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Retrograde blood aspiration: a vital reaction

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Abstract

Blood aspiration, which is based on an intact breathing activity, is one of the forensically most important vital reactions. On the example of 11 forensic cases it is shown that the aspiration of blood into the lung tissue is possible not only when the bleeding source is situated above the trachea or main bronchi, but also in a retrograde way, taking its origin from an injury of the peripheral lung tissue itself. Equally to 'classical' blood aspiration, the findings of retrograde blood aspiration are to be diagnosed by means of macroscopical and histological examination of the lung tissue. The lung tissue presents with roundish, reddish spots, which are situated close to, but separate from a lung contusion or other lung tissue injury, and microscopical examination reveals blood in the alveoli and the bronchioli. Retrograde blood aspiration may be a helpful vital sign in the forensic assessment of thorax trauma cases where no other vital reactions are present.

Keywords: Blood aspiration; Retrograde blood aspiration; Vital reaction; Lung trauma

1. Introduction

The question whether an injury was inflicted during life is one of the most important subjects in forensic practise [1–3]. Four basic forms of vital reactions based on circulation (e.g., hemorrhage, all forms of embolism), respiration (e.g., aspiration of blood, gases, gastric contents, water), consciousness (e.g., swallowing, crow's-feet), and metabolism (e.g., toxicological changes, secretion) are known to date.

Regarding their forensic value of evidence, the reliability of the various vital reactions has to be judged differently, as body tissues may 'survive' cardiovascular arrest and brain death for a certain time and consecutively react to a traumatic event even after the death of the individual (supravital reactions, e.g. the post-mortem excitability of skeletal muscles) [3–5]. Passive processes may mimic vital signs like for instance the oozing of blood from ruptured vessels into surrounding tissues resulting in post-mortem hematomas, or petechial bleeding caused by hypostasis [1,3,6]. The so-called 'crow's-feet' seen on burned corpses is a good vital sign in connection with an intact consciousness [7,8] whereas the swallowing of foreign material (drowning fluid, soot etc.) is less reliable since post-mortem influences may produce the same effects. The same must be considered for vital signs based on metabolism since they can be influenced by post-mortem biochemical processes.

Since breathing is exclusively triggered by the central nervous system and would stop quickly after the cardiovascular arrest or brain death, signs of vitality based on an intact respiration are of a high degree of reliance. One of the major pulmonary vital reactions is aspiration [9–11]. The possibility of supravital aspiration deriving from reflective respiratory movements after cardiovascular arrest can however not be denied [9,10]. In burned bodies, aspiration of soot into the bronchioli is considered as a reliable form of vital reaction. In cases of blood aspiration, an iatrogenic origin by pulmonary resuscitation should be outruled as well as the post-mortem flowing of blood into the trachea and bronchi [9].

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Table 1
Description of macroscopic and microscopic lung findings in 11 forensic cases

Case #/year	Sex/age	Event	Cause of death	Macroscopic lung findings	Microscopic lung findings
1/2000	M/22	Suicidal fall from great height	Massive organ destruction	Lacerations and lung contusions with patchy red discoloration in proximity	Intraalveolar hemorrhage and blood in small airways close to injuries
2/2000	F/36	Suicide, run over by train	Massive organ destruction	Lungs partially severed from body. Lacerations and lung contusions with patchy red discoloration in proximity	Intraalveolar hemorrhage in lung sections close to injuries
3/2000	M/50	Suicide, run over by train	Massive organ destruction	Lungs completely severed from body. Lacerations and lung contusions with patchy red discoloration in proximity	Intraalveolar hemorrhage in lung sections close to injuries
4/2000	F/38	Suicide, run over by train	Massive organ destruction	Lungs partially severed from body. Lacerations and lung contusions with patchy red discoloration in proximity	Alveolar hemorrhages and blood in small airways close to injuries
5/2000	F/15	Suicidal fall from height onto high-voltage line	Electrocution	Lacerations and lung contusions with patchy red discoloration in proximity	Blood in small airways close to injured lung parenchyma
6/2001	M/37	Accidental fall from great height	Internal blood loss	Lacerations and lung contusions with patchy red discoloration in proximity	Intraalveolar hemorrhage in lung sections close to injuries
7/2001	M/48	Accidental plane crash	Massive organ destruction	Lacerations and lung contusions with patchy red discoloration in proximity	Blood in small airways close to injured lung parenchyma
8/2002	F/42	Suicide, run over by train	Massive organ destruction	Lungs completely severed from body. Lacerations and lung contusions with patchy red discoloration in proximity	Blood in small airways close to injured lung parenchyma
9/2002	F/71	Pedestrian traffic accident	Blood loss	Lung perforations by fractured ribs. Patchy red discolorations in proximity of injured lung parenchyma	Alveolar blood and blood in terminal bronchioles
10/2002	M/27	Accidental car crash	Burns	Lacerations and lung contusions with patchy red discoloration in proximity	Blood in small airways close to injured lung parenchyma
11/2002	M/52	Homicide victim, stabbed by knive	Blood loss	Stab wounds of lungs with patches of red discoloration in proximity	Blood in small airways close to injured lung parenchyma

Aspiration as a vital reaction is defined as inhaling material deriving from a source located above the larynx, being principally blood from a fracture of the base of the skull, the viscerocranium or blood vessels of the throat, gastric contents or foreign material from outside the body [1,3], or from a bleeding source resulting from an injury of the trachea or main bronchi [12]. The diagnosis is based on macroscopic findings and histological identification of intrabronchial and intraalveolar aspirated material [11]. Since not only the central areas of the lung but also its periphery would undergo inspiratory and expiratory movements, and according to Patscheider [13], we assumed that aspiration of blood could also occur in a retrograde way from an injury located beneath the larynx and the brochial tree like contusions, lacerations and transections as well as gunshot injuries of the lung tissue itself.

The goal of this study is to present this variant of blood aspiration, which is unknown in forensic literature, by the means of casuistics and to discuss the possible ways of its genesis.

2. Materials and methods

Eleven forensic cases (Table 1; 15–71 years, mean age 39.8 years) were examined by standard forensic autopsy and external examination of the body. Immediate death on site had occurred as a result of accidental or suicidal incidents (four accidents, six suicides) and, in one case, homicide. In each case, several lung tissue specimens were collected from different lung regions and examined histologically (hematoxylin–eosin staining, magnification 100–400×) after formalin fixation and embedding in paraffin.

3. Results

The results are summarized in Table 1 (Figs. 2–4). In all examined cases, the lung tissue showed lacerations and multiple slightly elevated subpleural hematomas consistent with lung contusions; in cases 2, 3, 4 and 8, the lungs were partially or completely severed from the body. The upper airways were not containing blood or other foreign-body material. The cutting surfaces of the lung tissue showed patchy red, roundish discolorations of several millimetres to 1–2 cm in diameter in close proximity of the contusion sites. Histological examination of the lung tissue revealed destruction of the brochoalveolar ultrastructure in injured areas. In areas close to the lung injuries intraalveolar hemorrhage was found as well as blood within the small airways. The unaffected lung parenchyma was normal.