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ORIGINAL RESEARCH

Medico-Legal Aspects of Gross Findings in Drowning

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Abstract

Background: In this study we wanted to evaluate the gross appearance and presence of foreign bodies in air passages and lung tissues in 100 selected cases of drowning brought for autopsy to department of Forensic Medicine, Government Medical College Kottayam.

Materials and Methods: This was a descriptive study conducted among 100 cases in the Department of Forensic Medicine, Government Medical College, Kottayam.

Results: The most common classical feature of ante mortem drowning – fine froth in mouth and nostrils with or without blood stain was found in 33% of cases. Bluish discoloration of finger nails – a classical feature of asphyxia death – was found in 90% cases of the study subjects and the remaining cases were decomposed to the grade that such a finding could not be made out. Conjunctival congestion seen in 79% of subjects and the rest were decomposed to make out such a demarcation. Presence of foreign bodies in air passages by naked eye examination alone was found in only 25% of cases which was consistent with the finding of visualizing foreign bodies in distal bronchioles & alveoli which turned out to be 22%. Froth in mouth and nostrils was found in 54% cases which shows that this particular finding itself helps in the diagnosis of ante-mortem drowning to a high extend.

Conclusion: The well known classical pathognomonic feature of ante mortem drowning – Cadaveric spasm with materials pertaining to the media of drowning is extremely rare. Among body cavities showing fluid suggestive of ante-mortem drowning, supra sellar tursica (sphenoidsinus) showed the maximum with 34% while hemorrhage in petrous temporal bone was found in 30% cases and fluid in chest cavity was found in 21% cases. Fluid in stomach was found in 71% cases but it is well known that this particular finding does not have much role in diagnosis of ante-mortem drowning.

Keywords: Medico-Legal Aspects, Gross Findings, Drowning.

Introduction

Drowning is defined as a form of asphyxial death in which air is prevented from entering the lungs by submersion in any fluid medium. It is included in chapter 19 schedule T75.1 of international classification of diseases.[1]

Water is indispensable for the survival of mankind. Most of the world's populations and biggest civilizations have all evolved around water bodies like the Egyptian civilization, Mesopotamian civilization and our own Indus valley civilization. But undoubtedly water is potentially hostile environment for most air breathing animals and a pail of water is as effective in depriving those animals of oxygen as in the Pacific Ocean. The number of

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reported cases of death from drowning is on the increase year by year. Drowning is the 3rd leading cause of unintentional injury death worldwide, accounting for 7% of all injury related deaths. There are an estimated 3,88,000 annual drowning deaths worldwide. Global estimates may significantly underestimate the actual public health problem related to drowning.[2] The idea exists in the mind of most people that virtually all persons who drowned aspirates fluid into their lungs and so suffocates.[3] In about 1/4th of drowning cases there has been no evidence at post-mortem examination that fluid was aspirated into lungs of the diseased or of other findings that asphyxiation played any part in the mechanism of death. The exact mode of death often remained quite obscure after meticulous autopsies and appropriate laboratory investigations.

Investigation of bodies recovered out of water comprises an important proportion of the medico-legal requests. However, the key question whether the victim died due to ‘‘true’’ drowning can frequently not easily be solved. In addition, the diagnosis of hydrocution is even more difficult. Indeed, the diatom test is still considered as the ‘‘golden standard’’.

In conclusion, the ideal diagnostic test as definite proof for drowning still needs to be established. At present, the combination of the autopsy findings and the diatom test is a good compromise in arriving at a conclusion. Additional biochemical and technical methods could be useful. Unfortunately, the cost–benefit analysis in current practice could be hard to defend.

Recovery of dead bodies from fluid media is a common event occurring in India as well as other parts of the world. This has presented considerable problem for the legal and the medical investigators. Many cases go undetected for want of evidence or due to masking of useful diagnostic signs by putrefaction.

According to the global burden of disease 2009, overall death rate by drowning is estimated to be 8.4 per one lakh population. Majority of the cases are accidental. Very vide distribution of rivers, lakes, ponds, unprotected wells or tanks in the country provide chances for accidental drowning. The availability of navigable river carrying much of the water traffic also contributes the high incidence of drowning. In India, drowning is a common mode of committing suicide, occasional cases of homicide al drowning are not uncommon. Males and children are disproportionately represented in drowning statistics. Among children aged 5 to 11 years, drowning is the 4th leading cause of death while in children less than 5 years, it is the 11th. The higher risk in males is attributed to the greater recreation and occupational exposure to drowning. Among adults aged 15-44 years, drowning is the 10th leading cause of death. In United States of America, alcohol use is involved in about 25-50% of adolescent and adult deaths associated water recreation. These facts are published in the report of WHO’s water-related diseases 2009.[2]

Aim of the Study

To detect the gross appearance and presence of foreign bodies in air passages and lung tissues in 100 selected cases of drowning brought for autopsy Sto department of forensic Medicine, Government Medical College Kottayam.

