

## Histomorphological Alterations of the Human Heart: An Autopsy-Based Analysis at Dhaka Medical College

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### Abstract

**Background:** Cardiovascular disease, the coronary heart disease, is the main cause of death in industrialized countries and is rising at an alarming rate in much of developing countries. Autopsy is an important complementary tool for identifying and understanding cardiac diseases, and it gives a conclusive opinion on the involved cardiac pathology. Therefore, this study was aimed at observing various histomorphological changes in autopsy specimens of the heart.

**Methods:** This descriptive cross-sectional study was conducted at the Department of Pathology, Dhaka Medical College, Dhaka, from March 2020 to February 2022. A total of 150 hearts from autopsy specimens were included in this study. The hearts were examined grossly and microscopically, and findings were recorded in a predesigned data sheet. Statistical analysis was carried out as required.

**Results:** Analysis revealed that, out of the total 150 cases, more than half of the cases, 94 (62.7%), had cardiovascular changes, while the remaining 56 (37.3%) cases showed no significant changes. Among the pathological findings, more than half the cases (55.3%) had coronary atherosclerosis, followed by aortic atherosclerosis in 19.3% of cases, myocardial infarction (MI) in 18.7% of cases, left ventricular hypertrophy (LVH) in 15.3% of cases, and cardiac mural thrombus in 2% of cases. Only 1 (0.7%) case of non-bacterial thrombotic endocarditis and only 1 (0.7%) case of tuberculous pericarditis were also found in this study, unlike other studies done in this subcontinent.

**Conclusion:** Histopathological evaluation of the autopsied heart in medicolegal cases is essential to find out the pathological changes and cause of death as well. In this histomorphological study, the most common pathological finding was coronary atherosclerosis and which is the major underlying cause of ischemic heart diseases. Histopathological studies provide accurate knowledge for a better understanding of human cardiovascular diseases. With better insight into pathophysiology, proper interventions could be introduced to improve care and future outcomes for patients undergoing cardiovascular diseases.

[Journal of Histopathology and Cytopathology, 2026 Jan; 10 (1):17-26]

DOI: <https://www.doi.org/10.69950/jhc.2026.10.1.3>

**Keywords:** Histomorphology, Human heart, Autopsy-based study, Cardiac pathology, Myocardial changes

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## Introduction

Cardiovascular disease (CVD) is a group of conditions affecting the function of the heart or blood vessels and is one of the leading causes of death globally. Like elsewhere, cardiovascular disease prevalence is also increasing among adults in Bangladesh.<sup>1</sup>

Over the past few decades, due to the epidemiological transition, the prevailing disease pattern in this country has shifted from communicable to non-communicable diseases, with cardiovascular diseases contributing significantly to the latter.<sup>2</sup>

Due to fast economic growth, rapid urbanization has occurred in Bangladesh, and recently, it has emerged as a developing country. As a consequence of socio-economic development with resultant habituation of a sedentary lifestyle and changing food habits, cardiovascular diseases, particularly coronary artery disease, are increasing at an alarming rate.<sup>1</sup>

According to the World Health Organization (WHO), 17.9 million people died from CVDs in 2021, representing 32% of all global deaths. This number is expected to grow.

In Bangladesh, the burden of non-communicable diseases is an emerging public health challenge, which is responsible for 67% of all deaths. Among non-communicable diseases, CVD is the single most important contributor and is responsible for 30% of total mortality.<sup>3</sup>

The most common cardiovascular diseases in children and adolescents are congenital heart diseases, rheumatic heart diseases, infective endocarditis, hypertrophic and dilated cardiomyopathy, conduction system abnormalities, mitral valve prolapse, and aortic dissection.<sup>4</sup>

In adults, coronary atherosclerosis, ischemic heart diseases, heart failure, atrial fibrillation, and acquired forms of cardiomyopathy are the most common diseases and are also responsible for sudden cardiac death.<sup>5</sup> When death is believed to be due to an unnatural cause or in case of sudden death where a doctor is not able to write a death certificate, they are usually referred for an autopsy.<sup>6</sup>

