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Original Article

Pathology Section

Role of Histopathological Examination in Medicolegal Autopsies in Unravelling Precise Causes of Mortality

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ABSTRACT

Introduction: Medicolegal autopsies are performed to determine the cause and manner of death. Histopathological examination is reserved for only those cases where Cause Of Death (COD) is not readily apparent on autopsy. However, there are conflicting views regarding the utility of histopathological examination in medicolegal cases.

Aim: To examine the role of histopathological examination in unravelling specific causes of mortality in two settings: 1) where collaborative clinical history and gross autopsy findings were available; 2) where definitive cause could be discovered only at the time of microscopic examination, thus altering its legal implications.

Materials and Methods: This was a retrospective observational study including all medicolegal autopsy cases, in which histopathological examination was requested and sample was received at the Pathology Department, Dr Baba Saheb Ambedkar Medical College, New Delhi, India. Since this was a retrospective study, the data was compiled from medicolegal cases received by the department in two years i.e., from January 2018 to December 2019. Histopathological examination was performed in 96 cases out of which 10 were excluded due to autolysis (n=86). Haemotoxilin and Eosin (H&E)-stained slides were examined and special stains and Immunohistochemistry (IHC) applied wherever required. Gross and histopathological findings were recorded along with autopsy findings and clinical history. The results were tabulated and statistical analysis was done using the Chi-square and Fischer's test to look for any significance and association between gross and microscopic findings in various organs. The p-value of <0.05 was considered significant.

Results: Histopathological examination was conclusive in ascertaining the specific COD in 30/86 cases (35%). These were categorised as pulmonary causes (27) including one case each of fat embolism and Amniotic Fluid Embolism (AFE) and cardiac causes (3). In 8 of these cases (9%), the cause was discovered only on microscopy in clinically and grossly unsuspected cases, which would have been missed otherwise if not submitted for histopathological examination.

Conclusion: Histopathological examination is definitive in pointing towards the specific causes of death in considerable number of autopsies and can completely alter the legal implications.

Keywords: Cause of death, Clinical diagnosis, Postmortem diagnosis

INTRODUCTION

The term "autopsy" is derived from Greek word meaning "to see for oneself" and refers to examination of human body to discover diseases and COD [1]. There are four main types of autopsies: 1) Medicolegal or forensic autopsies; 2) Clinical or pathological autopsies, done to diagnose a particular disease for research purpose; 3) Anatomical or academic autopsies, performed for study purpose only; and 4) Virtual or medical imaging autopsies, which are performed utilising imaging technology like Magnetic Resonance Imaging (MRI) and Computed Tomography (CT).

This paper focuses on the medicolegal/forensic autopsies, which are performed as prescribed by applicable law, in cases of violent, suspicious or sudden death, death due to medical negligence or during surgical procedures. Forensic histopathology deals with changes observed at cellular and tissue level detected under light microscope that can contribute in some way towards the COD [2].

Not all medicolegal autopsies are routinely subjected to histopathologic analysis. Only those cases where COD is either not readily apparent or obvious on gross autopsy are sent for histopathologic examination to: a) either confirm the existing COD; b) to confirm existing disease; and c) to form the basis of COD. However, there are conflicting views regarding the utility of histopathological examination in medicolegal cases. In study conducted by Molina DK et al., who reviewed 189 autopsy cases, in only one case did the microscopic examination revised or altered the COD [3]. In contrast, studies conducted by De La Grandmaison GL et al., and Langlois NE recommend its rational use [4,5].

This study was undertaken to highlight the utility of conducting histopathological examinations in medicolegal autopsy cases as some studies have suggested that this step causes unnecessary strain on the resources and manpower of the concerned department, and therefore, should be done away with.

MATERIALS AND METHODS

In the present retrospective observational study, all the medicolegal cases which were received from Forensic Department of the hospital for histopathological examination during the two years (January 2018 to December 2019) in Department of Pathology, Dr Baba Saheb Ambedkar Medical College and Hospital, New Delhi, India were taken into account. Total of 96 medicolegal postmortem cases were received for histopathological examination.

Inclusion criteria: It included all the medicolegal postmortem cases in which histopathology was requested during study period.

Exclusion criteria: Cases showing extensive autolytic changes were excluded as they could not be interpreted. The study was compiled with all relevant data during the same time period.