Materials and methods

This was a descriptive study conducted among 100 cases in the Department of Forensic Medicine, Government Medical College, Kottayam.

Inclusion Criteria

Cases with definite history of drowning.

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Exclusion Criteria

Cases with a doubtful history and those cases where cause of death is drowning combination with others.

Study Procedure

All cases brought to forensic medicine for postmortem examination with the study criteria underwent a complete post mortum examination by modified Rokintansky method. The investigator carefully made a note of gross appearance of submersion and features of drowing.

Air passages were carefully dissected, taking the precautions to avoid loss or onward spreading or dislodging of any foreign body. The pharynx, larynx, trachea, bronchi and its divisions were exposed and examined. The dissection was carried out to the smallest division as far as possible for tracing the foreign body. Dissection of each levelS of the airway as mentioned above was followed by wiping of the lumen with a moist cotton pad so as to distinguish the minute particles against a white background. Whatever foreign body was sticking to the air passages was transferred to cotton swab by this method.

Statistical Analysis

The data obtained from the study is entered in MS Excel and further analysis is done using the software SPSS 16.0 version software with respect of their demographic profile, medium of submersion, the nature of froth seen at mouth, nostrils and air passages, the pattern of post-mortem staining, edema and emphysema acquosum, fluid in suprasellartursica, and middle ear hemorrhages.

Results

The mean age of the study subject were 42.56 years and had a standard deviation of 20.717 having a minimum age of 2 years and a maximum of 91 years.

The study sample consisted of 17 subjects who were known swimmers, 36 subjects who were non-swimmers and in 47 subjects the swimming status was not known.

Medium of Submersion

All the subjects who were included in the study had a fate of drowning in fresh water. It was grouped into drowning in well, river / canal / pond & other (buckets / bath tub etc.). There was a single case who drowned in a bucket of waterS in the bathroom. She had a history of recurrent seizures which would have led to the situation. No subject was drowned in the sea water as per history.

Table 1

Medium of Submersion	Frequency
Well	26
Pond / River / Canal	73
Others (in Bucket)	1

Distribution of Cases According to Decomposition Changes

Decomposition changes were grouped into three as no decomposition changes, early decomposition changes (time since death calculated as 18 to 72 hours) and late decomposition changes (time since death calculated as more than 72 hours). 69% of cases showed no decomposition changes while 18% of cases showed early decomposition changes and 13% of cases showed later decomposition changes.

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Table 2	
Decomposition Changes	**Frequency**
No Decomposition	69
Early decomposition	26
Late decomposition	05

Goose Skin Appearance in the Study Sample

Among the study sample, only 6 % of subjects turned to have goose skin appearance, while the majority did not have the same(93%) This would grossly suggest that the appearance of goose skin does not have much specificity in defining a suspected case of drowning to be due to drowning

Distribution of the Study Sample with Respect to Wrinkling / Bleaching/Soddening

In the study sample, two cases did not have any sign of wrinkling, bleaching or saddening. Seven cases were degloved and hence inferences could not be made upon them. 31 cases showed a full combination of wrinkling, bleaching and soddening suggestive of a submersion of not less than 10 hours. The other 60 cases showed various combinations of wrinkling, bleaching & or /saddening in all possible combinations suggesting a maximum time of submersion to be 24 hours.

Table 3	
Foreign body sticking to body surface	**Frequency**
Nil	22
Sand	15
Mud	44
Leafy particles	26

Presence of Cadaveric Spasm in the Study Samples

Among the 100 cases studied, only one case turned to have cadaveric spasm in hand which showed grass and twigs which pertained to the drowning medium. It is well known that cadaveric spasm is a rare entity and when present it directly shows the exact circumstances of death. In this particular case where we had a cadaveric spasm, the circumstances turned out to be the same and true.

