

## Histopathological Array of Cardiac Lesions in a Tertiary Care Hospital: An Autopsy Study

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### Abstract

**Context:** Cardiovascular diseases constitute the most common cause of sudden death. In medicolegal autopsies it is proposed that every possible organ must be sampled for histopathological examination as they provide the most accurate clues to a better understanding of human cardiovascular pathology.

**Aims:** The main aim of this study was to analyse the histopathological spectrum of cardiac diseases which play a major role as cause of death in autopsy specimens that were received in a tertiary care hospital.

**Settings and Design:** The study was conducted at a tertiary care hospital in Bangalore, the study period was from January 2015 to December 2019 during which a total of 276 autopsies were received. Out of these 173 cases included specimens of heart and were considered in this study.

**Methods and Material:** During the study period from January 2015 to December 2019, a total of 276 autopsies were received. Out of these 173 cases included specimens of heart and were considered in this study. Epidemiological data and post mortem findings were noted, gross findings documented and the heart opened through inflow outflow method. Microscopic findings on H and E stained sections were studied with special stains ordered wherever required. The histopathological findings were analysed.

**Results:** Males outnumbered females with 85% of the total cases and maximum number of cases were observed between 3rd decade to 5th decade. On histopathology, 60.4% of the cases showed atherosclerotic changes involving the coronary arteries followed by myocardial infarction (9%), myocardial hypertrophy (7%), cardiomyopathy (4.2%) cases, myocarditis (3.4%), 0.5% case each of aortic stenosis and infective endocarditis. 15% of cases showed no significant abnormalities on gross and microscopic examination.

**Conclusions:** Atherosclerosis involving the coronaries is probably the commonest finding on histopathology of the heart in cases subjected to autopsies. Cardiomyopathy and Myocarditis presenting as sudden death is common in the younger population.

**Keywords:** Coronaries; Heart; Post-mortem; Histopathology.

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### Introduction

Incidence of cardiac deaths has been increasing all over the world particularly in urban population during last five decades. In India incidence of ischaemic heart disease has increased to about 10%.<sup>1,2</sup> Cardiovascular pathology is a major contributor for sudden death. In most of the patients the first and

only clinical expression of coronary atherosclerotic process is sudden death.<sup>3</sup>

The autopsy is for long been regarded as the 'gold standard' as the most important tool for retrospective quality assessment of clinical diagnoses as well as a key education tool.<sup>4,5</sup>

The role of the Forensic pathologist is to provide a detailed examination of the organs, especially heart, in order to identify a definitive cause of death.<sup>3</sup>

One of the challenges faced by the forensic expert is the inability to determine the cause of death in a person previously thought healthy.

The autopsies can be a valuable source for epidemiological information in addition to providing valuable information to deceased immediate family.<sup>6,7</sup>

The autopsy study provides a means of understanding the basic process which sets a stage for clinically significant atherosclerotic cardiovascular disease. There is no valid method of sampling of living population. It was therefore considered that death suspected due to cardiovascular pathology, probably provide the best sample of the living population for studying cardiovascular diseases.<sup>8</sup>

It was reported that concordance between clinical and pathological causes of death are moderate, and the autopsy still provides a very important procedure for evaluating causes of deaths. Over one fifth of clinically unexpected autopsy findings can be correctly diagnosed only by histological examination. Autopsy and particularly autopsy histology are still the most accurate method of determining the cause of death and auditing accuracy of clinical diagnosis, diagnostic tests and death certification.<sup>6,8,9</sup>

The main objective of the autopsy is establishment of final diagnosis and to determine cause and manner of death whenever possible. Moreover, these autopsies help to reveal important data for public prosecutors.<sup>6,10</sup>

Sudden cardiac death is commonly defined as an unexpected natural death due to cardiac cause within a short time period (usually within one hour) with or without onset of symptoms and without any prior conditions that would appear fatal. The majority of sudden cardiac deaths (SCDs) are attributable to atherosclerotic coronary artery disease and are manifest in the older population, whereas cardiomyopathies predominate in the young (<35 years). Reduced mortality from

infectious diseases and the adoption of Western lifestyles has led to increased prevalence of ischemic heart disease in developing nations. More than 80% of cardiovascular deaths are associated with coronary atherosclerosis. Myocarditis is also a recognised cause of sudden unexpected death in both children and adults. Myocarditis is a recognised cause of cardiac failure in childhood and may present with non specific clinical features of progressive cardiac dysfunction or with those of dilated cardiomyopathy. Congenital heart diseases, which make up about 1% of human malformations, are among the most common malformations in fetuses. They contribute significantly to infant mortality rate due to poor prognosis.<sup>5</sup>

This study was conducted with the aim to study the various spectrum of cardiac diseases on histopathology in our institutional set up.

