Original Communication

Pattern of Drowning Cases at a Tertiary Care Hospital, Khammam

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Abstract

The diagnosis of death by drowning is one of the hardest challenges in forensic pathology. Circumstantial factors and physical evidence are important in drowning.The main objective of our study is epidemiology and pattern of drowning, contributing factors, and arriving diagnosis of ante mortem drowning by diatom test. The study included a total of 68 cases of drowning. When identity is taken in to consideration, nearly all the cases were of known type. Majority [n=27, 39.70%] of the victims were aged below 30years. Males [n=60, 88.23%] were predominantly affected. 37[54.41%] cases were married, in which 32 were males (47.05%) and 5were females (7.35%) and 31 cases are unmarried out of which 28[41.17%] are male and 3 females. Most of the people belong to Hindu community, from rural area. Incidence of fresh water drowning is more than sea water drowning. The wet drowning accounted more than dry drowning. Most of the incidents took place at well/lakes followed by river and canal. Highest number [n=32, 47.05%] occurred in afternoon than other timings. The incidence of drowning was more in summer. Major fatalities occurred within one to three days of hospitalization. Manner of drowning was accidental in 56[82.35%], followed by suicidal in 8[11.76%] cases and 4[5.88%] cases were homicidal in nature. Most of the victims witnessed respiratory complications [55.2%].In 6 cases drug /alcohol abuse was found in present study. In this study epilepsy, hypertension, giddiness and drug using for chronic diseases are the contributing factors for accidental drowning. Non swimmers were victims more than swimmers.Out of 68 cases 62[91.17%] cases were showing positive results for same diatoms in bone marrow and sample water, in 45.88% cases, only sample water showed positive results, 22.94% cases were showing no diatoms in bone marrow and sample water.

Keywords: Pattern of Drowning, River, Canals, Wells, Diatoms, Fresh water

Introduction:

Drowning is a type of asphyxia due to aspiration of fluid in to air passages, caused by submersion in water or any other fluid.

There are four types of drowning: (1) Wet [primary] drowning (2)Dry drowning (3)Secondary drowning [Post immersion syndrome or near drowning] and (4) Immersion syndrome [Hydrocution, submersion inhibition].[1]

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The main question in case of a body recovered from water is whether the individual was alive at the time he/she entered water. Circumstantial evidences, external appearances like cutis anserine, washer woman feet, and internal findings like emphysema aqueosum and froth in airways up to the terminal bronchioles give substantial amount of evidence for the diagnosis of ante mortem drowning. The discovery of diatoms and its application in diagnosis of drowning has increased the corroborative evidences for drowning[2].

During autopsy, one must focus attention to distinguish between changes that are due to drowning and those that are otherwise, i.e.,

those that occur in bodies immersed/submersed/disposed in water after death from causes other than drowning. The autopsy diagnosis of drowning is one of the major problems in forensic medicine, especially when there is delay in recovering the corpse. In advanced decomposed and skeletonized bodies, the only method of identifying the classical ante mortem drowning is estimation of the diatoms from the bone marrow and of comparing them with the diatoms available in the water.[2]

Drowning is the third leading cause of unintentional injury death worldwide, accounting for 7% of all injury related deaths worldwide[3].

According to National Crime Records Bureau, about 15 people end life every hour, and 80 people drown every day in India.The total number of accidental drowning deaths in India was 29,903 during 2014.[4]

Accidental deaths due to drowning are common in India and suicidal drowning is one of the most common means to commit suicide. Homicidal drowning occurs less commonly. Some murderers dispose of the dead bodies of their victims in the rivers, seas and wells to simulate death due to drowning. Sometimes unwanted bodies are thrown into water.

Aims & Objectives:

- Present trend in drowning deaths
- Epidemiology and pattern of drowning
- Types of submersion media and seasonal variation
- Study the water diatoms and tally them with sternal bone marrow diatoms.
- To know the validity of diatom test
- Cause and manner of drowning deaths

Materials & Methods:

The present study was conducted in the Department of Forensic Medicine, Mamata Medical College, Khammam, between January 2016 to December 2016. A total of 68 cases of drowning were statistically analysed with regard to general incidence, profile, pattern, and drug/alcohol abuse, contributing factors after complete and detailed post-mortem examination. Viscera were preserved for chemical analysis. Intact sternum and two-litre control sample of water from site of drowning was also preserved for comparative study with diatoms test. The diatoms from the sternal bone marrow of the cases were analysed by acid digestion and were compared with the water diatoms from the same source.