Presence of Froth in Mouth and or Nostrils as a Feature of Drowning

Table 4	
Appearance of mouth and nostrils	**Frequency**
Normal	38
Froth in mouth and or with or without blood stain	33
Blood stained fluid	29

Froth in mouth and or nostrils is considered to be a pathognomonicsign of death due to drowning. But, absence of the same does not rule out a diagnosis of death due to drowning as well. In the current study, we turned out to have 33 % of the study sample to have the above said pathognomonic sign. But, taking into consideration all the aspects of a meticulous autopsy, all the cases were found to have a diagnosis of death due to drowning. This feature could seem to correlate with the available literature discussed before.

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Observation of Post-Mortem Staining in the Study Sample

Among the 100 cases studied which were diagnosed as ante- mortem drowning, 46 % of cases had post-mortem staining on the front of chest and face while, in 50 % of cases post mortem staining was seen on the back of trunk. 4% of cases were decomposed to the extend that the post mortem staining could not be made in them.

Table 5	
Post-mortem Staining	**Frequency**
Front of trunk & face	46
Back of trunk	50
Decomposed	4

Appearence of Finger Nails in the Study Sample

90% of the cases showed bluish discoloration of nails while the rest 10% showed only stages of decomposition from which the appearance of finger nails could not be made out. Hence it is suggestive that bluish discoloration of finger nails has a high sensitivity in declaring a case to be as death due to drowning since it is a common feature seen in asphyxial deaths, which is a well-known fact.

Examination of the Conjunctivae of the Study Subjects

Among the study subjects 79% of individuals had conjunctival congestion while in 21% of cases the appearance of conjunctivae could not be made out due to decomposition changes. This finding seems very much similar to the above situation of bluish discoloration of finger nails since this particular finding is also well known to be present in asphyxial deaths.

Presence of Abrasion on Finger Nails in the Study Sample

In the study sample only 3 of the study subjects showed abrasion on finger nails which is suggestive of violent asphyxial death while in the great majority (97 cases) there was no abrasion on finger nails.

Presence of Foreign Body in Air Passages in the Study Sample

75% of the study subjects did not show any foreign bodies in air passages. Among those who showed food particles, sand, mud, leafy particles, and food aspirates were found almost evenly distributed in the sample studied.

Sand was found in 6% of the cases and mud was found in 8% of the cases.

Distribution of Nature of Froth in Mouth &Nostrils the Study Sample

Table 6	
Nature of Froth in Mouth & Nostrils	**Frequency**
Absent	24
Mucous	6
Fine froth with or without Blood stain	54
Blood stained fluid	16

In 24 cases studied, mucous, froth or fluid were absent in mouth andS air passages. Among the others 6 cases showed mucous, 54 showed fine froth with or without blood stain and 16 showed blood stained fluid in mouth & nostrils. This finding supports the classical dictem that fine froth with or without blood stain in mouth and nostrils though pathognomonic of antemortem drowning, it need not be present in all cases of death due to drowning.

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Gross Appearance of Lungs in the Study Sample

Some usuall findinngs thatseen in case of drowning are lungs over precordium,rib markings on lung and paltauffs heamorhages.In the current study lungs over precordium was seeen in 2/3rds of cases but the other 2 were found in only half of the cases.

Nature of Lungs in the Study Sample

Nature of lungs could not be made out in 20% cases because of decomposition changes in lung. 65% of cases showed Pale, Doughy, Crepitant, Balloonned & Oedematous lungs while the rest 15% showed Congested, Doughy, Crepitant, Balloonned & Oedematous lungs both suggestive of ante mortem drowning. We can observe here that nature of lungs would be a better & more reliable finding in arriving at a diagnosis of death due to drowning compared to the above discussed findings.

Table 7	
Nature of Lungs	**Frequency**
Decomposed	20
Pale, Doughy, Crepitant, Balloonned & Oedematous	65
Congested, Doughy, Crepitant, Balloonned & Oedematous	15

Weight of Lungs

Table 8				
	Mean Weight (gms)	**Standard Deviation**	**Minimum**	**Maximum**
Right Lung	437.28	161.689	66	814
Left Lung	393.16	152.816	54	790

37% of cases had their right lung weighing 500gms or more while only 25% of cases had their left lung weighing 500gms or more. Mean weight of right lung was 437.28gms and that of left lung was 393.16gms. The increase in weight of the lungs is caused by edema of the lung due to water logging.

