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Original Article

Pathology Section

Histopathological Analysis of Lung Lesions in Cases of Sudden Death: An Autopsy-based Study

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ABSTRACT

Introduction: Cardiovascular and respiratory causes account for the major chunks in sudden death cases in various Western studies. Overall, a very limited number of studies have been conducted on respiratory system changes in cases investigated as sudden and unknown death in India. Pathological respiratory findings are said to be common in the autopsy population; however, their nature and prevalence are not well documented.

Aim: To document the morphologic changes in lungs (both gross and microscopic) in cases of sudden death.

Materials and Methods: The present study was a cross-sectional, prospective, and observational study conducted over a period of 12 months from 1st April 2010 to 31st March 2011. It was conducted on autopsy lung specimens received in the Department of Pathology, RG Kar Medical College and Hospital, Kolkata, West Bengal, India. For the purpose of present study, sudden death was defined as death occurring within 24 hours of the onset of the terminal symptoms. Unidentified subjects who were declared "Brought Dead" at the emergency room were also included in the study.

The lungs were fixed in 10% formalin, weighed, and dimensions measured. Grossly, the lungs were examined for colour, volume, consistency, presence of any pathological changes, the status of bronchi and pleura, and findings were recorded. After routine processing and paraffin embedding, histological sections were stained with Haematoxylin and Eosin (H&E) stain and special stains as and when necessary. All the histological sections were examined microscopically, and findings were recorded. The obtained data were subjected to appropriate statistical analysis by entering the data in Microsoft (MS) excel 2010.

Results: There were 46 males (88.46%) and 6 females (11.54%). The age range was 26-86 years, with a mean age of 51.02 years. Among the 52 cases, significant pulmonary pathology was found in 26 cases (50%), excluding postmortem changes. Extensive fibrocaseous pulmonary Tuberculosis (TB) 15 (28.85%) was the most common pulmonary lesion found, present in all age groups. The other major pathological lesions encountered were lobar pneumonia 4 (7.69%), emphysema 3 (5.77%), bronchopneumonia 2 (3.85%), etc.

Conclusion: A significant number of cases with pathological lesions in the lung were detected during the histopathological examination of sudden death cases. All the lesions may or may not have contributed to death in a direct or indirect way. The undetected lung pathologies emphasise the importance of autopsy in cases of sudden death.

Keywords: Natural death, Respiratory pathology, Tuberculosis

INTRODUCTION

There has been much debate about the role of the autopsy in present-day medical practice, teaching, and research. Many questions have arisen regarding the value of the autopsy in view of the technological advances that have improved the sensitivity and specificity of new diagnostic methods. Despite technological advances in medical practice in recent decades, the autopsy, in combination with a competent investigation of the medical history, is still considered the gold standard for determining the cause and manner of death.

The autopsy rate in India, like all over the world, is remarkably low today, with proportionally fewer autopsies for natural causes of death. The failure to use the autopsy, especially for natural deaths, calls into question the validity of statistics derived from death certificate diagnoses and limits the sensitivity of epidemiological studies that do not consider this methodological limitation [1].

Currently, no formal statistics exist on the outcomes of forensic postmortem examinations performed on "sudden and unexpected deaths" referred to this institution. Overall, a very limited number of such studies are found to be done on respiratory system changes in the cases investigated as sudden and unknown death in India. As cardiovascular and respiratory causes account for the major chunks in sudden death cases in various Western studies [2,3], the lungs were chosen for present study to get an idea about the prevalence of such changes in the present study population.

The specific objectives of the study were to document the gross and microscopic pathological changes in the lungs of sudden death cases, collect the demographic data, clinical features if any, and corroborate these findings with the existing literature.

MATERIALS AND METHODS

The present study was a prospective cross-sectional and observational study conducted on autopsy lung specimens received in the Department of Pathology, RG Kar Medical College and Hospital, Kolkata, West Bengal, India. The viscera received were from sudden death cases on which medico-legal autopsies were performed over a period of 12 months from 1st April 2010 to 31st March 2011. The present study was approved by the Institutional Ethics Committee.