Result and Discussion:

Total 768 autopsies were conducted during the period of one year in the Department of Forensic Medicine, MGH, Khammam. Out of these cases, drowning was concluded as cause of death in 68[8.85%] cases. These are similar to studies by authors.[4-6]

When identityis taken in to consideration, nearly all the cases were of known type. The above distribution may be because most of the accidental drowned deaths occurred in a close place from their residence, where they were brought to the mortuary as known bodies. 4[5.88%] cases are brought to the mortuary as unknown identity by investigating officers and in stage of decomposition, in those cases the early signs of drowning, post-mortem examination was masked and diatom test becomes the only means of knowing whether death was due to ante mortem drowning or post-mortem disposal. These are similar to authors.[5, 6]

In this studypeak incidenceis observed during second [n=27, 39.70%] and third [n=26, 38.23%] decades of life, after which a gradual decline was evident. 2nd and 3rd decades together accounted for 77.94% of the total cases. These are consistent with authors[1-6].Young people are at greatest risk of drowning owing to their energy and curiosity that can easily lead them to jump into water source from which they cannot escape. In teenagers and adults, drowning has been associated with drugs and intoxication.

In our study, deaths were more among males by drowning [n= 60, 88.23%] as compared to females [n=8, 11.76%], male-female ratio being 7.5:1.This may be because of extensive outdoor activity of men. These are similar to other authors[1-8]. Married victims [n=37,

54.41%] outnumbered unmarried [n=31, 45.58%].A total of 37 married people out of which male were 32[47.05%] and 5 [7.35%] were female. Whereas unmarried males 28[41.17%] were more than the unmarried females 3 [4.41%]. Amongst female victims the percentage of married are more.In the males no much difference between married and unmarried. As depicted in table no.1.Same findings were noted by authors.[6-8]

44[64.70%] constituted from rural population**.** This distribution is because of the area under our jurisdiction consists of mostly rural, sub rural area surrounding the Khammam. Which are supported by authors.[5,7]

Occupation wise, students were top among the victims. Whereas labourers were 19[27.94%], employees were10 and house wives were 5. (Chart no.1).This might be because of over enthusiasm of students in swimming and lack of proper supervision as felt by authors[4-6].

Majority of people drowned in daytime as compared with night. Highest incidences reported in afternoon [n=40, 58.82%] followed by evening [n=23, 33.82%] and least [n=4, 5.88%] in night time. Same findings were made by authors[7-9].(Chart no.2)

In this study, the incidence of drowning was more in summer[n=46, 67.64%] when compared to other seasons. These are consistent with authors[6-9].(Chart no.5)

The month wise occurrence of drowning was more [n= 46, 67.64%] in April –June months followed by July-August months [n=10, 14.70%] and Sept-Nov months [n=9, 13.23%] and least in Dec-Feb months [n=34.41%]. The high incidence of drowning in summer season might be because, victims being students in vacation, high temperatures in this season forced them into swimming to beat the heat and lack of proper supervision.These are consistent with authors[6-9]**.**(Table no.2)

The commonest place of submersionwas well /lakes [n=40, 70.58%] followed by river [n=10, 14.7%] and canals [n=7, 10.29%].The reason might be due to jurisdiction of Khammam being surrounded by rural and semi-rural habituation. Place of incident and media of submersion was known in 68 cases. Chart no.3

Fresh water drowning was more commonly encountered with drowning in wells/lakes predominating 67[98.52%] when compared with sea water drowning 1[1.47%]. The reason might be due to presence of no sea in this jurisdiction. Similar observations were made by other studies.[5-9] (Chart no.3)

Pattern of drowning, 56[82.35%] of deaths occurred due to accidentaldrowning, while swimming in wells /lakes, canals and river water. The victims are usually children, fisherman, and waterfront workers, intoxicated or epileptic subjects. Unintentional drowning was reported in maximum studies[7-10]**. (**Chart no.6)

Suicidal drowning was seen in about 8[11.76%] of the cases. Drowning remains a relatively popular method of suicide in this region. This trend is because of increasing social, family, financial responsibilities and adjustment problems in the society, which might lead to increased suicidal tendencies. Suicidal episodes are fairly common amongst women or disabled persons. These are consistent with studies by authors[7-10].

