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Post Mortem Findings and Histopathological Profile of Sudden Death: A Cross-sectional Study in a Tertiary Care Hospital, Tripura

Santanu Das[1]*, Juthika Debbarma[2], Pradipta Narayan Chakraborty[3]

[1]Senior Resident, Dept of Forensic Medicine & Toxicology, Agartala Govt. Medical College and Hospital, Agartala, West Tripura, India

[2]Associate Professor, Dept of Forensic Medicine & Toxicology, Agartala Govt. Medical College and Hospital, Agartala, West Tripura, India

[3]Assistant Professor, Dept of Forensic Medicine & Toxicology, Agartala Govt. Medical College and Hospital, Agartala, West Tripura, India

*Address for Correspondence: Dr. Santanu Das, Senior Resident, Dept of Forensic Medicine & Toxicology, Agartala Govt. Medical College and Hospital, Agartala, West Tripura, India
E-mail: sdasagt.86@gmail.com

ABSTRACT
Background: Sudden unexpected natural death is an important medicolegal issue that occurs without warning in individuals not known to have serious illness. Determining the exact cause is essential for medical and legal purposes. Although gross autopsy findings may provide important clues, they are sometimes insufficient to establish the exact pathology. Histopathological examination, therefore, plays a crucial role in confirming the underlying disease and detecting occult lesions. Studying demographic profiles, risk factors, and organ involvement helps in understanding the pattern of sudden deaths.
Methods: This mortuary-based cross-sectional study was conducted at Agartala Government Medical College & GBP Hospital, Tripura, from December 2022 to April 2024. A total of 200 cases of sudden death without known pre-existing fatal illness were included. Gross post-mortem findings of major organs were recorded and correlated with histopathological examination.
Results: Among 200 cases, 78.5% were males and 21.5% females, with most cases in the 51–60-year age group. Hypertension and diabetes mellitus were common premorbid conditions, and addictions such as alcohol and tobacco were frequently noted. The cardiovascular system was the most involved (58%), followed by the respiratory and central nervous systems. Coronary artery occlusion, particularly involving the left anterior descending artery, was a frequent gross finding. Histopathology revealed myocardial infarction as the leading cause of sudden death.
Conclusion: Cardiovascular pathology, particularly myocardial infarction, was the predominant cause of sudden natural death. Histopathological examination remains essential for confirming the cause of death and strengthening medicolegal autopsy findings.

Key-words: Medicolegal autopsy, Histopathology, Myocardial infarction, Coronary artery disease, Cardiovascular pathology, Forensic pathology, Sudden cardiac death, Autopsy findings, Risk factors

INTRODUCTION

The World Health Organization (WHO) defines sudden death according to the International Classification of Diseases, version 11 (ICD-11), as a non-violent and unexplained death occurring within 24 hours of the onset of symptoms. [1] Sudden death is generally described as an unexpected natural death in a person not known to have any life-threatening disease, injury, or poisoning, and it usually occurs within a short period after the onset of terminal symptoms. In many cases, the emphasis is placed more on the unexpected nature of death rather than the exact time interval. [2]

Sudden unexpected deaths constitute an important medicolegal problem because they often occur in apparently healthy individuals and therefore require

detailed investigation to determine the exact cause of death. Medicolegal autopsy plays a crucial role in identifying the pathological changes responsible for such deaths and in differentiating natural causes from unnatural causes such as poisoning, trauma, or other external factors. Histopathological examination during autopsy not only confirms the gross findings but also helps in detecting microscopic lesions that may not be visible during routine post-mortem examination. It also provides valuable information about previously undiagnosed diseases and occult pathological changes present in different organs. [3,4]

Several studies have reported that cardiovascular diseases are the most common cause of sudden natural deaths, followed by respiratory and central nervous system disorders, although the pattern may vary depending on geographic region, lifestyle factors, and prevalence of underlying diseases in the population. [5,6]

The present study was conducted to evaluate the sociodemographic profile and etiology of sudden death and to correlate the gross post-mortem findings with histopathological features in cases of sudden death.

