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Original Research Article

Post Mortem Diagnosis in Sudden Neurovascular Death Victims: A Study of Macroscopic Findings

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Abstract: Among all the illnesses, which can blow out life's candle, cerebrovascular accidents (CVA) is the most alarming to the spectator, most grievous to the patient and most baffling to the physician. The aim of the study was to evaluate the data with respect to incidences, epidemiological aspects, impact of risk factors, estimate the survival time and cause of death in relation to sudden natural neurovascular death victims. This study was conducted on 63 victims of sudden neurovascular death brought to Seth G.S. Medical College & KEM Hospital, Mumbai, India during period from January 2014 to July 2015. The incidence of sudden natural neurovascular deaths among the total medico legal autopsies is 2.88%, with most affected age group of 41-50 years. The male to female ratio was 3.2:1. Smoking and alcohol habits outnumbered the other risk factors. Most common cause of death was intracerebral haemorrhage located in basal ganglia region.
Keywords: Sudden neurovascular death, Medico legal autopsies, intracerebral haemorrhage

INTRODUCTION

In a typical medical practice, approximately almost half of the deaths are natural, 5–10% are still unexplained after a gross autopsy, and 1– 5% remain unclear (negative) after completion of the gross and histological examination and other laboratory tests [1]. One of the challenges faced by the forensic experts is the inability to determine the cause of death in a person previously thought healthy. It is quite possible for a person to be in apparently perfect health but at the same time suffering from a serious disease of which he may not be aware. However, no definitive cause of death can be found at postmortem and subsequent histopathologic examination in a minority of cases [2]. Among the natural death, sudden deaths cases always carry potential risk of autopsy being negative or obscure one.

Main cause of sudden death is cerebrovascular disease or Stroke. Worldwide, it is estimated there are 31 million stroke survivors, though about 6 million deaths were due to cerebrovascular disease (2nd most common cause of death in the world and 6th most common cause of disability) [3]. Cerebrovascular disease primarily occurs with advanced age; the risk for developing it goes up significantly after 65 years of age. Several factors such as age, sex, occupation and marital status may also influence the sudden natural death. Longer the life span, greater are the incidences of atherosclerosis, diabetes mellitus, hypertension which are the principal etiological factors of cerebrovascular accidents [4].

Commonly, medico legal autopsies are conducted in cases of sudden and unexpected deaths primarily to establish the cause of death in cases where such deaths have occurred in apparently healthy individuals unexpectedly and/ or under suspicious circumstances. The outcome may quite often reveal some natural disease, the presence of which may trigger issues like association of the disease with trauma, work, crime, etc. and its relative contribution towards death. The association of disease with trauma may have

criminal aspect or may involve compensation benefits for the relatives. This is quite often encountered in circumstances where there has been possible association of effort, emotion, and excitement with sudden death. Sudden deaths are important from a medico legal standpoint as they raise suspicion of foul
Play [5].

In today's era, increase is reported in occurrence of sudden unexpected natural death, because ironically human's average life span has also increased. Sudden unexpected natural death cases in adults are steadily increasing world over and is an issue of great concern for medical professionals [6]. Many instances were reported where a healthy person without any significant past history of any illness was found dead at home or at work place, of course such cases always raise a suspicion of foul play. Sudden death especially of a young and apparently healthy adult is not only shocking but also has profound impact on the psyche of the society [7]. The Forensic specialist along with the help of Forensic histopathologist are not limiting themselves to excluding violent causes of death, but are trying to study sudden death cases in depth and unravel the cause behind it.

The aim of the study was to evaluate the data with respect to:

- Incidences of sudden natural neurological death victims.
- Epidemiological aspects of sudden natural neurological death victims.
- Impact of risk factors in relation to sudden natural neurological death victims.
- Estimate the survival time in cases of sudden neurological death victims.
- Cause of death in sudden natural neurological death victims.
- Medico legal aspects of sudden death.