In our study only four homicidal cases [5.88%] of drowning was reported. The reason is intentionally persons being drowned by others with various grounds such as business, financial problems, extra marital affairs, family quarrels, and property disputes. Same results are obtained by authors[7-10].

In this study**,** wet drowning54[79.44%] is commonest type of drowning, followed by dry drowning [n=10, 14.70%] and post immersion syndrome [n=4, 5.88%] in present study. These are consistent with authors[9-11.] **(**Chart no.4)

In this study non-swimmers[n=58, 85.29%] dominated swimmers [n=10, 14.17%]. These are supported by authors[8-12].

In our study, most [n=64, 94.11%] of the persons were alive at the time drowning when compared with post mortem drowning 4[5.88%].(Chart no.7). We could prove scientifically by positive diatom test and

similarity of diatoms in test sample of bone marrow and control sample of water as ante mortem drowning, especially in putrefied corpses where no other signs of ante mortem drowning are present. We have also made an attempt to find out that in four cases the cause of death was not drowning, in the bodies recovered from water, as the victims were thrown into the water after killing them by some other means. These are consistent with authors.[9-18]

In this study, out of 68 cases, 62(91.17%) cases are showing positive results for same diatoms in bone marrow and sample water, in 4[2.94%) cases, only sample water showed positive results, 2 (3.3%) cases showed no diatoms in bone marrow and sample water. The analysis of diatoms found in body may draw a fairly sound conclusion related to drowning as a mode of death. These are consistent with studies by authors[8-18]. We analysed the relationships between the numbers of the diatoms in the lung tissues and the drowning medium. Also we made a comparative analysis between the diatoms in the lung tissues and the drowning medium using the ratio of diatom numbers in both samples. Quantitative diatom analysis in the lung tissues, especially combined with the diatom analysis of the drowning medium, provides supportive evidence in determining if a body recovered in water was due to drowning or not.

We observed associated injuries in 12 cases. This is support that the person was alive at the time of drowning. Middle ear haemorrhage was present in 72% of cases. Similar findings were made by authors[14-17].

Duration of hospital stay, we observed that the maximum number [n= 6, 8.82%] of victims stay in hospital for 1-2 days, followed by 2-3 days [n= 4, 5.88%] and up to seven days [n=22.94%] while spot dead were 56[82.35%] cases and brought dead were 2 [2.94%] cases. These are consistent with authors.[9,16-20] Period of survival in fatal cases varied from 2 -7 days. The chances of survival depend on the duration of submersion, the water temperature, the person's age, and how soon resuscitation begins

In this study, 8[11.76%] people were positive for alcohol in their body**.** People who have consumed alcoholic beverages before submersion are more prone to develop brain or lung damage. Similar findings are made by authors. [9, 11, 21]

Respiratory complications were encountered in maximum number of cases [n=50, 73.52%] followed by 10[14.70%]victims who did not aspirate water but died of asphyxia due to laryngospasm,neurological complications were seen in 3[4.41%]cases and post immersion syndrome in 4[5.88%] cases. While seven victims [10.29%] died in the hospital. These are consistent with authors[18-22].The original concept of drowning deaths was that they were asphyxial in nature with water occluding the airways, death was due to electrolyte disturbance and or cardiac arrhythmias, produced by large volume of water entering the circulation through lungs. (Chart no.8)

Conclusion:

Males of 21-30 years' age group affected more. Day time drowning incidents were more. Commonest place of drowning was wells / lakes. Fresh water drowning was common. Maximum cases were seen in summer.Accidental drowning was seen commonly and more in males and children. Dry lungs were found in 14.07% of cases. Alcohol intake, disease status was found in 7.2% and 10.29% of cases respectively. Middle ear haemorrhage was present in 72% of cases. The diatom test was still considered as golden standard.