MATERIALS AND METHODS

Place of study- It is a mortuary-based cross-sectional study conducted in Agartala Government Medical College & GBP Hospital for a period of one year and five months from 10th Dec 2022 to 30th Apr 2024.

Methodology- A total of 200 sudden death cases with no known history of any pre-existing diseases were autopsied. The gross findings of the organs or pieces of organs like brain, lung, heart, liver & kidneys and any other organs which will appear suspicious are noted and sent to the Department of Pathology, AGMC & GBPH for histopathological examination. Cases presenting as sudden, unexpected deaths with a history suggestive of heart disease were studied in detail. Detailed history as to the circumstances leading to death, any history of myocardial infarction, or symptoms suggestive of heart disease, like breathlessness, chest pain, or collapse, were obtained from the relatives, inquest papers and wherever possible from the hospital records. The cases presenting as sudden death were either the patient was found dead or was declared as "brought dead" in the hospital and hospital admitted patients who died within 24 hours of admission.

Inclusion criteria
➢ Brought dead cases where the cause of death was not known.
➢ Undiagnosed death occurred within 24 hours of hospitalization.
➢ The gross findings, which are not conclusive of cause of death, were confirmed by histopathology examinations.

Exclusion criteria
➢ Body with advanced stage of decomposition.
➢ Death after 24 hours of onset of symptoms.
➢ Death due to poisoning, road traffic accidents, homicides, suicides and blast injuries.

Statistical Analysis- Collected data of 200 study subjects were checked for consistency and completeness and were entered in a Microsoft Office Excel data sheet. Data were organized and presented using the principles of descriptive statistics in the form of frequency and percentage and also in tables and diagrams. Data was entered in Microsoft Excel and analysis was done.

Ethical Approval- The study protocol was ethically approved by the Institutional Ethics Committee of Agartala Government Medical College & GBP Hospital, Agartala, Tripura.

RESULTS
Table 1 shows the sociodemographic profile of the study subjects. Out of 200 cases, the majority were males (78.5%), while females constituted 21.5% of cases. Most of the study subjects belonged to the 51–60 years age group (27.0%), followed by 41–50 years (26.0%). Most of the cases were reported from urban areas (66.5%), whereas 33.5% belonged to rural areas. About religion, most of the study subjects were Hindu (95%), followed by Muslim (3.5%) and Christian (1.5%).

Table 1: Sociodemographic profile of study subjects (n = 200)

Variable	Category	Frequency	Percentage (%)
Age group (years)	<10	1	0.5
	10–20	6	3.0
	21–30	13	6.5
	31–40	27	13.5
	41–50	52	26.0
	51–60	54	27.0
	>60	47	23.5
Sex	Male	157	78.5
	Female	43	21.5
Place of incidence	Urban	133	66.5
	Rural	67	33.5
Religion	Hindu	190	95.0
	Muslim	7	3.5
	Christian	3	1.5

Table 2 shows the occupational and socioeconomic distribution of the study subjects. Most of the cases were employed in government or private sectors (35%), followed by businessmen (20.5%) and unemployed individuals, such as farmers or drivers (16%). Housewives constituted 10%, while students and labourers accounted for 8% and 7.5% respectively. According to the modified BG Prasad socioeconomic classification, most of the study subjects belonged to the upper middle class (28.5%), followed by upper class (26%) and middle class (24%), while a smaller proportion belonged to the lower middle (15.5%) and lower class (6%).

Table 2: Occupational and socioeconomic distribution of study subjects (n = 200)

Variable	Category	Frequency	Percentage (%)
Occupation	Employed (Govt./Private)	70	35.0
	Business	41	20.5
	Unemployed (Farmer/Driver)	32	16.0
	Housewife	20	10.0
	Student	16	8.0
	Labourer	15	7.5
	Others	6	3.0
Socioeconomic status	Upper class	52	26.0
	Upper middle class	57	28.5
	Middle class	48	24.0
	Lower middle class	31	15.5
	Lower class	12	6.0

Table 3 shows the time of incidence of sudden death and history of addiction among the study subjects. Most sudden deaths occurred between 06:00 PM and 12:00 AM (33.5%), followed by 12:01 PM to 06:00 PM (32.47%). Regarding addiction history, alcohol consumption (37.5%) and multiple habituations (34.5%) were commonly observed among the study subjects, while 32.5% had tobacco addiction.

