Int. J Med. Pharm. Res. (P-ISSN: 2958-3675 | E-ISSN: 2958-3683)
Available on: https://ijmpr.in/
DOI:

International Journal
of Medical and
Pharmaceutical Research

ORIGINAL ARTICLE OPEN ACCESS

A Study of Autopsy Cases of Sudden Death

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OPEN ACCESS

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Received: 20-04-2024
Accepted: 02-05-2024
Available online: 20-05-2024

ABSTRACT

Background: Sudden death is defined by WHO as "Deaths within 24 hours from the onset of the symptoms." Sudden death is a traumatic event for the family, it has huge social and psychological consequences and is also a major contributor to years of life lost among the young. The causes of sudden death differ greatly among various age groups and it includes cardiovascular causes, pulmonary causes like thromboembolism, anaphylaxis, severe pneumonia, other causes like intracranial haemorrhage, gastrointestinal causes etc.
Aim: To study and classify the underlying causes of sudden death.
Materials and Method: A review of autopsy cases of sudden death was performed between August 2023 to December 2023 at the department of pathology, SMIMER medical college, Surat. Out of 210 total autopsy cases received during that period, 50 cases(23.8%) were studied for sudden deaths. Specimens were fixed in 10% formalin for fixation, grossing was done and representative sections were taken. Tissue processing was done according to standard protocol, routine Haematoxylin and Eosin staining was done and special stain was done whenever required.
Results: Out of 210 total autopsy cases received from August 2023 to December 2023, 50 cases(23.8%) were studied for sudden deaths. The age group with most cases of sudden death was 45 – 59 years. Males(88%) were affected more than female (12%)with male to female ratio of 7.3:1. The most common cause of sudden death comprised of cardiac causes(60%),in which CAD consists of 54% followed by myocarditis-04% and Cardiomyopathy- 02%, while deaths by respiratory causes(6%) comprises of deaths due to pneumonia(4%) and Tuberculosis of lung (2%),other systemic causes(4%) consists of cirrhosis of liver (hepatobiliary system-2%) and leukemia(Hematopoietic system-2%).
Conclusion: Meticulous autopsy and proper histopathological examination play an important role to find out the cause of sudden death.The most common cause of sudden death is attributed to cardiac causes. This study makes us aware about the serious health issues faced by our society.

Key Words: *Autopsy cases, Sudden death, Coronary Artery Disease.*

INTRODUCTION:

Sudden death is defined by World Health Organization as deaths occurring within 24 hours of the onset of symptoms. It can also be defined as deaths which are sudden, unexpected, clinically unexplained or otherwise obscure even though there need to be no unnatural element in their causation[1].Sudden death in apparently healthy individuals is a very challenging event for the family of the deceased, medical examiners, law enforcement officers, insurance companies as a whole. It can be seen in all age groups including infants, children, young people, adults and the elderly. Advanced age, low or high body mass index, diabetes mellitus, hypertension, sedentary lifestyle, unhealthy diet, smoking and stress have been identified as risk factors for sudden death.[2] Sudden cardiac deaths are accounted for>60% of all sudden deaths. [3] Young south Asians make approximately 60% of the world's Coronary artery disease(CAD) load. India being a developing country is the CAD capital of the world according to WHO.[1][4]CAD may be further divided into atherosclerotic and non-atherosclerotic types. The atherosclerotic type accounts for most of the cases. Atheromatous plaque coupled with obstruction causes sudden death due to sudden alteration in the plaque, probably with emotional or physical stress.[5] Non-atherosclerotic CAD include congenital abnormalities, embolism, arteritis, dissecting aneurysms

and external compression or ostial obstruction.[6]Non-coronary cardiovascular diseases are strictly related to congenital anomalies of heart, valvular heart disease such as rheumatic heart disease and syphilis, hypertensive heart disease, myocarditis, ruptured aortic aneurysm, cardiomyopathy, primary arrhythmogenic disorders and channelopathies.[6]Other causes of sudden deaths include pulmonary causes like asthma, pulmonary hypertension, anaphylaxis, embolism, poisoning, drowning, intracranial hemorrhage, sickle cell crisis,etc.Despite extensive macroscopic, microscopic and toxicological investigations, approximately 5-10% of cases will be unexplained and will be classified as sudden unexpected deaths, usually defined as death from a presumed arrhythmia. This rate varies between 30-50% in the young population. [7] This can have serious consequences from a medical point of view, as these unexpected deaths could be due to an inherited heart disease, that can also be inherited from and to the family members, hence putting them at risk. This study aims to know various causes of sudden deaths and to know its rate and pattern to promote strategies for its prevention in the population at risk.

