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Histo-morphological Changes in Lungs with Asphyxial Death Cases

Gupta Ved Prakash

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ABSTRACT

Asphyxial death is a common incident in forensic practices, and determination of the manner of death *that may be* ***accidental, suicidal, homicidal****, or* ***natural*** *is of utmost significance. In such deaths, a detailed and meticulous autopsy plays a major role to solve the case while the scene investigation and collection of samples have their own significance. This study has been undertaken on* ***11.54%*** *medico-legal cases of asphyxia to find out some conclusive differentiating histo-morphological findings among the various types of asphyxial deaths from findings of autopsy.*

Key Words*: Asphyxia, Intra-alveolar Hemorrhage*

Address for Correspondence and Reprint:
Dr. Ved Prakash Gupta
Demonstratorof Forensic Medicine and Toxicology
Jorhat Medical College, Jorhat
Phone: +919854875076
Email: mail2vedprakashtsk@gmail.com

INTRODUCTION

Literally, the term **asphyxia** means absence of pulsation (pulselessness), though its usage in Forensic Medicine has generally come to mean a lack of oxygen. Actually Asphyxia is best described as an interference with respiration due to any cause, Mechanical, Environmental, or Toxic[1].

Because of the increasing **scrutiny of media** and **lawyers in forensic issues**, forensic histo-pathology becomes an essential link in the chain of a suspicious death investigation.During the year 2011 and 2012, asphyxial deaths cases were 15.8% and 19% respectively. So there is enough scope of doing such study, as the number of such cases is high.

MATERIALS AND METHODS

This study is an **autopsy based descriptive cross-sectional study** undertaken on asphyxial death cases brought for autopsy at Gauhati Medical Collegefrom 1stJuly 2012 to 30thJune 2013. Relevant informationwas obtained from police, relative of the deceased, person accompanying the corpse and hospital records, if hospitalized prior to death.Detailed autopsy was performed in all the cases and findings were recorded in a suitable proforma especially made for this study.Ten healthycaseswere included as a control sample.

OBSERVATIONS AND RESULTS

Incidence of Asphyxial Death Cases

Out of the 2772 cases being autopsied in mortuary, 11.54% cases were of deaths due to asphyxia.

Types of Asphyxial Deaths

The incidence of various asphyxial deaths (**Table 1**) was recorded and, out of 320 asphyxial death cases, hanging was most common (78.12%) of which 54.06% were male,(20%) cases were due to drowning, of which 16.25% cases were male. Three cases were due to strangulation with female preponderance. All the three cases of choking were males.

Table 1 Various Methods of Asphyxial Deaths

Methods of Asphyxia	Male		Female		Total	
	No.	%	No.	%	No.	%
Hanging 78.12%	173	54.06%	77	24.06%	250	
Drowning	52	16.25%	12	3.75%	64	20%
Strangulation	1	0.31%	2	0.62%	3	0.94%
Choking	3	0.94%	0	0%	3	0.94%
Total	**229**	**71.56%**	**91**	**28.44%**	**320**	**100%**

Weight of Lung in Asphyxial Death Cases

The weight of the lungs in hanging cases was found to be in the range of 401-500 grams in maximum number of cases. The weight of the lungs in different types of asphyxial death are shown in **Table 2**.

MORPHOLOGY (EXTERNAL) OF THE LUNG

In Hanging Cases

The margins of the lungs were sharp in 85.2% cases and round in 14.8% cases. Lungs were spongy in 97.6% cases and doughy in 2.4% cases. Regarding the colour, in 82% of the cases, the lungs were pink, congested in all the cases of hanging. Petechial haemorrhages were present in 24.4% cases.

In Drowning Cases

The margins of the lungs were round in 87.5% and sharp in 12.5%cases. Lungs were doughy in 81.25% and spongy in 18.75% cases. In 78.12% of the cases the colour is pink followed by purple,17.18% cases. The lungs were congested and voluminous. Paltauf's haemorrhage was present in 21.87% cases.

In Strangulation Cases

The margins of the lungs were sharp in 66.67% and round in 33.33% case. Lungs were pinky, spongy and congested in all the cases.