Table 3: Time of incidence and history of addiction among study subjects (n = 200)

Variable	Category	Frequency	Percentage (%)
Time of incidence	06:00 PM – 12:00 AM	65	33.50
	12:01 PM – 06:00 PM	63	32.47
	12:01 AM – 06:00 AM	39	20.10
	06:01 AM – 12:00 PM	27	13.91
History of addiction	Alcohol	28	37.5
	Drug	18	13.5
	Multiple habituation	75	34.5
	Tobacco	65	32.5
	None	14	14.5

Fig. 1 shows the distribution of study subjects according to history of illness. Hypertension was the most common pre-existing disease observed among the study subjects (36.5%), followed by diabetes mellitus (24.0%). A smaller proportion of cases had both hypertension and diabetes (8.5%), while 15.5% had a history of kidney disease. About 8.0% of the study subjects had no significant past medical illness.
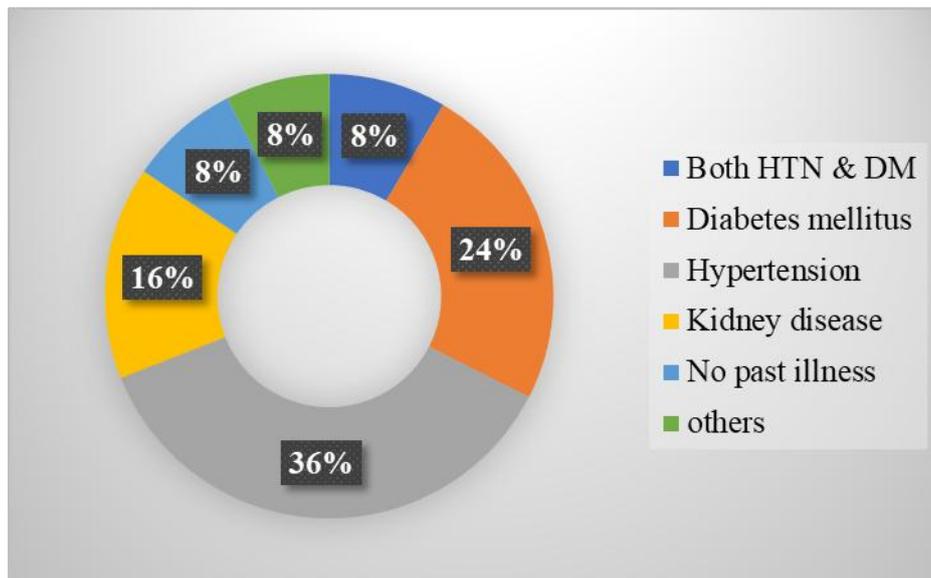

Fig. 1: Distribution of study subjects according to past history of illness. (N=200)

Fig. 2 shows the distribution of presenting symptoms among the study subjects. The most common presenting symptom was syncope (26%), followed by chest pain (22.5%) and breathlessness (22%). Abdominal pain (18.5%) and headache (9.5%) were also reported among some cases before death.