All the viscera were preserved in 10% formalin. All the sections were routinely processed, and haematoxylin and eosin-stained slides were prepared. Special stains e.g., Periodic Acid Schiff (PAS) and acid-fast stain and IHC was performed for Cytomegalovirus (CMV) antigen to confirm disseminated CMV infection.

General particulars like age, sex, time since death, gross and microscopic findings along with clinical details were tabulated in

a performa. Special emphasis was made on the cases in which histopathological examination was imperative in arriving at a COD or confirming the suspected COD. Any discrepancy between gross and microscopic findings was also noted.

STATISTICAL ANALYSIS

Statistical analysis was done using the Fischer's test to look for any significance and association between gross and microscopic findings in various organs. Statistical analysis was done using IBM SPSS software version 20.0. The p-value of <0.05 was considered significant.

RESULTS

Out of total 96 cases, 10 cases were excluded which were showing autolytic changes on microscopy. Thus, the study comprised of 86 cases observed during the time period of two years where histopathological examination was requested in medicolegal autopsies. It was observed that there was male preponderance (n=60,70%) with majority of cases (52.3%, n=45) being in the age group of 2nd to 4th decade followed by 4th to 6th decade (23.2%, n=20) [Table/Fig-1].

Age group (Years)	No. of cases	Percentage (%)
<20	18	20.9
21-40	45	52.3
41-60	20	23.2
>60	3	3.5

[Table/Fig-1]: Age wise distribution of cases.

The postmortem examination was conducted within 24 hours in 66.2% (n=57) and a small proportion of cases (n=29) showed time since death of more than 24 hours [Table/Fig-2].

Time since death (Hrs)	No. of cases	Percentage (%)
0-12	15	17.4
13-24	42	48.8
25-36	9	9.1
37-48	11	12.8
49-72	4	4.6
>72	5	5.8

[Table/Fig-2]: Time since death.

Histopathological examination was conclusive in ascertaining the specific COD in 30/86 cases (35%). In 8 of these cases (9%), the histological examination alone provided the COD, which otherwise could have been missed if not subjected to histopathological examination. These cases included one case each of fat and AFE (n=2), aspiration pneumonia (n=3), arrhythmogenic ventricular cardiomyopathy (n=2) and disseminated infection with CMV and Pneumocystis (n=1). In 65% (n=56) of cases histopathology findings were unremarkable. These included pneumonias (n=19), disseminated tuberculosis (n=1), CAD (n=1) and cerebral infarct in a known case of Takayasu arteritis (n=1) [Table/Fig-3]. Histology provided supplementary information about previous medical condition of the deceased in 22/86 cases (26%).

Discrepancies between gross and microscopic findings did exist and involved the various systems. In reasonable number of cases (52.3%) the gross findings were either not identified or misidentified. Majority of discrepancies were noted in liver (n=22) followed by pulmonary (n=6) and cardiovascular system (n=4). In the liver, the discrepancy mostly pertained to mild or moderate steatosis, which was documented on microscopy. On the other hand, significant association between consolidation on gross examination and pneumonia on microscopy in lung was noted in the present series (p=0.001, Fischer-exact test) [Table/Fig-4].

Pathology	Specific cause of death on histopathology	With corroborative history and gross findings	No corroborative history and gross findings
Pulmonary	Aspiration pneumonia	0	3
	Pneumonia	19	0
	Fat embolism	0	1
	Amniotic fluid embolism	0	1
Cardiac	ARVC	0	2
	CAD	1	0
	Takayasu arteritis	1	0
Infectious	Disseminated tuberculosis	1	0
	CMV with PJP	0	1
Total n=30 (35%)		22 (26%)	8 (9%)

[Table/Fig-3]: Specific Cause Of Death (COD) (N=86).
*ARVC: Arrhythmogenic right ventricular cardiomyopathy; CAD: Coronary artery disease; CMV: Cytomegalovirus; PJP: Pneumocystis jirovecii pneumonia

