



HISTOMORPHOLOGICAL SPECTRUM OF VARIOUS CARDIAC CHANGES IN SUDDEN DEATH: AN AUTOPSYSTUDY

Pathology

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ABSTRACT

INTRODUCTION : Cardiovascular disease (including coronary artery disease, stroke and peripheral vascular disease) is no.1 cause of worldwide mortality, with about 80% of burden occurring in developing countries. Sudden cardiac death is defined as unexpected death from cardiac causes either without symptoms or within 1-24 hours of onset of symptoms(1). The common cause of sudden cardiac death is ischaemic heart disease. Non ischaemic sudden cardiac death occurs in hypertrophic obstructive cardiomyopathy and in severe left ventricular hypertrophy(2). The purpose of this study will be to determine the causes of sudden death and observe the spectrum of morphological and histopathological changes in heart after sudden death. **MATERIALS AND METHODS:** This autopsy study was conducted on 121 cases of sudden death over a period extending from January 2019 to August 2020 in autopsy section of Pathology department of BJGMC, Pune. In this autopsy study hearts of patients with a history of sudden death were evaluated for histological and morphological changes. Each heart was grossed adopting the inflow outflow method and short axis method. Staining solutions used were Solution A: Alum Hematoxylin and Solution B: 1% Eosin Y. **OBSERVATIONS :** 50 (41.32%) cases out of 121 cases had coronary artery disease along with myocardial infarction of which 43 cases were males and 7 cases were females. No cardiac aetiology was found in 23.96% cases. Coronary artery disease was independently seen in 14.87% cases. Left ventricular concentric hypertrophy was noted in 4.13% cases. Myocardial infarction independently was noted in 3.30% cases, Myocarditis in 2.47% cases, myocarditis with pericarditis in 1.65% cases, HOCM, lipoma, mitral stenosis, pericarditis, septal infarct, secondaries of adenocarcinoma, early vegetation and small vessel disease in 0.82% cases. Calcific aortic stenosis was demonstrated in 1 case. Brown atrophy was demonstrated in 1 case. **DISCUSSION :** Out of 69 cases of coronary artery disease calcification was commonly seen in 34(49.27%) cases. 47(82.45%) (M-39,1 F-8) out of 57 cases of myocardial infarction demonstrated chronic or old infarct. Single vessel involvement was most common in which left anterior descending coronary artery was significantly involved in 68.75 % cases. Posterior wall was most commonly involved by myocardial infarction which included posterior, posteroseptal, and posterolateral infarcts.

KEYWORDS

INTRODUCTION:

Cardiovascular disease (including coronary artery disease, stroke and peripheral vascular disease) is no.1 cause of worldwide mortality, with about 80% of burden occurring in developing countries. Sudden cardiac death is defined as unexpected death from cardiac causes either without symptoms or within 1-24 hours of onset of symptoms(1). The common cause of sudden cardiac death is ischaemic heart disease. Non ischaemic sudden cardiac death occurs in hypertrophic obstructive cardiomyopathy and in severe left ventricular hypertrophy(2). Sudden death is often the first clinical manifestation of an underlying disease in previously asymptomatic, apparently "healthy" subjects. Furthermore death can be classified as sudden if a patient was resuscitated after cardiac arrest, survived on life support for a limited period, and then died due to irreversible brain damage(3). Among all the deaths, sudden death has accounted for 15-20%(4). The incidence of sudden cardiac death increases dramatically with age, in parallel with age related increase of coronary heart disease(5)

A study conducted by Kuller et al. shows that nearly two third of sudden non-traumatic deaths are due to atherosclerotic diseases(6). Non cardiac causes of sudden death are pneumonia, pulmonary embolism, amniotic fluid embolism, fat embolism. Metabolic disorders like alcoholic ketoacidosis, hyperglycemia, thyroiditis, anaphylactic shock(7).

There was an unexpectedly high overall prevalence of established cardiovascular risk factors (obesity, diabetes mellitus, hypertension, hyperlipidemia, smoking) with ≥ 1 risk factors in 58% of sudden cardiac death cases(8). The most common underlying pathologic conditions resulting in sudden death in children and adolescents are myocarditis, hypertrophic cardiomyopathy, congenital coronary artery anomalies, atherosclerotic coronary artery disease, mitral valve prolapse and aortic dissection(9)(1). In adults, coronary atherosclerosis and acquired forms of cardiomyopathy are most common findings of autopsies(10)(11).

The purpose of this study will be to determine the causes of sudden death and observe the spectrum of morphological and histopathological changes in heart after sudden death.