The autopsy is a medical procedure that consists of the systematic examination of the dead body to determine the cause and manner of death as well as to evaluate any disease or injury that may be present.<sup>6</sup> It has been observed that in many instances, gross findings observed by the forensic experts alone could not help to decide the cause of death; histopathology following autopsy can conclusively opine the involved cardiac pathology.<sup>7</sup> In Bangladesh, no histopathological study has yet been done to observe cardiovascular changes in autopsy specimens of the heart. In this context, this study was designed to observe various cardiovascular changes in autopsied heart specimens and to find out the pattern and frequency of heart diseases. Thus, the study findings can be a valuable source for epidemiological data in the context of Bangladesh.

## Methods

This descriptive, cross-sectional study was conducted in the Department of Pathology at Dhaka Medical College. The study period extended from March 2020 to February 2022. The study population comprised hearts obtained from autopsy specimens of medicolegal cases. A consecutive sampling technique was employed to collect the samples during the study period.

A total of 150 cases were included in the study. The sample size was calculated using Cochran's formula, considering a 5% level of significance and an 8% precision level

(marginal error). According to a study, cardiovascular changes were found in 53.5% of autopsy specimens.<sup>8</sup> Therefore, considering a 53.5% prevalence, the calculated sample size was 150. Before this study, the thesis protocol was submitted to the Ethical Review Committee of Dhaka Medical College for approval, and was approved.

#### *Selection Criteria*

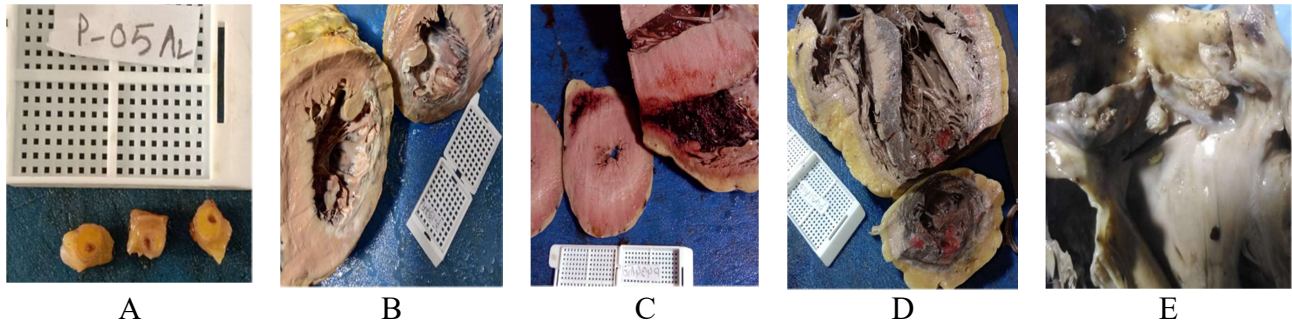
The inclusion criterion for this study was hearts obtained from autopsy specimens submitted for post-mortem analysis to the Department of Pathology, Dhaka Medical College. Specimens were excluded if the heart tissue was autolyzed, as such degradation could compromise the accuracy of histopathological evaluation.

#### *Collection of Samples*

Heart specimens from autopsy specimens were received as part of a histopathological examination in the Pathology Department of Dhaka Medical College. The specimens of the heart were fixed in 10% formalin. Age, sex, lab number, and case number of the deceased were recorded.