Table 4 shows the distribution of sudden death cases according to the predominantly involved organ system. The cardiovascular system was the most involved (58%), followed by the respiratory system (17.5%). Involvement of the central nervous system accounted for 11.5% of cases, while the gastrointestinal system and renal system contributed to 8% and 5% of cases, respectively.
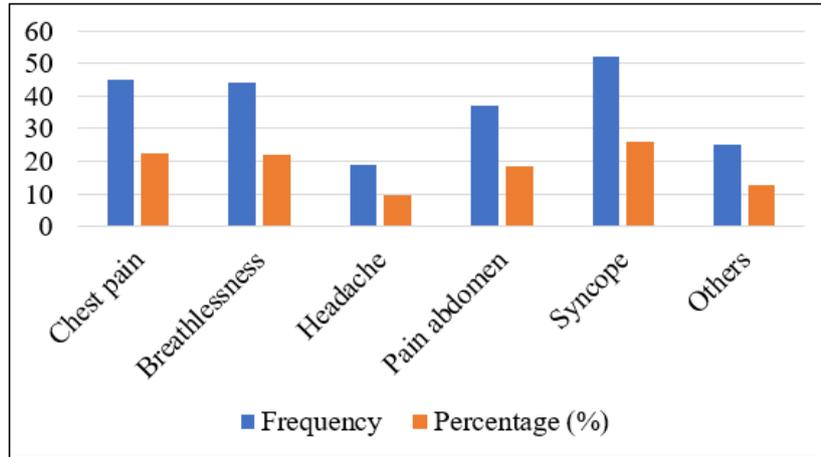
Fig. 2: Distribution of presenting symptoms of study subject

Table 4: Distribution of sudden death cases according to predominantly involved body system (n = 200)

Systems involved	Frequency	Percentage (%)
CNS	23	11.5
CVS	116	58
GI	16	8.0
Renal	10	5.0
Respiratory system	35	17.5

Table 5 shows the organ-specific postmortem findings among the study subjects. In the cardiovascular system, left anterior descending artery (LAD) occlusion was the most common finding (38.5%), followed by right coronary artery (RCA) occlusion (26.5%). Occlusion of both LAD and RCA was observed in 6% of cases, while 29% of cases showed no coronary vessel occlusion.

In the respiratory system, pulmonary edema (9%) was the most frequent finding, whereas consolidation (1%) and cavitary lesion (0.5%) were observed in a small proportion of cases, with the majority showing normal lung findings (89.5%).

In the gastrointestinal system, findings were relatively less common. Gastrointestinal perforation (3.5%) and upper gastrointestinal bleeding (3%) were the main abnormalities observed. Other findings included fatty liver (1.5%), pancreatitis (1%), and cirrhosis (0.5%), while 90.5% of cases showed normal gastrointestinal findings.

Table 5: Organ system involvement and postmortem findings (n = 200)

Organ system	Findings	Frequency	Percentage (%)
Cardiovascular system	LAD occlusion	77	38.5
	RCA occlusion	53	26.5
	Both LAD & RCA	12	6.0
	No occlusion	58	29.0
Respiratory system	Pulmonary edema	18	9.0
	Consolidation	2	1.0
	Cavitary lesion	1	0.5
	Normal	179	89.5
Gastrointestinal system	Upper GI bleeding	6	3.0
	GI perforation	7	3.5
	Fatty liver	3	1.5
	Cirrhosis	1	0.5
	Pancreatitis	2	1.0
	Normal	181	90.5

Fig. 3 shows the histopathological findings of the heart among the study subjects. Myocardial infarction was the most common histopathological finding (73.77%), followed by coronary artery disease (13.11%) and myocardial hypertrophy (6.55%). Other findings included myocarditis (3.27%) and myocardial fibrosis (3.27%).
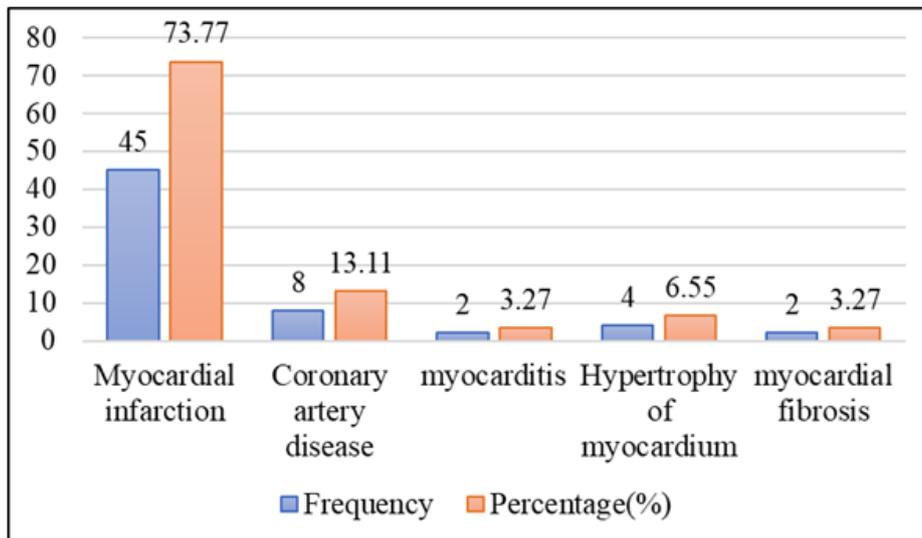

