

A Comprehensive Analysis of Post-Mortem Findings in Asphyxia Deaths

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Abstract: Introduction: "Asphyxia" refers to a multi-etiological set of conditions in which there is inadequate transport, uptake and/or utilization of oxygen by the body's tissues/cells, often accompanied by carbon dioxide retention. Death is attributed to asphyxia only when asphyxia itself is the condition that directly causes the death. This project was conducted to investigate the features of asphyxia that guide us towards the cause, mode and manner of Death. Material and Methods: After obtaining approval from the institutional ethics committee, all autopsy cases which came to the Department of Forensic Medicine, IGMC, Shimla over a period of one year with asphyxia as a mode of death as per Police papers or history provided by the accompanying attendant(s) were taken as the study sample. Observation and Results: 360 autopsy cases were performed between September 2015 to August 2016 out of which 100 cases were attributed to asphyxia; these were thus included for final analysis. The mean age was 35.14 ± 16.58 years. 54% of cases were attributed to poisoning followed by 21% to hanging. 99% of the study subjects had brain congestion and 84% had facial congestion. 99% had pulmonary oedema, 82% had fluid in trachea and only 5% had laryngeal oedema. Conclusion: It is recommended that while ascertaining asphyxia as a mode of death, a holistic and syndromic approach regarding circumstantial evidences, case history and autopsy findings must be considered.

Keywords: asphyxia, asphyxial deaths, autopsy, brain congestion, petechiae

1. Introduction

"Asphyxia" is a term derived from Greek that literally translates as "stopping of the pulse." This term refers to a multi-etiological set of conditions in which there is inadequate transport, uptake and/or utilization of oxygen by the body's tissues/cells, often accompanied by carbon dioxide retention. Asphyxia can be limited to a regional tissue deprived of blood e.g. ischemia) or manifest as blocked respiration in the body as a whole.^[1]

There is a hierarchy within the body in terms of how long different tissues can withstand oxygen deprivation, e.g. extremities can be deprived of blood flow for more than 30 minutes without damage while central nervous system especially the areas concerned with consciousness start perishing within seconds of oxygen deprivation. The disruption of cell metabolism in the tissues and the accumulation of toxic by-products result in pathophysiological consequences such as tissue necrosis, loss of consciousness and death. Forensic interest may then become a question of causation and how long the asphyxia lasted before death occurred.^[2]

Traditionally, the conditions leading to asphyxia have included breathing an oxygen-deficient atmosphere and/or interference with the act of breathing (i.e., inhaling and exhaling) and/or respiration (i.e. gas exchange and the utilization of oxygen). Conditions that historically were

thought to involve airway compromise but are now recognized to involve restriction of blood flow or altered hemodynamic (e.g. hanging, strangulation, and compression asphyxia) continue to be classified as asphyxia.

Although many natural disease processes may involve inadequate uptake and/or delivery of oxygen (e.g. chronic obstructive pulmonary disease [COPD]), the term "asphyxia" is generally reserved for conditions related to abnormal atmosphere and mechanical and chemical effects directly leading to the aforementioned abnormalities.

Technically speaking, everyone dies of asphyxia. There comes a point, arising from either natural disease, injury, drug toxicity, or some combination thereof, at which blood flow to and from the brain, heart, and other organs is insufficient, and terminal asphyxia is the end point of life.^[3]

A death is attributed to asphyxia only when asphyxia itself is the condition that directly causes the death. However, in the majority of these cases, the death is not attributed to asphyxia, but rather to the underlying condition leading to a cessation of respirations (such as myocardial infarct, ruptured cerebral artery berry aneurysm, drug toxicity, or multiple gunshot wounds).^[3]

Determination of the specific type of asphyxia operative in a particular case, the cause of death, and the manner of death are dependent on information elicited during the medico-legal death investigation—namely, history (circumstances), scene investigation, and post-mortem examination

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(including appropriate ancillary radiographic and laboratory studies).

