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Original Research Article

Autopsy Study of Death Due to Inhalation Poisons (Asphyxiants): A One Year Retrospective Study Done at Victoria Hospital, Bangalore

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Abstract

A poison may be defined as any substance which, if introduced into or brought in contact with a live body, produces disease, deformity, or death.1 Routes may be ingestion, injection, inhalation, or entry through any other orifices of the body. Poisoning may occur accidentally or intentionally as in suicide or homicide. Although poisoning by inhalation makes up the least common way of poisoning, most end up in sudden death. In urban setups like Central Bangalore, inhalational poisons are mainly due to occupational poisoning as seen in industries, sewage workers and in ill ventilated places (irrespirable gases). In both scenarios, most of the cases are lethal which makes this study important. A 12-month study was carried out at Victoria hospital attached to Bangalore Medical College & Research Institute. A total of 2,414 autopsies were done from July 2020 to June 2021, out of which 296 (12.26%) were poisoning cases and. Out of these 18 (6.08%) were due to inhalation of poisonous gases. In majority of cases, Forensic science laboratory reports revealed presence of poisonous substance / irrespirable gases with majority of the gender of the deceased being males. Most of the victims had died on spot or within short intervals after exposure, which points to sudden and high fatality characteristics of inhalation poisons. Maximum number of deaths occurred at workplace followed by accidental inhalation at place of residence.

Keywords: Asphyxiants, Sewer Gases, Industrial Accidents, Gas Geyser.

Introduction

Death due to inhalation of asphyxiants tends to occur less frequently in developed countries compared to the developing country like India. This can be attributed to manual cleaning of sewage manholes and tank (manual scavenging) and use of gas geyser as to electric

geysers. Industrial deaths due to inhalation of irreplaceable gases produced in industry carbon monoxide and carbon dioxide poisoning in ill ventilated places. Common asphyxiant that result in death are carbon dioxide, carbon monoxide, cyanide gases, sewage gases (hydrogen sulphide, methane, ammonia) and rarely accrediting gases in storage of grains. Irrespective of the gas inhaled, the common astonishing features is fatality which results from incapacitation of the person inhaling the gases which occur within short interval without their knowledge. Most of the time, scene of death gives suspicion of foul play. Hence, it is highly essential to understand the nature, mechanism of action and cause of death in death due to inhalation of asphyxiants. So, the same must be confirmed later with meticulous post-mortem examination and chemical analysis report (FSL report).

Material and Methods:

The present autopsy study was conducted at Department of Forensic Medicine, Victoria hospital attached to Bangalore Medical College and Research Institute for a period of one year starting from July 2020 to June 21. After gathering the circumstantial evidence as furnished by police and relatives, detailed medico-legal autopsy was performed. Relevant samples were collected, and their chemical analysis report analysed to arrive at conclusion. Hospital records were also referred in case of treated cases.

Results:

During that of the period, a total of 2414 autopsies were conducted out of which 296 (12.26%) were due to poisoning, which included suicidal, accidental, and homicidal. Among this poison related death 18 (6.08%) were due to inhalation of poisonous gases. The age of the disease varied from 19 years to 69 years. Maximum number of deaths was between 21 years to 30 years of age group followed by 31 years to 40 years.

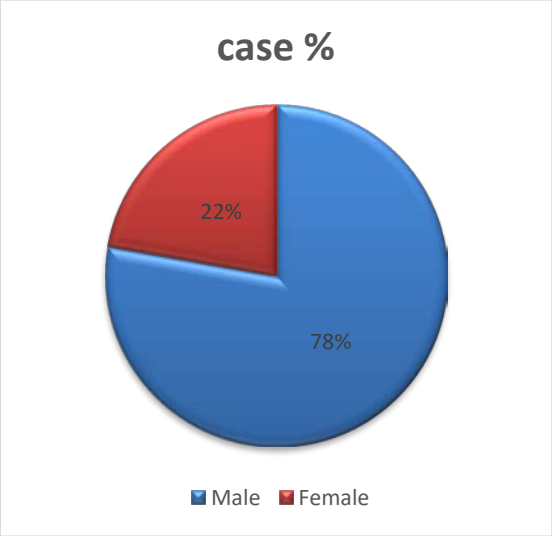

Figure 1: Sex wise distribution of cases. Out of 18 cases 04 cases were female.

