JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, May 2011, Vol. 56, No. 3
doi: 10.1111/j.1556-4029.2011.01716.x
Available online at: onlinelibrary.wiley.com

PAPER

PATHOLOGY/BIOLOGY

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Could Intra-alveolar Hemosiderin Deposition in Adults be Used as a Marker for Previous Asphyxial Episodes in Cases of Autoerotic Death?

ABSTRACT: Intra-alveolar hemorrhage and hemosiderin have been cited as possible markers of recent and remote asphyxial events. Little study has been undertaken of the potential significance of intra-alveolar hemosiderin in adults as a potential marker of previous sublethal asphyxial episodes. Ten cases of lethal sexual asphyxia (an entity known to be associated with repetitive sublethal asphyxial episodes) and 20 randomly selected, age- and sex-matched controls had sections of lung stained for hemosiderin. Subsequently, intra-alveolar, iron-containing macrophages were counted. All cases were men (ages 15–50 years; mean 31.8). No significant increase in hemosiderin was found in victims of sexual asphyxia, indicating that asphyxial episodes in sublethal sexual asphyxial activities may not be sufficiently intense or prolonged to cause intra-alveolar hemorrhage or that intra-alveolar hemorrhage in adults is a relatively nonspecific finding. These results do not support intra-alveolar hemosiderin deposition as a marker for previous sublethal asphyxial events in autoerotic asphyxia.

KEYWORDS: forensic science, sexual asphyxia, intra-alveolar hemorrhage, hemosiderin, autoerotic death, hanging

Intra-alveolar hemorrhage has been cited as a marker of asphyxial events, with the lungs at autopsy having a congested appearance because of hemorrhagic pulmonary edema (1,2). It has also been suggested that hemosiderin-containing intra-alveolar macrophages in infancy may indicate previous asphyxial events, the iron pigment deriving from the breakdown of erythrocytes (3–6).

Little information is, however, available on the degree of asphyxia that is required to cause significant intra-alveolar hemorrhage and how specific or not the finding of iron-containing intra-alveolar macrophages might be for previous asphyxial episodes in adults. To examine whether intra-alveolar hemosiderin may be a marker for previous sublethal asphyxial episodes in adults dying of sexual asphyxia, the following study was undertaken. Suicidal hangings were used as controls as these cases typically involve only one episode of asphyxia because of neck compression.

Materials and Methods

Ten cases of death because of neck compression by sexual asphyxia were retrieved from the files of Forensic Science SA (FSSA), Adelaide, Australia. Autopsy and coronial files were reviewed, and the diagnoses of sexual asphyxia were confirmed according to a standard definition (7). Twenty randomly selected age- and sex-matched cases where deaths were because of suicidal hanging were also selected as controls from the FSSA files. The controls had no histories of previous asphyxial episodes and no evidence of recent or remote chest disease or trauma. Each case had been the subject of full police and coronial inquiries, with standard postmortem examinations being performed.

The ages and sex of the victims were recorded, and routine hematoxylin and eosin sections of lung were reviewed. In addition, sections of lung were stained with Perls stain for hemosiderin according to a standard protocol (8). A single pathologist (HM), who was blinded to the cause and manner of death of all of the cases, counted the number of hemosiderin-containing macrophages in 20 randomly selected, but contiguous 400× high-power fields (hpf) in every available lung section stained by the Perls method. A mean value per 20 hpf per lung section was then calculated for each case. Continuous data were analyzed with two-sample *t*-tests and are summarized using means ± standard deviations. Calculations were performed with SPSS v. 11.5. (IBM Corporation, Somers, NY)

Results

All 10 cases of sexual asphyxia were men aged between 15 and 50 years (mean = 31.8 ± 11.2 years). The age range of controls was 15–50 years (mean 31.8 ± 10.9). The mean number and range of hemosiderin-containing macrophages in the sexual asphyxia

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Received 26 Feb. 2010; and in revised form 18 April 2010; accepted 24 April 2010.

TABLE 1—*Details of 10 cases of sexual asphyxia and 20 controls including the amount of hemosiderin staining in lung sections.*

	Number of Cases	Males	Age Range (years)	Hemosiderin Staining in Lung Sections (Alveolar Macrophage Count)
Autoerotic Deaths	10	10	15–50 years (31.8 ± 11.2)	Range = 0–58.5 Average = 13.8
Controls	20	20	15–50 years (31.8 ± 10.9)	Range = 0.6–456 Average = 106.7

cases was 13.8 ± 18.7 compared to the controls where values were significantly higher at 106.7 ± 144.9 ($p < 0.05$; Table 1).