MATERIALS AND METHOD:

This study includes autopsy cases of sudden death of all age groups, received in the pathology department, affiliated with tertiary care hospital of South Gujarat, from August 2023 to December 2023. Out of 210 total autopsy cases, 50 cases(23.8%) were studied for sudden deaths.Inclusion criteria: Autopsy of cases which comes under the definition of sudden deaths according to the WHO criteria are included in the study. Cases whose cause of death was suicide, electrocution, poisoning, accident, drowning and trauma were excluded. Specimens were fixed in 10% formalin according to standard protocol. Gross examination of the specimens was done, necessary details were taken and sections from representative areas were taken. Tissue processing was done andsections of 3 to 5 micrometer thickness were examined for microscopy after routine Haematoxylin and Eosin staining.Atheromatous changes of the aorta and coronary arteries were graded based on the AHA2011 criteria. Other special stains like ZiehlNeelsen stain was performed whenever necessary.

RESULTS:

A total of 210 autopsy cases were received during the study period among them 50 cases of sudden death were studied, the correlation with age and gender group is shown hereby. Among the 50 cases 44 were male and 6 were female. This shows that male gender is more affected than the female with the male to female ratio of 7.3:1.The youngest death was of an 18 year old female and the oldest was of a 67 years old male. The age-group with most cases of sudden death is 40-59 years of age which consists of 48% of the cases studied. Most of the deaths were due to cardiac causes i.e. 30 cases(60%). The major cardiac pathology involved in sudden cardiac death is Coronary Artery Disease(CAD) with 90% cases i.e. 27 out of total 30 cases. Out of 27 cases of sudden cardiac deaths, 24 cases(88.9%) show atherosclerotic changes with infarction in heart and 3 cases(11.1%) show atherosclerotic changes ranging from grade 4 to grade 6 without ischemic changes. The male to female ratio in cardiac deaths due to myocardial infarction is 5:1 whereas the 3 cases without ischemic changes were all males. In 1 male and 1 female the cause of death was myocarditis.In this the male was 55 year oldwhile the female was an 18 year old and she had sickle cells in all organs.There was only one case of hypertrophic cardiomyopathy seen in a 22 year old male.

Table-1:**Age and sex wise distribution of no. of cases of sudden death**

Age Group(Years)	Male	Female	Total
0-19	00	1	1(2%)
20-39	15	3	18(36%)
40-59	22	2	24(48%)
60-79	07	0	07(14%)
Total	44	06	50

Table-2:**Differentcauses of sudden deaths**

Causes of sudden death	Number(n=50)	Percentage
Cardiac	30	60%
Respiratory system	03	6%
Hematopoietic system	01	2%
Hepatobiliary system	01	2%
Unexplained cause	15	30%

A case of death of a 47year old male due to myocardial infarction also showed features of cirrhosis of liver and other case of a 58 year old male with features of myocardial infarction also showed features of pneumonia in both lungs along with features of diabetic nephropathy in both kidneys but they were included in cardiac deaths. A case of 30 year old male showed caseous necrosis with giant cells and epithelioid granuloma in one lung where Ziehl-Neelsen stain was positive suggestive of tuberculous granuloma whereas the other lung showed features of lobar pneumonia, but it has been counted in (Tuberculosis)TB lung.In a 37 year old female with history of sudden death,heart showed hypertrophy of myocardial fibers of all 3 chambersand in a 22 year old male with history of sudden death, left ventricular wall showed myocardial hypertrophy but no specific cause of death was found.

