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Original Research Article

Histopathological array of cardiac lesions: An autopsy based study in a tertiary care centre

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ABSTRACT

Background: Cardiac lesions are responsible for approximately 60-70% of sudden deaths. Histopathological examination of heart on autopsy plays an essential role in determining the cause of death. **Aims and Objectives :** The present study was conducted to analyse histopathological spectrum of various cardiac lesions in autopsy specimens.

Materials and Methods: This retrospective randomized study was conducted in the Department of Pathology, Pt. B. D. Sharma, PGIMS, Rohtak, Haryana. A total of 1152 autopsies were analysed, irrespective of cause of death. Among them heart was included in 1062 autopsies, out of which 62 were autolysed. Hence, 1000 specimen of whole heart were included in our study. A detailed gross and microscopic examination was done and histopathological findings were correlated clinically.

Results: Atherosclerosis was the most common cardiac lesion seen in 610 out of 1000 autopsied heart (61%), followed by ischaemic heart disease in 346 cases (34.6%). 27 cases had pericarditis, 23 cases revealed myocardial hypertrophy, 16 cases showed myocarditis, 11 cases had ventricular haemorrhage, 8 cases revealed changes of electrocution, 7 cases had tuberculosis, 6 cases had calcification of valve and 4 cases had metastasis from carcinoma. One case each of infective endocarditis, rheumatic heart disease and aortitis were also noted. The cause of death was not identified in 304 cases. Left anterior descending artery was most frequently involved vessels (35.02%) followed by left circumflex artery (33.41%) then right coronary artery (31.57%). Out of three major vessels 16.24% had single vessel involvement whereas 32.14% & 51.62% cases had two vessels and three vessels involvement respectively.

Conclusion: Ischemic heart disease with coronary artery atherosclerosis was found to be the leading cause of death with triple vessel disease as the most common pattern of involvement.

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1. Introduction

Cardiovascular diseases (CVD) are the leading cause of death worldwide with an incidence of 60-70%.¹ At the turn of century, it has become the leading cause of morbidity in India because of increase in cardiovascular risk factors. In 2016, the estimated prevalence of CVD in India was estimated to be 54.5 million. A quarter of all mortality is attributable to CVD. Ischemic heart disease and stroke are

the predominant causes and are responsible for >80% of CVD deaths.² These diseases tend to affect patients in the most productive years of their lives and result in catastrophic social and economic consequences.

There is no valid method for sampling living population also there is moderate concordance between clinical and pathological causes of death. Over one fifth of clinically unexpected autopsy findings are 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

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diagnosis, diagnostic tests and death certification. It can also help in studying epidemiological profile, patho-physiology and management modalities of various cardiac lesions.³

Against this background, to assess the magnitude of problem, this study was done to determine the cause and nature of cardiac death and to observe various histomorphological changes including 1000 autopsy specimens of whole heart.

2. Materials and Methods

The present retrospective randomized study was conducted in the Department of Pathology, Pt.B.D.Sharma, PGIMS, Rohtak, Haryana over the period of 9 months.

2.1. Case selection

A total of 1152 autopsies submitted to this institute for post-mortem examination, irrespective of cause of death, were analysed. The cases were medico legal and involved individuals of all age-group, sex, religion and caste. Epidemiological data and post mortem findings were noted from the post mortem and police papers.

2.2. Exclusion criteria

Out of total 1152 autopsies, specimen of heart was included in 1062 autopsies, out of which 62 were ill preserved and completely autolysed and were excluded from the study. Hence, 1000 whole heart specimens were included in our study.

2.3. Gross examination of heart

The samples were received in 10% formalin fixative with brief history and clinical details. The heart specimens were measured, weighed and examined externally for any rupture, infarct and discoloration. The heart was then dissected by modified Virchow's method following the direction of blood flow.⁴ All the chambers were washed off any blood clots and were examined for any pathology of valves including stenosis or calcification and endocardium for vegetations or thrombi. Thickness of ventricular walls and inter-ventricular septum was measured. Areas of myocardial ischaemia were serial sectioned and noted for their location and size. The three main vessels including right coronary artery (RCA), left circumflex artery (LCA) and left anterior descending artery (LAD) were examined using sections at regular intervals of 4-5 mm for any hardening, blockage and plaque. The aorta was checked for any dilatation, thickening and plaque.