Fig. 3: Distribution of histopathology findings in the heart

Table 6 shows the histopathological findings of the lungs among the study subjects. The most common histopathological finding was bronchopneumonia (58.6%), followed by pulmonary edema (20.68%). Pulmonary tuberculosis (10.34%) and bronchiolitis (10.34%) were also observed among the lung tissue samples.

Table 6: Distribution of histopathology of lung

HPE findings of lung	Frequency	Percentage (%)	Diagnosis
Cellular infiltration	17	58.6%	Bronchopneumonia
Epitheloid granuloma	3	10.34%	Pulmonary Tuberculosis
Alveolar edema	3	10.34%	Bronchiolitis
Hemosiderin-laden macrophages	6	20.68%	Pulmonary edema

Fig. 4 shows the distribution of kidney diseases confirmed by histopathological examination. The most common renal lesion observed was acute tubular necrosis (46.66%), followed by glomerulosclerosis (33.33%). Other findings included polycystic kidney disease (13.33%) and malignant nephrosclerosis (6.67%).

Fig. 5 shows the distribution of liver diseases confirmed by histopathological examination. The most common finding was fatty changes with triaditis (53%), followed by steatosis (30%), while hepatic necrosis (17%) was observed in a smaller proportion of cases.
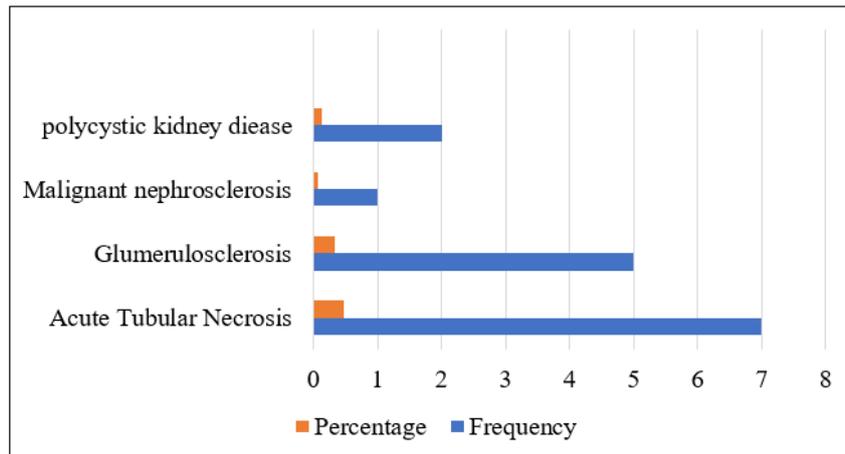
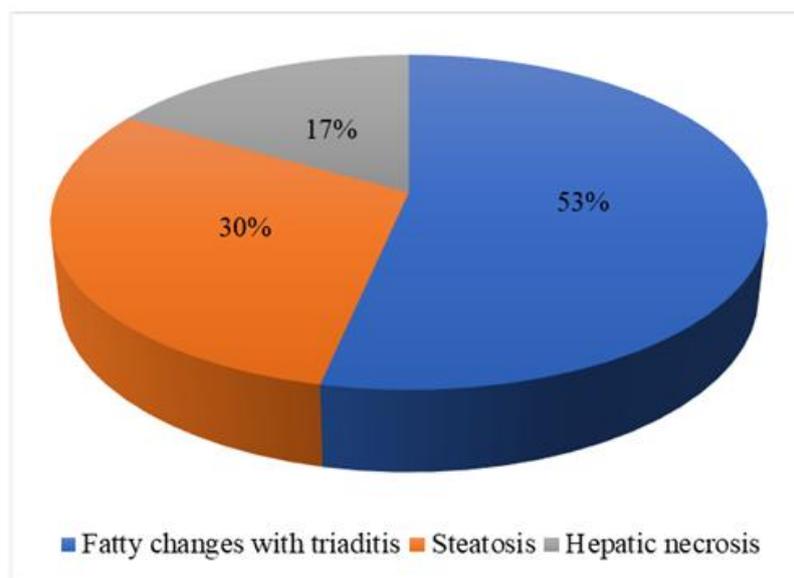**Fig. 4:** Distribution of kidney disease confirmed by Histopathology