Presence of Fluid in Body Cavities in the Study Sample

In the study sample, 21% of individuals showed presence of fluid in chest cavity, 34% showed presence of fluid in supra sellar fossa, hemorrhage in petrous part of temporal bone was present in 30% individuals & 71% showed presence of fluid in stomach. 6% of individuals had fluid with smell of alcohol in stomach.

Discussion

Diagnosis of Drowning

As said earlier, at autopsy there are no pathognomonic findings to indicate the diagnosis of drowning. The diagnosis is based on the circumstances of the death, plus a variety of nonspecific anatomical findings. According to Dimaio chemical tests put forth to make the diagnosis are nonspecific and essentially unreliable. Difficulties arise when the period of submersion increases. When finally putrefaction sets in and advances, the anatomical signs of drowning, meager as they are, disappear.[4]

Further the postmortem appearances of mere submersion in water must be carefully differentiated from the postmortem signs indicating actual drowning as the two processes have often been confused sometimes with unfortunate medico-legal results.[5]

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It is a common finding that while the lower part of the body may be in reasonably fresh condition, the upper part including the head shows the colour changes of decomposition. This may be explained by the fact that the head floats lower than the rest of the body and the blood gravitates first to the head and neck. On removing the body from water further putrefactive changes develops with remarkable rapidity.[6]

External Signs

If a body is recovered from water, the clothes are wet. The skin is wet cold, clammy and pale due to contraction of its blood vessels. The face may or may not be cyanotic. The conjunctivae may be congested and the pupils dilated.[7]

In the external signs one has to differentiate between features of submersion and those external signs typical of drowning. The signs of submersion may occur in actual drowning or if a dead body has been thrown in to water. The signs of submersion are washerwoman's hand and feet and cutis anserina.[8]

Washer Woman's Hand and Feet

It is a wrinkled, bleached and soddened appearance of the skin of hands and feet which develop as a result of contact with water during submersion similar to those seen in a washer woman. This indicates only the submersion of body in water. It may prove helpful to assess the period of submersion. Soddening of the skin occurs due to absorption of water into its outer layer. It is seen on the fingertips in 2 to 4 hours and spreads to the palm and back of Fingers and back of hand in that order in about 24 hours. The accuracy of timing is not possible due to variations in environmental conditions. Similar progress and changes are seen in the skin of the foot, in shod foot it takes almost twice as long. Wrinkling of the skin begins to appear shortly after immersion, bleaching of epidermis in 4 to 8 hours and the bleached, wrinkled and soddened appearance is seen in 24 hours. There will be maceration of skin due to swelling of the outer keratin layer from absorption of water and whole skin becomes soggy and white and because it increases in volume, it becomes wrinkled in order to accommodate the increased surface area. lt is best seen where the keratin is thickest as in the soles and palms called washer woman's skin. After prolonged immersion of some days the outer layer may become completely detached from the skin of the feet and hand and comes off in 'Glove and Stocking" fashion.

Hypostasis

The skin is more often pallid and cold with a pink colored hypostasis; the pink coloration appears to be due to cooling of oxygenated blood in the capillaries of the skin. The peculiar disposition of hypostasis which is seen on the face, neck and chest in bodies lying in water is not diagnostic of drowning. It is seen when a body continuously roll over in flowing water.

The retraction of the penis, scrotum and the papilla mammae have been designated reaction phenomena, because they were presumed to indicate reaction of cold water to skin and consequently to suggest strongly that the person reached the water alive. However these signs may develop post mortem as a result of rigormortis of smooth muscles of skin. Retraction of penis and scrotum is considered as a nonspecific finding by many authors.[9,10]

Cutis Anserina

Development of cutis anserina (goose skin like appearance of the Surface of the body) is another non specific finding which also does not tell about the antemortem or postmortem nature of drowning. This condition develops due to contraction of erector pilae muscles of the skin occurring due to contact of the body with cold water and earlier it was firmly thought to suggest that the person reached the water alive, but it can develop postmortem as a result of

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contraction of the smooth muscles of the skin when rigor mortis sets in. This change indicates that molecular life was present at the time of death. According to some authors this sign has no significance as sign of drowning.[11] The skin appears granular and puckered with hair standing on one**:** end. Normally about 12 to 18 hours in water are sufficient to produce such asign.[12] In tropical and subtropical countries like India, this is rarely encountered except in high mountainous area. Cutis anserina is regarded as non diagnostic feature by Gradwohl, Lyons, Gordon and Shapiro, John Gliaster et al.