Recommendations:

A person should not engage in swimming or boating when under the influence of alcohol or sedatives.

People who have seizures should be cautious near water source.

Immediate on-site resuscitation is the key in increasing the chances of survival without brain damage.

Source of Funding-Self
Ethical Clearance: Not Required
Conflict of Interest: Nil

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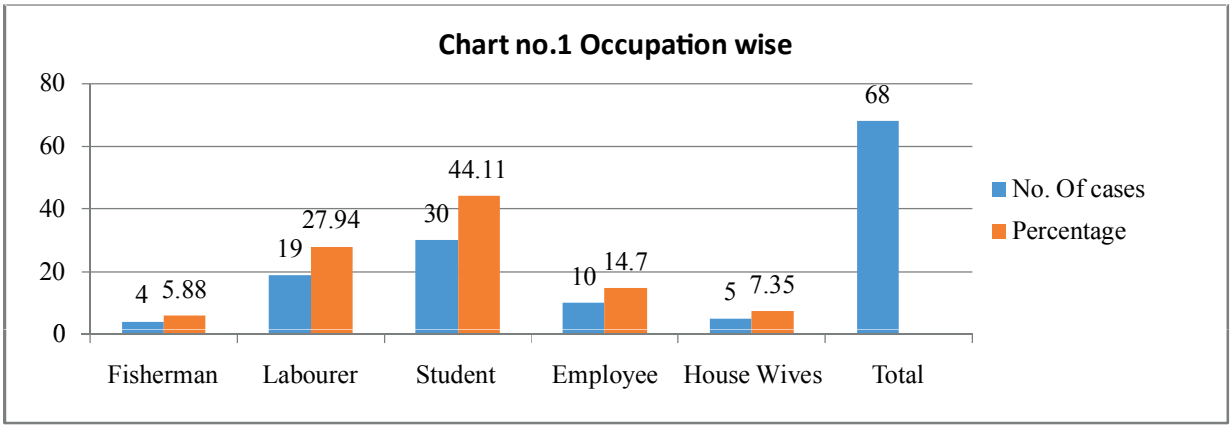
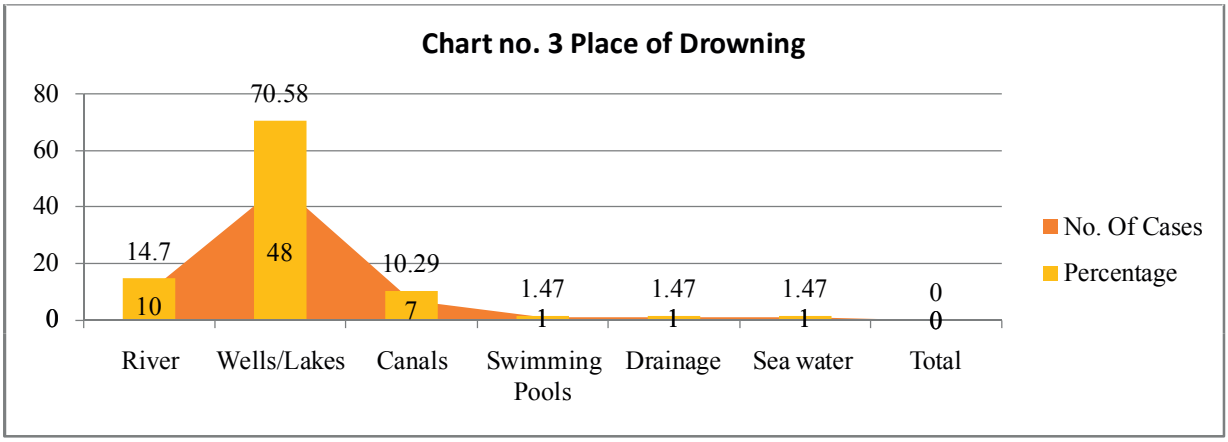
Table no.1 Age, Gender & Marital Analysis of Drowning Cases					
Age group	**Married**		**Unmarried**		**Total**
	Male	**Female**	**Male**	**Female**	
00-10yrs	-	-	2[2.94%]	-	2[2.94%]
11-20 yrs	-	-	8[76%]	3[4.41%]	11[16.17%]
21-30 yrs	4[5.88%]	5[7.35%]	18[-	26.47%]	27[39.70%]
31-40 yrs	26[38.26%]	-	-	-	26[38.23%]
41-50 yrs	1[1.47%]	-	-	-	1[1.47%]
51-60yrs	1[1.47%]	-	-	-	1[1.47%]
61-70yrs	-		-	-	-
Total	32[47.05%]	5[7.35%]	28[41.17%]	3[4.41%]	68





