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# Analysis of the Lung's Histopathologic Changes in a Variety of Acute Asphyxia Deaths at S.M.S Hospital In Jaipur

**[1]Jitendra Kumar Gour, [2]Ravi Kant Saini, [3]Deepali Pathak, [4]D.K.Sharma**

[1]Senior Resident, Department of Forensic Medicine, S.M.S. Medical College, Jaipur, Rajasthan, [2]Assistant Professor, American International Institute of Medical sciences, Udaipur, Rajasthan, India, [3]Professor, Department of Forensic Medicine, S.M.S. Medical College, Jaipur, Rajasthan, India, [4]Senior Professor, Department of Forensic Medicine, S.M.S. Medical College, Jaipur, Rajasthan, India.

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## ABSTRACT

Autopsy diagnosis of asphyxia rests upon the identification of classical signs of asphyxia viz. cyanosis, congestion and petechial hemorrhages. In essence, interference with breathing results in asphyxia. There are several ways to asphyxia can occur as a result of hanging, ligature/manual strangulation, mugging, smothering, throttling, chocking, aspiration, suffocation, asphyxia due to chronic lung disease etc. A cross sectional descriptive observational study that was conducted at the SMS Medical College, in the department of forensic medicine in Jaipur, Rajasthan from 1st June 2018 to October 2019. After a thorough autopsy investigation, samples of the relevant lung tissue from both sides were saved for histological analysis of any pulmonary abnormalities.160 (4.90%) autopsies were of these fatalities (n=3261) were taken in the study. The most frequent cause of acute lethal asphyxia was hanging (85%). In addition, this kind of Histopathologic diagnosis of lung can serve as an additional tool for diagnosis confirmation, particularly in situations where the distinguishing characteristics required determining the cause of death may be elusive. In 100% of cases of strangulation, alveolar tissue over insufflations was identified with histopathological score 3 and 4, whereas in hanging score was recorded in nearly all cases at 2. In All cases the score in the throttling was 1. Interstitial edema, intraalveolar edema, passive congestion and intra alveolar and interstitial hemorrhages are virtually always present in hanging and drowning patients. Only in cases of aspiration related asphyxia are intra alveolar deposits of protein and amorphous debris discovered. It demonstrates how the histopathological analysis of the lungs during autopsy can be utilised as an additional histopathologic criterion to confirm the asphyxia diagnosis.

**Keywords:** asphyxia, histopathological analysis, edema, congestion, insufflations.

## INTRODUCTION

The major difficulty for a Forensic expert is that asphyxia cannot always be reliably equated to hypoxia and there may not be truly distinctive signs to establish the post mortem diagnosis to reach to definite opinion of cause of death in such controversial cases. Asphyxia is a name given to different kinds of lesions that can produce similar Histopathologic findings4, 7, and 9,11,12,13. It is important to document the pathologic changes in such cases to exclude other forms of trauma or other modes of death that may denote murder made to appear as suicide or natural death

**Corresponding author:** Ravi Kant Saini, Assistant Professor, American International Institute of Medical sciences, Udaipur, Rajasthan, India.

**Email:** dr.ravikantsaini@gmail.com; Mob. 8239947789

and many more3. Several circumstances can cause sudden death secondary to respiratory failure; mechanical asphyxia is a potential concern in all suspected deaths. However, additional histological studies and molecular studies can help identify death secondary to asphyxia and drowning10. Lungs are the most important organs where an array of pathologic changes take place and help in the diagnosis of fatal asphyxia. This was thus initiated to study the Histopathologic findings of lungs in cases of acute fatal asphyxia along with the correlation with the post-mortem findings in these medico-legal autopsies.

## OBJECTIVE

The study was conducted to determine manner of death specific Histopathologic changes seen in various asphyxia death.

