

HISTO-MORPHOLOGICAL STUDY OF HEART IN SUDDEN CARDIAC DEATH WITH SPECIAL EMPHASIS ON CORONARY ARTERY LESIONS

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Abstract

Objective: To study the histo-morphological changes in the heart and coronary arteries and to determine the cause of sudden cardiac death. **Methods:** A prospective study of heart and coronary arteries from 86 autopsies of sudden cardiac death was done at Karnataka Institute of Medical Sciences Hubli, from 2003 to 2005. Histo-morphological changes in the heart and coronary arteries were studied in the department of pathology. **Results:** The ages ranged from 22 to 80 years. Majority of cases were seen in 3rd and 5th decades of life. Males were affected in 70 cases and females in 16 cases. Coronary atherosclerosis of varying grades was seen in 48 cases. Grade 4 coronary occlusion with critical narrowing was seen in 20 cases. Ischemic heart disease was encountered in 29 cases, Myocarditis in 9 cases, changes in conduction system of the heart in 4 cases; rheumatic heart disease, syphilitic heart disease and coronary arteritis were seen in 2 cases each. Hypertrophic cardiomyopathy was seen in one case. Ischemic heart disease due to coronary atherosclerosis of varying grade was seen in 26 cases, coronary arteries were normal in 3 cases. The cause of death could not be determined in 9 cases as there were no specific findings in heart and coronary arteries. **Conclusion:** The most common cardiovascular disease resulting in sudden cardiac death was coronary atherosclerosis of varying grades, leading to Ischemic heart disease followed by Myocarditis, Syphilitic heart disease, Rheumatic heart disease, changes in conduction system, coronary arteritis and Hypertrophic cardiomyopathy.

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Key words: Heart, coronary artery, histo-morphology, sudden cardiac death.

Introduction

Cardiovascular disease particularly, the coronary heart disease is the main cause of death in industrialized countries and rising at an alarming rate in much of the developing world.¹ The World Health Organization defines sudden cardiac death (SCD) as unexpected death within

one hour of symptom onset if witnessed or within 24 hours of the person having been observed alive and symptom-free if unwitnessed.² SCD most commonly results from cardiac arrest due to a lethal arrhythmia and usually occurs in the background of structural heart disease or coronary artery disease (CAD).² The cardiovascular etiology of sudden death reported in an autopsy based study is 60-70%.³ The most common cardiovascular diseases in children and adolescents are congenital heart diseases, rheumatic heart diseases, myocarditis, hypertrophic cardiomyopathy, atherosclerotic coronary artery disease, conduction system abnormalities, mitral valve prolapse and aortic dissection. In adults, coronary atherosclerosis,

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Ischemic heart diseases and acquired forms of cardiomyopathy are the most common diseases.⁴ In most cases, the fatal arrhythmia is triggered by electric irritability of myocardium distant from the conduction system, induced by Ischemia or infiltration.⁴ Ventricular fibrillation and less often bradycardia and asystole are responsible for sudden cardiac death.⁵ A detailed post-mortem examination helps to know the cause of sudden cardiac death. The purpose of this study was to determine the cause of sudden cardiac death by studying the histo- morphological changes in the heart and coronary arteries.

Material and Methods

This prospective study was done at Department of pathology, Karnataka Institute of Medical Sciences, Hubli from 2003 to 2005. A detailed proforma was prepared which included information collected from attendants and medical case history sheets, regarding the details of deceased, any physical activity prior to death, prodromal signs and symptoms, ECG findings duration of time between onset of symptoms and death. The heart specimen of cases meeting the criteria of sudden cardiac death was selected for the study. Weight of heart, coronary artery and its site from origin of vessel, state of coronary ostia, recent/old infarcts along with their size and location were noted. The coronary arteries were cut at 1 cm intervals from the apex of heart and examined. Heart was cut opened by modified Virchow's method following the direction of blood flow and bread loaf technique in cases of hypertrophy. Thickness of ventricular walls and interventricular septum was measured. Blocks for histopathological examination were taken from right atrium, SA node, AV node, base and middle of septum; anterior and posterior walls of both ventricles and from left anterior and posterior papillary muscles. Serial sections were taken from areas of infarct. These tissues were processed and four to five micron thick sections

were made with the help of manual microtome. The sections were examined under light microscope after staining with hematoxylin and eosin stain. The histological changes were studied and correlated with the cause of sudden cardiac death.