## Materials and Methods

This observational study was undertaken in the histopathology section in the Department of Pathology at a Tertiary Care Hospital, Bangalore over a period of 5 years. The study period was from January 2015 to December 2019 and all the autopsy cases including medico-legal cases submitted for postmortem analysis were a part of the study.

A total of 276 autopsies were received during this period out of which 173 cases included specimens of heart. Epidemiological data and post mortem findings were collected from the post mortem papers.

Gross examination of the heart Weight and dimensions of whole heart were recorded. The external surface was looked for pericardial pathology and for evidence of recent or old infarct. The dissection of heart and coronary blood vessels was done by Virchow's method (following the direction of blood flow i.e the inflow outflow method) mentioned in current method of autopsy practice by Ludwig.<sup>11</sup>

The thickness of right ventricular wall, left ventricular wall and interventricular septum were measured and noted. The valves were checked for their number, stenosis and calcification. Regions of either recent or old myocardial ischaemia were checked, and their location and sizes were recorded.

All the three coronary arteries; right coronary artery, left anterior descending artery and left circumflex coronary artery were examined using regular sections every 4-5mm.<sup>12</sup> The ascending aorta was checked for atherosclerotic changes and

dilatation/thickening. All gross findings as per proforma were recorded.

### Microscopic Examination

Sections were taken from right and left ventricular walls, interventricular septum, apex and multiple sections from all the coronary arteries. In addition, sections were taken from suspected pathological lesions. All sections were fixed in 10% neutral formalin for 1 to 3 days in automated tissue processor. The fixed tissue sections then were embedded in paraffin.

Sections of 3 to 5 micrometer in thickness were cut and stained with haematoxylin and eosin and examined under light microscope by using 10x and 40x objectives and results were recorded. Special stains were performed whenever required i.e, Von kossa for calcification, Von gieson for elastin and Masson 's trichome for collagen.<sup>6,12</sup>

### Results

A total of 173 hearts were studied. An obvious male dominance was observed with 85% (148) cases from male patients and 15% (25) cases from female patients. Our study included cases between newborns to 100 years old. Maximum number of cases were between 3rd decade to 5th decade.

Among these, on histopathology around 60.4% of the cases showed atherosclerotic changes involving the coronary arteries followed by myocardial infarction (9%) cases, myocardial hypertrophy (7%), cardiomyopathy (4.2%) cases, myocarditis (3.4%), 0.5% case each of aortic stenosis and infective endocarditis.

15% of cases showed no significant abnormalities on gross and microscopic examination. (Table 1)



Fig. 1: Gross Photograph Showing Cut Section of Left Anterior Descending Artery (Lad) With Atherosclerotic Plaque.

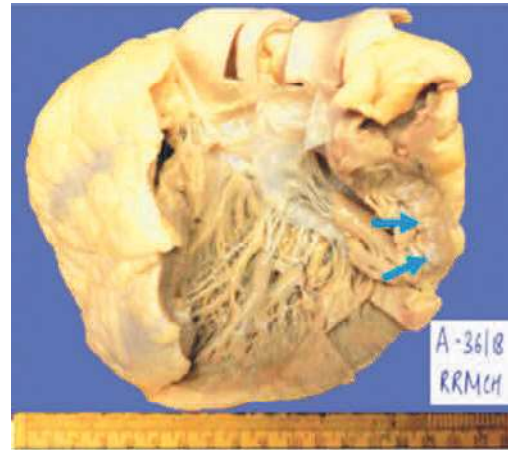


Fig. 2: Gross Photograph of Heart Showing Healed Myocardial Infarction (Blue Arrows Pointing at Grey White Areas).

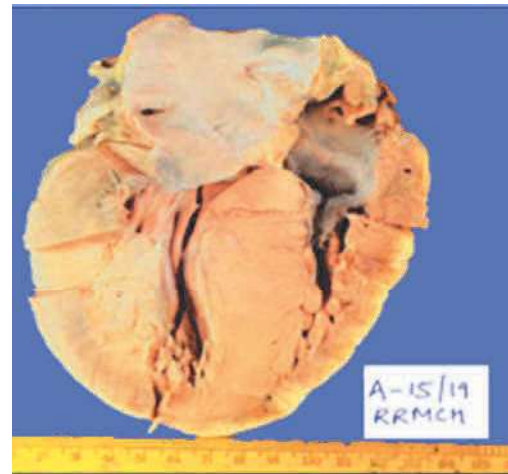


Fig. 3: Gross Photograph of Cut Section of Heart Showing Marked Left Ventricular and Interventricular Septal Hypertrophy.