Table-3:**Age-wise distribution of causes of sudden deaths**

Age-group	Cardiac	Respiratory	Hematopoietic	Hepatobiliary	Unexplained
0-19	01	00	00	00	00
20-39	05	03	01	00	09
40-59	19	00	00	01	04
60-79	05	00	00	00	02
Total	**30**	**03**	**01**	**01**	**15**

Table-4:**Genderwise distribution of causes of sudden deaths**

Gender	Cardiac	Respiratory	Hematopoietic	Hepatobiliary	Unexplained	Total
Male	25	03	01	01	14	**44(88%)**
Female	05	00	00	00	01	**06(12%)**

Table-5:**Sex-wise categorization of various pathological findings in involved systems**

System involved	Pathological Findings	Male	Female	Total No.of cases	Percentage (n=50)
Cardiovascular system	Myocardial Infarction (MI)	20	04	24	48%
	Atherosclerosis without MI	03	-	03	06%
	Myocarditis	01	01	02	04%
	Cardiomyopathy	01	-	01	02%
Respiratory system	Aspiration pneumonia	01	-	01	02%
	Tuberculosis of lung	01	-	01	02%
	Lobar pneumonia	01	-	01	02%
Hepatobiliary system	Cirrhosis of liver	01	-	01	02%
Hematopoietic system	Acute Lymphoblastic Leukemia	01	-	01	02%
Unexplained		14	01	15	30%

Table-6:**Age-group wise categorization of various pathological findings in involved systems**

System involved	Pathological findings	0-19	20-39	40-59	60-79	Total No.of cases
Cardiovascular system	Myocardial Infarction (MI)	-	04	16	04	24
	Atherosclerosis without MI	-	-	02	01	03
	Myocarditis	01	-	01	-	02
	Cardiomyopathy	-	01	-	-	01
Respiratory system	Aspiration pneumonia	-	01	-	-	01
	Tuberculosis of lung	-	01	-	-	01
	Lobar pneumonia	-	01	-	-	01
Hepatobiliary system	Cirrhosis of liver	-	-	01	-	01
Hematopoietic system	Acute Lymphoblastic Leukemia	-	01	-	-	01
Unexplained		-	09	04	02	15

We had a special case of a 25 year old male with history of sudden death, on histopathological examination of the autopsy organs, his heart, lungs liver, kidney and spleen showed leukemic cell infiltration, which was confirmed onImmunohistochemistry of CD3, CD5, Tdt positive blast cells and CD20 negative cells suggestive of "T cell-Acute lymphocytic leukemia"

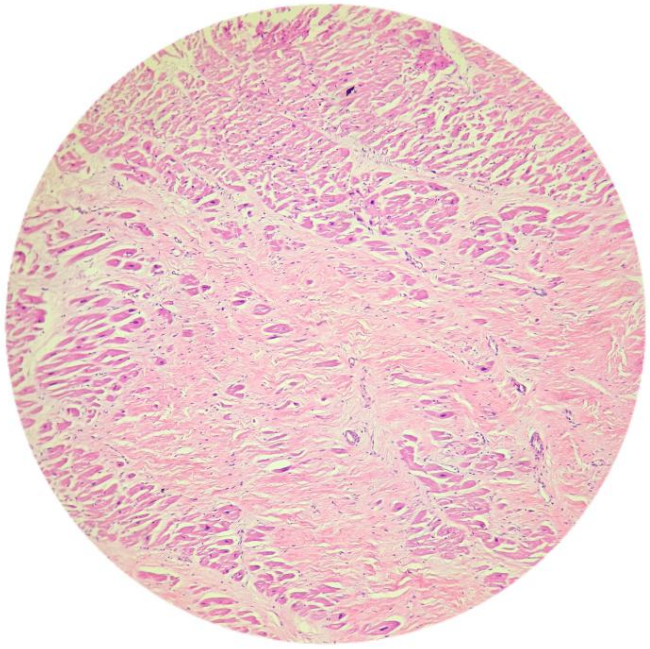


Figure 1: Healed Myocardial Infarction(H & E 40x)