Results

A total of 1200 autopsies were conducted during the study period. Of these 86 cases were included in the study which fulfilled the criteria of sudden cardiac death. The cases were studied according to above mentioned protocol. The age ranged between 22 to 80 years. Males were affected in 70 cases and females in 16 cases. Male: Female ratio was 4.3:1. Maximum numbers of cases were seen during 3rd and 5th decades of life. Out of 86 cases, majority of cases showed combined lesions where common lesion was coronary atherosclerosis of varying grades. The commonest cause of sudden cardiac death was coronary atherosclerosis seen in 48 cases, out of which 20 showed grade 4 coronary occlusion with critical narrowing. Ischemic heart disease was encountered in 29 cases, myocarditis in 9, changes in conduction system of the heart in 4; rheumatic heart disease, syphilitic heart diseases, and coronary arteritis without atherosclerosis were seen in 2 cases each and Hypertrophic cardiomyopathy was seen in one case. In nine cases cause of death could not be determined as there were no specific findings. In those with coronary atherosclerosis, triple vessel disease in 24, double vessel disease in 16 and single vessel disease in 08 cases was seen. The predominant involvement was seen in left anterior descending and left coronary artery in 87.5% of cases each followed by right coronary artery in 68.7%. Infarction was seen commonly in combined left ventricle and interventricular septum in 9 cases, followed by left ventricle and interventricular septum alone in 7 cases each. Transmural infarction was seen in 21 cases and

subendocardial in 8 cases. Combined recent and old infarcts were seen in 58.6% cases. Recent and old infarcts were seen alone in 17.2% and 13.7% cases respectively. Out of 29 cases of ischemic heart disease, 26 cases were associated with coronary atherosclerosis of varying grades. In three cases coronary arteries were normal. Nine cases of myocarditis showed myocytolysis and lymphocytic infiltration. Conduction system of the heart showed necrosis of SA and AV nodes due to narrowing of nutrient arteries. Symmetrical hypertrophy of left ventricle, tree bark appearance and dilatation of aorta, pulled up coronary ostia, widening of valve commissure with rolling of free edges was seen in both the cases of syphilitic heart disease. Valvular lesions were seen in both the cases of rheumatic heart diseases, but Aschoff body was seen in only one case. Asymmetric hypertrophy of interventricular septum and left ventricular wall was seen in one case of hypertrophic cardiomyopathy. Nine cases showed no specific findings in the heart and coronary arteries.

Discussion

Heart disease is the most common cause of sudden death and in these cases coronary atherosclerosis is the predominant lesion. However 10-20% cases of sudden cardiac death are of non-atheromatous origin.⁴ In our study sudden cardiac death below 40 years was 52.2% which is much higher than two previous studies (42.5%)⁶ (45.5%),⁴ possibly due to more number of cases at this age. The cause of death due to coronary artery diseases was seen in 58.1% of cases and triple vessel involvement was predominant in 52.17% which was much lower than detailed by Kasthuri et al,⁷ seen in 76.9% and triple vessel involvement in 80%. Grade 4 coronary occlusion was predominantly seen in 41.6% and grade 3 in 18.8 % cases, with similar findings seen in study by Mumtaz et al ⁴. In our study right coronary and left coronary was