## MATERIAL AND METHODS

All medical-legal autopsies of acute asphyxia deaths were included in this cross-sectional descriptive observational study. Inclusion criteria was deaths resulting from acute fatal asphyxia as per post mortem findings and Informed written consent from legal heir for participation in study. Exclusion criteria were Medico-legal autopsies of cases of suspected hypoxic episodes not characteristically acute fatal asphyxia and Cases of deaths due to terminal asphyxial event but not mechanical asphyxia in preview of Forensic context. Sample size was calculated at 95% confidence level assuming prevalence of Histopathologic findings of Ductal over-insufflation in lungs in 21.8% cases as found in reference article at the relative error of 30% for which sample of 159 cases of medico-legal autopsies of acute asphyxia autopsied were to be required, which are further rounded off to minimum 160 cases for the present study. After gross examination samples were preserved from appropriate parts of lungs tissues bilaterally for further histopathological examination and microscopic evaluation of pulmonary pathology, if any.

## RESULT AND DISCUSSION

3261 medico-legal autopsies were conducted at the study centre during the study period, amongst which 465 were of asphyxial fatalities, out of these 160 cases were recorded and analyzed in the present study. Majority were of young adults i.e. 21-40 years age including 94(58.75%) cases; with another high proportion of such deaths reported in middle aged adults i.e. 41-60 years age with 30 (18.75%) cases and adolescents being 26 (16.25%) cases. These findings were consistent with Delmonte C et al 2001[3].

The male: female ratio was 2.14, with 68.13% of cases being male and the remaining 31.87% being female. Similar results were found by Delmonte C et al 2001[3]. (73.65% male, 26.35% female), and Chaudhari KM et al 2016[2] (73.33% male, 26.67% female).

Amongst 160 cases of acute fatal asphyxia, majority of cases were of hanging (85%) (62.66% Chaudhari KM, et al 2016[2]) (51.88% Grellner W et al 1994[5]) followed by cases of drowning (6.25%) (37.34% Chaudhari KM et al 2016[2]) and suffocation (03.1%). Remaining nine cases in the present study had suffered fatal asphyxia due to Strangulation or throttling (1.9%) and two cases each suffered traumatic asphyxia, aspiration and lung pathology (1.25% each).

The known macroscopic and histologic signs of general damage through hypoxia, e.g., edema, hemorrhage, pulmonary emphysema, passive congestion, and degenerative cellular changes, are usually diverse and are not conclusive as individual findings[1,6]. Similar findings can also arise through injuries leading to impairment of the circulation, or ischemia, thereby reducing or interrupting the tissue oxygen supplies. The extent of terminal hypoxia is also relevant to the postmortem detectable changes[8].In our study Strangulation was associated with greater rates of alveolar bleeding, congestion, alveolar collapse, alveolar over-insufflation, bronchiolar constriction, and bronchiolar dilatation, whereas aspiration was associated with higher rates of septal haemorrhage and foreign body. Drowning and suffocation were

each characterised by intra-alveolar edema and ductal over-insufflation with interstitial edema, respectively.

In drowning cases, distinct morphologic alterations might also be anticipated in the parenchyma of the lungs. The pathophysiologic mechanism involves general hyperhydration of submicroscopic cell organelles such as mitochondria and endoplasmic reticulum, which causes swelling and intracytoplasmic vesicular formation in pneumocytes and capillary endothelia7. The degree of alveolar tissue collapse, over-insufflation, bronchiolar constriction, and dilatation was diverse in all instances after histological analysis of the pulmonary architecture. The four Histopathologic lesions—edema, intra-alveolar deposition of proteic and amorphous material, passive congestion, and hemorrhage—were equally prevalent in all four groups. The usual morphologic response identified in the lungs of suffocation victims was defined by acute significant emphysema (ductal over-insufflation). Similar findings were observed in study of Delmonte C et al 20013 and Chaudhari KM et al 20162.

In cases of deaths due to strangulation, alternating areas of bronchiolar constriction and dilatation leading to alveolar collapse and over-insufflation, associated with a picture of alveolar hemorrhage, were the morphologic characteristics of lung involvement. These disturbed morphologic disarrangements of the bronchiolar and alveolar architecture determine changes in the circulation relationship leading to a particular reaction pattern-the alveolar hemorrhage-which enabled them to be distinguished from other forms of death.