It is not unusual for different mechanisms of asphyxia to occur together in the same case. Because some types of asphyxia may leave no observable findings at autopsy and probably only crucial link is proper scene investigation. In some cases of asphyxia, if the scene has been altered, and the manner by which asphyxia was produced removed, one may not be able to determine the cause of death. In cases where body is still at the scene of death, scene investigation should include visualisation of the body and the immediate environmental factors producing asphyxia prior to movement of the body and subsequent autopsy.^[3]

Asphyxial deaths span the spectrum from the obvious to the inconspicuous. In fact sometimes the information needed for ascertaining of asphyxia may lie entirely in the circumstances of death.^[5]

This project was taken up as a sincere effort to rekindle the romance that Forensic Medicine once shared with Asphyxia and throw some light on the simple but very suggestive features of Asphyxia that guide us towards a line of investigation of the human body resulting in not only a cause but also a mode and manner of death.

Aims and Objectives

The primary aim and objective of the study was to conduct a comprehensive analysis of autopsy findings in Asphyxial deaths in and around Shimla.

2. Material and Methods

Study population:

After obtaining approval from the institutional ethics committee, all autopsy cases which came to the Department of Forensic Medicine, Indira Gandhi Medical College, Shimla over a period of one year (1st September'2015 up to 31st August'2016) with history suggesting asphyxia as a mode of death as per Police papers or history provided by the accompanying attendant(s) were taken as the study sample for this prospective study. All medico-Legal cases with history suggestive of asphyxia admitted to Indira Gandhi Medical College and Hospital who died during treatment, those brought to mortuary or declared brought dead and referred cases from adjoining health institutions for expert post mortem examination were included in the study. All decomposed or skeletonized bodies which came for autopsies were excluded (refrigerated bodies were accepted till 48 hours after death).

Detailed epidemiological data was obtained including routine information like age, sex, occupation, brief facts of history about the case was collected from Police Inquest papers and Death summaries/Hospital records (in case of admitted patients). Interview techniques were used as a tool to collect data, demographic and injury characteristics from police, relatives and attendants. A detailed autopsy examination as per the adopted procedures was carried out which included, complete external examination of the body comprising of general examination of the body and noting

the physical parameters like length, physique or any external injury marks present over the body.

Autopsy findings related to Asphyxia were explored in detail region wise. The color and distribution of Hypostasis on the body were also studied. Neck was examined with respect to the injuries and ligature mark position, situation with respect to anatomical landmarks, color; texture any other injuries on or around ligature mark on the neck. Face was examined for congestion, cyanosis, petechiae, and ecchymosis. Eyes were examined for conjunctival hemorrhages and other orifices were examined for fluid or blood. Position of tongue either clinched or inside mouth, dribbling of saliva, Semen emission or defecation was also noted.

Neck dissection was done in bloodless field. Dissection was done layer by layer with respect to skin, neck muscles, vessels, other soft tissue and internal deep structure of neck. Common and Internal Carotid artery were also examined for endothelial damage. Salivary glands were examined for congestion and hemorrhage. Thyroid cartilage and hyoid bone were examined and dissected to rule out injury or fracture. Simultaneously larynx and trachea were also dissected and examined for congestion or presence of fluid or any foreign body. In systemic dissection visceral pleura and pericardium were also examined for congestion and petechial hemorrhages. Lungs were eviscerated and examined individually with emphasis on searching for petechial haemorrhages, congestion, pulmonary oedema and atelectasis. Brain was examined for not only congestion and hemorrhages but also for any ischemic changes if present. Surface examination as well as serial sectioning were also employed. Visceral organs were also examined for congestion and petechial hemorrhages. Autopsy findings and required information furnished by accompanying persons were recorded on a Performa. Viscera of the deceased was preserved in cases where cause of death was suspected to be due to ante mortem poisoning or where exclusion of poisoning as cause of death had to be made or where no evidence of disease process/any injury to amount for cause of death was found or where alcohol/drugs were suspected to have had had a contributory role in causing death.

Statistical Analysis

Data was recorded on a Microsoft excel spreadsheet. Statistical analysis was performed with SPSS student version 20.0 (SPSS Inc. Chicago, USA). All discrete variables were expressed as percentages.

3. Observation and Results

A total number of 360 autopsy cases were performed between September 2015 to August 2016 in the Department of Forensic Medicine, Indira Gandhi Medical College, Shimla, out of which the mode of death was attributed to asphyxia in 100 cases; these were thus included for final analysis.