#### *Gross Examination*

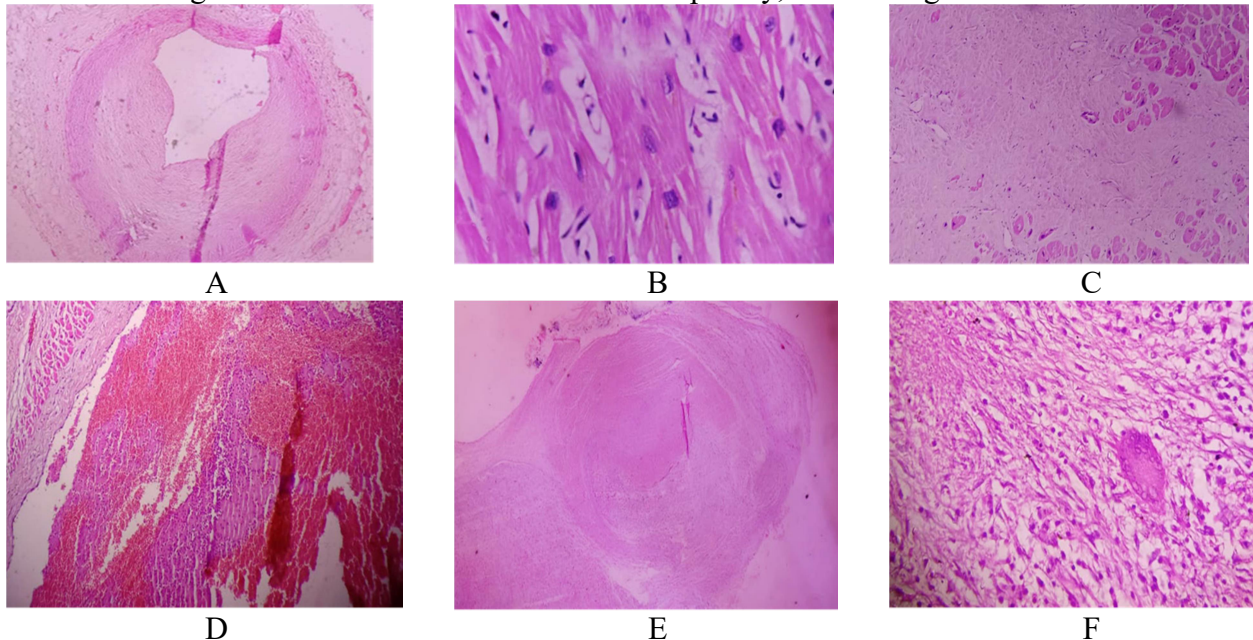
Formalin-fixed specimens of the heart were inspected externally, weighed, and then dissected by the Adult Heart Dissection Technique. Measurement of the thickness of the right ventricular wall, the left ventricular wall, and the interventricular septum was taken. The valves were examined for stenosis and calcification. All three coronary arteries, i.e. right coronary artery, the left anterior descending artery, and the left circumflex coronary artery, were examined, and all gross findings were recorded. Sections were taken from the right and left ventricular wall, the interventricular septum, apex, right coronary artery, left anterior descending artery, left circumflex coronary artery, stump of the aorta, and grossly abnormal cardiac valves. In the laboratory, tissue processing, paraffin embedding, sectioning of the paraffin blocks, and routine hematoxylin and eosin staining were done according to the standard protocol at the Department of Pathology, Dhaka Medical College.



Photograph 1. (A) Gross photomicrograph of coronary artery narrowed by atherosclerotic plaque (case no:04), (B) Gross photomicrograph of left ventricular hypertrophy showing thickened wall of left ventricle and interventricular septum (case no:130), (C) Gross photomicrograph of healed MI involving left ventricular wall (case no:15), (D) Gross photomicrograph of cardiac mural thrombus attached with the wall of left ventricle (case no:131), and (E) Gross photomicrograph vegetation on aortic valve (case no:118).

### *Microscopic Evaluation*

All the histological sections were examined microscopically, and findings were recorded.



Photograph 2. (A) Photomicrograph of coronary atherosclerosis showing thickened intimal layer with foam cells and fibro collagenous tissue (case no:04; H&E x 40), (B) Photomicrograph of left ventricular hypertrophy showing increase size of myocytes with large, rectangular, hyperchromatic nuclei (“box-car” nuclei) (case no:130; H&E x 40), (C) Photomicrograph of healed MI showing dense collagenous scar tissue between viable myocytes (case no:15; H&E x 40), (D) Photomicrograph of left ventricle showing mural thrombus with alternating layer of fibrin and red blood cells (case no:131; H&E x 40), (E) Photomicrograph of organizing nonbacterial thrombotic endocarditis with fibrin being converted to fibrosis without inflammation or organism (case no:118; H&E x 40), and (F) Photomicrograph showing epithelioid granuloma, caseous necrosis, Langhans type giant cells and infiltration of lymphocytes (case no:76; H&E x 400).