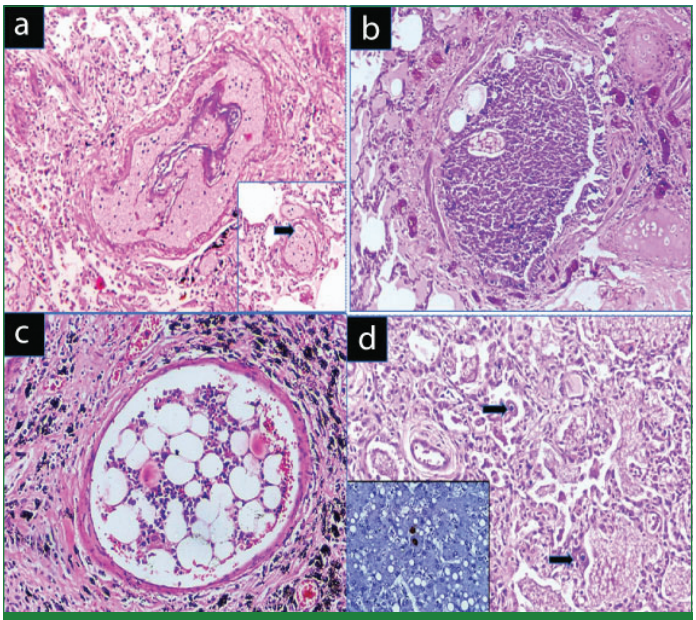
Findings	Not Identified/ Misidentified grossly	Correctly identified microscopic	p-value (Fischers exact)
Hepatic steatosis†	14	3	0.25
Hepatic fibrosis	1	1	1
Hepatitis	4	0	NA
Acute myocardial ischaemia	1	0	NA
Ischaemic heart disease	3	0	NA
Cardiomyopathy	0	2	NA
Pneumonia	3	19	0.001
Chronic interstitial lung disease (Emphysema, chronic bronchitis)	1	2	NA
Embolism	2	0	NA
Multiorgan granuloma*	7	0	NA
Chronic nephritis	6	1	0.086
Nephrosclerosis	2	0	NA
Atheroma in cerebral vessels	1	0	NA
Total=73	45 (52.3%)	28 (32.5%)	

[Table/Fig-4]: Discrepancies between gross and microscopic findings.
*: Granulomas found in the liver, spleen, kidney and lungs in a pattern consistent with tuberculosis; †: steatosis mostly pertained to mild and moderate degree; NA: Not applicable (In 86-73=13 cases both gross and microscopy were unremarkable so could not be put into definite category)

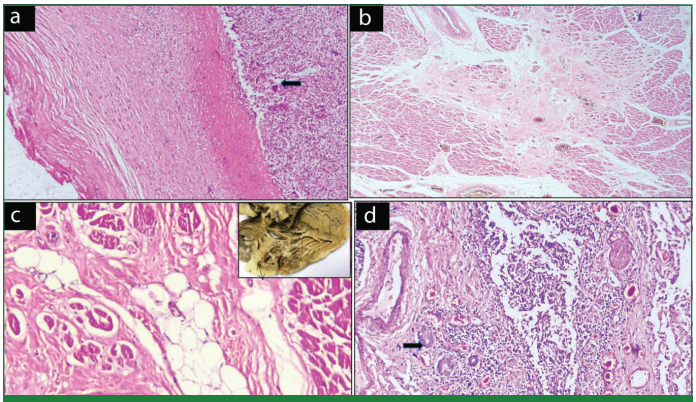
DISCUSSION

While dependency on macroscopic findings was the foundation of the past practice, microscopic examination is proving to be a valuable tool in forensic research. However, the routine use of histopathological examination in forensic autopsies is still debatable. In the present series, histopathology by itself ascertained the COD in 9% of cases which were lacking supportive history or gross findings. These cases included aspiration pneumonia (n=3), embolism (n=2), disseminated CMV with Pneumocystis infection (n=1) and arrythmogenic ventricular cardiomyopathy (n=2). Examples included presence of amniotic fluid contents in pulmonary vessels of a clinically suspected Postpartum Haemorrhage (PPH) and the presence of bone marrow elements in pulmonary vessel in a road traffic accident case establishing the diagnosis of amniotic fluid and fat embolism, respectively. The presence of intranuclear CMV inclusions in lungs, liver and kidney along with cotton wool deposits in the lung parenchyma of a three-month-old female infant established the exact COD [Table/Fig-5,6]. These findings are in concordance with De La Grandmaison GL et al., who found histopathology to be extremely useful in determining the COD in 8.4% of cases and complemented the gross findings in 49% of cases [4]. Fronczek J et al., also agreed with the present study

where 2% of postmortem cases were diagnosed by microscopic examination without any accompanying history and gross findings [6]. The present findings are also in concordance with recently conducted study by Jhajj KK et al., in which they made rare diagnosis based on histopathology alone in 2.7% of cases [7].