2.4. Microscopic examination

Representative sections were taken from right and left ventricular wall, atrio-ventricular junction, inter ventricular septum, apex, three coronary arteries, valves and stump

of aorta. Additional sections were taken from suspected pathological lesions. The sections were routinely processed and stained with Haematoxylin and Eosin stain for microscopic examination.^{5,6} Special stains including Van Gieson, Masson Trichrome and Von Kossa were applied according to need and nature of lesion. The microscopic findings were noted and were correlated clinically.

2.5. Statistical analysis

The results of the study were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 20 (IBM Corp. SPSS statistics, in Armonk NY) for windows. Data were expressed as mean±standard deviation and range for quantitative variables, numbers, and percentage.

3. Results

A total of 1152 autopsies received in the department of pathology were analysed. Out of these 90 cases did not include heart tissue and 62 cases were autolysed to yield any findings and were excluded from the study. Hence, a total of 1000 specimen of whole heart were included in our study.

3.1. Age and sex distribution

All the cases were divided into age groups based on the age at the time of death. The youngest case was newborn female and the oldest was 96 years male forming a age range of 0-96 years. Mean age was 42.64 years. Mean age for males was 40.65 years and for females was 36.13 years. Maximum number of cases presented in the age group of 41-50 years i.e. 242 (24.2%).

Out of 1000 cases, 832 (83.2%) were males and 168 (16.8%) were females forming a ratio of 4:95. There was remarkable male dominance. The age and sex distribution are shown in Figure 1

3.2. Weight distribution

The post fixation heart weight ranged from 20 gm to 680 gm in males and 20 gm to 530 gm in females. The mean weight of the heart was 293.73 gm. Mean weight of heart for males was determined to be 302.08 gm and for females was 241.43 gm. (Table 1)

3.3. Clinical details

The cases presented with variable cause of death. Majority of them (36.3%) had cardiovascular symptoms like chest pain, breathlessness and dizziness. Second most common cause was unknown previous illness (11%) and cases were under treatment. 10% cases were brought dead following collapse or an uncommon preceding event. (Table 2)

3.4. Histopathological changes in heart

A wide spectrum of histopathological changes were observed on microscopic examination. Coronary atherosclerosis (CA) was the most common finding seen in 610 cases, followed by ischaemic heart disease (IHD) in 346 cases. 27 cases showed pericarditis, myocardial hypertrophy was found in 23 cases, 16 cases revealed myocarditis, 11 cases had ventricular haemorrhage due to trauma, 8 cases had changes of electrocution, 7 cases showed tuberculosis with variable involvement of pericardium and myocardium, 6 cases had calcification of valve and 4 cases revealed metastasis from carcinoma. In 304 cases (30.4%), no significant pathological changes were noted in heart. (Figures 2 and 3 and Table 3)

One case each of rheumatic heart disease (at 14 year of age) and infective endocarditis (at 35 year of age) were also noted. In age group 0-10 years microscopic examination of heart and vessels was unremarkable. No congenital anomaly was seen in newborn and infants heart.

3.5. Changes in coronary arteries

Overall prevalence of atherosclerosis was 61.0%. In our study there was no case in age less than 10 years and there was significant increase in number and severity of atherosclerosis after third decades. All the cases with age more than 70 years had significant atherosclerosis

Out of the three coronary arteries, left anterior descending (LAD) was most commonly involved vessel (436 cases), followed by left circumflex artery (LCA) (416 cases) and right coronary artery (RCA) (393 cases). Secondary changes in coronary arteries like calcification, thrombus formation and plaque rupture were seen in 130, 97, 86 cases of LAD, LCA and RCA respectively. (Figure 4 and Table 4)

Complete occlusion of vessel was seen in 16, 12, 4 cases of LAD, LCA and RCA respectively. In 152 cases (24.4%) aorta also showed atherosclerotic plaques. One case of aortitis was also noted. The calcification was confirmed by Von kossa stain and disrupted elastic fibres were demonstrated by Von Geison stain. Most of the cases (51.62 %) revealed triple vessel disease followed by double vessel disease (32.14%) and single vessel disease (16.24%).

3.6. Pattern and distribution of IHD

Overall prevalence of IHD was 34.6% with features of chronic IHD (CIHD) in 21.6%, acute myocardial infarction (AMI) in 8.5% and acute on chronic IHD in 4.5%. A significant association was found between increasing age and incidence of IHD, with maximum number of cases reported in the age group of 51-60 years.