**Data Processing and Analysis**

After the collection of all the required data, this was tabulated using SPSS version 24. Continuous data were expressed as mean and standard deviation, and categorical data were expressed as frequency and percentage. To determine the association between categorical variables, chi chi-square test was done. P values less than 0.05 were considered significant.

**Ethical Consideration**

The protocol was presented and approved by the research review committee of the Pathology Department, Dhaka Medical College. Ethical Clearance was taken from the Ethical Review Committee of the Dhaka Medical College & Hospital. Informed written consent was not taken as all the autopsy specimens were submitted from the

Forensic Medicine Department of Dhaka Medical College, and the relatives of the deceased were not identified. All the information about the deceased was kept confidential. The collected data was used only for research purposes.

**Results**

This descriptive cross-sectional study was performed in the Pathology Department of Dhaka Medical College to observe the histomorphological changes in autopsy specimens of the heart. For this purpose, a total of 150 autopsied hearts of medicolegal cases were included. After evaluation of gross and microscopic examination, it has been observed that out of 150 cases, 94 (62.7%) cases had cardiovascular changes, and the remaining 56 (37.3%) cases showed no significant changes.

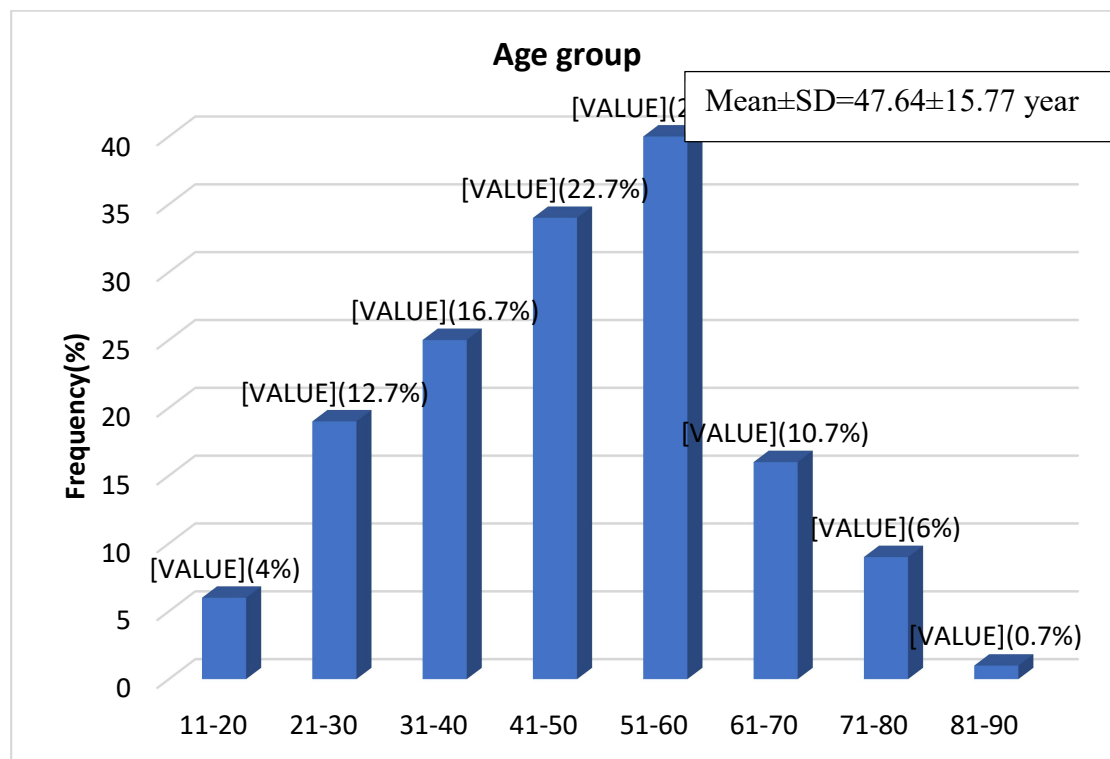


Figure 3. Distribution of age group of cases (n=150)

Figure 3 shows age age-wise distribution of cases. It was observed that most of the cases were from the 51-60 years age group, 40 (26.7%). The mean age was 47.64±15.77 (SD) years.

