



## THE STUDY OF DROWNING DEATHS WITH GROSS FINDINGS AND HISTOPATHOLOGICAL CHANGES IN LUNGS.

### Forensic Medicine

**Dr. Laxman Gangadhar Phad\*** Assistant Professor Dept of Forensic Medicine Govt. Medical College Aurangabad.  
\*Corresponding Author

**Dr. M.S. Vyawahare** Professor and Head Dept. Of Forensic Medicine Indira Gandhi Govt. Medical College Nagpur.

### ABSTRACT

**Background:** Drowning is described in forensic medicine literature, one of the most difficult thing to diagnose. The macroscopic findings and histopathological examination of lungs combinly gives a good approach to form an opinion regarding cause of death. This study was carried out during period December 2013 to October 2015 on 176 cases of deceased with history of drowning.

**Conclusion:** We concluded that, washerwomen's hands present in 85.22% cases, foreign bodies in hands in 68.18% cases, goose skin appearance in 81.82% cases, froth in mouth and nostrils in 85.79% cases, cyanosis in 80.68% cases. Internal findings, oedematous and voluminous lungs were seen in 85.80% cases; petechial haemorrhages in 76.14% cases, rib indentation over the lung surface in 77.84% cases, froth in respiratory tract in 88.64% cases and mud particles in respiratory tract in 5.68% cases. Alcoholic smell of stomach contents was present in 19.88% cases. Histopathological changes in lungs, congestion was present in 92.61% cases, oedema in 91.47% cases, dilatation of alveoli in 84.09% cases, thinning of septa in 84.09% cases, rupture of alveoli in 25.56 cases, and haemorrhage in 46.02% cases.

### KEYWORDS

Washerwomen's hands, Goose skin appearance, Petechial haemorrhages, Dilatation of alveoli, Thinning of septa, Rupture of alveoli.

### Introduction

World Health Organization adopted new definition at first world congress on drowning in 2002 as "Drowning is the process of experiencing respiratory impairment from submersion or immersion in liquid."<sup>1</sup> Currently, the most classical definition provided by "Roll" is "Death by drowning is the result of hampering of respiration by obstruction of mouth & nose by fluid medium."<sup>2</sup> WHO described, drowning as serious and neglected public health problem, as near about 42 people every hour and more than 3.7 lakh people every year die from drowning in the world.<sup>1</sup> In India out of total cases of unnatural deaths 9.4% were died due to drowning, this was the second most common cause of unnatural death after road accidents.<sup>3</sup>

As the time passes typical findings of drowning start to vanish due to decomposition or loss of time in retrieval of body and may obscure the features of drowning, so in these cases the findings of drowning may be minimal or completely absent; nevertheless careful postmortem examination may elicit sufficient positive and negative findings to allow reasonable conclusions to be drawn.<sup>5</sup>

The death of a victim found in water should not always be related to drowning because there are a number of possibilities of the bodies found in water.<sup>5</sup>

The reliable signs of drowning at autopsy are fine white froth at the mouth and nose, presence of weeds, sand, mud firmly grasped in hands, presence of fine froth in lungs and air passages, voluminous and water logged lungs, presence of water in stomach and intestine..<sup>6,7,8</sup> The histopathological changes seen in the lungs, in cases of drowning are congestion, haemorrhage, intraalveolar oedema, interstitial oedema, dilatation of alveolar spaces, thinning of alveolar septa and secondary compression of septal capillaries.<sup>9,10,11,12</sup>

### 2. Material and methods

This cross sectional study entitled "Examination of drowning deaths with special reference to histopathological changes in lungs" was carried out in the Department of Forensic Medicine at Government Medical College and Hospital, The present study was carried out on the dead bodies of victims with alleged history of drowning brought to the mortuary for medicolegal post-mortem examination. Total 176 cases of death due to drowning were studied during period of 1st December 2013 to 31st October 2015.

### Histopathological examination<sup>13</sup>

#### Tissue Processing

**Fixation** with 10% Formalin used to preserve the tissue, Followed by

**Dehydration** from the tissue components with concentrated ethanol, followed by **Clearing** for the removal of dehydrating solutions. Infiltration was done for permitting the tissues with a support medium. Embedding done by placing the tissue samples into moulds along with paraffin wax to prepare blocks.

#### Sectioning and staining<sup>13</sup>

An appropriate number of 4-5 microns thick sections were cut with a microtome knife, fixed on the glass slides and stained with Haematoxylin and Eosin (H & E) stains. After preparation of slides, they were examined for microscopic findings under the light microscope at 40x and 100x optical zoom.

#### Data Analysis:

- Data entry:** It was done using Microsoft excel worksheet
- Statistical Analysis:**

Cross sectional study was used to summarize baseline characteristic of the study subjects. Chi square test was used to study the association between two categorical variables with  $P < 0.05$  to be statistically significant.

