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REVIEW ARTICLE

Forensic parameters to approach drowning fatalities, a type of asphyxia death

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ABSTRACT
Drowning is a very common type of asphyxial deaths occurred due to accidental and any other reasons. In it obstruction of air passage towards lungs occurred due to filling of water. Mainly it is of typical and atypical type. Drowning shows different symptoms in both freshwater and sea water deaths. After autopsy of drowning deaths found different types of body changes, death due to cardiovascular disease during swimming, analysis of sinus fluid, percentage of deaths in males or females, disorders in victim, age factor, alcohol percentage, poison in body, coronary arteriosclerosis, Myocardial scars, arterial gas embolism and bacterial analysis from the tissues of dead body. Whether death occurred due to drowning or not is studied by diatoms. Diatoms played a very important role in identification of drowning deaths. Diatoms played a very important role in identification of drowning deaths. Diatoms presence inside the organs of body helps the forensic expert in solving the drowning cases. Diatoms can be extracted from body organs through different methods like acid digestion, nitric acid method etc. Also explained the difficulties in analyzing drowning dead bodies.
Keywords: *Drowning, Cardiovascular disease, Disorder, Diatoms, Forensic.*

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INTRODUCTION

World health organization give definition of drowning which stated that "Drowning is the process of experiencing respiratory impairment from submersion or immersion in liquid" [1].Drowning is a continuous process, it starts with respiratory failure because sufferer's airway is going beneath the floor of liquid i.e. submerged condition form and water splashes over the face which shows immersion condition [1]. In drowning if the victim or sufferer is rescued or protected during that time, the condition referred as non-fatal drowning. Second if victim died at any time during drowning is known as fatal drowning. Without an evidence any submersion and immersion incident would not be considered as drowning [2]. If we discussed about pathophysiology of drowning, initially water aspirated into airways and coughing occurs. In very rare conditions laryngospasm occurred about 2% cases [3]. After a continuous aspiration of water, hypoxemia occurred which leads to cardiac arrest and person died [4]. If person rescued timely during drowning then some clinical damage pictures will come such as alveoli surface destruction, disruption in permeability, plasma, electrolyte shifts, decrease in arterial oxygen pressure etc. [2]. In human beings alterations occurred in pulmonary gas exchange during drowning and it decreases pulmonary compliance upto 40%. Decrease in pulmonary compliance occurred due to the effect of fluids in lungs, loss of alveoli surfactant and increased capillary alveolar permeability [5].

Death mainly occurred in two types either in somatic or clinical death and cellular death. Death is considered in forensic thanatology which means death science [6]. Asphyxial death is a kind of death which occurs due to the failure of respiratory system due to any reasons like pneumonia, poisoning, coma, drowning etc. [7]. Drowning is the third leading cause of injury death in the world. Approximately 3,20,000 persons died to drowning death annually. Drowning death cases mainly occurred due to lower

socio economic status which leads to suicide, unsupervised people, medical conditions like epilepsy, unfamiliar tourists etc. Drowning mainly a top cause of death in 1-14 years aged people in 48 countries. A survey was conducted in 85 countries [8]. Drowning is a very silent and fast cause of death. It takes just 20-60 seconds [9]. Drowning occurred when water inhaled and obstruction of air passages towards lungs occurred. Entry of water into lungs reduces the chances of survival. Both fresh and marine water causes physio-pathological changes in body during drowning [10]. Water crosses the alveolar region membrane and cause hypervolemia. Drowning is of mainly two types typical and atypical. Typical drowning also known as wet drowning and Atypical drowning considered in dry drowning which include generally secondary drowning syndrome [11]. During drowning asphyxia is the first cause of drowning then vagal inhibition and hypothermia are the secondary causes [12]. Secondary changes occurred in lungs due to drowning is known as Fibrosingalveolitis. In this case rigidness and stiffness occurred in lungs [13]. An untrained person falls into water due to any reason, firstly he or she got sink then rises to surface due to natural buoyancy [14]. This condition of buoyancy occurred due to air trapped between clothes and body due to struggling movements of body. Water entered into mouth to lungs and lungs to stomach, then produce panic conditions [15]. Body swallowed due to specific gravity of body, it raised and sink on the water surface. Continuous filling of water occurred through air passages [16]. During death a liquid – air interface is formed and it obstruct the entry of oxygen. Various studies shows many cause and examination methods of drowning [6].