The sampling was done by employing a convenience sampling method. Informed consent was obtained from the deceased persons' legal guardians.

Inclusion criteria: Cases of sudden death and brought dead cases without alleged history of unnatural death. For the purpose of present study, sudden death was defined as death occurring within 24 hours of the onset of terminal symptoms such as loss of consciousness, dyspnoea, chest pain, etc.

Exclusion criteria: Cases of sudden death, when the lungs were received in a decomposed state were excluded.

Study Procedure

Method of examination of the lungs: The lungs were dissected from the diaphragm. Any pleural adhesions were carefully transected as close to the parietal pleura as possible. They were removed, transecting the bronchi at the carina and the pulmonary arteries and veins near the hilum of the lung. The lungs were then separated from each other by transverse cuts across the main stem bronchi and weighed. Their pleural surfaces were inspected, and the pulmonary parenchyma palpated. The pulmonary arteries and bronchi were opened from the hilum toward the periphery of the mediastinal surface of the lung.

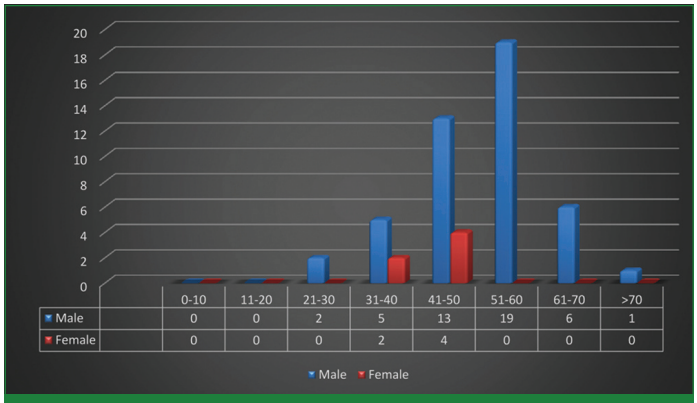
The lungs were inspected and palpated for any gross pathology. They were then sliced 2 cm apart by a sharp knife from the hilum to the lateral surface, and the lung parenchyma was examined to identify abnormalities and areas of congestion, consolidation, oedema, emphysema, tumour, or scarring. The hilar lymph nodes, if enlarged, were noted. The larger airways and vessels were opened as needed to complete the examination. Regardless of the presence or absence of morphologically demonstrable lesions, a minimum of two sections per lung were studied. Representative sections were also taken from any grossly visible abnormal area(s). Paraffin sections of 5 µm thickness made from the grossed specimens were subjected to H&E staining. Special stains such as Gomori Methenamine Silver (GMS) were used wherever required. Gross photographs and photomicrographs of slides were taken as and when necessary.

STATISTICAL ANALYSIS

The obtained data were subjected to appropriate statistical analysis by entering the data in MS Excel 2010.

RESULTS

Among a total of 52 autopsy cases, there were 46 males (88.46%) and 6 females (11.54%). The age range was 26-86 years, with a mean age of 51.02 years. The majority of them 19 (36.54%) were in the age group of 51-60 years, followed by the 41-50 years age group 17 (32.69%). Most female cases in present study were in the 41-50 years age group [Table/Fig-1]. In the present study, out of 52 cases, lung lesions were present in 51 cases (98.08%), while it was normal in a single (1.92%) case.