Fig. 5: Distribution of liver diseases confirmed by histopathology

DISCUSSION

The frequency and disease pattern of sudden unexpected natural death are known to reflect the disease pattern prevalent in a particular geographic location and thus vary in different parts of the world. Nevertheless, it is well established in many studies that the cardiovascular, respiratory, and central nervous systems constitute the most common organ systems contributing to sudden unexpected natural deaths. Out of the total 1478 postmortem examinations conducted at the mortuary of the Department of Forensic Medicine & Toxicology, AGMC & GBPH, Tripura, 200 cases (13.53%) were sudden death or death within 24hours of onset of terminal signs and symptoms. This is consistent with studies by Jambure *et al.* [2] (10.58%), Pandian *et al.* [3] (11.60%), Pelemo *et al.* [4] (13.4%), Shashikant *et al.* [5] (10.0%).

In contrast to the present study higher incidence of sudden natural death was found in studies by Nwafor *et al.* [6] (61.01%), Kumar *et al.* [7] (40.60%), and Bhagora *et al.* [8] (21.29%).

In this study most vulnerable age group was found to be 51-60 years (27.0%), followed by 41-50 years (26.0%). This distribution may be due to work stress during the peak of their professions for earning a livelihood and temperament for securing future generations. Similar findings were observed in studies by Gaiwale *et al.* [9], Bhuba *et al.* [10], Gupta and Panigrahi [11], Kumar *et al.* [7], Bhagora *et al.* [8], Haridas *et al.* [12], and Chaudhury *et al.* [13]. Apart from this age group of 51-60 years, there has been a significant effect of various risk factors along with physical and mental stress. Many chronic and degenerative diseases show a progressive increase in prevalence with advancing age. In this present study

male were affected more (78.5%) than females (21.4%) with a male-to-female ratio of 3.66:1. This reflects the disparity in the occurrence of sudden death between males and females. Similar observation was found in studies conducted by Gaiwale *et al.* [9], Haridas *et al.* [12], and Rana and Pandey [14]. The possible reasons are that males, being the primary breadwinners of a family, are more prone to stress for livelihood and involvement in more outdoor engagement. They are more prone to indulge themselves in smoking, drugs, alcoholism, etc., due to availability of the said items outside their homes and also because of the common belief that such addictions relieve one of stress and strain and help in better performance at their workplace. In this present study, it is found that 35% of the study subjects were employed either in the government or private sector. 20.5% were businessmen, followed by 16% were unemployed. Among the study subjects, 10% were housewives and & 7% were daily labourers. Employees in the government. The private sector has more sedentary workplace setup, which may contribute to sudden death. Similar findings were found in a study conducted by Rana and Pandey [14], where the employed was 33.33% and businessmen counted 8.93%, followed by housewife 8.48% and 8.93% were labourers. Narsireddy *et al.* [15], Gaiwale *et al.* [9] observed 45.50% of the victims were occupied with sedentary works followed by 29.5% were heavy workers. Populations with higher socioeconomic status have sedentary lifestyles, are more stressed due to work-related responsibilities, engage in smoking, alcohol, drugs etc, which may make them prone to sudden death. People belonging to the lower class cannot access the healthcare facilities due to a lack of resources or the availability of centre nearby, thereby not visiting the healthcare centres and death occurs at home. The social stigma against postmortem examination may result in less reporting of cases in this class. In contrast to the present study higher incidence of sudden deaths is seen in the low socioeconomic status group (53.775%), followed by the middle socioeconomic status group (39.13%), as observed in a study by Guntheti *et al*. [17]. Rana and Pandey [14].