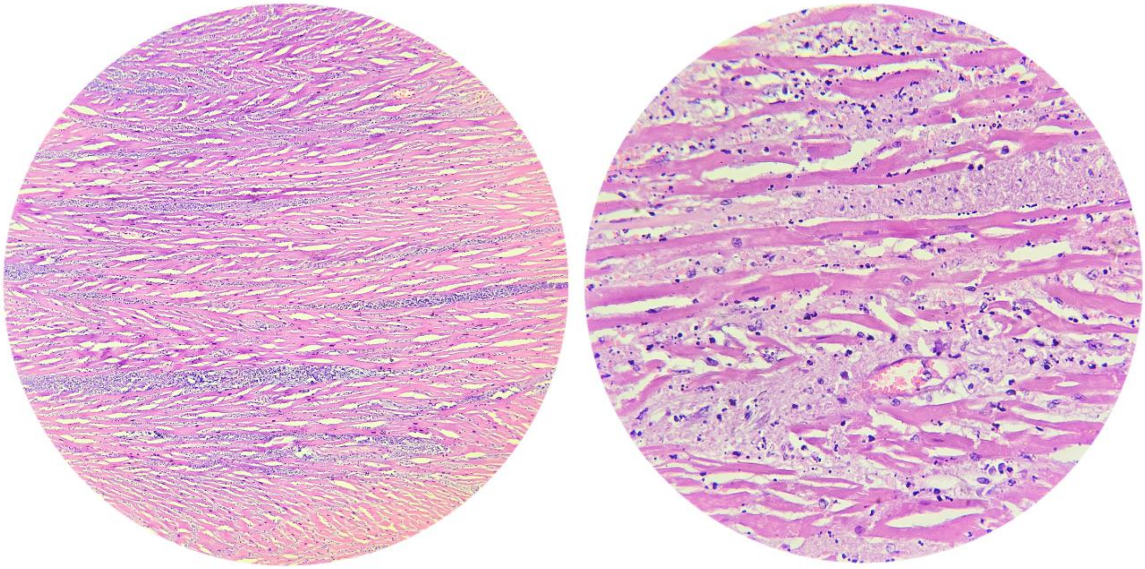


Figure 2: Acute Myocardial Infarction(H & E 10x, 40x)

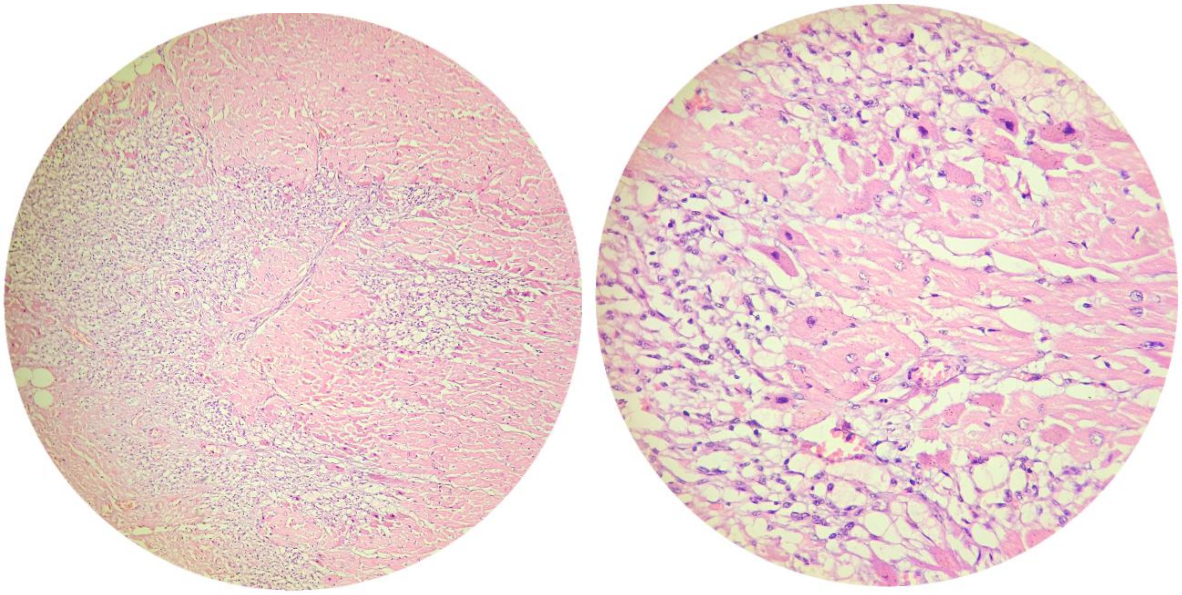


Figure 3: Myocarditis(H & E 10x,40x)