AIMS AND OBJECTIVES:

- To study the histomorphology of Various Cardiac Changes in Sudden Death.
- To establish whether the death is attributable to a cardiac disease.
- To study the spectrum of various cardiac pathologies in victims of sudden death.

Inclusion Criteria:

All the specimen of hearts received in Department of Pathology, Tertiary Care Centre of Cases of sudden death.

Exclusion Criteria:

- Cases of trauma, homicide and suicide, fetal heart, unknown bodies, autolysed Viscera.

MATERIAL AND METHODS:

This autopsy study was conducted on 121 cases of sudden death over a period extending from January 2019 to August 2020 in autopsy section of Pathology department of BJGMC, Pune. Ethical committee approval was obtained from IEC, BJGMC, Pune. In this autopsy study hearts of patients with a history of sudden death were evaluated for histological and morphological changes. These were received in autopsy section as medico-legal post mortem. Other organs like lungs, liver, spleen, kidney and brain were also examined.

Method for examination of heart:

Each heart was grossed adopting the inflow outflow method and short axis method.

- Hearts were examined grossly to identify suspected areas of early myocardial infarction for any soft consistency, pallor, oedema, fibrinous pericarditis, epicardial fibrosis, subepicardial

- haemorrhage and aneurysm of ventricle and rupture.
2. Epicardial coronary arteries were dissected by transverse sectioning at intervals of 5 mm for any occlusion of lumen by thrombus/ embolus, extent and severity of atherosclerotic narrowing of the coronary artery lumen and transverse slicing of heart:

I) The heart was cut into transverse slices, 1 cm thick commencing at the apex of the heart and stopping 1 cm short of mitral valve for histological examination from apex, anterior wall, posterior wall, lateral wall and coronary arteries. In presence of grossly obvious infarction sections were taken from margin of the infarcted area covering full thickness of the wall. Staining solutions used were Solution A: Alum Hematoxylin and Solution B: 1% Eosin Y.

Staining procedure:1. Deparaffinize tissue sections and rehydrate through descending grades of alcohol to water.2. Stain in alum hematoxylin for 10 seconds.3. Wash in running tap water until the tissue sections turn blue. It should be performed for 5 minutes or less.4. Differentiate in 1% acid alcohol for 5-10 seconds.5. Wash well in tap water for 10-15 minutes until the tissue sections turn blue again.6. Stain in 1% eosin Y for 10 minutes.7. Wash in running tap water for a duration of 1-5 minutes.8. Dehydrate through series of alcohols, clear in xylol and mount(12).All the data entered was in the predesigned format.

RESULTS AND OBSERVATIONS :

Tables 1: Distribution of weight of heart among males and females.

Weight	Male	Female	Total (n=121)	Percentage
300-400 grams	40	5	45	37.19%
>400 grams	9	3	12	9.91%
<200 grams	6	2	8	6.61%

Table 1 shows normal weight of heart (300 – 400 gms) in 45 cases (37.19%) (40 – males, 5 - females). 12 cases (9.91%) (9 – males , 3 - females) were having > 400 gms of weight of heart. While in 8 cases (6.61%) (6-males, 2- females) heart was atrophied (<200 gms weight).

Age And Sex Distribution Of Sudden Death Cases :

Table 2: Age and Sex distribution of cases of sudden death.

Age	Male	Female	Total	Percentage
<30	10	5	15	12.3%
30-39	18	1	19	15.7%
40-49	28	6	34	28.09%
50-59	16	4	20	16.52%
60-69	18	2	20	16.52%
70-79	9	3	12	9.91%
>80	0	1	1	0.82%

Table 2 shows maximum number (34 cases – 28.09%) (28 – males, 6 - females) of sudden death were found in the age group of 40-49 years.

Cardiac Aetiological Factors For Sudden Death

Table 3 : Cardiac aetiologies of cases of sudden death.

CARDIAC AETIOLOGICAL FACTORS	No. of Cases (n=121)	Male	Female	Percentage
Coronary artery disease with myocardial infarction	50	43	7	41.32%
No cardiac aetiology found	29	22	7	23.96%
Coronary artery disease	18	15	3	14.87%
Left ventricular concentric hypertrophy	5	5	0	4.13%
Myocardial infarction	4	3	1	3.30%
Myocarditis	3	3	0	2.47%
Myocarditis + pericarditis	2	2	0	1.65%
Hypertrophic obstructive cardiomyopathy	1	1	0	0.82%
Lipoma	1	0	1	0.82%
Mitral stenosis	1	0	1	0.82%
Pericarditis	1	1	0	0.82%
Septic infarct	1	1	0	0.82%