Addiction to smoking, alcohol and habituation to tobacco and related products can significantly increase the risk of sudden death through various mechanisms, primarily due to overdose, cardiovascular events, and respiratory depression. In this present study, it is found that 28 cases

of victims were addicted to alcohol (37.5%), addicted to drug 18cases (13.5%), habituated to tobacco and related products 65cases (32.5%), and multiple addiction 75cases (34.5%). Similar findings were found in the study of Guntheti *et al*. [17], where smokers were 39.18% and 32.43% were alcohol abusers. Mukhopadhyay *et al.* [18] also found in their study that sudden death was caused by alcohol in 29.2% cases and by tobacco 54.2% cases. In a study conducted by Narsireddy *et al.* [15], it was found that the persons having habits of smoking, alcoholism and drug abuse outnumbered those not having any habit. Almost more than half of the cases were smokers and alcoholics, with 31 cases (51.7%) and 35 cases (58.3%), respectively. Drug abuse was seen in 2 cases (3.3%). 30.50% cases were smokers,17.52% chronic alcoholic and one heroin abuser as observed in the study by Tyagi *et al.* [19]

It is observed in this present study that most of the deceased had a history of hypertension (36.5%), followed by diabetes mellitus (24.0%) and kidney disease (15.5%). Both hypertension and diabetes were (8.5%) and others constituted 7.5%. Mukhopadhyay *et al.* [18] found similar findings that hypertension as a preexisting disease were 45.8%, and diabetes 8.3%. Apart from this, they also found in their study that a history of stroke and myocardial infarction was present in 16.7% and 8.3% of deceased subsequently. Kumar *et al.* [7] also found in their study that 42.01% (n=255) were already diagnosed with some premorbid condition related to death. Hypertension and diabetes mellitus (DM), which are recognized as atherosclerotic cardiovascular disease risk factors, can increase the risk of sudden cardiac arrest through their association with coronary artery disease, aortic disease of the aorta, cerebrovascular accident, and heart failure. Hypertension and DM are significantly associated with an increased risk of sudden cardiac arrest (SCA). The risk of SCA is also increased in people with pre-hypertension and impaired fasting glucose. Uncontrolled diabetes had a significantly higher risk of SCA compared with DM patients taking medications and people with both hypertension and diabetes had an increased risk of SCA as compared with people having only one of those conditions.

CONCLUSIONS

Sudden natural death remains an important concern in medicolegal practice. The present study highlights that

most cases of sudden death occur due to underlying natural diseases that may remain undiagnosed during life. Cardiovascular disorders were found to be the most common cause, particularly coronary artery disease leading to occlusion of major coronary vessels. Other organ systems such as respiratory and gastrointestinal systems contributed to a smaller proportion of cases. Post-mortem examination, along with detailed histopathological analysis, plays a crucial role in identifying the exact cause of death and detecting underlying pathological changes. Such examinations not only help in establishing the cause of death accurately but also provide valuable information regarding the pattern and prevalence of sudden natural deaths in the community. Therefore, thorough autopsy evaluation is essential for improving the understanding of sudden death and for providing reliable data for medical and forensic purposes.

CONTRIBUTION OF AUTHORS
Research concept- Dr. Santanu Das
Research design- Dr. Santanu Das
Supervision- Dr. Juthika Debbarma, Dr. Pradipta Narayan Chakraborty
Materials- Dr. Santanu Das
Data collection- Dr. Santanu Das
Data analysis and interpretation Dr. Santanu Das
Literature search- Dr. Santanu Das
Writing article- Dr. Santanu Das
Critical review- Dr. Juthika Debbarma, Dr. Pradipta Narayan Chakraborty
Article editing- Dr. Juthika Debbarma, Dr. Pradipta Narayan Chakraborty
Final approval- Dr. Juthika Debbarma, Dr. Pradipta Narayan Chakraborty

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