MATERIAL AND METHODS

The study was conducted in the Department of Forensic Medicine of Seth G.S. Medical College & K.E.M. Hospital, Mumbai, India during period from January 2014 to July 2015. All cases, irrespective of age groups and sex, who died suddenly and/or unexpectedly and brought to this institute for post-mortem examination, were studied. Criteria for selection of cases were as follows:

Inclusion criteria:

- The cases, which were died within 24 hours of onset of terminal symptoms of natural disease and then brought to our hospital, for post-mortem examination.
- The cases which were brought in casualty in unconscious state and were brought to institution for post-mortem examination with the manner of death either natural or not known and the cause of which subsequently on post-mortem examination, turned out to be sudden natural were included.
- The cases which were belonged to only neurological system after post-mortem examination.

Exclusion criteria:

- All cases of unnatural deaths were not included in this study.
- The cases where cause of death turned out to be unnatural after the post-mortem examination.
- The cases where cause of death remained obscure even after detailed post-mortem gross examination; histopathological, toxicological, microbiological, virological screening investigations were not included.
- All natural deaths where duration between onset of symptoms and death is more than 24 hrs.
- Deaths related to Non-neurological origin.

OBSERVATION

During this period 2187 autopsies were conducted, out of which, 282 cases (12.89 %) were of sudden natural death and out of that, 63 cases (22.34 %) were of neurological system. Amongst these 63 cases, 48 cases (76.19%) were male and 15 (23.81%) were female. The male to female ratio was 3.2:1.

Maximum number of cases belonged to 41-50 years age group (14) closely followed by 51-60 years age group and 21-30 years age group 12 cases each. While the least reported in more than 70 years age group (2). Maximum number of male deaths was seen in 41-50 years age group (13), while Maximum number of female deaths reported in 21-30 years age group (5).

In present study, it was observed that worker constituted highest number of cases i.e. 19 (30.16%) followed by retired and unemployed cases 9 (14.29%) each and office / private employees constituted minimum number 2 (3.17%) of cases. It was observed that 43 (68.25%) cases were married and 20 (31.75%) cases were unmarried.

Most of the cases of sudden neurological deaths, i.e. 44 cases (69.84%) took place when the deceased was in his/her home, followed by public place 15 cases (23.81%), on duty 3 cases (4.76%) and road side 1 case (1.59%). The present study was carried out from January 2014 to July 2015 period. Average of two years were collected from January to July month. It was observed that in month of March maximum number of sudden neurological deaths were seen i.e.10 (15.88 %).

Modifiable risk factors like hypertension (HTN), diabetes mellitus (DM), cigarette smoking, alcoholism, drug abuse present in cases of sudden neurological deaths. It was observed that the persons having habits of smoking and alcohol outnumbered the other risk factors. In CNS, male outnumbered the female in all risk factors. One case of chronic ganja abuser leads to meningitis.

Maximum number of time of onset of symptoms was between 18 hrs to 24 hrs in 21 (33.34%) cases, followed by the 06 hrs to 12 hrs in 18 (28.57%) cases. The least number was seen in between 00hrs to 06 hours i.e. 9 (14.28%) cases. Out of 63 cases, 16 (25.39 %) cases were died within 1 hour of onset of symptoms, while 33 (52.38%) cases died between 6-24 hours of onset of symptoms. It was observed that out of 63 cases, intracerebral haemorrhage (28) was the most common cause in sudden neurological death victims. Male deaths (22) were in greater in number than female deaths (6).

The analyzed data, showed that intracerebral haemorrhage was the commonest type of intracranial haemorrhages, which contributed 44.45% of the cases having their mean weight of brain 1700 gms, followed by subarachnoid haemorrhage, which contributed 14.28% cases with mean weight of brain 1682.8 gms. Small number of the victims had space occupying lesions and meningitis (06.35% each) prior to their death with mean weight of brain 1267.5 gms and 1617.5 gms respectively. Out of 4 cases of space occupying lesions, 3 cases were below 12 years of age, thus their mean weight of brain was 1267.5 gms.

Commonest site of intracerebral haemorrhage was basal ganglia ("striatum" and thalamus) 50% cases, followed by lobar region 35.71 % cases. One case of rupture of meningioma, haemorrhage was seen in basal ganglia region. It was observed that maximum number of cases were belonged to intracerebral haemorrhage i.e. 28 (44.45 %) cases. On gross examination, bright red acute haemorrhage, peri-haematoma oedema and ischaemia were seen and confirmed by microscopic examination i.e. lysis of erythrocytes, Oedema, ischaemia, polymorph infiltration.