As in other conditions of violent asphyxia, the eyes show congestion and rarely the conjunctivae present haemorrhages. The face may or may not be cyanotic, the pupils may be dilated.

Cadaveric Spasm

During the last stages of drowning as in all cases of asphyxia convulsion or at least a spasm of group of muscles occur most commonly in the muscles of the hand without undergoing primary relaxation. In such a spasm the hand may close on weeds, mud or sand and if death occurs in the convulsion or spasm these matters will be retained in the tightly clenched hand called cadaveric spasm. It indicates the last work of the person which he performed during the process of his death. It is also seen in deaths during frightening or violent circumstances such as during battles or fall from heights.

Cadaveric spasm is a rare or infrequent finding in drowning.[13] Most authors regarded it as an absolute proof of drowning. Some say that, cadaveric spasm indicate that the person was alive or conscious at the time of eSntering the water.[14] John Glaister considers it as one of the external signs of substantial importance.[15] Apurba Nandy says that it is a confirmatory sign of drowning but Spitz and Fischer say that "We do not believe in cadaveric spasm as some prefer to call it rather it is our opinion that the weeds remain entangled between the fingers.[16]

Presence of Froth

Fine white froth or foam may be seen exuding from the mouth and nostrils and is found in the trachea and bronchi.[17,18]This foam presents as a small balloon or mushroom like mass "champagne de mousse" which is white or pinkish in color. The foam is tenacious and persistent, if wiped away more may reappear, especially if pressure is applied on the chest. The mass of foam is composed of fine bubbles which do not readily collapse when touched with the point of knife. The foam occurs due to the churning effect of air in the alveoli with the water inhaled and the mucus secreted from the respiratory wall during the violent respiratory efforts during third stage of drowning.

It may be present when the body is recovered from water or may appear later when pressure is applied on the chest or when rigor mortis contracts the chest muscles and expels the contents of the trachea. It can also appear in or any attempted resuscitation or when clothes are removed.

The froth is a mixture of air, surfactant, and inhaled water due to respiratory efforts and is considered as a vital sign by Polson, D J Gee, Roger Byard et al. It is regarded as a characteristic and important sign by Bhattacharjee, Guharaj and Lyons. If present in a body freshly recovered from water and no other cause of death can be found in autopsy, this froth is nearly pathognomonic of drowning.[19] The froth from mouth and nostrils may be seen in other conditions where pulmonary oedema precedes death such as overdose of heroin, congestive cardiac failure, neurogenic pulmonary oedema, left ventricular failure due to coronary artery disease, hypertensive heart disease, violence etc., So the finding of froth in air passages should be interpreted with caution. In a body submerged in water the foam usually persists for 2 to 3 days in summer an up and up to to 8 days in winter, until it is destroyed by

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putrefaction which produce a pseudo foam of reddish brown malodorous fluid containing coarse bubbles of putrefactive gas, a finding of no significance

Internal Signs

The lungs are voluminous and oedematous with a ballooned appearance and are bulky. As a result there is overlapping of the medial edges of the lungs which is seen on opening the breast plate.[20] The distension and ballooning of lungs occur due to the inhalation of water, struggling breaths of the victims, reactive pulmonary oedema and also the result of foam formed in the process of drowning which act as a ball valve permitting entry of air into the lungs but prevent the exit of air from the lungs The ballooned lungs are pressed so firmly against the thorax so that the indentations of ribs are produced on them. The lungs have a doughy feel and pit on pressure. The weight of the lungs is increased. According to Polson, Gee and Bernard knight the weight of the lungs is increased to about twice the normal and contrary to expectations the weight of the lungs in fresh water drowning are not statistically different from lung weights in salt water drowning.

The average combined weight of the lungs in drowning in both mediumis 1400 gm. As the postmortem interval increases there will be fluid shift from the lungs into the pleural cavities and in salt water drowning if there is continued immersion of the body for more than 3 days there will be a decrease in weight of the lungs with pleural effusion as a result of post mortem osmotic shift of water. The weight of the lungs in drowning fatalities is significantly influenced by the age, individual physical constitution and period of survival.