Alveolar tissue over insufflation was characteristically found with histopathological scores of 3 & 4 in 100% cases of strangulation whereas was detected at score 2 in almost all cases of hanging and was at score 1 in all cases of throttling (100%). it was graded at score 3 in all cases of Drowning (100%). These scores were highly significantly related to the Type of incidence that resulted in asphyxia. In the present study, the type of incidence was revealed to be highly significantly correlated with the quantitative analysis of scores for all histological characteristics. But, yet specificities cannot be concluded for different asphyxias because of the small sample size for most variants of asphyxia included in the two studies. Still, it can be said that in comparison to drowning, the histopathology findings of alveolar tissue collapse, alveolar over-insufflation, bronchiolar constriction and bronchiolar dilatations, congestion, interstitial edema and alveolar hemorrhage were more commonly observed in lungs of hanging. The only histopathology finding that was more commonly noticed in lungs of drowning was intra-alveolar edema. These findings are similar to those of Chaudhari KM, et al[2], an Indian study where the study sample is quite similar to that of the present study (Table 1).

**Table 1: Depiction of the presence/absence and type of changes in pulmonary architecture and histopathological characteristics in the cases**

| **Histopathological Score (No. of cases)** | **0** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|---|
| Alveolar Tissue Collapse | 1 | 19 | 139 | 0 | 1 |
| Alveolar Tissue Over-insufflation | 1 | 9 | 149 | 1 | 0 |
| Bronchiolar Constriction | 6 | 22 | 132 | 0 | 0 |
| Bronchiolar dilatation | 2 | 24 | 133 | 1 | 0 |
| Interstitial Edema | 6 | 8 | 143 | 3 | 0 |
| Intra-Alveolar Edema | 5 | 145 | 0 | 0 | 10 |
| Intra-alveolar Deposition of Proteic & Amorphous Material | 150 | 8 | 2 | 0 | 0 |

**Table 1 Contd.**

| Histopathological Score (No. of cases) | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Intra-Alveolar Hemorrhage | 5 | 26 | 129 | 0 | 0 |
| Passive congestion | 1 | 150 | 9 | 0 | 0 |
| Interstitial Hemorrhage | 1 | 159 | 0 | 0 | 0 |
| Septal Hemorrhage | 31 | 121 | 8 | 0 | 0 |
| Alveolar Hemorrhage | 6 | 14 | 139 | 0 | 1 |
| Ductal Over-insufflation | 52 | 97 | 10 | 1 | 0 |
| Dilatation of the Alveolar Spaces | 1 | 156 | 3 | 0 | 0 |
| Congestion | 0 | 5 | 155 | 0 | 0 |
| Foreign material/body | 155 | 3 | 2 | 0 | 0 |