Table I: Sex distribution of cases with cardiovascular changes (n=94)

Sex	Frequency (n=94)	Percentage (%)
Male	84	89.4
Female	10	10.6
Total	94	100

Values are expressed within parentheses, percentage (%) over the column in total

Table I shows sex wise distribution of cases with cardiovascular changes. It was observed that out of 94 cases with cardiovascular change, 84 were male (89.4%) and the rest were female 10 (10.6%).

Table II: Various histomorphological changes in autopsied hearts (n=150)

Histomorphological changes	Frequency (n=150)	Percentage (%)
Coronary Atherosclerosis	83	55.3
Aortic Atherosclerosis	29	19.3
Myocardial infarction	28	18.7
Left ventricular hypertrophy	23	15.3
Cardiac mural thrombus	3	2
Non-bacterial endocarditis	1	0.7
Tuberculous pericarditis	1	0.7
Unremarkable	56	37.3

Values are expressed within parentheses, percentage (%) over the column in total, and multiple responses were considered.

Table II shows histo-morphological changes in autopsied hearts. It was observed that, out of 150 cases, unremarkable findings were in 56 (37.3%) cases, coronary atherosclerosis in 83 (55.3%) cases, aortic atherosclerosis in 29 (19.3%) cases, MI in 28 (18.7%) cases, and LVH was found in 23 (15.3%) cases. Cardiac mural thrombus was found in 3 (2%) cases, nonbacterial thrombotic (NBTE) endocarditis and tuberculous pericarditis were found in 1 (0.7%) case each.

Table III: Age-wise distribution of histomorphological changes of the autopsied heart (n=150)

Age group	No. of cases	No changes	LVH	Coronary atherosclerosis	MI	Cardiac mural thrombus	NBTE	Tuberculous Pericarditis	Aortic atherosclerosis
11-20	6	6	0	0	0	0	0	0	0
21-30	19	13	2	5	3	0	1	0	0
31-40	25	19	4	1	0	1	0	0	3
41-50	34	14	4	17	6	0	0	0	4
51-60	40	4	8	35	13	1	0	1	10
61-70	16	0	2	16	4	0	0	0	8
71-80	9	0	3	8	1	1	0	0	4
81-90	1	0	0	1	1	0	0	0	0
Total	150	56	23	83	28	3	1	1	29
	(100%)	(37.3%)	(15.3%)	(55.3%)	(18.7%)	(2.0%)	(0.7%)	(0.7%)	(19.3%)

LVH= Left ventricular hypertrophy

MI= Myocardial infarction

NBTE= Nonbacterial thrombotic endocarditis

Table III shows that, in the 11-20-year age group, all 6 cases were unremarkable. Most of the pathological changes were seen in the 51-60 age group, where out of 40 cases, only 4 cases were unremarkable, and 36 cases had cardiovascular changes, including coronary atherosclerosis in 35 cases, aortic atherosclerosis in 10 cases, MI in 13 cases, LVH in 8 cases, cardiac mural thrombus and tuberculous pericarditis in 1 case each. No unremarkable case was seen among 16 cases in the 61-70 age group, 9 cases in the 71-80 age group, and 1 case in the 81-90 age group.

### Discussion

This descriptive cross-sectional study was performed on a total of 150 autopsied hearts of medicolegal cases, submitted for post-mortem analysis. The main purpose of the study was to observe the histomorphological changes in the autopsy specimen of the heart.