The most common pattern of involvement was diffuse i.e. involvement of all the areas including left ventricular wall (LVW), inter ventricular septum (IVS) and apex (37.57%),

followed by isolated involvement of left ventricular wall (22.83%). Isolated involvement of right ventricular wall (RVW) was seen in one case of acute MI. (Table 5)

4. Discussion

Histopathological examination of heart plays an important role in determining whether death is attributable to a cardiac disease or to other cause, to determine the nature of cardiac disease, whether the mechanism was mechanical or arrhythmic and to rule out the possibility of trauma or any other unnatural cause.⁷

Out of 1000 whole heart specimens from our study, 83.2% were males and 16.8% were females, indicating that death from all causes including cardiac and non-cardiac was more common in men, and most of the cardiovascular deaths occurred within the age range of 41-60 years. This may be due to westernization of Indian society, sedentary life style, poor diet habits and lack of regular medical checkups. Secondly, there is increased indulgence to smoking and alcohol in males, while in females, estrogen has vasoprotective effects. These findings are supported by many studies showing similar male predominance and role of increasing age in sudden cardiac death patients with Karnafil R et al having maximum case in 41-50 years age range, Rao D et al in 50-60 years and Chug SS et al in 50-59 years.⁸⁻¹⁰

We also observed that in adolescents and young adults (<40 years) hypertrophic cardiomyopathy, myocarditis, pericarditis, tuberculosis, electrocution, ventricular haemorrhage due to trauma and premature coronary artery disease were found to be a major causative factor. While after 40 years, coronary atherosclerosis and IHD were predominant findings along with metastasis and calcification of valve in a few cases. These findings are in concordance with study done by Rao D et al, Singh P et al and Marwah et al.^{9,11,12}

In this study, the prevalence of coronary atherosclerosis was 61.0%, which is comparable to other studies done by Shah SN et al (61.18%), Garg S et al (55.3%) and Joshi C et al (64%).¹³⁻¹⁵ In terms of frequency of involvement and secondary changes LAD was most commonly involved vessel, followed by LCA and RCA. These findings are in concordance with studies done by Shah SN et al with LAD as most frequently involved vessel (38.70%) followed by LCA (36.56%) and RCA (31.18%). However, secondary changes were more commonly seen in LCA followed by LAD and RCA.¹³

Triple vessel involvement was most common in our study (51.62 %) followed by double and single vessel involvement 32.14% & 16.24% respectively. It was correlated with the study done by Porwal et al with triple vessel involvement in 40%, double vessel in 37% and single vessel in 15% case.¹⁶ It was supported by Garg M et al who also reported triple vessels as the most commonly involved vessels (44.4%).¹⁷

Table 1: Weight distribution of cases

Heart Weight (gm)	Male	Female	Total (%)
0-50	10	05	15(1.5)
51-100	06	03	09(0.9)
101-150	12	04	16(1.6)
151-200	64	27	91(9.1)
201-250	115	50	165(16.5)
251-300	250	42	292(29.2)
301-350	181	20	201(20.1)
351-400	120	10	130(13.0)
401-450	42	04	46(4.6)
451-500	15	02	17(1.7)
501-550	08	01	0 (0.9)
551-600	05	00	05(0.5)
601-650	03	00	03(0.3)
651-700	01	00	01(0.1)
Total	832	168	1000(100)

Table 2: Clinical Details

S.No.	Cause of death	No. of cases	Percentage
1.	Cardiovascular symptoms	363	36.3
2.	Unknown illness	110	11.0
3.	Brought dead	100	10.0
4.	Sudden & natural death	79	7.9
5.	Poisoning	68	6.8
6.	Road side accident	47	4.7
7.	Respiratory symptoms, Tuberculosis	40	4.0
8.	GIT symptoms	26	2.6
9.	Alcohol intoxication	24	2.4
10.	Drowning	23	2.3
11.	Death due to cold	22	2.2
12.	Electrocution	20	2.0
13.	Post-partum illness	16	1.6
14.	Hanging	15	1.5
15.	Homicide	12	1.2
16.	Snake bite	09	0.9
17.	Fall from height	08	0.8
18.	Starvation	07	0.7
19.	Seizures	05	0.5
20.	Burns	04	0.4
21.	Still birth	02	0.2
	Total	1000	100