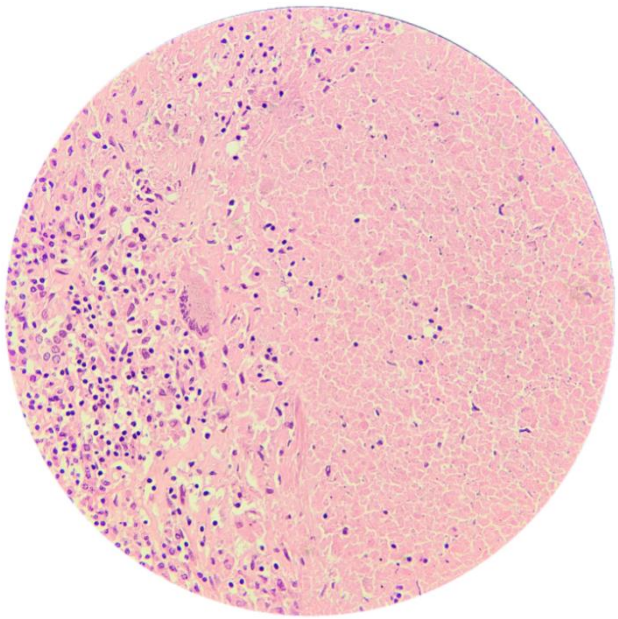


Figure 4: Tuberculosis lung(H & E 40x)

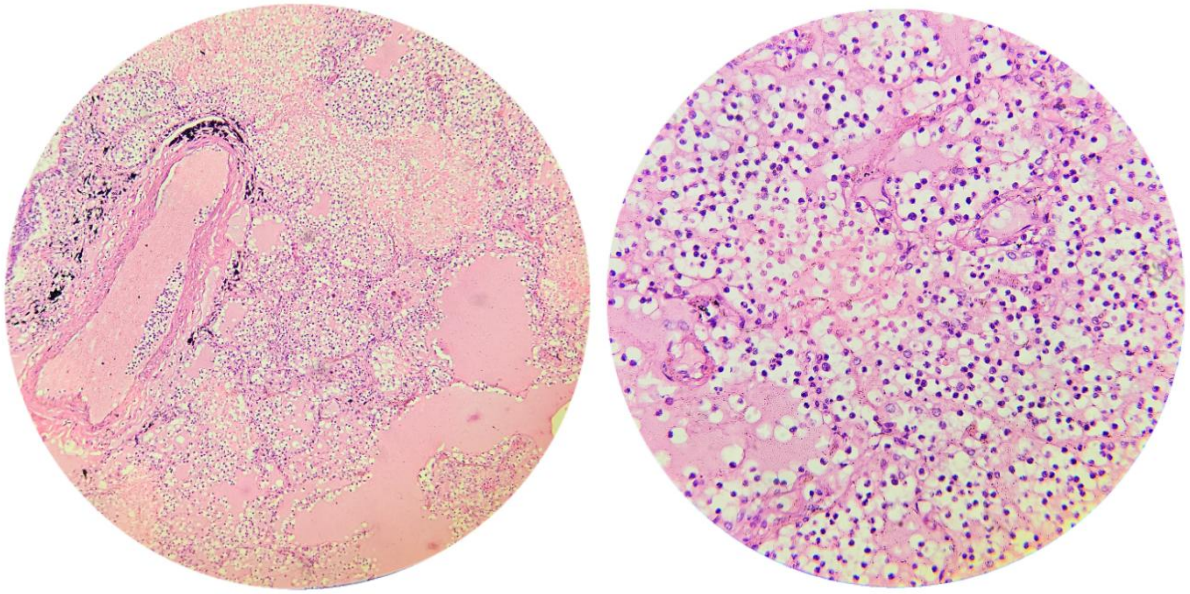


Figure 5: Lobar pneumonia(H & E 10x, 40x)

