

Pulmonary Aspiration of Brain Matter in a Motor Vehicle Fatality: A Case Study

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Abstract

We present the case of an adult man who was involved in a motor vehicle accident as a driver. Histological examination of the lung tissue showed the presence of brain tissue within the lumens of the bronchi and bronchioles. Aspiration of brain matter is a rare phenomenon, with only 1 case described in the literature. The finding of brain tissue within the bronchi and terminal bronchioles supports the scenario of a period of agonal respiration with consequent cerebral aspiration. This article adds to the limited literature, distinguishing antemortem or agonal aspiration from **postmortem passive movement**.

Keywords: aspiration, brain matter, motor vehicle fatality, forensic pathology.

Case Summary

We report the unfamiliar finding of aspiration of brain matter in the lungs in a motor vehicle fatality case. A 34-year-old male was involved in a single-vehicle motor vehicle accident as a driver in March 2021. The man allegedly struck a solid object in an urban area in Pretoria and the vehicle rolled multiple times. He was found within the vehicle and declared dead on the scene at approximately 15h00. No resuscitation attempts were documented to have taken place.

Due to the traumatic nature of the death, it was considered an unnatural death, and the case was referred for medicolegal autopsy in accordance with the provisions of the Inquests Act (Act 58 of 1959). The medicolegal autopsy was performed in March 2021, three days after death occurred, due to logistical reasons.

Examination revealed a well-nourished adult male with a height of 160 cm and a body mass of 71 kg. The head, face, and neck showed multiple lacerations, abrasions, and contusions, and brain matter extruded from the lacerations. Multiple fracture deformities involving the skull, facial bones, maxilla, and mandible were observed. Internal examination revealed an extensive comminuted fracture of the calvaria and the base of the skull.

The dura was lacerated at multiple sites and the brain was pulpified (residual mass of the brain weighing 960 g). The atlanto-occipital joint was disrupted with partial transection of the cervical spinal cord at that level. The airways contained brain matter. Sectioning of the lungs revealed brain matter exuding from the cut surfaces of the distal airways. The left and right lungs weighed 360 and 440 g, respectively.

Histological examination of the lung tissue showed the presence of brain tissue within the lumens of the bronchi and bronchioles of representative tissues of both lungs. Further findings showed distortion of the broncho-alveolar architecture and patchy intra-alveolar oedema in the lungs.

Blood ethanol concentration measured 0.14 grams per 100 millilitres.



Figure 1. Lodox™ scanning of the body showed fractures of the skull, facial bones, maxilla, and mandible.

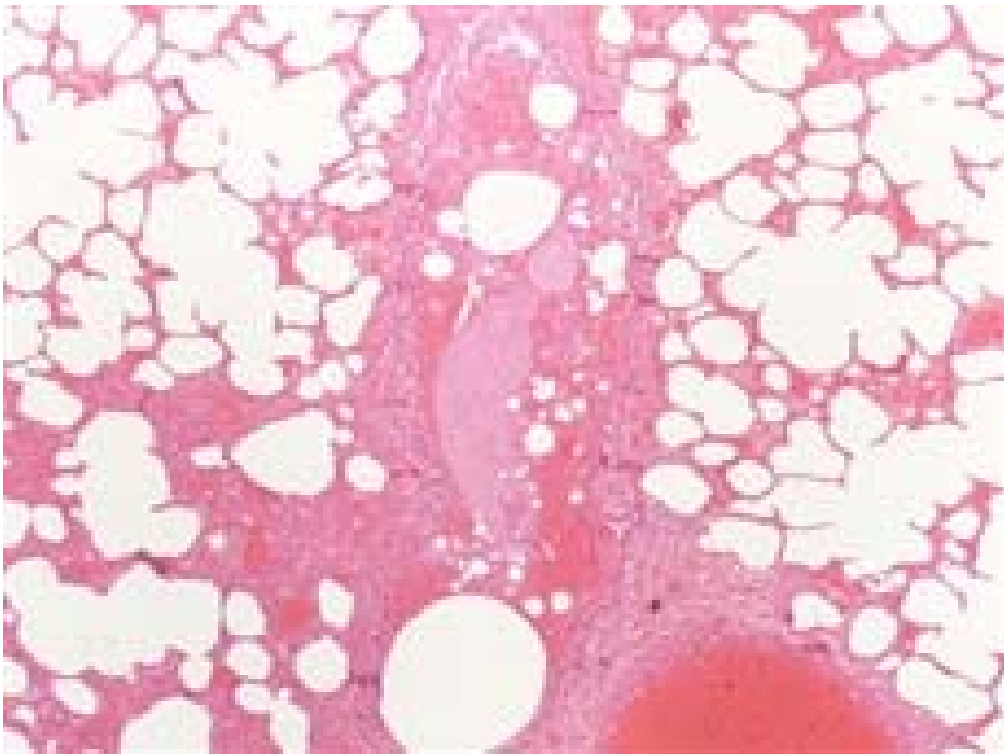


Figure 2. Brain tissue and fresh haemorrhage inside the lumen of the bronchiole (haematoxylin and eosin staining, 4 x magnification).