Table 3: Histopathological changes in heart according to age group distribution

Age (Years)	Normal	CA	CIHD	AMI	Acute on CIHD	HCMPMyo-carditis	Peri-carditis	Electrocution	Calc. of valve	TB	Vent H'ghe	Mets
0-10	24	0	0	0	0	0	0	0	0	0	0	0
11-20	58	2	0	0	0	3	3	2	0	0	0	0
21-30	86	70	10	14	4	5	3	6	2	0	2	4
31-40	70	134	46	16	6	5	4	7	3	0	3	3
41-50	46	181	50	20	8	6	2	5	2	1	1	3
51-60	16	128	52	22	10	3	3	4	1	1	1	1
61-70	4	69	44	10	12	1	1	2	0	2	0	0
71-80	0	13	7	2	3	0	0	0	0	1	0	0
81-90	0	11	5	1	2	0	0	1	0	1	0	0
91-100	0	2	2	0	0	0	0	0	0	0	0	0
Total	304	610	216	85	45	23	16	27	8	6	7	11

Table 4: Frequency distribution of atherosclerosis in three major coronary vessels

Coronary artery	Atherosclerosis			Calcification	Complications Thrombus	Plaque rupture	Total
	Mild	Moderate	Severe				
RCA	113	122	72	83	3	0	393
LCA	121	128	70	90	6	1	416
LAD	102	106	98	112	16	2	436
Total	336	356	240	285	25	3	1245

Table 5: Frequency distribution of areas involved in ischaemic heart disease

Walls affected	Chronic IHD	Acute MI	Acute on chronic IHD	Total (%)
Only RVW	0	1	0	1(0.29)
Only LVW	50	19	10	79(22.83)
Only IVS	16	3	0	19(5.49)
LVW and IVS	18	5	2	25(7.22)
Apex	33	16	6	55(15.90)
Apex and IVS	21	8	8	37(10.70)
All	78	33	19	130(37.57)
Total	216	85	45	346(100)