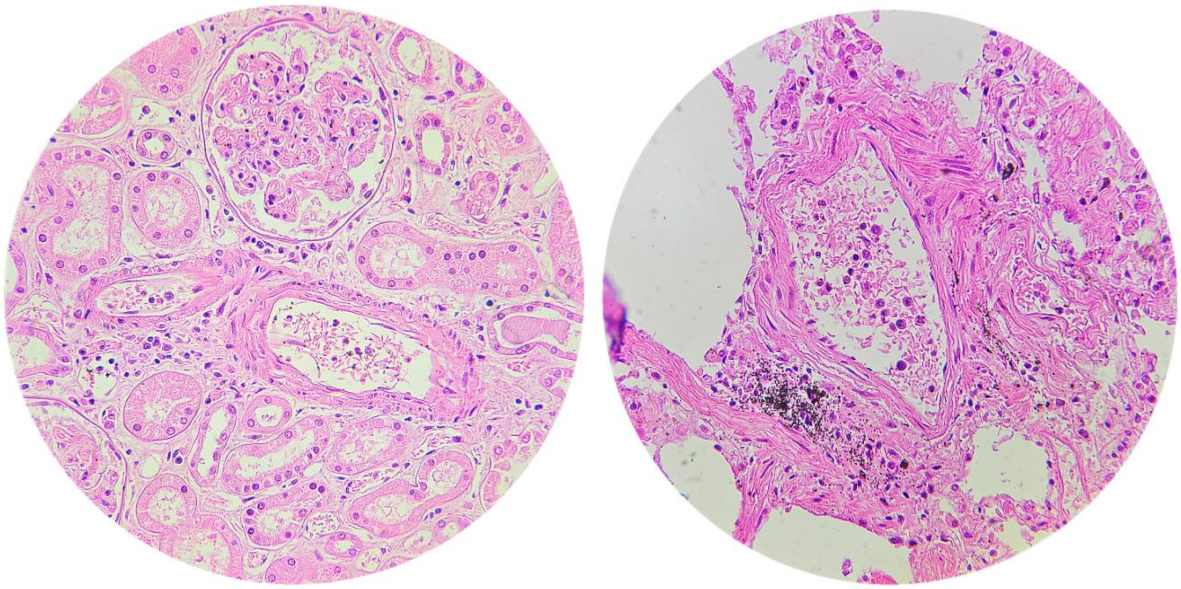
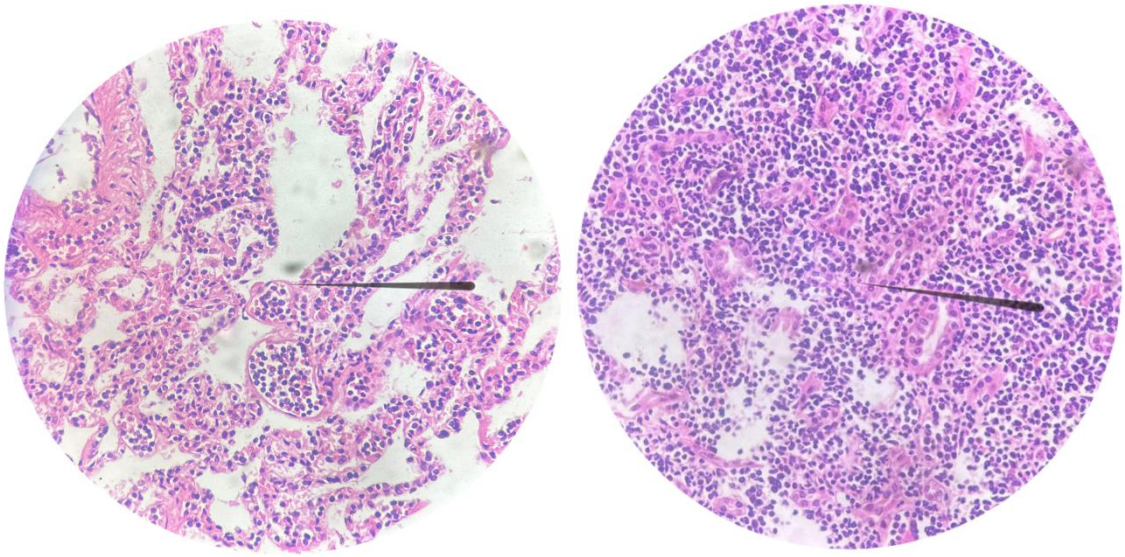
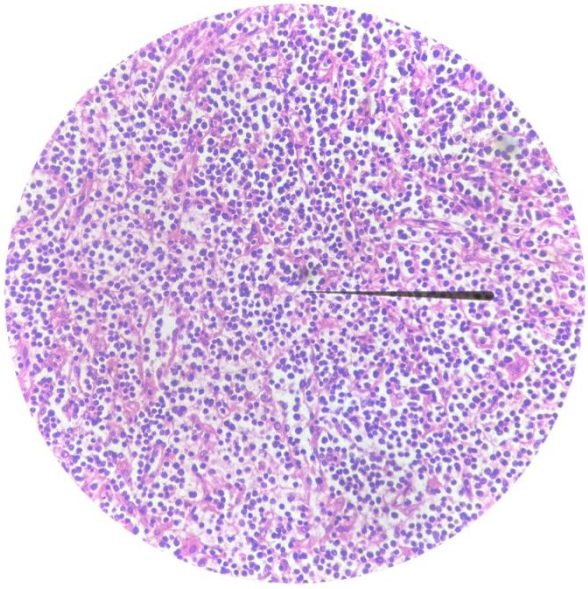