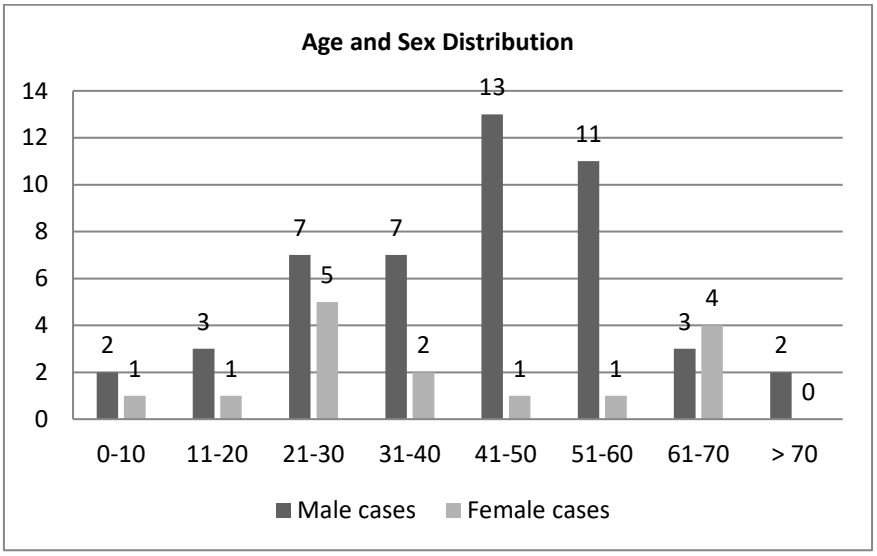

Fig-1: Showing age and sex distribution.

Table-1: Occupation wise distribution of sudden natural deaths

Occupation	Number of cases	Percentage
Not applicable (<18 years / student)	5	7.94
Office / Private employees	2	3.17
Business	4	6.35
Laborer	7	11.11
Worker in industries, mills, shops, farm, other sectors	**19**	**30.16**
Unemployed	9	14.29
Retired (>60 years)	9	14.29
Housewife	8	12.69
Total	63	100

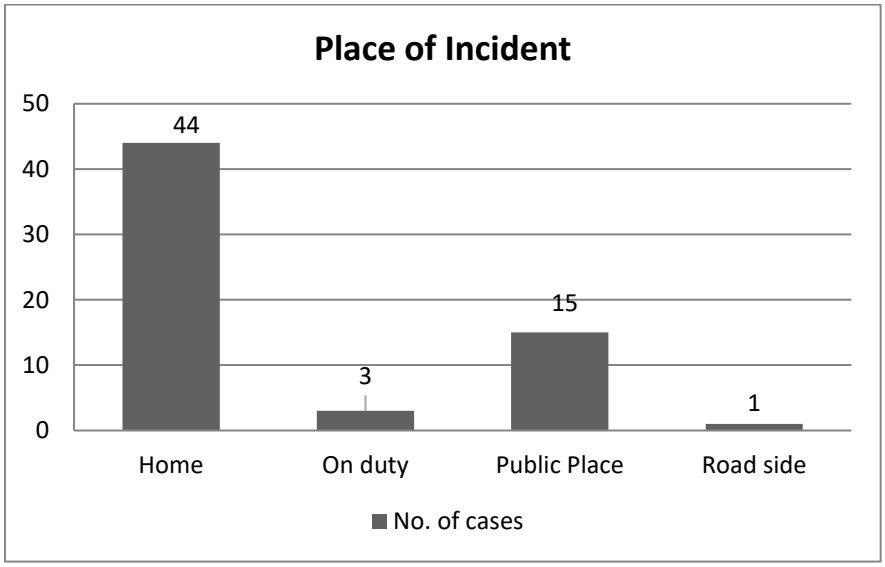

Fig-2: Showing distribution of cases according to Place of incident.