[Table/Fig-1]: Distribution of cases according to age and sex (N=52).
(X axis denotes age in years and Y axis denotes frequency)

[Table/Fig-2] shows the spectrum of pulmonary lesions in various age groups and also categorises them according to sex. [Table/Fig-3] shows the salient gross features with histopathological correlation. It shows that the most common lung pathology in the present study was fibrocaseous TB (15, 28.85%), followed by lobar pneumonia 4 (7.69%), excluding pulmonary oedema and mild congestion. Out of 52 cases, 26 cases (50%) showed significant pulmonary lesions. The majority of the deceased showing significant lung lesions were in the 5th and 6th decade, where fibrocaseous TB was the most common pathology found [Table/Fig-4a,5a,b]. There was one case of miliary TB in the present study affecting the heart, bilateral lungs, pleura, and liver [Table/Fig-4b]. The authors found four cases of lobar pneumonia [Table/Fig-6a,b] and two cases of bronchopneumonia accounting for 11.54% of the study population. There were 3 cases of emphysema (5.77%) seen in male individuals over 50 years of age who were heavy smokers [Table/Fig-7a,b]. A 57-year-old male patient had a cystic lesion in the right lung with opalescent fluid inside, which was histologically proven to be a hydatid cyst. Invasive pulmonary aspergillosis was found incidentally in a 35-year-old immunosuppressed male. Pulmonary oedema and mild congestion were seen in a total of 24 cases (46.15%). These are likely terminal events and are not considered significant lesions.

DISCUSSION

The investigation of unexpected sudden death poses a unique challenge for forensic investigators and pathologists. When faced with a "probably natural death" scenario, the differential diagnosis becomes less clear. Often, there is a lack of significant historical information available during the autopsy. The range of possible causes of death is broad [4]. Sudden death refers to fatal events that occur unexpectedly in apparently healthy individuals or in those whose diseases were not severe enough to predict such an abrupt outcome. However, in cases where medical attention was not sought by individuals in low socio-economic status, a death may appear natural. In the present study, the highest number of cases (32, 69.23%) occurred in the fifth and sixth decades of life [Table/Fig-1], which is consistent with a study by Azmak AD from Turkey [3]. In that study, the age group of 50-59 years accounted for 21.58% of sudden natural death cases. Gupta S et al., [5] and Rao DS and Yadhukul [6] reported a peak incidence of sudden and unexpected deaths between 40-65 years, while Thomas AC et al., [2] found a higher incidence in the seventh decade.

Similar to other studies, the current study showed a predominance of males (46, 88.46%) over females in all age groups [Table/Fig-2], with a male-to-female ratio of 7.7:1. In autopsy studies on sudden natural deaths conducted by Gupta S et al., a male-to-female ratio of 4.7:1 was reported, while Rao DS et al., observed a ratio of 5.8:1 [5,6]. Azmak AD found a male-to-female ratio of 5.1:1, and Kasthuri AS et al., had exclusively male subjects (n=13) [3,7].

In India, several studies have documented the histopathological spectrum of pulmonary lesions in autopsies. One such study conducted in Punjab, India by Bal MS et al., analysed 150 autopsy lung specimens, revealing that in 116 cases, the causes of death were extrapulmonary, while the lungs showed associated findings such as interstitial oedema or changes related to cardiovascular causes [8]. Similarly, in the present study, pneumonia (9.33%) and pulmonary tuberculosis (8.67%) were the two most common primary lung lesions.

Lung microscopy / Age	21-30	31-40	41-50	51-60	61-70	>70	Male	Female	Total (%)
Fibrocaseous TB	1	1	3	7	3	0	15	0	15 (28.85)
Military TB	0	0	1	0	0	0	1	0	1 (1.92)
Lobar pneumonia	0	1	2	0	1	0	1	3	4 (7.69)
Bronchopneumonia	0	1	0	0	1	0	2	0	2 (3.85)
Emphysema	0	0	0	2	1	0	3	0	3 (5.77)