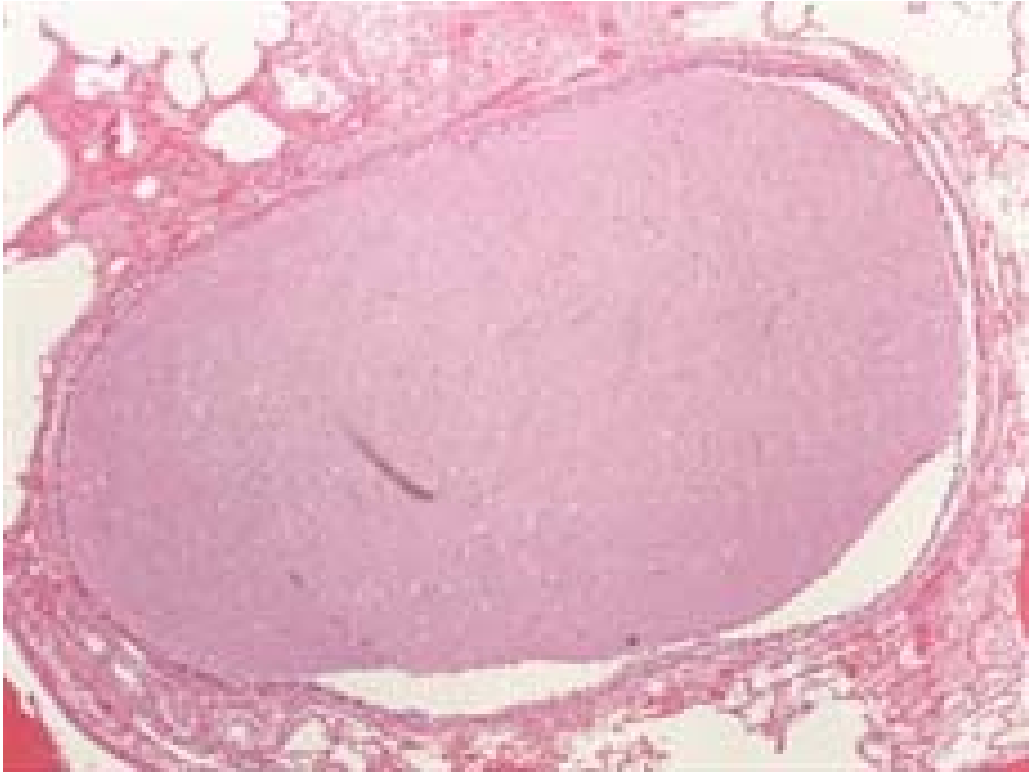


Figure 3. Brain tissue inside the lumen of the bronchiole (haematoxylin and eosin staining, 4 x magnification).