Socio-demographic variables

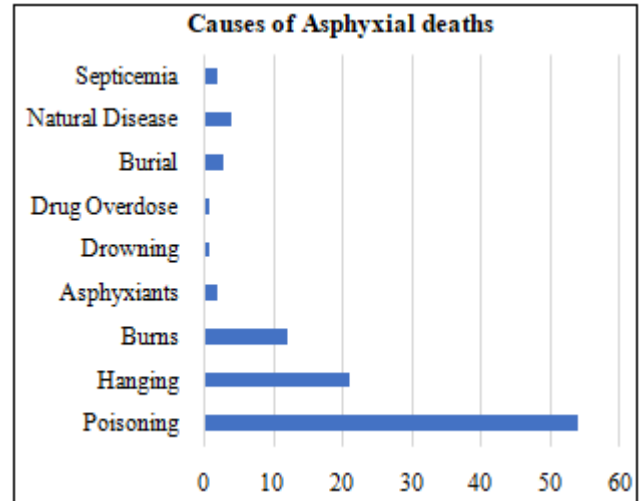
The mean age was 35.14 ± 16.58 years with range of 3 months to 85 years. Maximum number of patients belonged to the age group of 21-40 years. The number of females in the study group were 35 and males 65 with a ratio of 0.53:1.

54% of the subjects belonged to urban areas whereas 46% were from rural areas. Out of the 54% urban population 35% were males and 19% were females. In the rural population also the male gender constituted the majority i.e. 30% and females were 16%. Amongst the rural population the most common occupation was farmer (24%), whereas in the urban population maximum number were unemployed (19%). Majority of our study population i.e. 57% belonged to the low socio-economic status followed by 40% from the middle socio-economic class. The detailed socio-demographic characteristics are represented in Table-1.

Table 1: Socio-demographic characteristics of the study population

Socio-demographic Variable	Number of cases
Age in years	
< 20	15
21-40	57
41-60	20
>60	08
Gender	
Male	65
Female	35
Location of residence	
Urban	54
Rural	46
Occupation	
Farmer and labourer	37
Student	6
Govt and Private Employee	19
Unemployed	19
Home maker	19
Social Status	
Low	57
Middle	40
High	3
Marital Status	
Married	69
Unmarried	29
Widow	2
Substance abuse and addiction	
Smoking	46
Alcoholic	62
Substance abusers	04

The various causes which were associated with the asphyxial deaths in the study population were noted. 54% of these deaths could be attributed to poisoning followed by 21% due to hanging (Figure-1).



67% of all the deaths could be attributed to suicide, 25% due to accident whereas only 4% of the deaths were due to homicide (Figure-2).

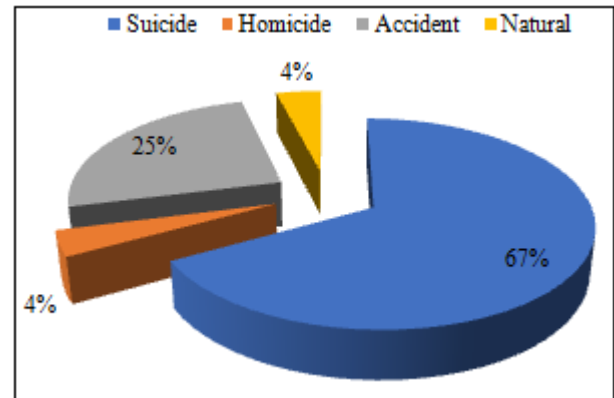


Figure 2: Nature of death

56% of the study subjects were brought to us after 12-20hrs of death, followed by 22% which were brought after 24-36 hrs and only 17% of the subjects were analysed within 8hrs of death.

Asphyxial Findings: 99% of the study subjects had findings suggestive of brain congestion and facial congestion was seen in 84% cases. The next common finding observed was the presence of petechiae in 55% of cases, presence of bluish lips (24%) and dribbling of saliva (21%). Presence of La Facie Sympathique was not observed in any of the asphyxia deaths examined (Table-2). On examination of brain in these subjects, brain oedema was noted in 100% population. Out of the 100 asphyxial deaths, 21 cases had ligature marks. The direction of the mark was oblique in all the 21 cases. Ligature mark was complete in 13 of the 21 cases. In all the cases the ligature mark was present at or above the level of thyroid cartilage. The knot was found to be atypical in 20 of 21 cases, was fixed in 14 cases and had ecchymotic edges in all the cases. The underlying tissue in 20 cases was white or glistening.