Secondary deposits of adenocarcinoma	1	1	0	0.82%
Early vegetation	1	1	0	0.82%
Small vessel disease	1	1	0	0.82%
Myocardial infarction and left ventricular concentric hypertrophy	1	1	0	0.82%
CAD+ Chronic IHD	1	1	0	0.82%

In table 3, 50 (41.32%) cases out of 121 cases had coronary artery disease along with myocardial infarction of which 43 cases were males and 7 cases were females. No cardiac aetiology was found in 23.96% cases. Coronary artery disease was independently seen in 14.87% cases. Left ventricular concentric hypertrophy was noted in 4.13% cases. Myocardial infarction independently was noted in 3.30% cases, Myocarditis in 2.47% cases, myocarditis with pericarditis in 1.65% cases, HOCM, lipoma, mitral stenosis, pericarditis, septic infarct, secondaries of adenocarcinoma, early vegetation and small vessel disease in 0.82% cases. Calcific aortic stenosis was demonstrated in 1 case. Brown atrophy was demonstrated in 1 case.

Vessel Involvement :

Distribution Of Cases As Per Number Of Vessels Involved (>75%)				
No. of Vessels Involved	No. of Cases (n=32)	Male	Female	Percentage
One vessel disease	18	15	3	56.25%
Two vessel disease	12	11	1	37.50%
Triple vessel disease	2	2	0	6.25%

Table 4 : Significant Vessel Involvement

In Table 4 32 cases with one vessel involved in 18 (56.25%) cases (M – 15, F-3), two vessel involved in 12 (37.50%) cases (M-11, F-1) and triple vessel involved in 2 males (6.25%).

Complications In Atherosclerotic Plaque:

Table 5: Distribution of complications in atherosclerotic plaques:

CHANGES	NO. OF CASE(N=69)	MALES	FEMALES	PERCENTAGE
Calcification	34	29	5	49.27%
Thrombus	12	10	2	17.39%
Recanalization	3	3	0	4.34%

In table 5 out of 69 cases of coronary artery disease calcification was commonly seen in 34(49.27%) cases, thrombus was noted in 12(17.39%) cases while recanalization was seen in 3 (4.34%) cases.

Myocardial Infarction:

Tables 6: Percentage of types of myocardial infarction.

Types of infarct	No. of cases (n=57)	Males	Females	Percentage
Chronic	47	39	8	82.45%
Acute	9	8	1	15.78%
Acute on chronic	1	1	0	1.75%

In table 6, 47(82.45%) (M-39, F-8) out of 57 cases of myocardial infarction demonstrated chronic or old infarct. Acute or recent infarct was demonstrated in 9 (15.78%) out of 57 cases and acute on chronic infarct was demonstrated in 1 (1.75%) cases.

Area Wise Distribution Of Myocardial Infarcts:

Table 7: Percentage area-wise distribution of myocardial infarction.

Area involved	No. of cases (n=57)	Males	Females	Percentage
Posterior wall	43	37	6	75.43%
Anterior wall	22	20	2	38.59%
Lateral wall	24	21	5	42.10%
Circumferential	2	2	0	3.50%
Subendocardial	2	2	0	3.50%

Posterior wall was most commonly involved which included posterior, posteroseptal, and posterolateral infarcts. Out of 57 cases 43 (75.43%) cases demonstrated posterior wall infarcts. Anterior wall infarcts were

demonstrated in 22 (38.59%) cases. Lateral wall group constitutes lateral wall only which was seen in 42.10% cases. 2 cases demonstrated circumferential involvement while 2 demonstrated subendocardial infarcts.

DISCUSSION:

"Sudden natural death" means different things to different people. Some believe that the term should be limited to those cases wherein the time from the onset of symptoms to collapse and death is seconds, whereas others will accept up to 24 hours of symptomatic illness prior to death. It is interesting to note that the spectrum of diseases causing a sudden natural death varies significantly with the definition used. The truly sudden or "instantaneous" death almost invariably involves diseases of the cardiovascular system, whereas broader definitions can involve virtually any organ system or disease(13).

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. Some prodromal symptoms like palpitation, chest pain and dyspnoea may suggest a cardiovascular etiology(11).

In the present autopsy study Table no. 1 results were in accordance with E.Matova et al¹⁴ and Achalkar et al¹⁷.

In present study table No. 2 shows that youngest patient was 18 year old and oldest was 87 year old. Maximum patients were found in age group of 30-70 years with commonest age group of 40-49 years 28.09%. These findings were in accordance with Dantkale et al¹⁶, Chandrakala et al¹⁷, Sonawane et al¹⁸, Dinesh Rao et al¹⁹ and Neerav et al²⁰. Male to female ratio was found to be 4.5:1 indicating that males are more commonly affected. Out of 121 cases of sudden death 99(82%) were males and 22(18%) were females. These findings were in accordance with Gupta et al²¹, Sonawane et al²² and Shilpa Garg et al²³.