#### 3. Results:

##### 3.1 External findings.

Distribution of external findings present over the body in drowning deaths is shown in table 1. Out of 176 cases, washerwomen's hands and feet were present in 85.22% cases of drowning deaths. Foreign bodies in hands were present in 68.18% and goose skin appearance in 81.82% and wet clothes in 81.82% in case of drowning deaths. Froth at mouth and nostrils was present in 85.79% and cyanosis were present in 80.68% cases of drowning deaths.

**Table 1. Distribution of external findings in drowning deaths.**

(n=176)

External findings	Present		Absent		Total
	Cases	%	Cases	%	
Washerwomen's hands and feet (WWHF)	150	85.22	26	14.78	176
Foreign body in hands	120	68.18	56	31.82	176
Goose skin appearance	144	81.82	32	18.18	176
Wet cloths	144	81.82	32	18.18	176
Froth at mouth & nostrils	151	85.79	25	14.21	176
Cyanosis	142	80.68	34	19.32	176

**3.2 Internal findings**

Distribution of internal findings in drowning deaths is shown in table 2. Out of 176 cases, oedematous and voluminous lungs were present in 85.80% cases; congestion of lungs was present in 96.60% cases, petechial haemorrhages in 76.13% cases, evidence of rib indentation present over the lung surface in 77.84% cases, froth in respiratory tract was present in 88.64% cases and mud particles in respiratory tract was present in 5.68% cases.

**Table 2: Distribution of internal findings in drowning deaths. (n=176)**

Internal findings	Present		Absent		Total Cases
	Cases	%	Cases	%	
Oedematous and voluminous lungs	151	85.80	25	14.20	176
Congestion of lungs	170	96.60	6	3.40	176
Petechial haemorrhage	134	76.14	42	23.86	176
Rib Indentation over lung surface	137	77.84	39	22.16	176
Froth in respiratory tract	156	88.64	20	11.36	176
Mud particles in respiratory tract	10	5.68	166	94.32	176

**3.3 Stomach contents**

Distribution of stomach contents in drowning deaths shown in table 3. The cases were divided into four categories viz. less than 500 ml, 500-1000 ml, greater than 1000 ml and empty stomach. The content of stomach includes water and suspended food particles. Most number of victims of drowning deaths shows stomach contents in range of 500-1000 ml seen in 64.78% cases. This is followed by stomach contents in range of less than 500 ml in 17.04% cases and greater than 1000ml in 14.78% cases. In 3.40% cases of drowning deaths, the stomach was found to be empty.

**3.4 Alcoholic smell of stomach contents.**

The alcoholic smell of stomach contents in drowning deaths shown in table 4. Out of 176 cases, Alcoholic smell of stomach contents was present in 19.88% cases and absent in 80.12% cases. Alcoholic smell was present in 26.40% of males and only 3.92% of females. Significantly higher proportion of males had alcoholic smell of stomach contents (P=0.0007)

**Table 4. Distribution of drowning deaths as per alcoholic smell of stomach contents**

Alcoholic smell	Male		Female		Total	
	Cases	%	Cases	%	Cases	%
Present	33	26.40	2	3.92	35	19.88
Absent	92	73.60	49	96.08	141	80.12
Total	125	100	51	100	176	100

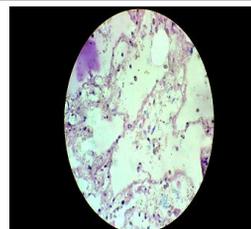
$\chi^2 = 11.48, df=1, P=0.0007$

**3.5 Histopathological findings.**

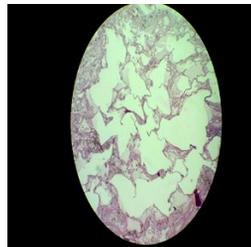
Histopathological changes of lungs in drowning deaths shown in table 5. Out of total 176 cases, Congestion of lungs was present in 92.61%, oedema of lungs was present in 91.47% cases, dilatation of alveoli was present in 84.09% cases, thinning of septa was present in 84.09% cases, rupture of alveoli was present in 25.56 cases, haemorrhage in alveoli and septal region was present in 46.02% cases.

**Table 5: Distribution of Histopathological findings of lungs in drowning deaths. (n=176)**

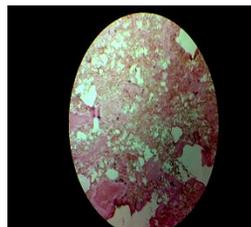
Findings	No of cases	Percentages
Congestion	163	92.61
Oedema	161	91.47
Dilatation of alveoli	148	84.09
Thinning of septa	148	84.09
Rupture of alveoli	45	25.56
Haemorrhage	81	46.02
None	9	5.11



**Fig 1. Showing oedematous changes of lungs in drowning death**



**Fig 2. Showing dilatation and rupture of alveoli in drowning death.**



**Fig. 3 Showing distortion of alveolar architecture with hemorrhage in drowning**

**4. Discussion:**

**Distribution of External findings in drowning deaths.**

In the present study, washerwomen's hands and feet were present in 85.22% cases of drowning deaths. Foreign bodies in hands were present in 68.18% and goose skin appearance in 81.82% and wet clothes in 81.82%. Froth at mouth and nostrils were present in 85.79% and cyanosis in 80.68% cases of drowning deaths.

