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

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1. Introduction

Cardiovascular diseases (CVD) are the leading cause of death worldwide with an incidence of 60-70%. 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. 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
diagnosis, diagnostic tests and death certification. It can also help in studying epidemiological profile, patho-physiology and management modalities of various cardiac lesions. 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. 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. 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 (44.4%) followed by left circumflex artery (LCA) (36.56%) and right coronary artery (RCA) (31.18%). However, secondary changes LAD was most commonly involved as most frequently involved vessel (38.70%) 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.

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.

We also observed that in adolescents and young adults (<40 years) hypertrophic cardiomypathy, 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.

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%). In terms of frequency of involvement and secondary changes LAD was most commonly involved vessel, followed by 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 RCA (31.18%). However, secondary changes were more commonly seen in LCA followed by LAD and RCA.

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. It was supported by Garg M et al who also reported triple vessels as the most commonly involved vessels (44.4%).
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 intoxicication                      | 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 | CHD | AMI | Acute on CHD | HCMP | Myocarditis | Pericarditis | Electrocutaneous 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            | 0    | 0           | 0            | 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          | 2    |
| 61-70       | 4      | 69 | 44  | 10  | 12           | 1    | 1           | 2            | 0                         | 2  | 0          | 0    |
| 71-80       | 0      | 13 | 7   | 2   | 3            | 0    | 0           | 0            | 1                         | 0  | 0          | 0    |
| 81-90       | 0      | 11 | 5   | 1   | 2            | 0    | 0           | 1            | 0                         | 1  | 0          | 1    |
| 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 | Mild | Atherosclerosis | Moderate | Severe | Calcification | Complications | Thrombus | Plaque rupture | Total |
|-----------------|------|-----------------|----------|--------|---------------|---------------|----------|----------------|-------|
| RCA             | 113  | 122             | 72       | 83     | 3             | 0             | 6        | 393            |
| LCA             | 121  | 128             | 70       | 90     | 6             | 1             | 2        | 416            |
| LAD             | 102  | 106             | 98       | 112    | 16            | 2             | 3        | 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)
However, Virmani et al showed single vessel involvement as most commonly involved vessels (44%).

In our study, nearly all cases with ischaemic heart disease had variable degree of atherosclerosis as reported by Marwah N et al. 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.

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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Cite this article: Verma R, Singh S, Marwah N, Pawar R, Rana D. Histopathological array of cardiac lesions: An autopsy based study in a tertiary care centre. *IP Arch Cytol Histopathology Res*. 2021;6(3):173-180.