Fig. 4: Gross Photograph of A 7 Year Old Patient's Heart.

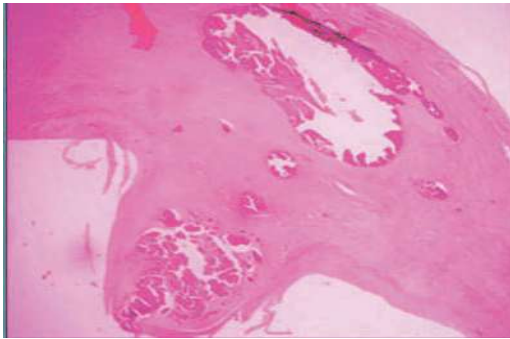


Fig. 5: Photomicrograph of Aortic Valve Showing Specks of Calcifications, H&E 10x.

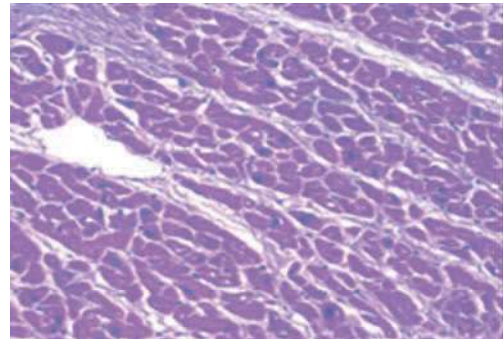


Fig. 9: Photomicrograph of Cardiac Muscle Tissue Exhibiting Marked Hypertrophy of Cardiomyocytes, H&E: 40x.

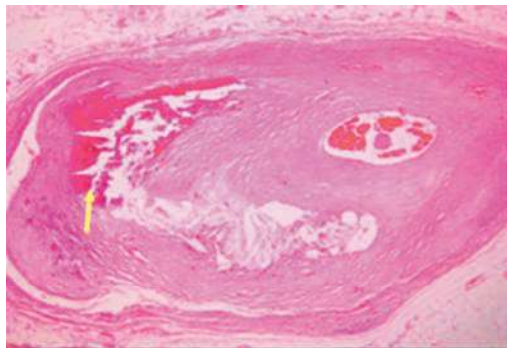


Fig. 6: Photomicrograph of Coronary Artery Showing Complicated Atherosclerotic Plaque (Grade -VI) Yellow Arrow Calcifications, H&E 10x.

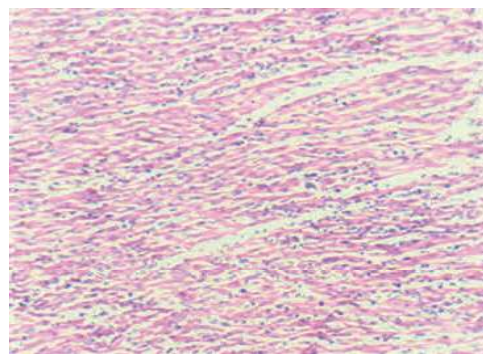


Fig. 10: Photomicrograph Showing Section of Left Ventricular Wall With Lymphocytic Myocarditis H&E, 10x.

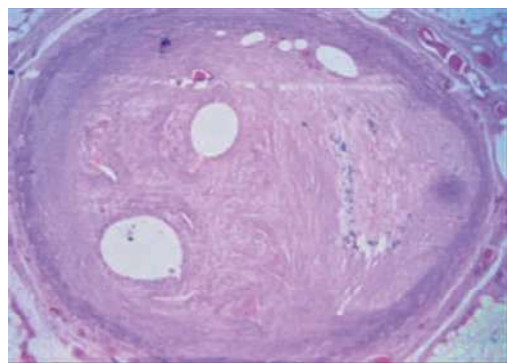


Fig. 7: Photomicrograph of Coronary Artery Showing Thrombus with Recanalisation of the Lumen, H&E 10x.