predominantly involved in 56.2% of cases each followed by left anterior descending artery in 54.2% of cases. The predominant involvement was seen in left anterior descending and left coronary artery in 87.5% of cases each followed by right coronary artery in 68.7% which was in contrast to Vijay Singh et al.⁸ The evidence of occlusive coronary atherosclerosis as a cause of sudden cardiac death in the present study was 55.8% which is lower than previous studies done by Crawford et al (64%)⁹ and James et al (62%).¹⁰ Recent infarcts were found in 17.2% of cases and old infarcts in 13.7% of cases which was in contrast to reported by Mumtaz et al,³ healed infarct in 35.1% recent infarct in 20.8% of cases. In our study changes in cardiac conduction system was seen in 4.6% of cases whereas Cohle et al¹¹ noted such lesions considered to be lethal in 3% cases. Myocarditis as a cause of death was seen in 10.4% cases in our study. Some past studies show lesser incidence of myocarditis which could be due to lack of well defined histological criteria.^{12, 13} Syphilitic and rheumatic heart diseases as a cause of sudden cardiac death were seen only in 2.3% of cases each in our study. There is a significant reduction in the incidence of rheumatic and syphilitic heart diseases in recent years owing to early detection methods, use of antibiotics and various screening, health programmes educating the people. Coronary arteritis is an important finding in forensic pathology and merits consideration in a case of unexplained death. One case of SCD was due to hypertrophic cardiomyopathy (HOCM). The mechanism of sudden death due to HOCM is not completely understood but the available data suggests the role of arrhythmia and/or hemodynamic disturbances as precipitating factors.¹⁴ The cause of SCD could not be determined in 10.4% cases which correlates with two previous studies where it was 11.8%¹¹ to 16.3%.¹⁵ In such cases possibility of myocardial ischemia caused by coronary spasm secondary to

overdriven adrenergic activity, autosomal dominant long QT syndrome, hereditary abnormalities of cardiac conduction system, triggering lethal arrhythmias lead to sudden cardiac death. Exclusion of noncardiac causes, such as pulmonary embolus or drug overdose, is also critical, since sudden cardiac arrhythmias may be the ?nal common pathway in these disease states also.

Conclusion

The most common cardiovascular disease resulting in sudden cardiac death was coronary atherosclerosis of varying grades, leading to Ischemic heart disease followed by

Myocarditis, Syphilitic heart disease, Rheumatic heart disease, changes in conduction system, coronary arteritis and Hypertrophic cardiomyopathy. In this study coronary atherosclerosis was the major cause of sudden cardiac death. The cause of sudden cardiac death noted could not be determined in 9 cases, where possibly myocardial ischemia due to various factors triggered lethal arrhythmias leading to sudden cardiac death. Histo-morphologic study of heart and coronary arteries helps us to know various causes of sudden cardiac death. Sudden cardiac death is a source of concern and a detailed post-mortem examination is mandatory to ascertain the cause.

Table 1) Age and sex distribution of the cases in the present study

Age groups(yrs)	21-30		31-40		41-50		51-60		61-70		71-80	
Sex	M	F	M	F	M	F	M	F	M	F	M	F
	16	7	18	4	22	1	9	1	5	2	0	1
No of cases (86)	23(26.7%)		22(25.5%)		23(26.7%)		10(11.6%)		7(8.1%)		1(1.1%)	

Table 2) showing various causes of sudden cardiac death in the present study

Cause of sudden cardiac death	No of cases (86)
Coronary atherosclerosis	48 (55.8%)
Ischemic heart disease	29 (33.7%)
Myocarditis	9 (10.4%)
Conduction defects	4 (4.6%)
Syphilitic heart disease	2 (2.3%)
Rheumatic heart disease	2 (2.3%)
Coronary arteritis	2 (2.3%)
Hypertrophic cardiomyopathy	1 (1.1%)
No specific findings	9 (10.4%)