REVIEW OF LITERATURE

June 2002 first World Congress on drowning (WCOD) was held. In this conference different world class experts talked about the epidemiology of drowning. This expert section prepared a background document related to drowning including new definition of drowning and key risk factors for drowning [2]. Flaig and his team have shown a comparison study suicidal cases and non-natural deaths. Analyze suicidal death cases in both genders and different age groups. Describe about suicide methods with self-poisoning, violent reasons etc. Female suicidal victims shows lower body mass then of its control group[17]. Some other experts haveanalyzed drowning cases occurred accidently or uncertain manner with medico-legal autopsy. They weight both left and right lungs and found time interval of water less than one hour. Found no difference in the weight of lungs in both salt water and fresh water drowning cases[18].Considering Alaknanda river, [19] observers described about the epidemiology of drowning in hilly river regions. Mainly tell about the accidental drowning cases in Alaknanda River. Found most cases of drowning in summer season during pilgrimage movement of Chardhamyatra. They analyzed more percentage of accidental drowning deaths as compared to suicidal drowning deaths. Papadodimain and his teammates have studied the people suffered from pre – existing cardiovascular disease died due to drowning[20]. They found the reason of death during drowning is cardiovascular disease and most percentage of death are men as compared to others.Patetta and Biddinger have studied the drowning rates in North Carolina during 80's period. They found high percentage of drowning rate in non-white males then white males[21]. Some experts mentioned the death rate of elder people in bath tub is very high in Japan. A confusion is also formed during diagnosis whether death in bath tub is accidental or from natural aspect[22].Morgan along with his team have studied the reasons of drowning deaths in swimmers[23].Now Forensic imaging and endoscopic autopsy techniques are combinedly used for post-mortem examinations[24].Yukawa with his expert team used diatom examination test for supporting the conclusion of death by drowning[25].Lin and his team analyzed diatom species from sinus fluid and lungs after autopsy of persons died due to drowning. They also analyzed natural deaths as a control for examination[26].Some Forensic experts explained the drowning deaths differ from immersion deaths in other types of water bodies. They also find maximum number of male drowning deaths. Water currents are very complex and also effect it[27].Ryan and Dowling have studied persons died from drowning who are already effected from seizure disorder and its types[28].Experts also told diatom test as a golden standard method for identification drowning cases along with autopsy findings, biochemical and technical methods[29].Garrido and his team stated that drowning is the third leading cause of unintentional death[30].Peden with experts have explained the percentage of risk factors swimming, water craft, age, alcohol etc. for causing drowning[31]. Some researchers discussed the death mechanism in drowning is more complicated and involved more things than asphyxia[32]. Armstrong and Erskine have discussed about water related deaths are mainly due to drowning. Forensic pathologist also required pre-autopsy information along with autopsy and toxicological findings for solving drowning cases[33].Experts have also studied different body organs during an autopsy of drowning dead body. They found Coronary arteriosclerosis, Heart hypertrophy, Myocardial scars, vascular malformation during diagnosis[34].Tirmiz and his team determined the frequencies of violent asphyxial deaths like drowning. Also explain

traumatic asphyxial types[35].Sharma and Bajpai have also explained the importance of diatom test in solving drowning cases[36].Yale and his teammates described the drowning deaths due to flood related motor vehicle injuries[37].Racz along with experts have studied the DNA of phytoplanktons found in water body with PCR. They compare this phytoplanktonic DNA with the diatoms found during autopsy of dead body[38]. Re with his team have used virtopsy in diagnosing drowning deaths[39].Some experts described two cases of Scuba diving deaths occurred due to pulmonary barotrauma and arterial gasembolism during drowning[40].A diagnosis of Aeromonas genus bacteria from the tissue samples of drowning cases was done by experts to identify the situation during death [41].Stephenson and his teamhave explained the difficulties in diagnosing drowning deaths[42].

Some experts have studied both known and unknown drowning sites. Diatoms were identified from liver, kidney and lungs with Microwave digestion – Vacuum filtration – Automated Scanning electron microscopy method. Use type consistency and cluster analysis methods for evaluating the diatom consistency in drowning cases[43]. Zhou and his teamhave told about chemical digestion method, Electron microscopy, DNA sequencing with V4 region of 18SrDNA method for detection of diatom species. Explain the importance of diatom in forensic studies[44].Some experts have discussed aboutmicrosopy and DNA barcode amplification for Diatom detection[45].Zhao along with his teammates analyzed various drowning death cases and quantitatively studied the content of diatoms in lungs, kidney and liver tissues[46].Sane with researchers have done the diatomological mapping of diatom species[47].