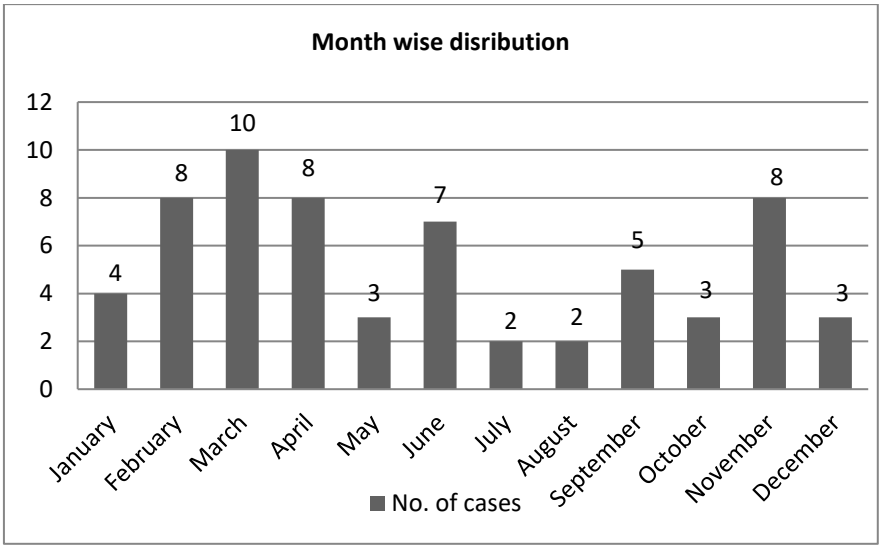

Fig-3: Showing distribution of cases according to Month.

Table-2: Distribution of cases according to Modifiable risk factors assessed for neurological deaths

Risk factors	CNS*		Total
	M	F	M/F
HTN	07	02	07/02
DM	01	--	01/--
HTN + DM	02	--	02/--
Cigarette Smoking	**18**	**01**	**18/01**
Alcohol	11	01	11/01
Drug abuse	01	--	01/--
Total	40	04	40/04

* Central nervous system

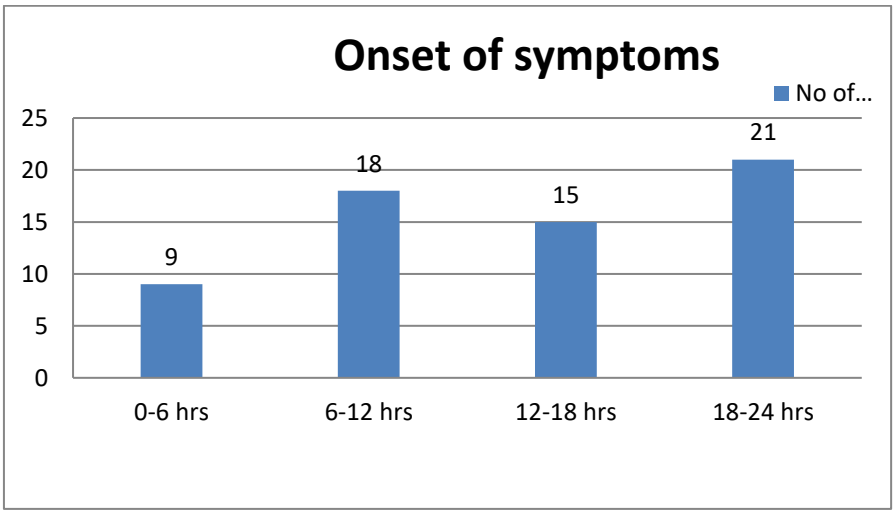

Fig-4: Showing distribution of cases according to time of onset of symptoms.