In the present study, age-wise distribution of the autopsy cases showed that the maximum number of cases was from the 51-60 years age group (26.7%). The mean age was  $47.64 \pm 15.77$  (SD) years. Similarly, Gaikwad et al. (2019) and Garg et al. (2018) also found maximum cases in the age group of 51-60 years.<sup>7,9</sup>

In this study, age distribution of cases with cardiovascular changes showed, in comparison with 21-30 and 31-40 age group, most of the cases with cardiovascular changes were seen in 51-60 age group having 36 (38.3%) cases followed by 20 (21.3%) cases in 41-50 age group, 16 (17%) cases in 61-70 age group and 9 (9.6%) cases in 71-80 age group.

This proved that increasing age is one of the major risk factors for cardiovascular diseases.<sup>5</sup>

In the present study, it was observed that out of the total 150 cases, most of the cases were male, 128 (85.3%), and 22 (14.7%) were female. Male predominance as compared to female was found in this study, and similarly, in the studies conducted by Garg et al. (2018) and Gaikwad et al. (2019).<sup>7,9</sup>

This study showed that, out of 94 cases with cardiovascular changes, around 90% (84 out of 94 cases) were male. This finding emphasizes the fact that male gender is one of the major risk factors for atherosclerosis and ischemic heart diseases.<sup>5</sup>

In this current study, histo-morphological examination of autopsy specimens of the heart showed a wide spectrum of cardiac changes. Out of 150 cases, more than half of the cases, 94 (62.7%), had cardiovascular changes, and the remaining 56 (37.3%) cases showed no significant changes. The most common pathological changes were coronary atherosclerosis in 83 (55.3%) cases, followed by aortic atherosclerosis in 29 (19.3%) cases, myocardial infarction (MI) in 28 (18.7%) cases, and LVH was found in 23 (15.3%) cases. Cardiac mural thrombus was found in 3 (2%) cases, non-bacterial endocarditis and tuberculous pericarditis were found in 1 (0.7%) case each.

The comparative studies of histomorphological changes and their frequencies are summarized in the following table:

### Comparison of various histomorphological changes in the heart and their frequencies with similar study findings

Histomorphological changes	Current study	Gaikwad et al. (2019)	Garg et al. (2018)
Coronary Atherosclerosis	55.3%	53.0%	55.3%
Aortic Atherosclerosis	19.3%	61.5%	-
Myocardial infarction	18.7%	19.5%	14.1%
Left ventricular hypertrophy (LVH)	15.3%	0.9%	7.09%
Cardiac mural thrombus	2.0%	0.5%	-
Non-bacterial endocarditis	0.7%	-	-
Tuberculous pericarditis	0.7%	-	-
No changes	37.3%	21.2%	15.6%

In the present study, coronary atherosclerosis was the most common finding and was observed in 55.3% cases. Similar findings were seen in the study done by Garg et al. (2018) and Gaikwad et al. (2019), where they found coronary atherosclerosis in 55.3% cases and 53.0% cases, respectively.<sup>7,9</sup>

On the other hand, aortic atherosclerosis was found in 19.3% cases in the current study, whereas aortic atherosclerosis was reportedly three times higher (61.5%) in the study done by Gaikwad et al. (2019)<sup>9</sup>, and no cases of aortic atherosclerosis were found by Garg et al. (2018).<sup>7</sup> Again, left ventricular hypertrophy was found in 15.3% cases in this study, which is much higher than what was reported by Gaikwad et al. (2019)<sup>9</sup> (0.9%) and Garg et al. (2018)<sup>7</sup> (7.09%). The exact reason behind these discrepancies is not apparent due to the unavailability of clinical data.

Unlike the previous studies on autopsy heart specimens in the context of the Indian subcontinent, the present study has reported a single case of tuberculous pericarditis and a single case of nonbacterial thrombotic endocarditis (NBTE).