Figure 6: Sickle cells in kidney and lung(H & E 40x)



Lung **Kidney**



Spleen

Figure 7 : Lymphoblastic cell infiltration in lung , kidney and spleen in case of ALL(H & E 40x)

DISCUSSION:

India has shown a rise in the number of sudden deaths in the recent few years which is due to increase in CAD(Coronary artery disease) deaths.[8] This is due to advanced age, low or high body mass index, hypertension, diabetes mellitus, sedentary lifestyle, smoking, increased westernization of Indian society, leading to the increase in comorbidities.[2] A study by Hajra K Mehdi et al. showed maximum no. of deaths in the mean age of 44.36 years, Modi RA et al had maximum sudden deaths in 35-45 years of age group and Srivatsa U et al reported a mean age of 55 years.[5][9][4] These findings are comparable with our study where maximum cases of sudden deaths are reported in the age of 45-59 years of age, with the mean age of 51.5 years.

Most of the studies had a male preponderance of sudden deaths as seen in the study by Hajra K Mehdi et al and Modi RA et al with a male : female ratio of 10:1 and 4:1 respectively.[5][9] In our study males are more affected than females with the ratio of7.3 :1.

Kuller et al. showed that nearly two third of sudden non-traumatic deaths are due to arteriosclerotic diseases.[10]In our study the major contributing cause of sudden death is cardiac diseases(60%).The mean age for sudden cardiac deaths in a study conducted by Rao et al, Hajra et al and Madhavan SR et al is of 50-59 years,44 years and 45 yearsrespectively.[11][5][12] The mean age in our study for SCDs is 40- 59 years with mean age of 47.6 yearswhich is in line with the latter two studies. The male to female ratio for coronary heart disease in our study is 5.7:1 which shows male preponderance which is concurrent with a study byHajra et al where male preponderance is seen.In our study ishaemic changes(48%) are most commonly seen in majority of the cases followed by only atheromatous changes(6%). The cardiovascular diseases which lead to sudden deaths in our study are as follows in decreasing order: CAD, myocarditis and cardiomyopathy. Eckart et al. has reported in his study that arrhythmic causes are probably the main cause of sudden unexplained cardiac deaths in patients under 35 years of age, whereas atherosclerotic heart disease is the predominant cause in persons over 35 years of age.[13]Finocchiaro et al also stated in their study that arrhythmia and coronary artery anomalies are the most important causes of sudden deaths in young athletes under the age of 35 years, while myocardial diseases are predominant cause in athletes over 40 years of age.[14]

The major contributors of sudden deaths in our study are cardiovascular causes, followed by unexplained causes, respiratory cause, hepatobiliary cause and other systemic causes. The comparison with other studies is as follows.