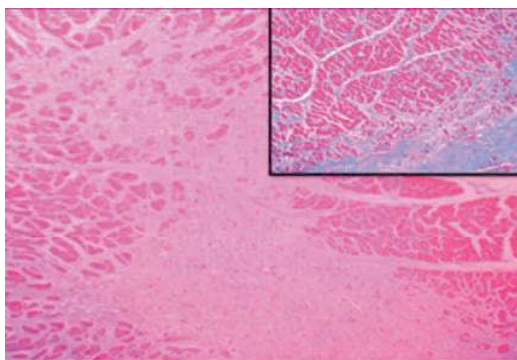


Fig. 8: Photomicrograph of Cardiac Muscle with Old/Healed Myocardial Infarction Replaced By Fibrous Scar, H&E, 10x. "Inset: Masson's Trichrome Stain"

Table 1:

Pathological Findings	Number of Cases	Percentage %
Atherosclerosis	105	60.6
Myocardial infarction	16	9.2
Myocardial hypertrophy	12	6.9
Cardiomyopathy	7	4
Myocarditis	6	3.4
Aortic Stenosis	1	0.5
Infective Endocarditis	1	0.5
No abnormality	25	14.9%
Total	173	100%

Table 2:

Coronary Artery Involved	Uncomplicated Plaque	Complicated Plaque	% Total
LAD	45%	29.5%	74.5%
LCX	9.5%	5%	14.5%
RCA	7%	3%	10%
Total	-	-	100%

In histopathological evaluation, most common finding was atherosclerosis 105 cases (60.9%) (Table 1). Triple vessel disease was observed in 66 cases (62.8%) of coronary atherosclerosis. Among 105 cases of atherosclerosis, 27 (25.7%) cases were

complicated with calcification within atheromatous plaque, 3 (2.8%) cases showed superimposed thrombus (Table 3).

**Table 3:** Changes in coronaries.

Findings	Number of Cases	%	Coronary Artery Involved
Atherosclerosis	75	71.5%	LAD-60% LCX-20% RCA-20%
Atherosclerosis with calcification	27	25.7%	LAD-40% LCX-30% RCA-30%
Atherosclerosis with thrombus	3	2.8%	LAD- 25% LCX-35% RCA-40%
Total	105	100%	

Aortic atherosclerosis was noted in 122 cases (70.5%) out of total 173 cases.

Myocardial Infarction was observed in 16 cases. Out of 16 cases, 10 (62.5%) cases showed recent or acute infarct and 6 (37.5%) cases revealed old infarct (Table 4)

**Table 4:**

	Number	Percentage
Acute/recent infarct	10	62.5%
Old healed infarct	6	37.5%
Total	16	100%

Myocardial hypertrophy was observed in 12 of 173 (7%) cases in total which involved the left ventricle and interventricular septum in 83.3 % cases, bilateral ventricles in 41.6% cases and only IVS in 33.3% cases.

4.2% (7/173) cases of cardiomyopathy comprising of HOCM(4) and DCM(3) and 3.4% (6/173) cases of myocarditis consisting of 5 cases of viral myocarditis and 1 cases of plasmodium falciparum myocarditis was observed. They were more common in younger population especially young adults & children. One case (0.5%) each of aortic stenosis and infective endocarditis were also observed in this present study.

26 out of 173 hearts accounting to almost 15% cases showed no abnormality in the heart on both gross and histopathologic examination.

### Discussion

Cardiovascular diseases being the most common cause of deaths as mentioned in literature, the cardiac autopsies were performed with the aim to observe histomorphological spectrum that could guide and solve the mystery of death, especially

sudden death.<sup>3,6</sup>

The major goal of the present study was to focus on cardiovascular findings in a study population at a tertiary care hospital whose corpses were subjected to medico-legal examination.

This study seems to represent an underrepresentation of the cardiac conditions prevalent in the female population as clearly there is male dominance of the cases studied. This type of gender bias was also noted in the studies conducted by Wang et al.<sup>13</sup>, Garg et al.<sup>8</sup>, Ahmad et al.<sup>14</sup> and Sonawane et al.<sup>15</sup>

In present study, most of cardiovascular deaths occurred within age range of 21-50 years. This shows that age is a powerful risk factor for heart disease.