The case of tuberculous pericarditis was found in a 55-year-old female. Grossly, the surfaces of the heart were firmly adhered to the adjacent parts of both lungs, and also some nodular structures were seen in

adhesion with the surrounding great vessels. The epicardium shows a whitish-yellow granular surface. Histologically, sections of the ventricular wall show epithelioid granuloma, areas of caseous necrosis, Langhans' type giant cells, and infiltration of lymphocytes along the pericardial margin. Examination of the specimens of both lungs also shows evidence of pulmonary tuberculosis in this case. However, detection of tubercle bacilli by acid-fast stain or PCR was not done as a confirmatory diagnosis. Kamakeri et al. (2018) studied 1500 autopsied hearts in sudden death cases and found 5 (0.33%) cases of tuberculous pericarditis.<sup>10</sup>

The case of nonbacterial endocarditis was observed in 24 24-year-old female with a heart weighing 400 kg. Grossly multiple, small vegetations were found on the leaflets of the aortic valves. Histological examination shows an organized thrombus with fibrin being converted to fibrosis without infiltration of inflammatory cells. Bacteriological examination could not be done due to a formalin-fixed specimen. Hence, the diagnosis was based on gross and histopathological examination. Asopa et al. (2007) reported that, in approximately 1.2% of all autopsy cases, vegetations caused by nonbacterial thrombotic endocarditis may be found, although the reported incidence of

nonbacterial thrombotic endocarditis (NBTE) ranges from 0.3% to 9.3%.<sup>11</sup>

In the present study, age-wise distribution of histomorphological changes in autopsied heart specimens shows, all 6 cases of the 11-20 years age group reveal no changes detected in the heart. In the 21-30 age group, out of 19 cases, only 6 cases had pathological cardiac changes. In the 31-40 age group, out of 25 cases, only 5 cases had pathological cardiac changes. In the 41-50 age group, out of 34 cases, 20 cases had pathological cardiac changes. In the 51-60 age group, out of 40 cases, only 4 cases revealed no changes in the heart, and 36 cases had pathological changes. No significant changes were seen among 16 cases in the 61-70 age group, 9 cases in the 71-80 age group, and 1 case in the 81-90 age group. These observed data are comparable with the study done by Saloni et al. (2019), where investigators found that only 1 case was seen in the 0-10 age group and showed no changes in the heart. In the 11-20 age group, out of 14 cases, 8 cases showed no changes, and 4 cases had hypertrophy. In the 51-60 age group, out of 32 cases, 24 cases had pathological changes.<sup>12</sup> In the 61-70 age group, out of 22 cases, 18 cases had pathological changes. Cases of no changes of the heart were not found in the 71-80 age group and the 81-90 age group.<sup>12</sup> The present study and the study done by Saloni et al., 2019 showed that, as the age group increases number of pathological cardiac changes increases, and cases of no changes decrease.

The results of this study correspond with the findings of previous studies with slight variations. However, histomorphological studies not only determine the cause of death in medicolegal cases but also provide a better understanding of the pattern and frequencies of cardiovascular diseases.

One of the major limitations of this study is that autopsies are not routinely performed in Bangladesh; only medicolegal autopsies are conducted. As a result, it is challenging to determine the actual incidence of cardiovascular lesions based on autopsy series alone. Additionally, the absence of medical and demographic records of the study subjects hindered the possibility of clinical correlation with the histopathological findings. Therefore, further studies with a larger sample size are recommended to gain a more comprehensive understanding of the histomorphological changes in autopsy specimens of the heart and to better identify the pattern of cardiovascular changes prevalent in the Bangladeshi population.

#### *Conclusion*

This histomorphological study of autopsied hearts revealed that, out of 150 cases, more than half (94, 62.7%) exhibited cardiovascular changes, while the remaining 56 (37.3%) cases showed no significant changes. Among the pathological findings, most of the cases had atherosclerotic changes in the coronary arteries and aorta, followed by myocardial infarction and left ventricular hypertrophy. The cardiac changes were detected mostly in middle-aged and older adults (87.2% cases were above 40 years). This finding is alarming for young adults in Bangladesh. Therefore, public awareness should be created regarding high CVD prevalence in Bangladesh and its incidence at an early age. Detection of tuberculous pericarditis in one autopsy specimen serves as an indicator of the high prevalence of tuberculosis in Bangladesh.

#### *Acknowledgement*

We are grateful to all those who supported me throughout this study. I would like to express my sincere thanks to my supervisor for their invaluable guidance and encouragement. I

also thank the laboratory staff and patients who made this research possible.

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