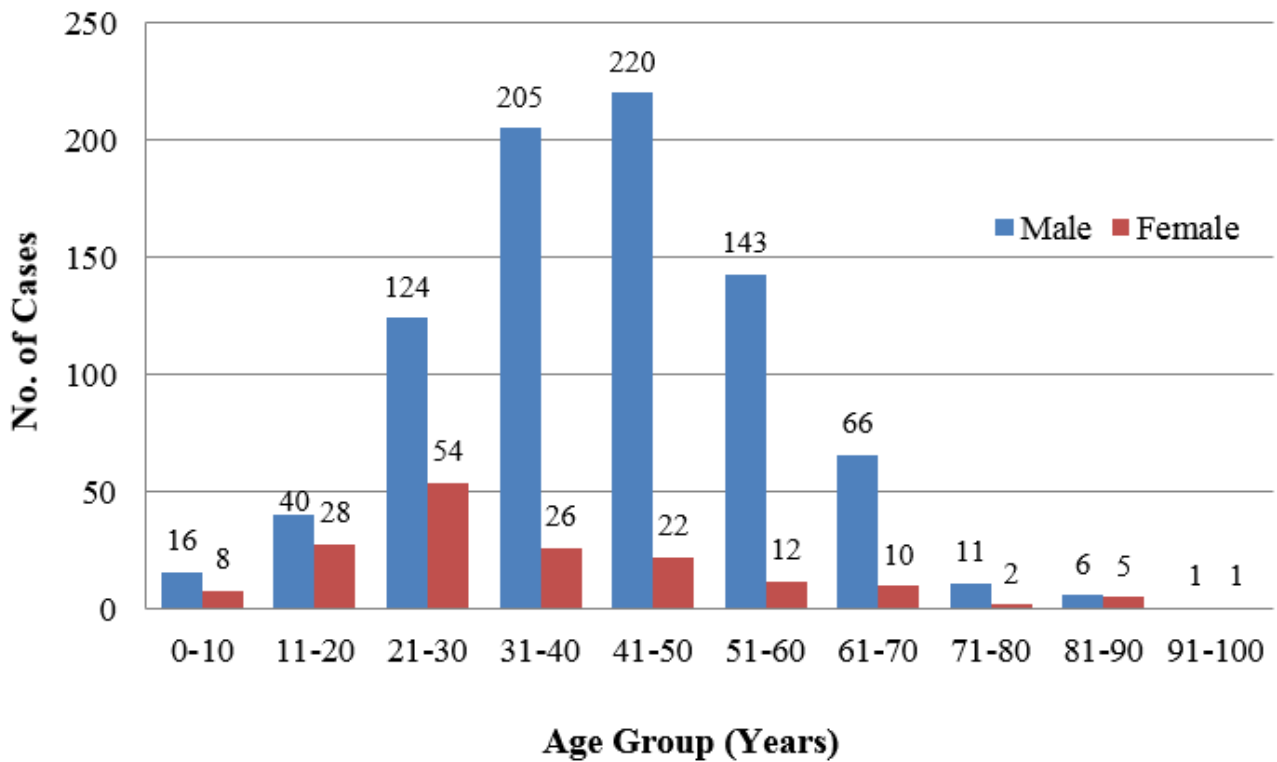


Fig. 1: Age and sex distribution of cases

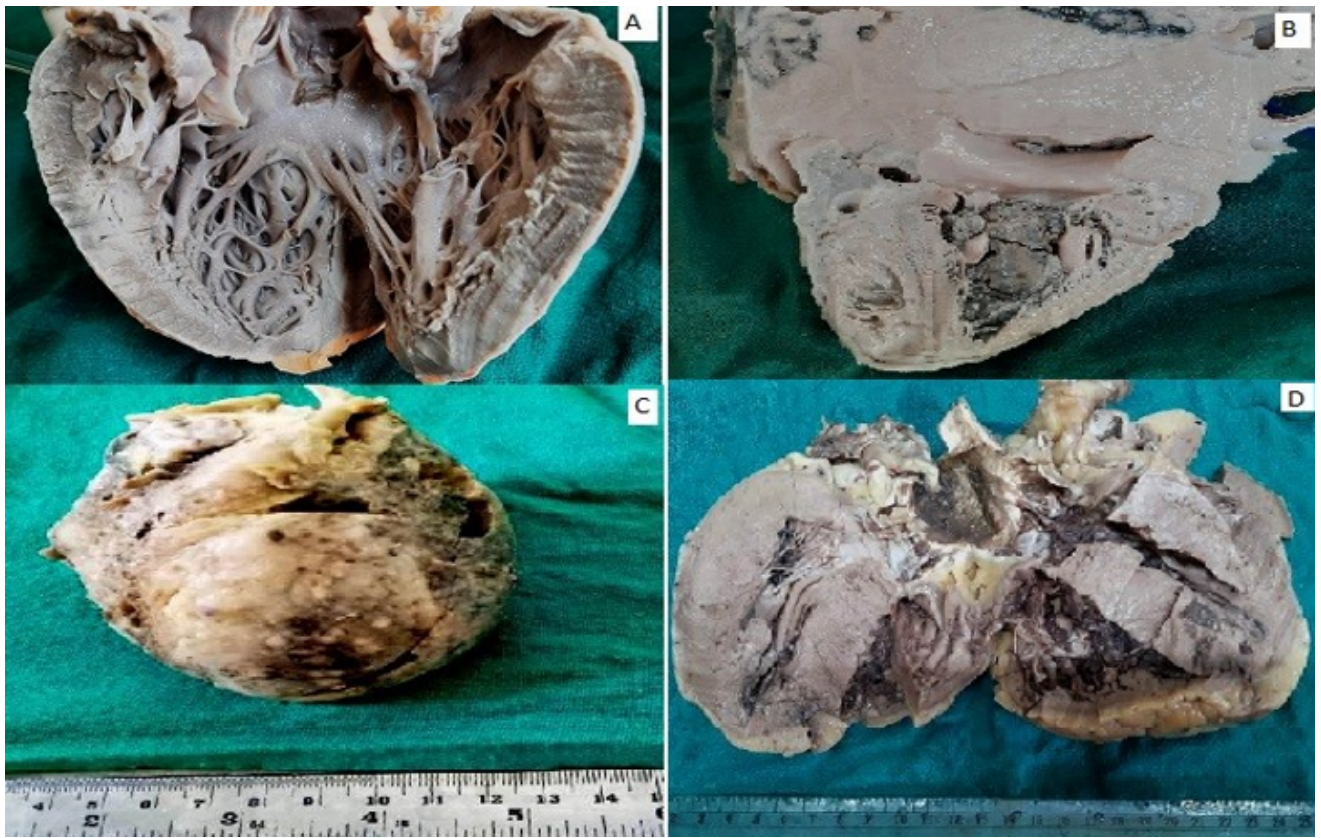


Fig. 2: Gross findings of heart revealing; **A):** Ventricular wall infarct; **B):** Metastatic infiltrate from lung carcinoma; **C):** Pericardial tuberculosis; **D):** Hypertrophic cardiomyopathy