Table 2 Weight of both the lungs in grams

Weight of both lungs in grams	Hanging (250)		Drowning (64)		Strangulation (3)		Choking(3)		Total(320)	
	No.	%	No.	%	No.	%	No	%	No.	%
101-200	0	0%	2	3.12%	0	0%	0	0%	2	0.63%
201-300	1	0.4%	1	1.56%	0	0%	0%	0%	2	0.63%
301-400	1	0.4%	2	3.12%	1	33.33%	0	0%	4	1.25%
401-500 53.75%	**165**	66%	5	7.82%	0	0%	**2**	66.67%	172	
501-600 26.88%	80	32%	3	4.69%	**2**	66.67%	1	33.33%	86	
601-700	3	1.2%	2	3.12%	0	0%	0	0%	5	1.56%
701-800	0	0%	14	21.88%	0	0%	0	0%	14	4.37%
801-900	0	0%	29	45.31%	0	0%	0	0%	29	9.06%
901-1000	0	0%	6	9.38%	0	0%	0	0%	6	1.87%
Total	**250**	**100%**	**64**	**100%**	**3**	**100%**	**3**	**100%**	**320**	**100%**

In Choking Cases

The margins of the lungs were sharp in 66.67% and round in 33.33% case. Lungs were spongy and congested and pink in all cases.

HISTOLOGICAL FINDINGS OF LUNG

In Hanging Cases

Table 3, shows that, amongst the hanging cases, congestion was found in 81.2% cases; interstitial oedema was found in 9.2% cases; alveolar haemorrhage was detected in 26.4% cases; intra-alveolar oedema was found in 9.6% cases; bronchiolar constriction was present in 1.6% cases; alveolar dilatation was detected in 1.6% cases and interstitial haemorrhage was found in 1.2% cases.

Table 3 Histological findings of lung in hanging

Findings	**Hanging** (Total no. of cases = 250)	
	Number	%
Congestion	203	81.20%
Interstitial oedema	23	9.2%
Interstitial haemorrhage	3	1.2%
Alveolar haemorrhage	66	26.4%
Intra-alveolar oedema	24	9.6%
Bronchiolar constriction	4	1.6%
Alveolar dilatation	4	1.6%

In Drowning Cases

Within the drowning cases, alveolar dilatation was detected in 76.56% cases, intra-alveolar oedema was detected in 65.62% cases; interstitial oedema was present in 54.68% cases; congestion in 17.18% cases, bronchiolar constriction in 31.25% cases, interstitial haemorrhage in 3.12% cases, and alveolar haemorrhage in 10.93% cases (**Table 4**).

Table 4 Histological findings of lungs in drowning cases

Findings	**Drowning** (Total no. of cases = 64)	
	No.	**%**
Congestion	11	17.18%
Interstitial oedema	35	54.68%
Interstitial haemorrhage	2	3.12%
Alveolar haemorrhage	7	10.93%
Intra-alveolar oedema	42	65.62%
Bronchiolar constriction	20	31.25%
Alveolar dilatation	49	76.56%

In Strangulation

In all (100%) cases of strangulation, alveolar haemorrhage was detected. Congestion was found in 33.33% case and bronchiolar constriction was found in 66.67% cases.Other features like interstitial oedema, intra-alveolar oedema, interstitial hemorrhage, etc., were not detected in the strangulation cases (**Table 5**).

Table 5 Histological findings of lung in strangulation cases

Findings	**Strangulation** (Total no. of cases =3)	
	No.	**%**
Congestion	1	33.33%
Interstitial oedema	0	0%
Interstitial haemorrhage	0	0%
Alveolar haemorrhage	3	100%
Intra-alveolar oedema	0	0%
Bronchiolar constriction	2	66.67%
Alveolar dilatation	0	0%

In Choking

In choking, all the cases, had congestion, and interstitial oedema. Bronchiolar constriction was found in 66.67% cases. Interstitial haemorrhage, alveolar haemorrhage, alveolar dilatation, etc., were not found in the choking cases studied.The control case has no significant findings except congestion of the lungs.