Table 2: Asphyxial findings in the study population

Typical Asphyxial Findings	Present	Not Present
Petechiae	55	45
Congestion of Face	84	16
Protrusion of Eyes	1	99
Conjunctival Haemorrhage	9	91
Protrusion of Tongue	15	85
Cyanosis	7	93
Dribbling of saliva	21	69
Le facie sympathique	0	100
Bluish Lips	24	76
Burns	15	85
Tumour	0	100
# Base of Skull	0	100
Congestion Brain	99	1

99% of the observed subjects had pulmonary oedema, 82% had fluid in trachea and only 5% had laryngeal oedema. 24%

of the subjects revealed the finding of petechiae on cardiac surface while only 4% had petechiae on chest wall. 11% had lung abscess, 4% had adhesions in lung, 1% had aspirated and 1% had bullae on lung surface.

Distension of abdomen was found in 30% of the cases. All the major abdominal organs including liver, spleen, kidney, stomach, small intestine, large intestine and adrenals were found congested. The organs which were found congested in only 15 of the population included ovaries and uterus.

83% of the subjects had hypostasis in the lower limb followed by 77% in upper limb. Significant number of subjects also had hypostasis in the back (76%), thorax (75%) and neck (71%). (Figure-3)

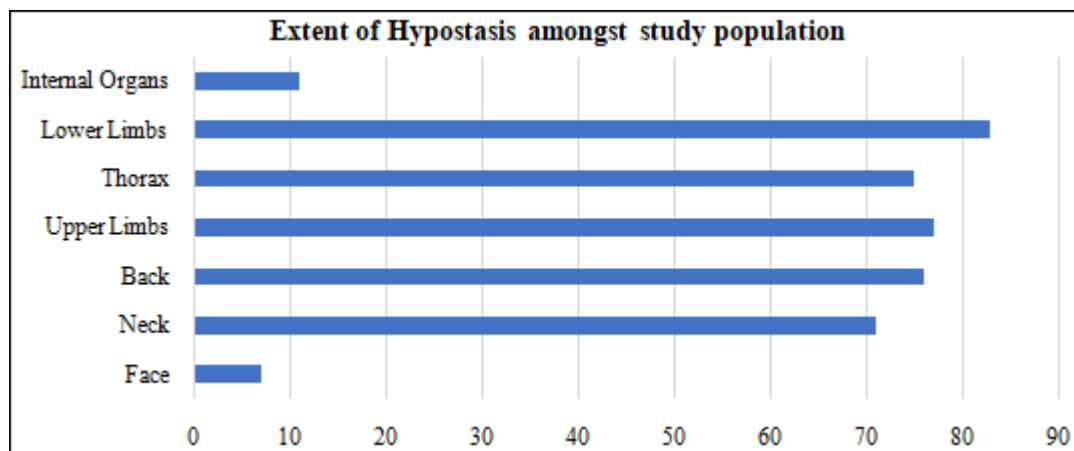


Figure 3: Extent of hypostasis depending on location on the body observed in study population

Loss of sphincter control was found in 90% of the study population, while fluidity of blood was observed in 97% of the study subjects.

4. Discussion

In our prospective study of one year duration there were 100 cases of asphyxia deaths which were 27.78% of the total autopsy cases. Similar incidence (27%) was reported in a study by Kumar MTS et al.^[4]This was however in contrast to the study reported by Bakkannavar et al who after a 4 year retrospective study reported a total of 135 cases of fatal Asphyxia cases constituting 9.91% of all the forensic autopsies.^[5]Similarly other retrospective studies done in North India also report lesser incidence of asphyxia deaths, Chaurasia N et al (6.95%), Reddy SP et al (19.15%) and Azmac D et al(15.7%).^{[6],[7],[8]}