Table no 3 shows that no etiology was demonstrated in 4 (3.3%) cases. Our findings were in accordance with Shubhangi Agale et al²⁴, Sun et al²⁵, Pinkal Shah et al²⁶, Ding et al²⁷.

Cardiovascular disease is a major cause of mortality. In Western societies, coronary artery disease is the major cause of sudden cardiac death(24).

Table 8 shows An analysis in etiology of sudden death revealed atherosclerosis in the form of stenosing plaque causing reduction of cross sectional area of coronary lumen in 41.32% of cases. These findings were in accordance with Shubhangi agale et al²⁴, Sun et al²⁵ and Risgaard et al²⁹.

Table no 4 and 5 shows that Single vessel involvement was most common while the most common vessel involved was left anterior descending coronary artery. Our findings were in accordance with Shubhangi et al²⁴, Baroldi et al³⁰, Tyagi et al³¹, Nisha Marwah et al³² and Domenico Corrado et al³³.

Table 8: Comparison of vessel involvement in various studies.

Vessel involvement	Present study	Shubhangi Agale et al	Baroldi et al	Tyagi et al
Single vessel	56.25%	29.80%	33.75%	35.03%
Double vessel	37.50%	41.35%	38.21%	22.22%
Triple vessel	6.25%	28.85%	28.02%	46.91%

Table 9. Comparison of vessel involved.

Vessel involved	Present study	Shubhangi et al	Nisha Marwah et al
LAD	68.75%	78.84%	83.80%
LCX	40.62%	75%	50 %
RCA	37.5%	67.30%	52.81%

Table 9 was in accordance with Rajiv Kumar Gupta et al²¹. Single vessel involvement was most common in which left anterior descending coronary artery was significantly involved in 68.75 % cases.

Table no 5 and 10 findings were in accordance with Joshi et al¹⁷, Shilpa Garg et al²³, Gupta et al²¹ and Shubhangi Agale et al²⁴.

Table 10: Studies comparing complication of atherosclerosis.

Complication	Present study	Joshi et al	Gupta et al	Agale et al
Calcification	49.27%	17.56%	69.05%	11.54%
Thrombus	17.39%	5.40%	-	0.96%
Recanalisation	4.34%	-	-	0.96%

Table 6 and 10 findings were in accordance with Nisha Marwah et al³², Baroldi et al³⁰, Dinesh rao et al¹⁹, A Farb et al²⁸, Ahmad et al³¹ and Joshi et al¹⁷.

Table 11 Studied comparing percentage of types of infarctions.

Study	Acute	Healed or chronic	Acute on chronic
Present study	15.78%	82.45%	1.75%
Marwah et al	26.38%	66.66%	NA
Baroldi et al	17%	82%	NA
Farb et al	21%	41%	11%

In the present study posterior wall was most commonly involved by myocardial infarction which included posterior, posteroseptal, and posterolateral infarcts. Table no 7 and 11 findings were in accordance with Davies Wool Robertson et al³⁴. In the present study left ventricular concentric hypertrophy was demonstrated in 6(4.9%) cases and right ventricular hypertrophy in 1 (0.82%) case out of 121 cases of sudden death. Dilated cardiomyopathy was demonstrated in 1 (0.82%) case. Our findings were in accordance with Joshi et al¹⁷.

In the present study hypertrophic obstructive cardiomyopathy was demonstrated in 1(0.82%) case. Weight of heart was recorded as 650 grams. Biventricular hypertrophy was noted. Our findings were in accordance with Srivatsa et al¹⁰ and Sushil Sonawane et al²².

In the present study dilated cardiomyopathy was demonstrated in 1 (0.82%) case out of 121 cases which was in accordance with Puranik et al³⁵ and Corrado et al³³.

In present study calcific aortic stenosis was demonstrated in 1 case (0.82%). This finding was in accordance with Corrado et al³³.

In the present study mitral stenosis was demonstrated in 1 case (0.82%) which was in accordance with Lauri Holmstroem et al.

In the present study myocarditis was demonstrated in myocarditis in 2.47% cases, myocarditis with pericarditis in 1.65% cases and pericarditis was demonstrated in 0.82% cases. These findings were in accordance with Shubhangi Agale et al²⁴ and Joshi et al¹⁷.

In present study lipoma was demonstrated in 1 (0.82%) case out of 121 cases which was in accordance with Junaid Patel et al³⁶.

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