Rubio L. et al<sup>12</sup> (2014) in his study found that external froth was present in 62.80% cases.

**Distribution of Internal findings in drowning deaths.**

In present study oedematous and voluminous lungs were present in 85.80% cases; congestion of lungs was present in 96.60% cases, petechial haemorrhages in 76.14% cases, evidence of rib indentation over the lung surface in 77.84% cases of drowning. Froth in respiratory tract was present in 88.64% and mud particles in respiratory tract were present in 5.68% drowning deaths.

The present study is in accordance with Ambade V. N. et al<sup>14</sup> (2013) where they found the froth and mud particles in respiratory tract.

**Distribution of drowning deaths as per alcoholic smell of stomach contents** Alcoholic smell of stomach contents was present in 19.88% cases and absent in 80.12% cases. Alcoholic smell was present in 26.40% of males and only 3.92% of female.

Present study is in accordance with Dietz P. et al<sup>15</sup> (1974), Auer A.16 (1990), Quan L. et al<sup>17</sup> (2003), Patetta M. et al<sup>18</sup> (1988), Shekhazadi A. et al<sup>19</sup> (2009), Royal Life Saving Society<sup>20</sup> (2012), A Canadian Drowning Report<sup>21</sup> (2013), Seattle & king county<sup>22</sup> (2013), Rubio L. et al<sup>12</sup> (2014) and Ambade V. N. et al<sup>14</sup> (2013) where positive correlation with alcohol was found in drowning deaths.

**Distribution of stomach contents in drowning deaths**

Most number of victims of drowning deaths shows stomach contents in range of 500-1000 ml seen in 64.78% cases, followed by stomach contents in range of less than 500ml in 17.04% cases and greater than 1000ml in 14.78% cases. In 3.40% cases of drowning deaths, the stomach was found to be empty.

Rubio L. et al<sup>12</sup> (2014) also reported that water was found in 57.7% cases in stomach.

### Distribution of Histopathological findings of lungs in drowning deaths.

In the present study, congestion was present in 92.61%, oedema in 91.47% cases, dilatation of alveoli in 84.09% cases, thinning of septa in 84.09% cases, rupture of alveoli in 25.56 cases, haemorrhage present in 46.02% cases. Present study is in accordance with Moar J.9 (1983), Betz P. et al<sup>23</sup> (1993), Delmonte C. et al<sup>10</sup> (2001), Pounder D.<sup>24</sup> (2005), Piette M. et al<sup>12</sup> (2006), Perez-carceles MD. et al<sup>11</sup> (2008), Rubio L. et al<sup>12</sup> (2014) where the positive correlation was seen in histopathological findings in lungs in drowning cases.

Moar J.9 (1983) concluded that pulmonary oedema and injury to alveolar membrane was present in cases of drowning deaths. Betz P. et al<sup>23</sup> (1993) found that dilatation of alveoli and thinning of septa was present in cases of drowning deaths. Delmonte C. et al<sup>10</sup> (2001) reported that the dilatation of alveoli, thinning of septa and haemorrhage was present in cases of drowning deaths. Pounder D.<sup>24</sup> (2005) reported that, distention of alveoli, thinning of septa, haemorrhage and rupture of alveoli was present in cases of drowning deaths.

Piette M. et al<sup>12</sup> (2006) found oedema and dilatation of alveoli was present in cases of drowning deaths. Perez-carceles MD. et al<sup>11</sup> (2008) reported that, congestion was found in 100% cases in left lung and 98% cases in right lung. Oedema was found in 84% cases in right lung and 84.6% in left lung. Haemorrhage was found in 51.3% cases in right lung and 61.9% cases in left lung. Rubio L. et al<sup>12</sup> (2014) found that rupture of alveoli was present in 95% of cases and oedema was present in 88% cases.

### 5. Summary and conclusions.

Washerwomen's hands and feet, foreign body in hands, goose skin appearance, wet cloths, and froth at mouth and nostrils and cyanosis are the most common external findings seen in drowning deaths. Oedematous and voluminous lungs, congestion of lungs, petechial haemorrhage over lung surfaces, rib indentation over lung surface, froth in respiratory tract, and mud particles in respiratory tract are the most common internal findings seen in drowning deaths. Congestion of lungs, oedema, dilatation of alveoli, thinning of septa, rupture of alveoli, haemorrhage are the most common Histopathological changes of lungs seen in drowning deaths. In maximum number of drowning deaths the stomach contains fluid and suspended material, but in only few cases (3.40%) stomach remains empty. Alcoholic smell of stomach contents is present in 19.88% cases.

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