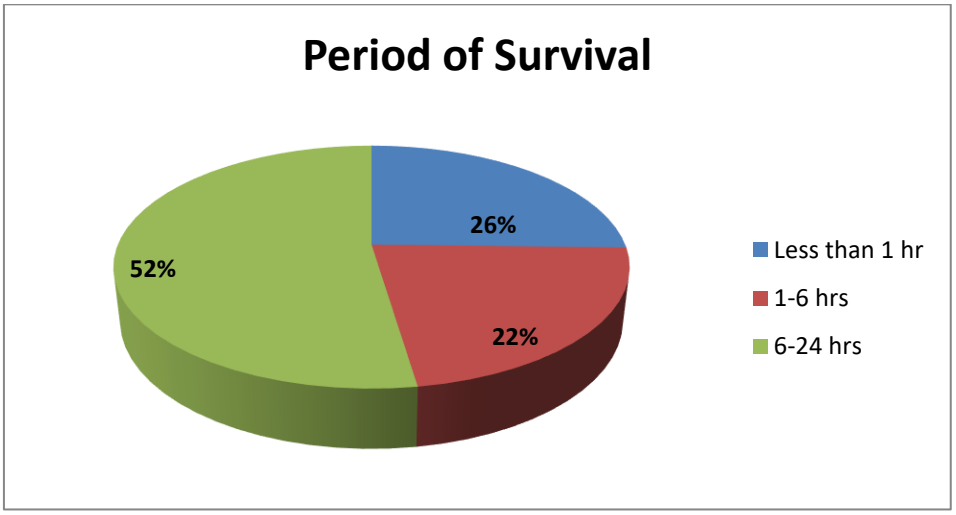

Fig-5: showing period of survival after onset of symptoms.

Table-3: Showing diseases and sex-wise distribution of cases

	Diseases	Male death	Female death	Total death
CNS	**Intracerebral hemorrhage**	**22**	**06**	**28**
	Cerebral oedema in a k/c/o epilepsy	10	02	12
	Subarachnoid hemorrhage	04	05	09
	Hypoxic Ischemic Encephalopathy + Infarction	05	01	06
	Space Occupying lesions	04	--	04
	Meningitis	03	01	04
	Total	**48**	**15**	**63**

Table-4: Central Nervous System – Disease-wise affection in different age group

Age (Yrs.)	ICH* M/F	Edema M/F	SAH** M/F	HIE*** M/F	SOL **** M/F	Meningitis M/F	TOTAL M/F
0-10	--	--/01	--	--	02/--	--	02/01
11-20	01/--	--/01	01/--	--	01/--	--	03/01
21-30	02/--	02/--	02/02	03/01	--	--/01	09/04
31-40	03/01	--/01	02/--	--	---	01/--	06/02
41-50	**05/01**	**05/--**	**01/--**	**01/--**	**01/--**	**02/--**	**15/01**
51-60	07/01	01/--	01/--	01/--	--	--	10/01
61-70	03/03	01/--	--	--	--	--	04/03
> 70	01/--	--	--	--	--	--	01/--
Total	22/06	09/03	07/02	05/01	04/--	03/01	50/13

*Intracerebral haemorrhage, **Subarachnoid haemorrhage, ***Hypoxic ischemic encephalopathy, ****Space occupying lesion

Table-5: CNS-Relation of weight of brain and cause of death

	Cause of Death	No. of cases	Weight of Brain (gms) Mean ± SD
CNS	Intracerebral hemorrhage	28	1700 ± 72.51
	Cerebral oedema in a k/c/o epilepsy	12	1616.7 ± 85.10
	Subarachnoid hemorrhage	09	1682.8 ± 65.57
	Hypoxic Ischemic Encephalopathy + Infarction	06	1590 ± 164.43
	Space Occupying lesions	04	1267.5 ± 592.81
	Meningitis	04	1617.5 ± 55.60

Table-6: Showing location of haemorrhage in cerebrovascular death victims

	Cause of Death	Location of Haemorrhage				Total
		Basal Ganglia	Lobar	Cerebellar	Brainstem	
CNS	Intracerebral hemorrhage	14	10	03	01	28
	Subarachnoid hemorrhage	07	02	--	--	09
	Rupture of Meningioma (S.O.L.)	01	--	--	--	01

DISCUSSION

In the present study, it has been observed that incidence of sudden natural deaths was 12.89 % i.e. in 282 cases out of 2187 total deaths amongst the medico legal autopsies conducted during the study period. Out of which, 63 cases (22.34 %) involved the neurological system.