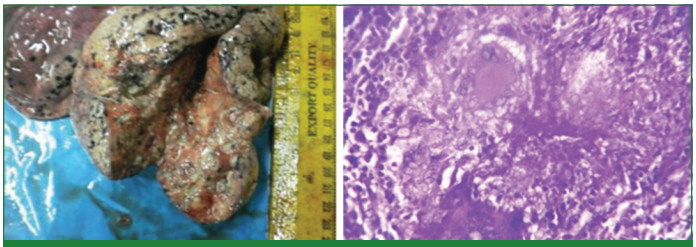
Hydatid cyst	0	0	0	1	0	0	1	0	1 (1.92)
Aspergillosis	0	1	0	0	0	0	1	0	1 (1.92)
Pulmonary oedema	1	1	3	2	1	1	7	2	9 (17.31)
Mild congestion	0	2	6	7	0	0	15	0	15 (28.85)
Normal	0	0	1	0	0	0	0	1	1 (1.92)
Total (%)	2 (3.85)	7 (13.46)	16 (30.77)	19 (36.54)	7 (13.46)	1 (1.92)	46 (88.46)	6 (11.54)	52 (100)

[Table/Fig-2]: Histopathological pattern in lung autopsies according to age and sex (N=52).
(The age range is given in years)

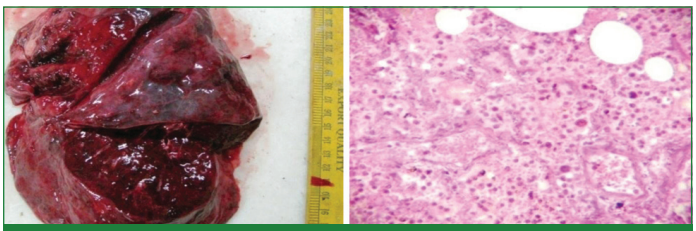
Salient gross feature of lungs	Frequency (%)	Histological diagnosis
Multiple caseation filled cavities	15 (28.85)	Fibrocaseous TB
Consolidation involving entire lobe	4 (7.69)	Lobar pneumonia
Mild congestion with oedema	15 (28.85)	Mild congestion
Proteinaceous material in alveolar lumen	9 (17.31)	Pulmonary oedema
Patchy consolidation	3 (5.77)	Bronchopneumonia, invasive pulmonary aspergillosis
Apical bulla, voluminous lung	3 (5.77)	Emphysema
White cyst wall of with opalescent fluid inside	1 (1.92)	Hydatid cyst
Studded with multiple small grayish nodules	1 (1.92)	Miliary tuberculosis
Unremarkable	1 (1.92)	Normal

[Table/Fig-3]: Gross findings of the lungs with histological correlation.

[Table/Fig-4a]: Pulmonary tuberculosis-adhesion of lung with the chest wall.
[Table/Fig-4b]: Miliary tuberculosis lung. (Images from left to right)

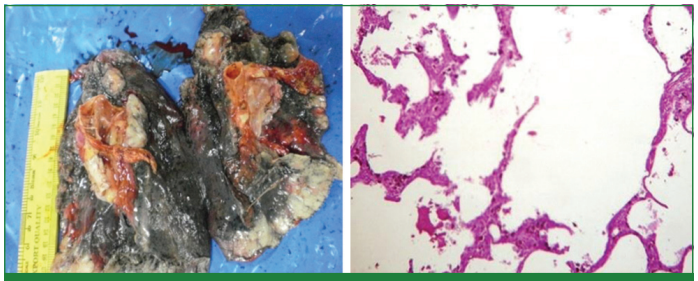


[Table/Fig-5a,b]: Gross and microphotograph (H&E stain 40x magnification)-Fibrocaseous pulmonary tuberculosis. (Images from left to right)



[Table/Fig-6a,b]: Gross and microphotograph (H&E stain 40x magnification) Lobar pneumonia-red hepatisation stage. (Images from left to right)

Another recent autopsy study conducted in a tertiary care hospital by Goswami PR et al., found pneumonia to be the most common lesion observed (33.8%), followed by emphysema and tuberculosis [9]. In the study by Rao DS and Yadhukul, pulmonary lesions were identified as the cause of death in 27.45% of cases [6], while Thomas AC et al., reported respiratory causes accounting for 17.7% of deaths in a similar population [2].