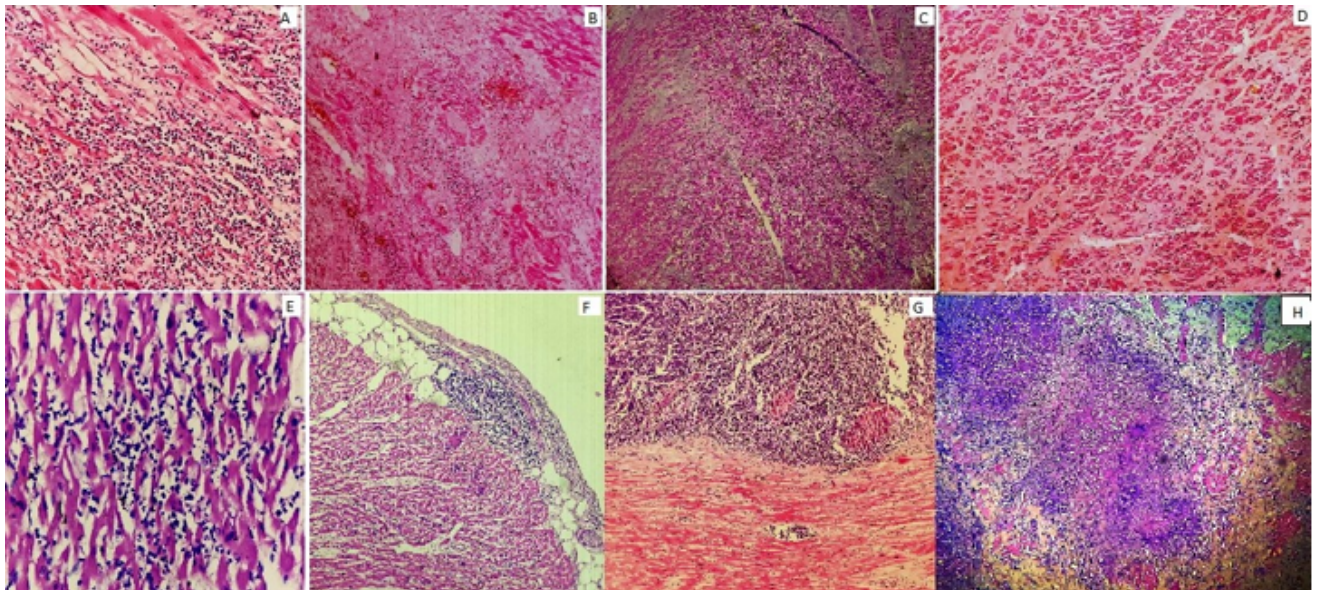


Fig. 3: Microscopic changes in heart showing **A):** Acute myocardial infarction with abundant neutrophilic infiltrate and myonecrosis; **B):** Acute on chronic ischaemic heart disease; **C):** Chronic ischaemic heart disease with variable fibrosis; **D):** Myocardial hypertrophy; **E):** Myocarditis; **F):** Pericarditis; **G):** Metastatic deposits from small cell carcinoma; **H):** Necrotising granulomatous inflammation involving myocardium. (H&E 200 x)



Fig. 4: Microscopic changes in coronaries; A, B and C show variable grades of atherosclerosis with calcification, D show neovascularisation, E show mural thrombus formation, F show metastatic deposits in aorta (H&E 100x)

However, Virmani et al showed single vessel involvement as most commonly involved vessels (44%).¹⁸

In our study, nearly all cases with ischaemic heart disease had variable degree of atherosclerosis as reported by Marwah N et al.¹¹ In terms of frequency distribution of various areas, diffuse involvement of all the areas was most common pattern (37.57%), followed by involvement of left ventricular wall (22.83%) and apex (15.90%). Isolated involvement of RVW was seen in one case of acute MI. These findings are in accordance to those well documented in literature.^{13,19}

5. Conclusion

To conclude, in this study, ischemic heart disease with coronary artery atherosclerosis was found to be the leading cause of death with triple vessel disease as the most common pattern of involvement. Autopsy is the first and last opportunity to make an accurate diagnosis. The autopsy report should relate the pathological findings to the clinical history including circumstances of death and any other investigation performed close to the time of death.

6. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

7. Source of Funding

None.

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