DISCUSSION

Incidence of Asphyxial Death Cases

The incidence rate of asphyxial death in the present study is found to be **11.54%**.The findings of present study are different from the study of *Singh A* et al[2], *Palimer Vikram* et al[3], *Chaurasia N, Pandey SK*et al[4], and *Dhillon Sangeet*et al[5]who observed slightly lower incidence of violent asphyxial deaths in their study. However, *Choudhury BL*[6], *Patel-A*[7] and *Azmak D*[8] observed slightly higher incidence.

The findings of present study are similar with the study done by *Lalwani S*et al[9] in which the incidence of violent asphyxial deaths comprised approximately 11.21% of all forensic autopsies.The reason for variation in the incidence of asphyxial death in the different parts of world may be due to cultural, ethnic, geo-graphical and genetic difference.

Types of Asphyxial Deaths

In the present study, it was observed that hanging was the commonest form (78.12%) of asphyxial death followed by drowning (20%), choking (0.94%) and strangulation (0.94%).The findings of the present study is similar with the several workers like Singh B et al[10], *Momochand A* et al[11], *Azmak D*[8], *Palimer Vikram*[3], *Chaurasia N, Pandey SK*et al[4],*Choudhury BL*[6] and *Patel Ankur* et al[7] in which hanging constitutes the majority of cases.This study however differs from the study of *Singh A* et al[2], where drowning is the leading cause.

Weight of Lung in Asphyxial Death Cases

The weight of both the lungs in hanging cases was found to be in the range of 401-500 grams in maximum number of cases, i.e. 66%. In cases of drowning 45.31% cases had maximum weight of lungs which were found in the range of 801-900 grams followed by 21.88%cases in the range of 701-800 grams. In 66.67% cases of strangulation, the weight of lungs were detected in the range of 501-600 grams and 33.33% case had weight in the range of 301-400 grams. In cases of choking, 67.67% cases had weight in the range of 401-500 grams and 33.33% case in the range of 501-600 grams.

Copeland[12] found the weights of lung in drowning were around 600-700g, whilst the non-drowned were in the 370-540g ranges.

Pathak NM[13] recorded the average weights of lungs in cases of hanging and found maximally in the range of 301-400 grams (64.7 %). In cases of drowning 63.63% cases had maximum weights of the lungs in the range of 701–800 grams.According to *Polson CJ*[14], in drowning cases, the weight of lung is increased to about twice the normal weight, i.e., 700–800 g.

The findings of the above studies are almost similar with the findings of the present study. However, the findings of Kringsholm et al that 7 per cent of cases of dry-lung drowning with a combined lung weight of less than a kilogram and in the remainder, the average weight of both lungs, 1411 g, compared to 994 g in controls, contradicts the present study.

External Morphology of Lung in Hanging Cases

The lungs were found congested with sharp margin, spongy and pink in colour in maximum number of hanging cases. However, Petechial haemorrhages (Tardieu's spots) were present in 24.4% cases only which is marginally different from the findings of *Luke JL et al*[15] who found petechiae in 21% cases. **The formation of petechiae in hanging cases may be caused by an acute rise in venous pressure that in turn causes over-distension and rupture of thin-walled peripheral venules, especially in lax tissues, such as the eyelid, and in unsupported serous membranes, such as the pleura and epicardium.**

External Features of Lung in Drowning Cases

In maximum number of cases of drowning the margins of lungs were round 87.5% and consistency was doughy 81.25%.Majority, i.e. 78.12% cases had pink colour followed by purple in 17.18% cases.Paltauf's haemorrhage was present in 21.87% cases of drowning. The above findings are consistent with *Shkrum M J*, *Ross CF*[16], *Taylor AS*[17], *Reddy KSN*[1], *Mukherjee JB*[18], *viz. K* and *Polson CJ*[14].

Presence of large sub-pleural haemorrhages (Paltauf's haemorrhage) may be due to rupture of inter-alveolar partitions beneath the pleura. They are more prominent over the lower lobes, and the inter-lobar surfaces.