[Table/Fig-7a]: Bilateral pulmonary emphysema showing apical bulla.
[Table/Fig-7b]: Microphotograph (H&E stain 40x magnification) emphysema showing airway destruction. (Images from left to right)

In the present study, the most common lesion identified was bilateral extensive fibrocaseous pulmonary tuberculosis (15, 28.85%), predominantly affecting males [Table/Fig-4a,5a,b], particularly in the 6th decade (7, 46.67%). Additionally, there was one case of miliary tuberculosis affecting the lungs, heart, and liver [Table/Fig-4b].

In a study by Garg M et al., from Haryana focusing on tubercular lesions at autopsy, they found 8.7% of cases with active pulmonary tuberculosis, predominantly in males (60%), with a mean age of 38 years [10]. In the series by Kaur B et al., only 6.1% of deceased individuals were diagnosed with tuberculosis, and 3.2% were identified as having miliary tuberculosis [11]. Another autopsy study on tuberculosis was conducted in New Zealand by Lum D and Koyelmeyer T. The study revealed that a large proportion (70%) of tuberculosis cases found during autopsy were unexpected and had not been diagnosed during the individuals' lifetimes [12]. The high number of tuberculosis cases discovered in this study may also be attributed to the disease not being properly addressed during their lives or due to the presence of multi-drug resistant strains.

The authors of the current study found very few Indian autopsy studies focusing on the histopathological examination of lungs in cases of sudden death. One such study was conducted by Sindu V and Dhanalakshmi A in Tamil Nadu [13]. Their study showed a higher number of deceased males compared to females, and the two most common lung pathologies observed were usual bacterial pneumonia and granulomatous lesions consistent with tuberculosis, which aligns with the present study findings. Another autopsy study conducted in Gujarat, focusing on sudden death cases among adults aged 15-45 years, was performed by Modi RA et al., [14]. The study revealed that respiratory causes accounted for 17.3% of the deaths. The most common lung lesions observed were pulmonary tuberculosis and pneumonia, which is consistent with the present study results.

The authors identified four cases of lobar pneumonia [Table/Fig-6a,b] and two cases of bronchopneumonia, collectively accounting for 11.54% of the study population. Lobar pneumonia was more prevalent in females (three cases, accounting for 75% of all lobar pneumonia cases), while both bronchopneumonia cases were observed in males. No specific age group prevalence was found. The authors also observed 3 cases of emphysema (5.77%) in males over 50 years of age with a history of heavy smoking [Table/Fig-7a,b]. Recent reviews on the epidemiology of Chronic Obstructive Pulmonary Disease (COPD) in India report prevalence rates ranging

from 2% to 22% (median 5%) in men and 1.2% to 19% (median 2.7%) in women [15].

In addition, authors found one case of a hydatid cyst and one case of invasive pulmonary aspergillosis in the lungs. The hydatid cyst was detected in a 57-year-old male patient who had a cystic lesion in the right lung containing opalescent fluid. The individual with invasive pulmonary aspergillosis was a 35-year-old immunosuppressed male. No cases of lung malignancy were identified in the present study.

Limitation(s)

One limitation of the present study is that the observation of pathological changes in a single organ cannot be definitively stated as the cause of death.

CONCLUSION(S)

A significant number of cases with lung lesions were detected during the histopathological examination of sudden death cases. These lesions may or may not have directly or indirectly contributed to death. The presence of undetected lung pathologies highlights the importance of autopsies in cases of sudden death. The fact that fibrocaseous tuberculosis was found most commonly in present study indirectly indicates a high prevalence of pulmonary tuberculosis in the population, which may have gone unnoticed during life and caused significant mortality. Therefore, more effective tuberculosis screening should be undertaken in the community to ensure that every patient receives appropriate treatment. Smoking-related lung diseases cause significant morbidity and mortality, so it is recommended to place more emphasis on discouraging smoking and screening smokers for any lung pathology. Further studies with a larger number of cases and multiple organ systems should be conducted in sudden death cases to unveil the hidden diseases and determine the exact cause of death.

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