EXAMINATION AND METHODOLOGY

Asphyxia is the major cause of death during drowning. Obstruction of air passage occurred due to entry of fluid inside larynx which cause Laryngeal spasm [6] .Freshwater drowning shows ventricular fibrillation while sea water shows pulmonary edema, Vagal inhibition, hypothermia, injury, unconsciousness due to epileptic attack, cerebral aneurysm injury, cardiac failure, hemorrhages in neck muscles, fractures in cerebral vertebrates etc. [7]. Freshwater death occurs more fastly than sea water deaths freshwater death takes five minutes while sea water death required eight to twelve minutes.

Medico-legal aspects of finding are occurred with both external and internal appearances. Externally clothes are wet and muddy. Skin becomes cold, wet and pale in colour. Pupils dilated. Rigor mortis appeared. Froth is fine and tightly clenched hand present [15]. Froth is not if victim has taken poison and opioids. Cutis anserine occurred also known as Goose bump in which skin becomes rough and hair stands [12]. Due to standing of hair at one end it is also known as Horripilation. Skin changes occurred in fingers, palm and soles of feet [14]. These changes in skin are known as hands and feet of washer-women. Now talk about the internal appearances a lots of changes occurred in respiratory tract. Emphysema aquosum or Edema aquosum occurred in which ballooning of lungs form [10]. Lungs become heavy and alveoli capillaries compressed. Biochemical changes also studied to diagnose drowning. Gettler's test is used to estimate or check the amount of chlorine content [13]. Water inside stomach and intestine consist salty or freshwater, weeds, algae, mud and sand. Water enter from stomach to intestine through peristaltic movements [7]. If a dead body thrown into water then water remained beyond cardiac sphincter, stomach and intestine. In this way temperature, Rigor mortis, skin appearance, bleaching of cuticle in 4-8 hours, sodden appearance in 18-24 hours in epidermis, formation of putrefactive gases takes 18-24 hours in summer and 24-36 hours in winters for formation, Insect found on body, Adipocere formation etc. all are factors which are studied during medico-legal studies [6]. In some cases whether person died in particular water body or died before drowning or whether died in water or not all these things are studied on the basis of diatoms [10]. Diatoms are unicellular algae live unite or in colonies. Diatoms can be enter in live body through circulation. They penetrated into lungs, brain, kidney, blood, bone marrow, sternum and femur. The diatoms are extracted from body tissue, organs and bones by acid digestion method. Acid digestion method include Nitric acid method and Sulphuric acid method[32]. These diatoms are identified through simple microscopy, Transmission electron microscopy (TEM), Scanning electron microscopy (SEM) etc. Diatoms are very essential and very helpful in prospective of forensic studies. Diatoms are found in almost all types of water bodies. Diatoms have 2,00,000 taxa species worldwide and about 14,700 taxa species in India [42].

FORENSIC SIGNIFICANCE

Forensically drowning tragedies are very challenging work experts whether victim died due to drowning or not [50]. In past many drowning cases were solved by forensic experts on the basis of diatoms a Bacillariophyta (Algae) community [51]. Most famous case of Shopian, Jammu Kashmir in which death of two women became a mystery whether they died due to rape or murder. But diatom study from victim's body proves that they died due to drowning. MansukhHiran death case was also proved by diatom test.

Orissa's Senior Journalist's son case was also solved by diatom studies. Hence diatoms are becoming much reliable among all forensic identification parameters used during drowning investigation.

CONCLUSION

From the whole study, drowning deaths can be occurred through many reason and factors like suicide, Cardiac arrest, poisoning, heath disorders, alcohol etc. Freshwater drowning shows decrease in plasma concentration due to haemodilution while sea water drowning shows increase in plasma concentration upto 25%. Described the medicolegal aspects during Ante and post mortem studies. External finding shows the condition of body whether it is muddy, wet, weeds are present, tight clenched hand condition, face in pale, bloated and discolored condition, pupil dilated, tongue swollen, froth is mucoid or fine. So all these things noted in first appearance. In internal finding shows the changes occurred in respiratory tract, biochemical changes, presence of water in stomach, intestine and diatoms present in different organs of drowned body. Diatoms are very helpful in solving the drowning cases whether person died through drowning or not. Also they are helpful in determining whether person is died in that particular water body or not. So diatoms are very valuable things from the prospective of forensic investigation.

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