[Table/Fig-5]: a): Amniotic Fluid Embolism (AFE)-Maternal pulmonary vessels showing squames and hair shaft (H&E, 200X)) Inset: T.S of hair in emboli (arrow); b): Aspirated vegetable matter in bronchus (H&E,100X); c): Fat embolism: Fat globules with accompanying marrow in pulmonary vessels (H&E, 400X) d): Intranuclear inclusions separated by clear halo from the thickened nuclear membrane of CMV (arrows) along with foamy eosinophilic exudate cotton wool exudates in alveoli typical of pneumocystis jiroveci (H&E,200X) Inset: IHC for CMV antigen in liver.



[Table/Fig-6]: a): Takayasu aortitis: Thickening of vessel wall with disruption of the elastic lamina and granulomatous inflammation with mixed inflammatory infiltrate and giant cells (arrow) (H&E,100X); b): Healed scar of old infarct (H&E,100x); c): ARVC-Myocardium being replaced by adipose tissue and fibrosis (arrow) (H&E, 40X) Inset: Gross of Right ventricular wall showing fatty infiltration (arrow); d): COPD- Mucous gland hypertrophy (arrow) and chronic inflammation of the bronchioles, with desquamation of the mucosa (H&E,200X).

However, the present study results are conflicting with Molina DK et al., [3]. They concluded that histology altered the COD in only one of 189 cases studied (a case of leukaemia). The possible explanation for the marked disagreement may be due to the inclusion criteria adopted by them. Most cases included by them were accidental cases with only one fourth of cases due to natural causes. The present series included both suspicious natural deaths and violent deaths and thus may be more representative of the forensic autopsy cases [Table/Fig-7].

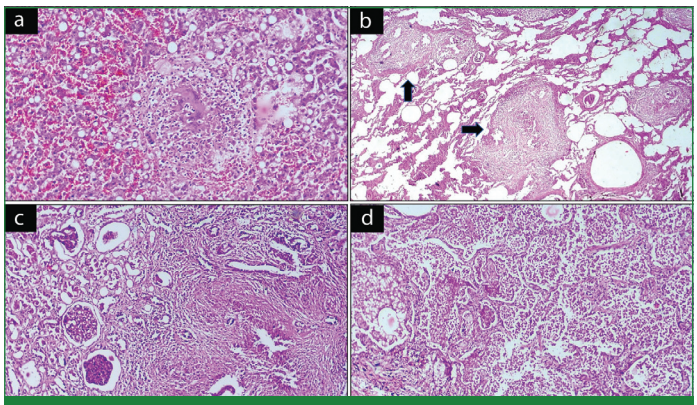
The histological examination was deemed as "contributory" to the postmortem examination if it added to or confirmed the COD [5]. Out of the total cases (n=86), histopathology supplemented with clinical details and gross findings was useful in establishing the COD in 26% of the cases. This is comparable to the study by Langlois NE and Fronczek J et al., who found histology to be contributory in 53% and 41% cases, respectively [5,6].

S. No.	Author	Year	HPE alone (%)	HPE contributory (%)
1	Langlois NE [5]	2006	4.8	53
2	Molina DK et al., [3]	2007	1	-
3	De La Grandmaison GL et al., [4]	2010	8.4	49
4	Fronczek J et al., [6]	2013	2	41
5	Present study	2020	9	26

[Table/Fig-7]: Comparison with other studies.
HPE: Histopathology

In the present series, microscopy confirmed the diagnosis made by gross examination and clinical details in 35% of the cases and in 65% of cases, it did not aid in the determination of the COD. This is similar to the study by Fronczek J et al., where in 8% of cases, the histology added to the medical COD and in 30% histology played no part in determination of COD [6].