The pleural surface of the lungs has a marbled appearance with greyblue to dark red areas that are interspersed with pink aerated tissue. Lungs maybe congested or pale. Cut section of the lungs sets free a quantity of watery fluid which may be blood stained and which usually contain fine bubbles. This overall appearance of the lungs is called Emphysema aquosum or Trockene's oedema or Emphysema hydroaerique.[21,22]

Tardieu's spots as seen in other forms of asphyxia are rare in drowning; this may be due to compression of interalveolar septa as suggested by Gardnerin 1942. There will be large hemorrhages produced by tearing of the interalveolar partition seen especially beneath the pleura as noticed originally by Paltauf (I882)[23] According to Hansen (I938) they are shining, pale bluish or red in color and may be minute or have a diameter of 3 to 5cm and are usually present in the lower lobes of lungs, more often seen on the interlobar surfaces. They are usually rare.

Pleural adhesion when extensive and dense will prevent the occurrence of emphysema aquosum The degree of emphysema aquosum will depend on the time taken to drown, will be absent in rapid death, death due to cardiac inhibition and it will be less in dry drowning.

When death occurs before total submersion or when the person goes under water in an unconscious state, there will be no violent effort for respiration and there may not be any sign of Emphysema aquosum. Instead some water may trickle down the lung bed passively causing passive oedema of the lungs. This condition is known as 'Oedemaaquosum or Hydrostaticlung. The hydrostatic lung does not simulate the drowning lung in any way. According to Tedeschi when the drowning lung is found in combination with froth in the air passages no forensic pathologist should be in doubt about the diagnosis of drowning.

Conclusions

All the cases selected turned out to have a diagnosis consistent with death due to drowning after meticulous autopsy. The study sample consisted of a population were the age was normally distributed between 2 years to 91 years with a mean age of 42 years. The number of cases in younger age group (< 15 years) was less compared to other age groups. Majority of the cases were males (85%). Only 17% of the cases were known swimmers suggesting that

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skill of swimming could decrease the chances of death due to drowning. This finding could go hand in hand with the finding that majority of cases who drowned were accidental (78%). The study showed that among those who had co-morbidities who died due to drowning, majority (50%) was alcoholism while all other co-morbidities were 25% or less. Classical features of submersion like cutis anserine, washer woman's hands and soles were present in various combinations in 6 to 60% cases. The well known classical pathognomonic feature of ante mortem drowning – Cadaveric spasm with materials pertaining to the media of drowning is extremely rare. But the investigator had the chance of having one case with such a situation among the study sample. The most common classical feature of ante mortem drowning – fine froth in mouth and nostrils with or without blood stain was found only in 33% of cases. Bluish discoloration of finger nails – a classical feature of asphyxia death – was found in 90% of the study subjects and the remainng were decomposed to the grade that such a finding could not be made out. Conjunctival congestion which is a similar finding was seen in 79% of subjects and the remaining were decomposed to make out such a demarcation. Presence of foreign bodies in air passages by naked eye was found in only 25% of cases which was consistent with the finding of visualizing foreign bodies in distal bronchioles & alveoli which turned out to be 22%. Froth in mouth and nostrils was found in 54% cases which shows that this particular finding itself helps in the diagnosis of ante-mortem drowning to a high extend. The classical findings of Lungs over Precordium was present in 33% cases, Rib markings on Lungs in 54% cases & Paltauffs haemorrhages in 53% cases but the appearance of lungs as pale / congested with Doughy, Crepitant, Balloonned & Oedematous feel suggested that 80% of the cases had a diagnosis consistent with death due to drowning making this finding the most probable sensitive and specific one among the available data. Among body cavities showing fluid suggestive of ante-mortem drowning, supra sellar tursica(sphenoid sinus) showed the maximum with 34% while hemorrhage in petrous temporal bone was found in 30% cases and fluid in chest cavity was found in 21% cases. Fluid in stomach was found in 71% cases but it is well known that this purticular finding does not have much role in diagnosis of ante-mortem drowning.

Recommendations

1) Identical diatoms in medium of submersion and bone marrow found only in 9% of case,showing low sensitivity of diatoms test in cases of drowining. Hence,as the study has to be done with other tissues samples like lungs, liver, kidneys, brain,spleen etc for clinical diagnosis
2) The present study reveal that polarizing microscopy was far more better over light microscopy in indentifying foreign bodies in distant bronchioles and alveoli, only 17% of study subjects know swimming
3) This suggest that the skill of swimming could decrese the chances of death due to drowning and that it could be included as a co-curricular in both schools and colleges
4) The study had 36% of cases of non-swimmers and 17% of cases knowing swimming. Alcoholism was signifacant contributing factor(19% out of 100%) resulting in increasing the risk of drowing even if the subject knows swimming.So,in health education and in awarness program.

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