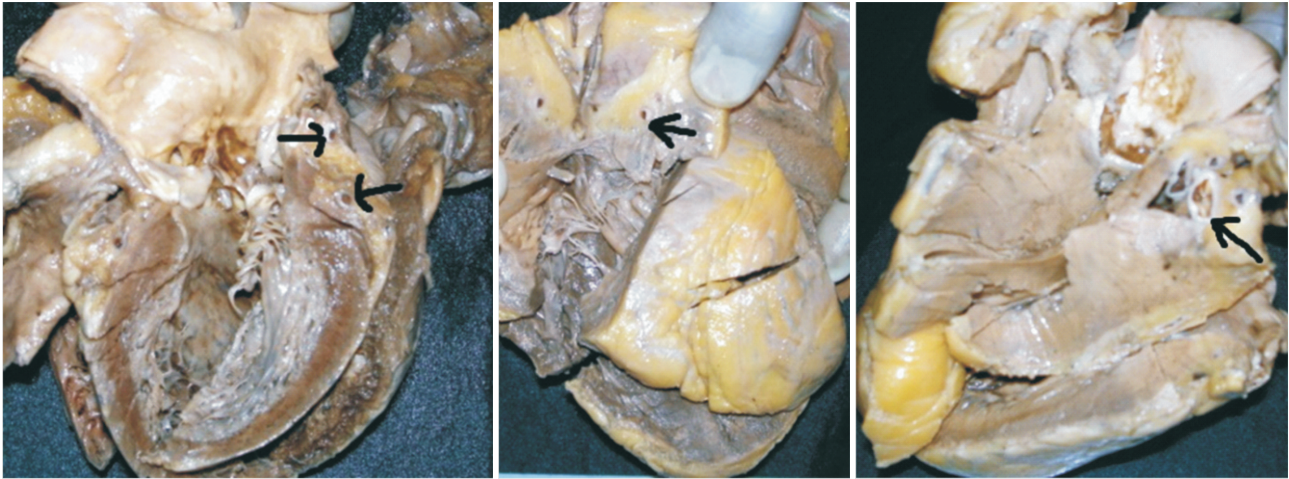


Figure 1) Gross photos of coronary atherosclerosis showing
a) complete occlusion b) thrombosis c) calcification.

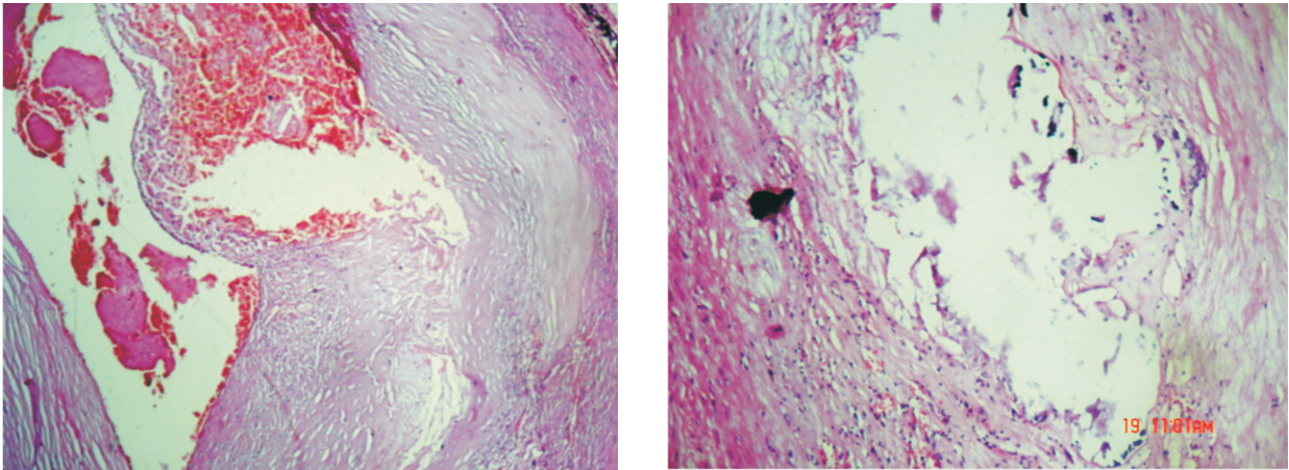


Figure 2) Microscopy showing coronary atherosclerosis with
a) thrombus and hemorrhage. b) calcification. (Hematoxylin&Eosin stain X 400)



Figure 3) Gross photo of heart showing healed infarction.