35% of the study population was females and 65% were males with a ratio of 0.53:1. This is consistent with the findings of Kumar MTS et al who in their study on unnatural deaths reported that of all the asphyxia cases 71% victims, were males and 29% females. Sharma et al also reported that number of males (75%) was more than females (25%) in a ratio of 3: 1.^[4]Parietkar et al who conducted a retrospective study from 2012 to 2015 on 1774 patients between the age group of 14-85 years of which 1064 (59.97%) were males and 710 were females.^[9]Similar findings are reported in a

25-year retrospective study on Crush asphyxia conducted in Australia which reported male victims to be 80% while females to be 20%.^[10]

Mean age was 35.14 ± 16.58 years with range of 3 months to 85 years with maximum victims in the age group of 21-40 years (57%) (Table-1).MTS Kumar et al have also reported similar findings in their study on unnatural deaths where around 50% of the total fatalities were in the age group of 20-39 years.^[4]

In our study amongst the rural population the most common occupation was farmer (24%), whereas in the urban population maximum number were unemployed (19%). This was in sharp contrast to findings of Gupta VP who reported that highest number of cases were students (22.5%), followed by daily labourers (18.12%) 69% of the victims in our study were married and only 29% were unmarried as compared to the 55.62% married victims in the study of P V Gupta^[69] but was almost consistent with the findings of Vijaykumari N.^[70] Substance abuse may play an important role in asphyxia deaths, as seen in 62 % of the victims who were alcoholics similar to 44.68% alcoholics in findings of P V Gupta.^[11]

In the study we found that of the deaths attributed to asphyxia, 54% were poisoning, 21 % were hanging, traumatic asphyxia cases were 4% and asphyxiants contributed to 2% of cases (Figure-1). Similar findings have

been reported by MTS Kumar et al who also observed poisoning to be the most common method of asphyxial death.^[4] However, Azmak D reported that hanging was the most common method of asphyxial deaths in his retrospective study conducted in Turkey.^[12] This difference can be attributed to the fact that our study was conducted in Shimla which is catering to not only the urban but also rural areas adjoining it where poisoning by organophosphorus compounds is fairly easy and common than in a metro city like Edirne, one of the biggest cities in the north-western Turkey.

Suicide is the most common mode behind asphyxia deaths, Azmack D et al have also reported suicide to be the commonest mode followed by accidental and homicide.^[12] Similarly, we also observed that 67% of all the deaths could be attributed to suicide.

The most commonly described features for asphyxia include petechiae, congestion of face and internal organs, fluidity of blood, cyanosis^[13] and loss of sphincter control. We found that, 99% of the study subjects had findings suggestive of brain congestion and facial congestion was seen in 84% cases. 99% of the observed subjects had pulmonary oedema.

The cases which had ligatures, the level of ligature mark was noted at or above the level of thyroid cartilage, similar to the findings reported by V Dekal et al in their study conducted on asphyxia deaths due to hanging.^[14] Dribbling of saliva as reported as the most common finding in asphyxial deaths by hanging, was reported in 100% of hanging cases studied by us. The pattern of hypostasis as observed by us is also consistent with findings reported by Shaikh et al and Sarangi et al.^{[15],[16]}

5. Conclusion

No age is immune to asphyxial deaths and ranged between individual of 3 months to 85 years with mean age of 35.14 years. The maximum number of victims were seen between the age of 20 to 40 years (57%) with male to female ratio of 2:1. Poisoning history should be carefully elicited in all asphyxia deaths, as it is a very common and easily available tool for suicide, accident and homicide as well, especially in certain areas in our country. Congestion of all organs of the body is a finding most consistent with asphyxial deaths, and careful clean autopsy is warranted. We don't find pathological signs of asphyxia in every case, but even if we do find them asphyxia signs are common to a number of other conditions besides those in which mechanical interferences with respiration takes place. It is necessary to furnish such evidences while attributing death to asphyxia by violence i.e. in medicolegal perspective vis.a.vis by external evidences of asphyxia and by internal evidences of asphyxia. It is recommended that while ascertaining asphyxia as a mode of death, a holistic and syndromic approach regarding circumstantial evidences, case history and autopsy findings must be considered.

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