The study of Nandy [8] shows the incidence of sudden death was 10% and in the study by Reddy

Narayan K.S [10] the incidence is noted to be approximately 10% of all deaths. The study by Zanjad *et al* [9] and Rao *et al* [12] show the incidences of sudden unexpected death 8.92% and 8.67% respectively, whereas in study of Ambade A.D. [11] it was 15.48%.

Maximum number of cases belonged to 41-50 years age group (14) closely followed by 51-60 years and 21-30 years age group. Kumar *et al* [13] showed the largest number of sudden natural death were in the age group of 41-50 years. Sarkioja *et al* [14] showed maximum number of cases were from the age group of 40-49 years. This may be due to westernization of Indian society, sedentary life style and increased smoking habit and alcohol drinking. More prone to pathological changes due to various eating habits, indiscriminate use of alcohol, smoking and tobacco, sedentary life style, stress and strain in life and lack of regular medical check-up.

Workers in industries, mills, shops, farm and other sectors constituted highest number of cases i.e. 19 (30.16%). It coincides with study of Kumar *et al* [13] where majority of the patients came from the semiskilled–unskilled group (30.6%). The preponderance in workers is possibly due to low socioeconomic status, neglect of alarming symptoms of illness, non-affording treatment, physical and mental stress etc.

Maximum deaths were observed in married persons i.e. 43 (68.25%). The probable reason might be, once a person gets married, they will have more responsibilities. Therefore they are prone to get stress which is one of the predisposing factors to many diseases. Furthermore, some finds other ways like consuming alcohol and smoking to release their tension. All these unhealthy lifestyle slowly leads the people prone to sudden cardiac and neurovascular deaths. This coincides with study of Kumar *et al* [13] and O P Murty *et al* [15] that majority of the patients were married (59.8%) and (54.5 %) respectively.

Most of the cases of sudden neurological deaths, i.e. 44 cases (69.84%) took place when the deceased was in his/her home. In the study of Kuller *et al* [16] in 62.4% cases place of onset of symptoms was at home. Durigon M. and De La Grandmaison G.L. [17] showed that the sudden death occurred more frequently in males at rest. Derya A. A. [18] showed 188 cases (67.7%) were found dead indoors.

It was *observed* that the persons having habits of smoking and alcohol outnumbered the other risk factors. In CNS, male outnumbered the female in all risk factors. Various studies had contradictory findings of alcohol intake and risk of sudden cardiac deaths. Though alcohol could not be established as independent risk factor in combination it may augment the effect of other risk factors. Hypertension is important risk factor for sudden neurovascular deaths. It increases risk of atherosclerosis, myocardial work load along with oxygen demand. It is the most common underlying cause of primary brain parenchymal hemorrhage. In study of O.P. Murty *et al* [15], more than 50% of the cases had history of severe hypertension who suffered from intracranial haemorrhages. Chronic drug abuse is one of the major risk factors for sudden natural death. Chronic marijuana use causes inflammation in the brain that leads to meningoencephalitis. In present study, one case of chronic ganja abuser leads to meningoencephalitis was seen.

Maximum number of time of onset of symptoms was between 18 hrs to 24 hrs in 21 (33.34%) cases, followed by the 06 hrs to 12 hrs in 18 (28.57%) cases. Out of 63 cases, 16 (25.39 %) cases were died within 1 hour of onset of symptoms, while 33 (52.38%) cases died between 6-24 hours of onset of symptoms. In present study, it has been observed that out of 63 cases, 28 (44.45 %) cases were due to intracerebral haemorrhage. Thus intracerebral haemorrhage was principle cause among sudden neurovascular deaths.

Out of 28 cases, 22 (78.57 %) were male and 6 (21.43 %) were female. The most common age group affected by sudden neurological deaths belonged to young age group i.e. 41-50 years 16 (25.40 %) cases, closely followed by 21-30 years of age group 13 (20.63 %) cases. This finding was consistent with Broderick JP *et al* [19] study, which showed primary intracerebral haemorrhage was, overall, almost three times as common as SAH. M Black *et al* [20] study showed that in sudden unexplained death in adults caused by intracranial pathology the mean age was 46 years. As per O.P. Murty *et al* [15] study, most of the cases of intracranial hemorrhages (28%) died between 41 to 50 years of age group, which is consistent to the present study.