Table-7: **Comparison of incidence of sudden death due to various systemic causes in different studies**

Studies	Cardiovascular System	Respiratory system	Hepatobiliary system	Unexplained cause
Modi RA et al[9]	56%	17.3%	5.4%	8.6%
Eckart RE et al[13]	61%	-	-	-
Owada M et al[3]	62%	-	-	-
Hajra K Mehdi et al[5]	81.81%	No case	9.09%	9.1%

Ardra et al[15]	39%	30%	No case	No case
Present study	60%	06%	02%	30%

In our study unexplained cause of death(30%) is comparatively more than other studies. Unexplained cause of death is where no histopathological findings are identified on microscopy.In cases where no structural cardiac abnormalities have been reported, death may be due to an underlying primary arrhythmogenic disease such as long or short QT syndrome(LQTS/SQTS), Brugada syndrome (BrS), and catecholaminergic polymorphic ventricular tachycardia(CPVT).[5]Use or abuse of anabolic-androgenic steroids(AAS) for treatment of hormonal diseases or by young people to improve physical appearance and performance is seen very frequently. AAS use/abuse is strictly related to increased risk for sudden deaths.[6] Assumption of drugs for recreational purposes, for example, cocaine in its various forms could be related to fatal cardiac arrhythmias, microvascular injury, acute myocardial ischemia due to coronary vasospasm are the important causes of cocaine-related cardiac deaths.[6] Other recreational drugs such as heroin, marijuana, psychotropic drugs consumed by young people may be related to sudden deaths.Deaths due to respiratory causes, hepatobiliary diseases and other systemic causes consists of 6%, 2% and 2% respectively.

Out of 17% of the deaths due to respiratory causes reported by Modi RA et al, deaths due to pneumonia and tuberculosis were 96% in total, followed by death due to other respiratory causes.[9]In a study by Ardra et al, out of 30% cases of deaths due to respiratory causes, 26% were due to pneumonia and rest of all due to chronic parenchymal lung diseases.[15]In our study 6% of sudden deaths were due to Respiratory causes which includes mainly lobar pneumonia(2%) and tuberculosis of lung(2%) followed by aspiration pneumonia(2%).The predominance of pneumonia and tuberculosis might be due to the poor economical conditions, poor immunity and crowding in the area of study, leading to less ventilation and more chances of transmission.

Modi RA et al had 8 cases (5.4%) of death due to involvement of hepatobiliary system. Hajra et al had 1 case (9.09%) of sudden death due to severe steatohepatitis.[5]We had reported 1 case (2%) of a 43 year old male with sudden death due to liver cirrhosis.

CONCLUSION:

Meticulous autopsy and proper histopathological examination play an important role to find out the cause of sudden death. In our study the most common cause of sudden death is attributed to cardiac causes(60%) and the most common age affected is 40-59 years with male preponderance whereas 30% of the cases had unexplained cause of death i.e. with no morphologic alteration found on microscopy. For cases of acute cardiac processes without morphological alteration, post mortem imaging such as Computed tomography(CT), Magnetic Resonance Imaging(MRI), X-rays, biochemical markers (Troponin-I in pericardial fluid) play a pivotal role to identify the cardiac pathology, before performing the autopsy.Moreover, by means of modern radiological methods, such as MDCT(Multi-detector computed tomography), MDCT-angiography and cardiac MRI a radiological investigation, different heart abnormalities can be highlighted.Genetic testing, next generation sequencing(NGS) could be done to discover the upcoming casualty with the identification of family member carriers and adopting preventive strategies.Awareness about the risk factors of sudden deaths and routine health check-upamongst the general public would help to reduce incidence of such deaths.

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