Histological Findings of Lungs in Hanging Cases

It was observed from the present study that congestion, 81.2% and interstitial oedema 9.2% were more frequent in hanging cases than strangulation where as alveolar haemorrhage was more common in strangulation than hanging (26.40%).

The findings of the present study are similar to some extent with the findings of the study conducted by *Carlos Delmonte, Vera Luiza Capelozzi*[19], Shkrum MJ in which the lung parenchyma in suicidal hanging is predominated with intra-alveolar haemorrhage, alternating areas of alveolar collapse and over-insufflations with zones of bronchiolar constriction and dilatation and*Pathak NM*[13], in which, 29.41% cases of hanging had bronchiolar constriction followed by intra-alveolar haemorrhage, 23.53% cases.

The presence of oedema in hanging cases may be due to exaggerated negative intra-pleural pressure which results in increased venous return to the right ventricle and increased pulmonary blood flow and elevated capillary hydrostatic pressure. These changes favor the transudation of fluid from the pulmonary capillary into the interstitial and alveolar spaces. Also, hypoxia may be partly responsible for development of pulmonary oedema. Congestion of the lung may be due to the obstructed venous return (venous stasis) and hypoxia of the vascular endothelium.

Histological Findings of Lungs in Drowning Cases

Within the drowning cases, alveolar dilatation 76.56%, interstitial oedema 54.68% and intra-alveolar oedema 65.62% were statistically more frequent. The other parameters, although still present, were not as statistically significant in drowning as the oedema was.

The findings of the present study are similar to the findings of *Carlos Delmonte et al*[19], *Perez-Carceles, et al*[20], *Pathak NM*[13], *Taylor AS*[17]and *Ross CF*[16].

The presence of intra-alveolar and interstitial oedema in drowning cases may be due to deposition of proteic and amorphous material. Freshwater is hypotonic relative to plasma and causes disruption of alveolar surfactant. This results in alveolar instability and atelectasis. Seawater, which is hyperosmolar relative to blood, increases the osmotic gradient and, therefore, draws ûuid into the alveoli. This dilutes the surfactant. Both mechanisms injure the alveolar/ capillary unit, resulting in a lower functional residual capacity and pulmonary oedema.

Histological Findings of Lungs in Strangulation

The alveolar haemorrhage (100%) was significantly higher in lungs associated with strangulation. Equally significant was the association of bronchiolar constriction (66.67%) and congestion (33.33%). This particular morphologic picture thus characterized the lung involvement in asphyxial deaths due to strangulation.
The findings of the present study is similar with the study conducted by *Carlos Delmonte et al*[19], *Pathak NM*[13]and *Michael JS*, *Grellner W etal*[21], *Mukherjee JB*[18], *Modi JP*[22] and *KSN Reddy*[1].

The predominance of alveolar haemorrhage in strangulation cases may due to morphologic disarrangement of the bronchiolar and alveolar architecture which changes the ventilation/perfusion relationship leading to acute vascular congestion and engorgement of capillaries protruding into the alveolar space causing rupture and haemorrhage.

Histological Findings of Lung in Choking

Interstitial oedema 100% and congestion 100% were statistically more frequent in choking than in hanging or strangulation. Congestion is present in all the forms of ashyxial deaths whereas interstitial oedema was a common parameter between choking and drowning cases. Bronchiolar constriction 66.67% also characterized choking.

Findings of the present study are in accordance with the findings of the study conducted by *Carlos Delmonte et al*[19], *Pathak NM*[13], *Michael JS* and *Taylor AS*[17].The control cases has no significant findings except congestion of the lungs.

CONCLUSION

The present study revealed some common morphologic parameters for the different groups of asphyxia, but in cases histologically analyzed, the pulmonary architecture showed variables mainly in the degree of interstitial oedema, intra-alveolar oedema, alveolar haemorrhage, bronchiolar constriction, and alveolar dilatation. We have also seen that by means of a simple and quick histopathology method, with negligible additional cost to the Forensic Institute, it is possible to further characterize four specific groups of asphyxia and to suggest a specific diagnosis with reasonable accuracy. The method also allowed obtaining complementary parameters to refuse natural causes of death.

Ethical clearance: Taken

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Conflict of Interest: Nil

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