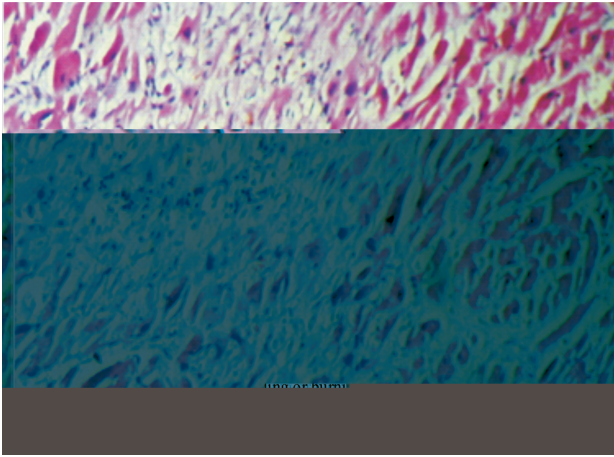


Figure 4) Microscopy showing
a) recent infarction. b) healed infarction. (Hematoxylin&Eosin stain X 400)

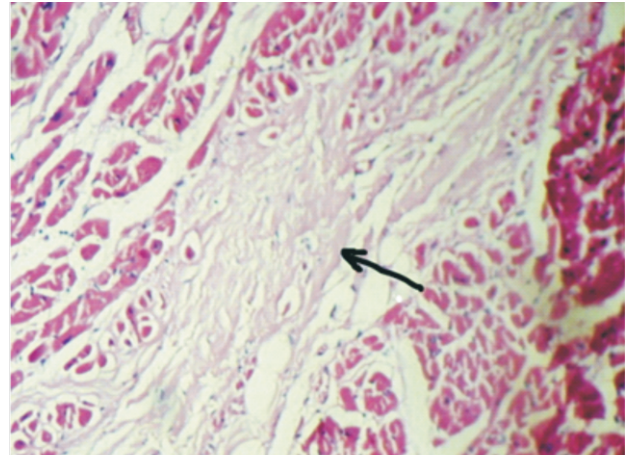


Figure 6) Microscopy showing perivascular
infiltration with lymphocytes and plasma cells in
syphilitic heart disease.
(Hematoxylin&Eosin stain X 400)

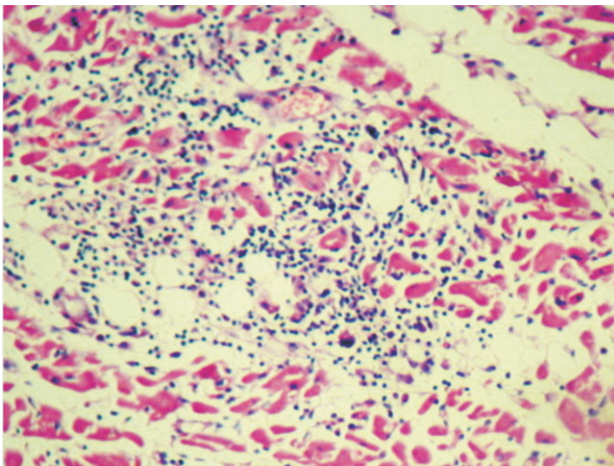


Figure 5) Microscopy showing lymphocytic
infiltration and myocytolysis seen in myocarditis.
(Hematoxylin&Eosin stain X 400)

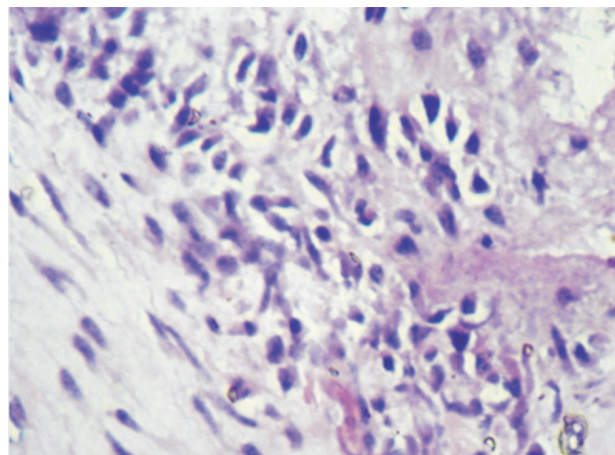


Figure 7) Microscopy showing aschoff body with anistcshow cells in rheumatic heart disease.
(Hematoxylin&Eosin stain X 400)

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