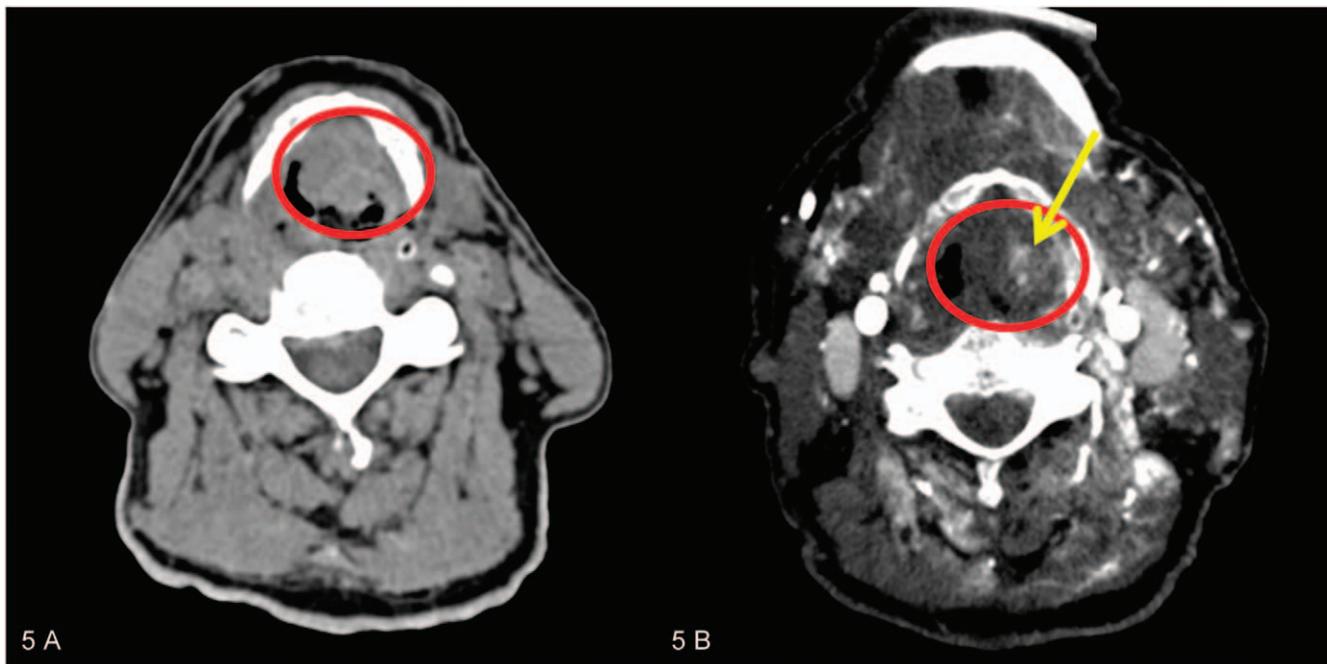


Figure 5. Axial multislice computed tomography cross sections on the neck. Laryngeal masses (red circle). A, Multiplanar reformation of unenhanced multislice computed tomography cross section data. B, Multiplanar reformation of multislice computed tomography cross section data after postmortem angiography. Contrast enhancement of the tumor (yellow arrow).

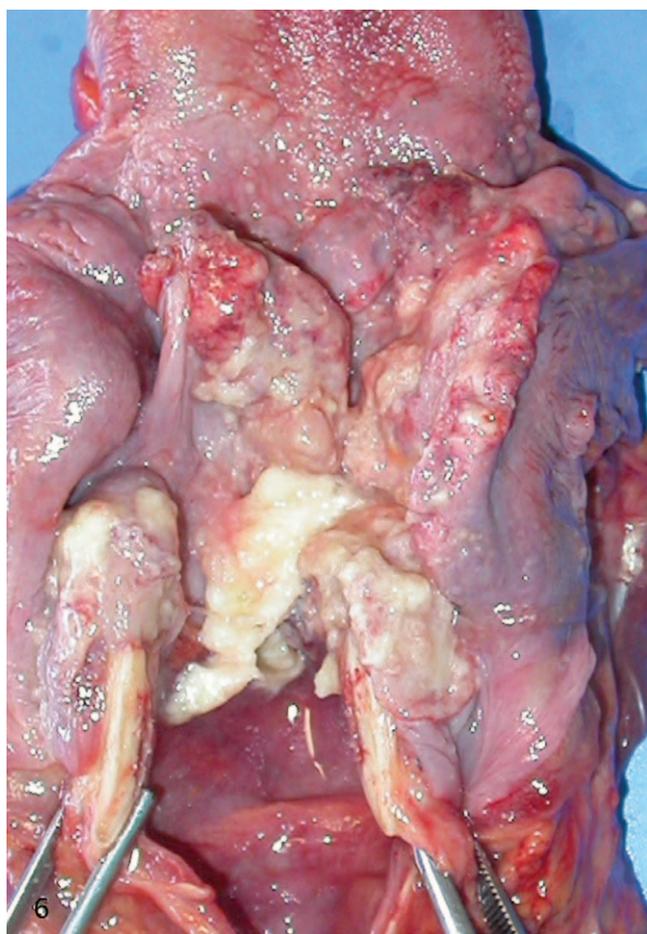


Figure 6. Autopsy photograph: squamous cell carcinoma of the larynx with hemicircular obstruction of the lumen.

procedure before—or even instead of—an autopsy.^{27–31} The data survey for a full-body, virtual autopsy is possible within a few minutes by MSCT. The present cases demonstrate the diagnostic value in locating a foreign body and abnormalities in the larynx without any major manipulation that might lead to a movement of the bolus. The differentiation between neoplasm or soft foreign bodies is possible, but difficult, by MSCT alone. By MRI, the discrimination of the soft tissue structures and soft foreign bodies—like fried meat—is much easier. In addition to the postmortem MSCT, the combination of MSCT with postmortem angiography will give more valuable information because of enhancement in neoplastic tissue.³²

CONCLUSION

Postmortem imaging methods like MSCT and MRI are highly valuable procedures for the detection of bolus fatalities. The advantage of these procedures is the noninvasive approach that provides a diagnosis without an autopsy. By the use of MSCT, it is even possible to get the necessary images within a few minutes.

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