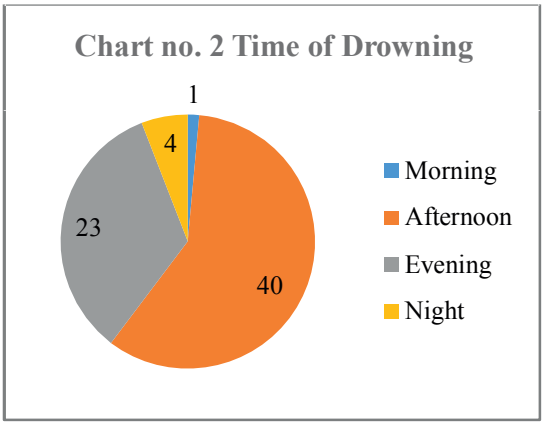


Table no.2 Season & Month Wise Occurrence of Drowning Case					
Season	Month	Male	Female	Total	%
Summer	Mar-May	41	5	46	67.64
Rainy	June-Aug	9	1	10	14.70
Autumn	Sept-Nov	8	1	9	13.23
Winter	Dec-Feb	2	1	3	4.41
Total	Total	60	8	68	

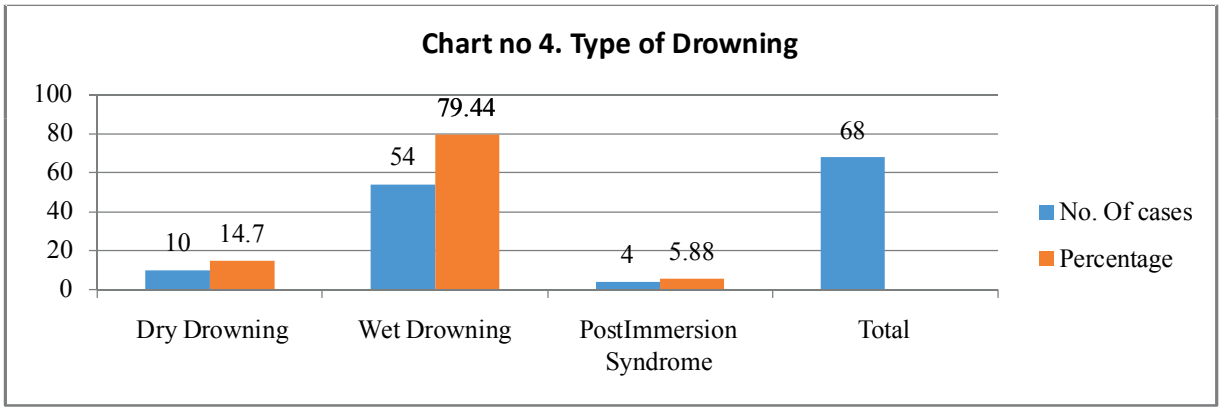


Chart no 4. Type of Drowning
100
80
60
40
20
0
10
14.7
54
79.44
4
5.88
68
Dry Drowning
Wet Drowning
PostImmersion Syndrome
Total
No. Of cases
Percentage