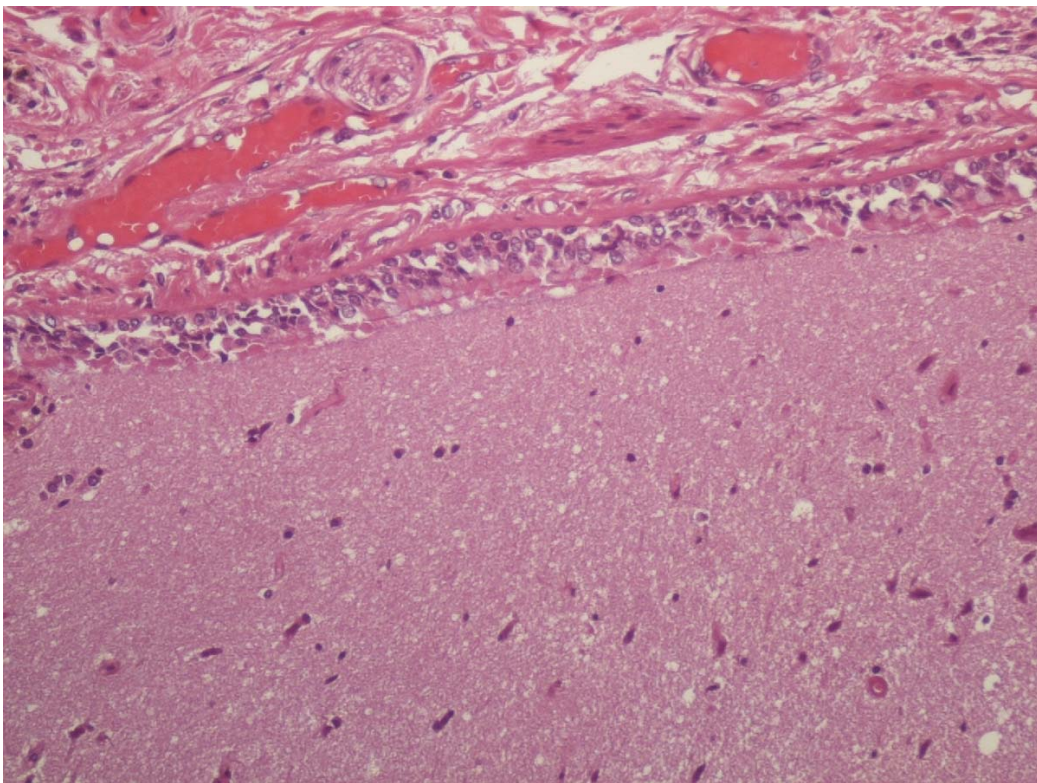


Figure 4. Brain tissue inside the lumen of the bronchiole (haematoxylin and eosin staining, 20 x magnification).

Discussion

Aspiration of brain matter is a rare phenomenon, with only one such recorded case in the literature [1]. The purpose of this article is to document the finding of broncho-pulmonary aspiration of brain matter in a motor vehicle fatality and present an overview of related research.

An estimated 5.48 million people suffer from traumatic brain injury globally per year (73 cases per 100 000 people), of which road traffic collisions and falls are the most common mechanisms [2]. Traumatic brain injuries are frequently fatal in the out-of-hospital and in-hospital settings.

Agonal respiration frequently occurs during a cardiac arrest. Agonal respiration occurs in 40 % of people who experience out-of-hospital cardiac arrest. This respiratory effort originates from neurons in the lower brainstem in hypoxic conditions where higher centers cease to function [1] [3].

Pulmonary aspiration involves inhalation of foreign substances into the tracheobronchial passages. Commonly aspirated content includes oropharyngeal secretions, gastrointestinal contents, oral fluids, blood, bacteria, and food [4] [5]. Aspiration is an objective sign of respiratory effort, and is also often associated with dysphagia [1] [4]. Aspiration in in-hospital critically ill patients and its associated complications are well documented. This is the most common setting in which aspiration occurs [4] [5] [6].

Aspiration of brain matter; however, is a rare phenomenon, with only one case described in the literature [1]. Cerebral aspiration is anatomically possible due to the close association of the anterior skull base and the posterior wall of the frontal sinus, cribriform plate and roof of the sphenoid sinus. Anterior skull base fracture involving these structures, in combination with significant disruption of the cerebral parenchyma, results in communication between the cranial cavity and the nasal cavity and/ or paranasal sinuses. [7]

When aspiration is demonstrated in an out-of-hospital case where death occurs rapidly, this suggests that respiratory efforts took place during the agonal period [1]. An alternative to consider is the post-mortem passive movement of content into the airways. This is a well-documented phenomenon, particularly with respect to the gastric content. Knight demonstrated that 25 % of a series of 100 autopsies showed gastric contents in the airways, the majority of which were caused by agonal spillage. The definitive method for determining ante-mortem aspiration is either reliable antemortem observation by a witness or histological findings of definitive inflammatory infiltration, necrosis, and infection [8].

One can only surmise how this phenomenon might have happened. The cardiorespiratory center is located in the brainstem, which controls breathing, therefore, the findings suggest that the brainstem must have been functional. There was a skull base fracture involving the anterior aspect with exposure to the airway. The occurrence of terminal (agonal) respirations before death resulted in aspiration of pulpified brain tissue into the tracheobronchial tree and lungs. In this case, the finding of brain tissue within the bronchi and terminal bronchioles supports the scenario of a period of agonal respiration with consequent cerebral aspiration.

The finding of broncho-pulmonary aspiration enabled us to demonstrate a sequela of agonal gasping. This may allow for a better evaluation of the duration of the agonal process and any medicolegal significance thereof, for example, distinguishing ante-mortem or agonal aspiration from post-mortem passive movement [1].

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