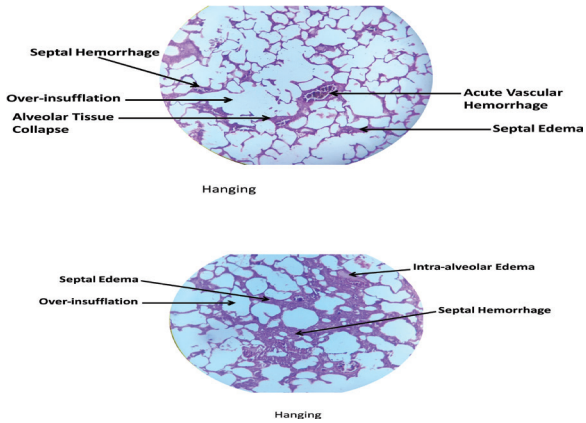


**Fig. 1: showing histopathological findings of lung in the case of hanging**

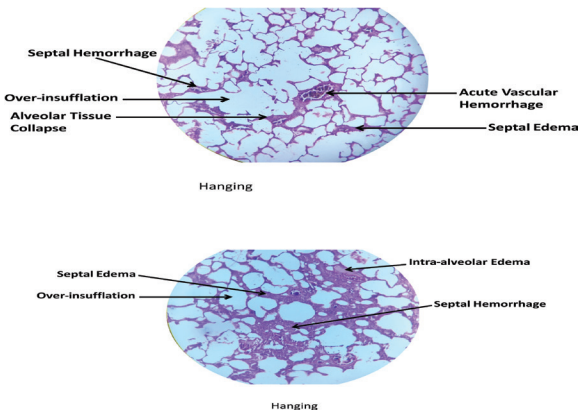


**Fig. 2: showing histopathological findings of lung in the case of strangulation**

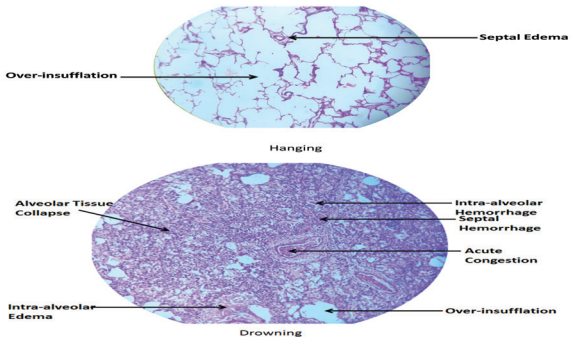


**Fig. 3: showing histopathological findings of lung in the case of suffocation**

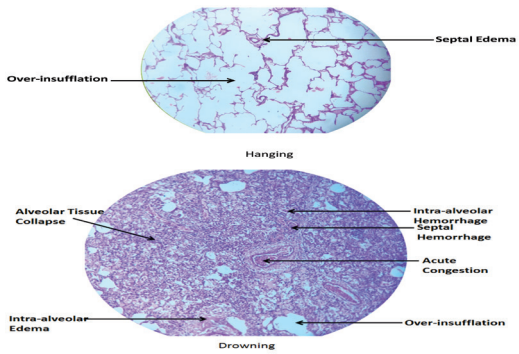


**Fig. 4: showing histopathological findings of lung in the case of drowning**

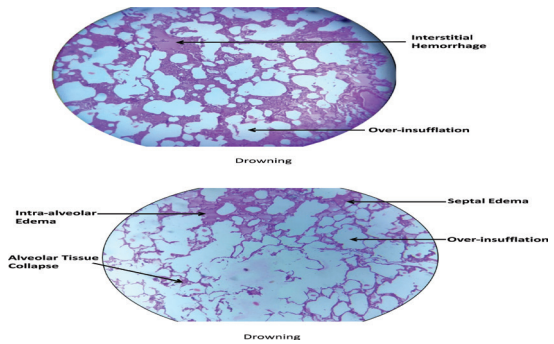


**Fig. 5: showing histopathological findings of lung in the case of aspiration**

## CONCLUSION

As an additional histologic criterion to support the asphyxia diagnosis, the histopathologic examination of the lungs at autopsy may be helpful. In 85.03% of cases, the discriminant parameters produced the correct permitted classification. Thus, documenting histopathology findings of lungs as supplementary autopsy evidence based on the theory that asphyxia comprises

various types of lesions that can produce varying histopathology findings can be a worthwhile exercise. Also, additional studies, including macroscopic characteristics, clinical data, and electron microscopy techniques, are probably required for better identification of asphyxia. However, the use of morphometric instruments in normal procedures should be encouraged in the analysis of death by asphyxia for confirmation due to its ease of use, effectiveness, and low cost.

Moreover, this type of histopathological diagnosis of lung morphological findings of lungs can act as a supplemental tool for confirmation of diagnosis especially in cases where the characteristic findings necessary to conclude the cause of death may be subtle thus, resulting in dilemmas for the forensic experts.

**Ethical clearance:** Taken from institutional ethics committee of SMS Medical College Jaipur

**Source of funding:** Self

**Conflict of Interest:** The main causes of conflicts in day-to-day work in mortuary settings are typically asphyxial deaths. We are attempting to investigate additional angles for examining asphyxial deaths through this effort.

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