Sonawane et al., reported most cases between age group 41-50years (23.38%), also Marwah et al. observed most cases in the age group of 41-50 years and Garg et al. reported maximum cases in the age group of 51-60 years (26.24%). These variations in the age incidence may be due to sample size variation.<sup>5</sup>

In adults, sudden cardiac death (SCD) is a complication and often the first clinical manifestation of ischaemic heart disease. With decreasing age of the victim, the non atherosclerotic causes of sudden cardiac death like congenital coronary arterial abnormalities, premature coronary artery disease, cardiomyopathies, mitral valve prolapse and myocarditis become increasingly probable.<sup>10</sup>

Coronary atherosclerosis was most common histopathological finding in the present study accounting to 60.6% of cases. Similar findings were reported by Joshi C, 7 (65%), Karanfil R et al.<sup>16</sup> (75%) and Drory Y et al.<sup>17</sup> (58%). In more than 90% of cases, the cause of myocardial ischaemia is reduction in coronary blood flow due to atherosclerotic coronary arterial obstruction. Atherosclerosis with calcification was present in 25.7% cases in this study, whereas with thrombosis was present in 2.8% of cases. Joshi C, 7 reported calcification in 17% cases and thrombosis in 5 % cases. Ozdemir B et al.<sup>18</sup> reported coronary thrombosis in 4.8% cases. Patients with advanced coronary atherosclerotic calcification appear to be at increased risk for coronary events.

Thrombus formation is the most feared complication of atherosclerosis and may partially or completely occlude the lumen.<sup>19</sup> In the present study, major blockage was noted in Left anterior descending artery (LAD) (74.5%) left circumflex artery (LCA) (14.5%), and right coronary artery

(RCA) (10%). Rao DS, 2 reported 24 (11.8%) cases with major blockage in both main coronaries, in 87 (42.6%) cases in LADA and in 18 (51.5%) cases in RCA. The LAD is considered the most important of the three main coronary arteries and is almost always the largest. The Left anterior descending artery typically supplies over half of the heart muscle with blood, so twice as much as the other coronary arteries. For this reason, a major blockage occurs at the beginning of the artery.<sup>3</sup>

Plaque calcification is found more frequently in advanced lesions, it may also occur in small amounts in earlier lesions, which appear in 2nd and third decade of life. Histopathological investigations had shown that plaques with microscopic evidence of mineralization are larger. However, the relation of arterial calcification to the probability of plaque rupture is unknown.<sup>8</sup>

In this study histological evidence of myocardial infarction was present in 16 (9.2%) cases, similarly Wang HY, et al.<sup>13</sup>, reported ischaemic heart disease in 7% cases whereas Bora Ozdemir et al.<sup>18</sup>, reported myocardial infarction in 26% cases.<sup>6</sup> Ramazan et al.<sup>20</sup>, reported myocardial infarction in 48% cases, which is higher than our study.

This difference may be due to time variability between onset of ischaemia and time of death. Because microscopic features depend upon the time period between onset of ischaemia and death.

Next common lesion in our study was myocardial hypertrophy which was present in 12 (6.9%) cases. In the literature, similar incidence that is 7% was reported by Cristino Basso et al, and Wang HY et al.<sup>13</sup> Ramazan Karanfil et al, and Chandrakala et al, reported a much higher incidence of cardiac hypertrophy in 66% and 52% cases respectively.<sup>7,16,20</sup>

Myocarditis was found in 6 (3.4%) out of total 173 cases. Variable percentage of myocarditis has been reported by different authors. Chandrakala Joshi 9%, Cristina Basso et al, 10%, Bora Ozdemir et al, 7%, Drory et al, 25% and Kramer et al, 29%.<sup>5,7,8,18</sup>

Myocarditis is defined as an inflammatory disease of the myocardium established by histology, immunology and immunohistochemistry. Myocarditis can present in many different ways, including SD, particularly in the young population.<sup>21</sup>

All 6 cases of myocarditis were from young age group ranging from 4 yrs to <25 years presenting with sudden death. Grossly, the heart may appear normal, as seen in our case (Fig. 3) but at histological analysis, interstitial edema, focal or diffuse inflammatory infiltrates, predominantly lymphocytic with associated myocyte necrosis and

replacement type fibrosis can be observed in the ventricular myocardium.

## Conclusion

Cardiovascular diseases constitute the most common cause of sudden death. It is well known that lifestyle modification and drug therapy in selected individuals can reduce the risk of cardiac events, but current Framingham risk assessment is suboptimal.

So in medicolegal autopsies it is proposed that every possible organ must be sampled for histopathological examination and must be examined with a multidisciplinary approach (scene investigation, medical history, biochemical, microbiological, toxicological etc). Histopathology of various organs is very helpful to the forensic surgeons in arriving at a conclusion regarding the cause of death.

In present study most common cause of death is myocardial infarction due to atherosclerosis. Histopathological studies provide the most accurate clues to a better understanding of human cardiovascular diseases. With better insight into disease pathophysiology, novel interventions could be introduced to improve care and future outcomes for patients undergoing cardiovascular diseases.

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