Discussion

A variety of features may be found at postmortem in individuals who have asphyxiated. Ligature or finger grip marks around the neck may be seen in cases of hanging or strangulation, along with congestion and petechial hemorrhages of the face and conjunctivae. Features of smothering may be more subtle and leave no marks of trauma, particularly in infancy (9). Although it has been proposed that intra-alveolar hemorrhage in the young is a marker of airway obstruction because of overlaying or smothering (3), it is a common finding at autopsy which may be influenced by postmortem interval, resuscitation, body position, and the area from where tissue was sampled (10). Frank blood around the mouth or nares in cases of smothering may be inhaled (11).

Evidence for previous asphyxial episodes is even more controversial, with hypotheses that prior hypoxic episodes in infants may have resulted in intra-alveolar hemorrhage, with intra-alveolar and interstitial hemosiderin deposition occurring as the extravasated red blood cells break down (4–6,12). This has been debated with suggestions made that iron deposition in the lungs in infants is an essentially nonspecific and nondiagnostic finding (8,13). There has, however, been little investigation of the possible significance of iron deposition in the lungs of adults and its relation to previous hypoxic episodes. Studies of this topic have been complicated by difficulties in obtaining cases where previous hypoxic episodes had occurred without confounding factors, such as significant underlying medical illnesses, chest trauma, mechanical ventilation, or previous resuscitative efforts. Cases of autoerotic death or sexual asphyxia could, therefore, provide a good model for the study of this phenomenon, as death usually occurs suddenly by misadventure in previously healthy individuals who have typically engaged in multiple previous sublethal asphyxial episodes.

Sexual asphyxia refers to a situation where individuals utilize hypoxia to increase sexual pleasure, and autoerotic death refers to the situation where an individual utilizing hypoxia to enhance solitary sexual activity has succumbed accidentally because of a malfunction of a device that was being used to cause hypoxia (14,15). Cases most often occur in men who are found hanging in a secluded environment with characteristic surrounding paraphernalia. This often includes pornographic images, bondage equipment, and articles of female clothing. Cases do occur where other methods are used, women are involved, and very occasionally where the manner of death is suicide (16–21). At the scene, there is often evidence of previous activity indicating that the victim has subjected himself or herself to episodes of significant hypoxia in the past (7). Given this likelihood, it was decided to examine lung sections from a series of cases of autoerotic asphyxial death for evidence of hemosiderin deposition to determine whether intra-alveolar hemosiderin in adults could be used as a marker of previous hypoxic episodes in this condition.

Counts of intra-alveolar hemosiderin-containing macrophages, however, revealed no significant increase in numbers in cases of lethal sexual asphyxia compared to hanging controls. In fact, the numbers of macrophages were greater in the controls than in the study group. Even when the three outliers in the control group with the highest scores were removed from the study, the average macrophage count in cases of sexual asphyxia of 13.8 (±18.8) was less than the control value of 50.23 (±47.7), although there was a significant overlap (cases 0–58.5; controls 0.6–456). The reason for the higher numbers of iron-containing macrophages in controls was not apparent, but may have been influenced by the relatively small numbers in the study. Thus, this study has demonstrated no increase in hemosiderin counts in individuals who had died of a syndrome known to be associated with repetitive asphyxia. Although it was not possible to definitely confirm previous asphyxial episodes in all of the victims, given the secretive nature of this activity, the presence of props and associated paraphernalia in each case was in keeping with prior activity. In one case, there was certainly a well-documented history obtained from the partner of the deceased of repetitive episodes going back at least several years (17).

The finding of no significant increase in hemosiderin in lung sections from victims of sexual asphyxia may indicate that the asphyxial episodes are not sufficiently intense or prolonged to cause intra-alveolar hemorrhage. Certainly, this would concur with hemoptysis not being a recognized feature in practitioners and the fact that the degree of neck compression is usually kept under close control. The results may also indicate that intra-alveolar hemorrhage in adults may be a relatively nonspecific finding not indicating previous asphyxial events. This would be in keeping with the nonspecificity of other markers of asphyxia at autopsy (9). In summary, this study does not support intra-alveolar hemosiderin deposition in adults as a marker for previous sublethal asphyxial events in sexual asphyxia.

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