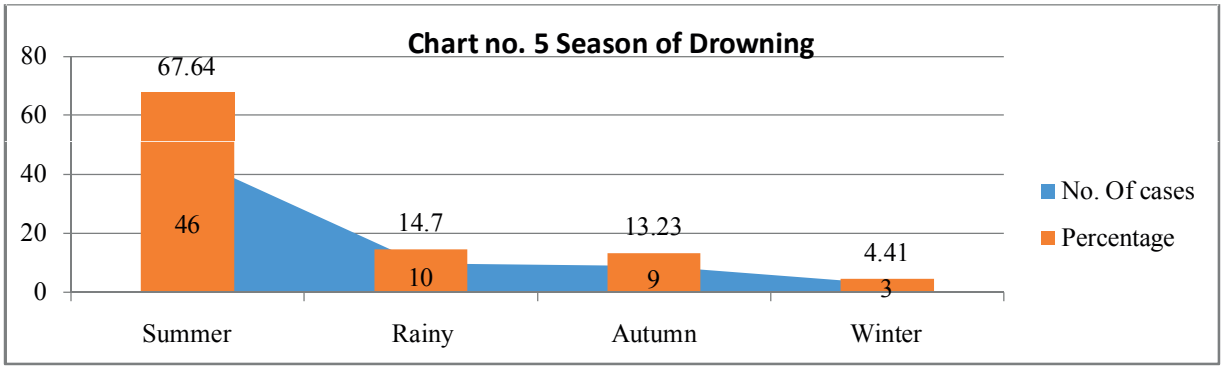


Chart no. 5 Season of Drowning
80
60
40
20
0
67.64
46
14.7
10
13.23
9
4.41
3
Summer
Rainy
Autumn
Winter
No. Of cases
Percentage

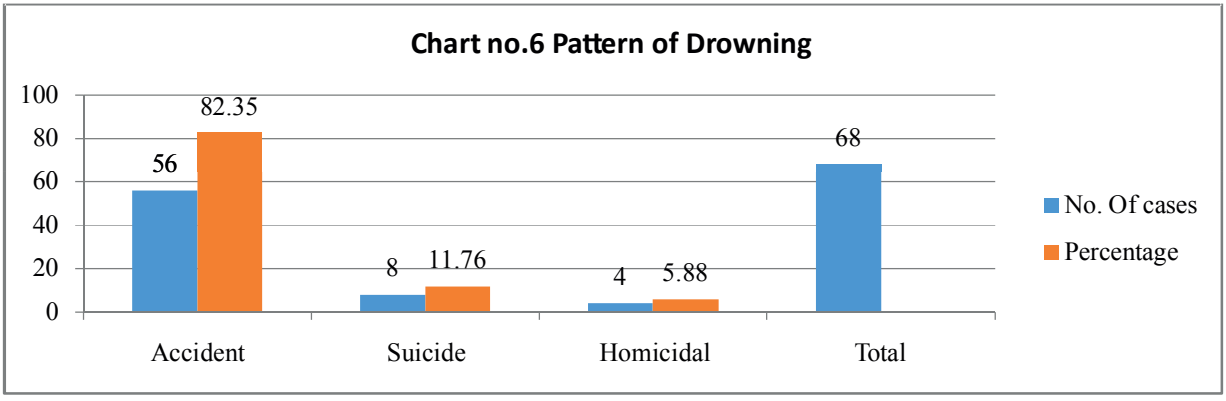


Chart no.6 Pattern of Drowning
100
80
60
40
20
0
56
82.35
8
11.76
4
5.88
68
Accident
Suicide
Homicidal
Total
No. Of cases
Percentage