Therefore, besides establishing the COD, histology is important to confirm and refine the macroscopic diagnosis. Equivocal or suspicious features of lesions such as pneumonia, tuberculosis and myocardial infarction are confirmed on histology as evident in the present series [Table/Fig-8]. The significance of histology is also highlighted in its role in corroborating or refuting the antemortem diagnosis and clinical suspicion as exemplified by cerebral infarction in a known case of Takayasu aortitis in the present series.



[Table/Fig-8]: a) Epitheloid cell granuloma in liver (H&E,200X); b): Multiple foci of epithelioid cell granuloma (arrows) in miliary pattern in lung (H&E,100X); c): Focus of epithelioid cell granuloma in kidney (H&E,100X); d: Lobar pneumonia (H&E, 100X).

On comparing the gross findings with the microscopic findings in different organs, several discrepancies were observed. These discrepancies were noted in 52.3% of cases. This was most often observed in liver (n=22) followed by heart and lungs. Such finding is in concordance with De La Grandmaison GL et al., who reported maximum discrepancy in liver followed by lung [4]. Langlois NE also described major discrepancy in heart and lungs [5]. Moreover, Roulson J et al., concluded that over 20% of clinically unexpected autopsy findings, including 5% of major findings can be correctly diagnosed only by histological examination [8]. On the other hand, significant association between consolidation on gross examination and pneumonia on microscopy in lung was noted in the present series.

The utility of histopathology in forensic autopsy is further refined by applying IHC. The presence of intranuclear inclusions of CMV was confirmed by demonstration of CMV antigen on IHC in one of our case. Other scenarios in which IHC is useful include the increased expression of complement C9 and Trop T and Trop C within the ischaemic myocardium to detect acute MI. Additional IHC marker is cytokeratin expression in identifying the epithelial cells in a suspected case of AFE. These adjunctive techniques along with microscopic examination show significant potential in forensic practice and their routine application remains largely unexplored.

Not only the common findings, forensic histopathology exposes and helps a pathologist study rare entity which is not usually encountered in routine histopathology. These incidental findings are a great source of knowledge for the pathologist and contribute immensely to the understanding the pathogenesis of diseases. Furthermore, histology provides a permanent record in medicolegal cases.

Limitation(s)

Being a single centre study, where subjective observation/opinion by forensic experts conducting autopsies played a major role in referring cases for histopathological examination contributing to bias. So, a multi-centric large-scale study may provide clear picture.

CONCLUSION(S)

To conclude, microscopic examination of tissues in forensic practice cannot be entirely done away with. In addition to confirming or refuting the suspected clinical COD, it is valuable in determining the specific COD in considerable number of autopsies thereby altering its legal implications and thus is imperative to forensic macroscopic examination of tissues. Also, it provides an enriching experience for the pathologist to acquire knowledge in this usually neglected aspect of histopathology.

REFERENCES

[1] Rothenberg K. In Ayn Embar-seddon, Allan D. Pass (eds.). Forensic Science. Salem Press; 2008. The Autopsy through History. pp. 100-100.
[2] Dettmeyer RB. The role of histopathology in forensic practice: An overview. Forensic Sci Med Pathol. 2014;10:401-12.
[3] Molina DK, Wood LE, Frost RE. Is routine histopathologic examination beneficial in all medicolegal autopsies? Am J Forensic Med Pathol. 2007;28:01-03.
[4] De La Grandmaison GL, Charlier P, Durigon M. Usefulness of systematic histological examination in routine forensic autopsy. J Forensic Sci. 2010;55:85-88.
[5] Langlois NE. The use of histology in 638 coronial postmortem examinations of adults: an audit. Med Sci Law. 2006;46(4):310-20.
[6] Fronczek J, Hollingbury F, Biggs M, Rutty G. The role of histology in forensic autopsies: Is histological examination always necessary to determine a cause of death? Forensic Sci Med Pathol. 2014;10:39-43.
[7] Jhajj KK, Nibhoria S, Sandhu SK, Bamra NS, Padda P. A study of histopathological examination in medicolegal autopsies in Faridkot, Punjab. Indian Journal of Forensic Medicine and Toxicology. 2013;7:77-81.
[8] Roulson J, Benbow EW, Hasleton PS. Discrepancies between clinical and autopsy diagnosis and the value of postmortem histology; A metaanalysis and review. Histopathology. 2005;47:551-59.

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