Intra parenchymal (intra cerebral) haemorrhage is the most common type of spontaneous intracranial haemorrhage. It accounts for 10% of all strokes with a 50% case fatality rate. Hypertension is one of the most common causes of intra parenchymal

haemorrhage followed by other causes like, amyloid angiopathies, cocaine abuse, haematologic disorders and head injury.

Normally, the weight of human brain is 1300-1400 gram. In this study, a large number of victims had their weight of brain more than 1500 gram, which is a significant increase from normal value. Intracerebral haemorrhage was the commonest type of intracranial haemorrhages, which contributed 28 (44.45%) of the cases having their mean weight of brain 1700 gms, followed by subarachnoid haemorrhage, which contributed 9 (14.28%) cases with mean weight of brain 1682.8 gms.

In present study, commonest site of intracerebral haemorrhage was basal ganglia ("striatum" and thalamus) which contributed to 14 (50%) cases, followed by lobar region in 10 (35.71 %) cases. This finding consistent with Freytag E *et al* [21] study, in which 40% originated within the basal ganglia, 16% in the pons, 15% in the thalamus, 12% in the cerebellum, and 10% in the cerebral white matter. Basal ganglia haemorrhage is a common form of intracerebral haemorrhage, and usually as a result of poorly controlled long standing hypertension. The stigmata of chronic hypertensive encephalopathy are often present. The explanation behind that, is the usual source of intracerebral haemorrhage is rupture of a lenticulostriate branch of the middle cerebral artery, with bleeding in to the basal ganglia and adjacent structures. Rarely, bleeding occurs in the pons or cerebellum [22].

CONCLUSION

The incidence of sudden natural deaths among the total medico legal autopsies is 12.89% and Out of which, 63 cases (22.34 %) involved the neurological system. Maximum number of cases belonged to 41-50 years age group (14) closely followed by 51-60 years and 21-30 years age group. People are more prone to pathological changes due to various eating habits, indiscriminate use of alcohol, smoking and tobacco, sedentary life style, stress and strain in life and lack of regular medical check-up.

Maximum number of male deaths was seen in 41-50 years age group (13), while Maximum number of female deaths reported in 21-30 years age group (5). The male to female ratio is 3.2:1. The reason behind that is because, male is more indulged in to the risk factors like smoking, alcohol consumption, bad eating habits and lack of regular medical checkup. On the other hand, in females, estrogen has vaso-protective effects

Industry workers constituted highest number of cases i.e. 19 (30.16%). The preponderance in workers is possibly due to low socioeconomic status, neglect of alarming symptoms of illness, non-affording treatment, physical and mental stress. Maximum sudden neurological deaths, i.e. 44 cases (69.84%) took place when the deceased was in his/her home. Most of the sudden neurological deaths were seen in month of March i.e.10 (15.88 %).

In CNS, male outnumbered the female in all risk factors. The persons having habits of smoking and alcohol outnumbered the other risk factors. Hypertension is important risk factor for sudden neurovascular deaths. It increases risk of atherosclerosis, myocardial work load along with oxygen demand. It is the most common underlying cause of primary brain parenchymal hemorrhage.

Maximum number of time of onset of symptoms was between 18 hrs to 24 hrs in 21 (33.34%) cases. 33 (52.38%) cases died between 6-24 hours after the onset of symptoms. Out of 63 cases, intracerebral haemorrhage (28) was the most common cause in sudden neurological death victims. Maximum mean weight of brain was present in intracerebral haemorrhage cases i.e. 1700 gms.

Most common site of intracerebral haemorrhage was basal ganglia region (50 %), followed by lobar region (35.71 %). The explanation behind that, is the usual source of intracerebral haemorrhage is rupture of a lenticulostriate branch of the middle cerebral artery, with bleeding in to the basal ganglia and adjacent structures.

In last few years, medical science has changed a lot due to invention in medical and paramedical fields. The diseases which were not in position to be diagnosed during life in past, can now be easily diagnosed. In such cases newer techniques are found to be helpful in diagnosis of cause of death especially in sudden unexpected deaths in persons without any signs of disease.

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