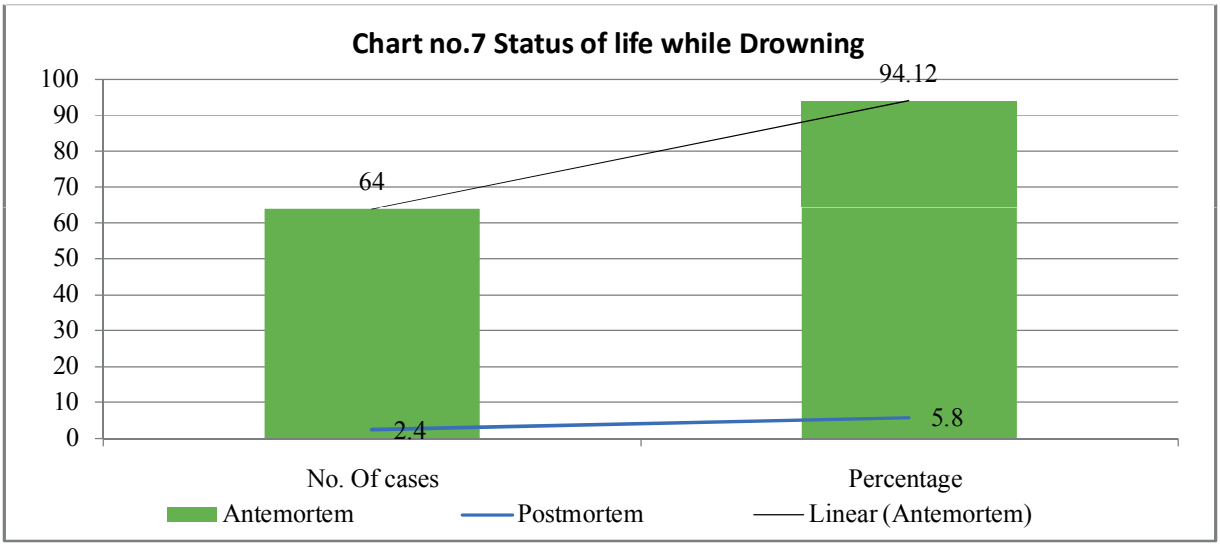


Chart no.7 Status of life while Drowning
100
90
80
70
60
50
40
30
20
10
0
64
94.12
2.4
5.8
No. Of cases
Percentage
Antemortem
Postmortem
Linear (Antemortem)

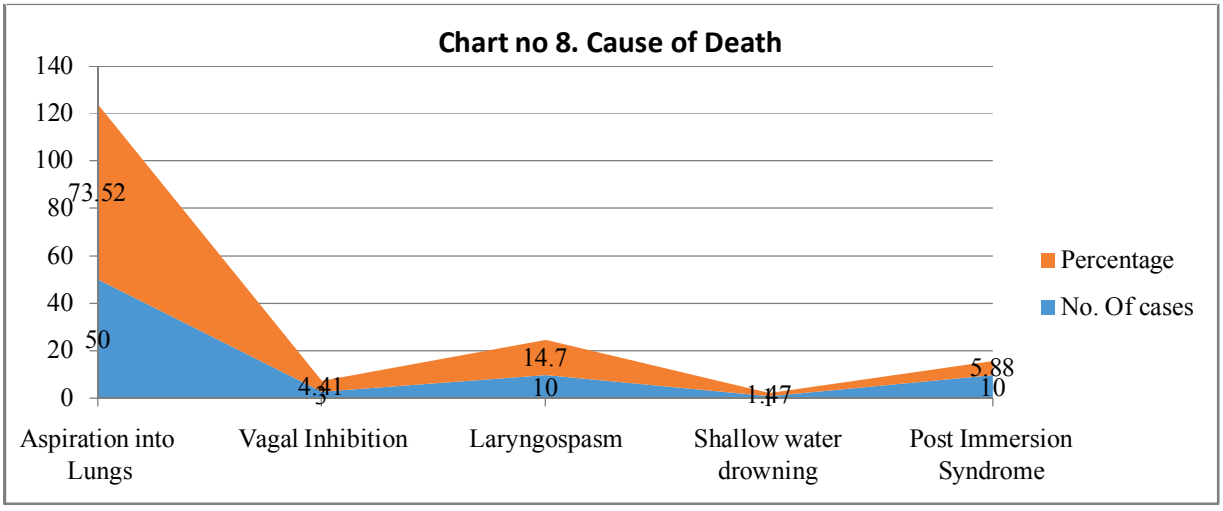


Chart no 8. Cause of Death
140
120
100
80
60
40
20
0
73.52
50
4.41
14.7
10
1.47
5.88
10
Aspiration into Lungs
Vagal Inhibition
Laryngospasm
Shallow water drowning
Post Immersion Syndrome
Percentage
No. Of cases