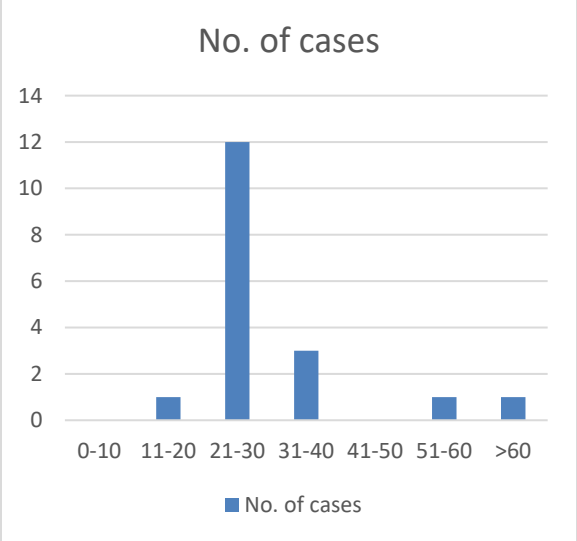

Figure 2: Age of deceased at the time of death

Table 1: Place of incident

Sl. No.	Place of incident	Number of cases	Percentage
01.	Bathroom	04	22.22
02.	Car shed	02	11.11
03.	Sewage tank/ manhole	07	38.89
04.	Ill-ventilated room	01	05.5
05.	Industry/ factory	04	22.22
	Total	**18**	**100%**

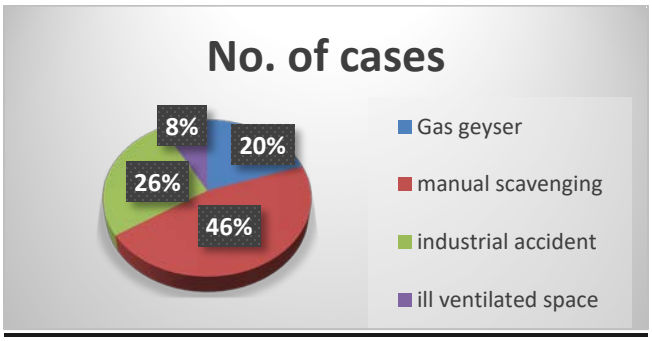

Figure 3: Source of toxic gas

Table 2: Chemical Analysis Report of FSL

Source Of Toxic Gas	FSL Report
Gas geyser	CO, CO2
Sewer Gas	H_2S, Methane, Ammonia, CO_2, CO
Car exhaust gas	CO, CO_2
Ill- ventilated room	CO, CO_2
Industry	HCN

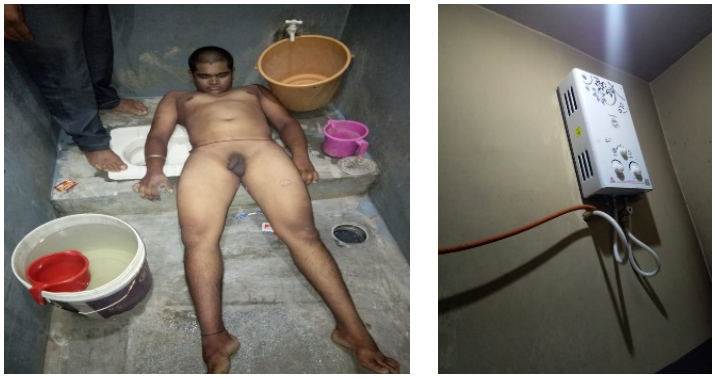

Figure 4: Place of incident & Source of toxic gas

4 cases out of 18 were females and rest male. Out of 4 females, 2 were married and to were unmarried. Out of 14 males, 11 were married and 3 were single. Most of the cases are from urban areas, 15 cases and rest from rural areas.

All the manual scavenging worker and industry worker were from lower social economic status. Although constituents of inhaled gases varied from place to place, most common asphyxiant was carbon monoxide followed by carbon

dioxide. Other asphyxiants detected in FSL being hydrogen sulphide, methane, ammonia, HCN (1case of HCN in metal industry). All the death were accidental amounting to 100%. Although a few were due to negligence of the employer in providing safety gear and safe environment. Death due to gas geyser resulting in carbon monoxide inhalation, resulted from incomplete combustion of LPG gas, which was fitted inside the bathroom, though it is supposed to be fitted outside in a well-ventilated place. In 2 cases, it was due to inhalation of recirculating air from car exhaust through air conditioner as the car was parked and locked in closed garage with its engine and air conditioner on. Most of the cases (16 cases), people were found dead or died within short interval. Only 2 of the victims survived till they reached hospital where they breathed their last. Maximum period of survival was 4 hours after exposure. Along with the gases, alcohol was detected in 5 cases which could have further added to the respiratory depression and incapacitation.

Figure 5: Cherry-Red Colour" PM staining

Figure 6: Petechiae in Brain & Heart

Discussions:

- The term asphyxiants refers to toxic gases, noxious gases or irrespirable gases which are gaseous poison which kill either way of displacing oxygen from environment.
- Toxic gases may be classified as follows[2]

1) ***Simple asphyxiants*:** gases displace oxygen from the ambient air and reduce the partial pressure of available oxygen. Example: Nitrogen, carbon dioxide
2) ***Respiratory irritants*:** gases damage the respiratory tract by destroying the integrity of the mucosal barrier (RADS)[3] example: ammonia, chlorine, nitrogen dioxide, hydrogen sulphide
3) ***Systemic asphyxiants*:** produces significant systemic toxicity by specialized mechanism. Example: carbon monoxide, cyanide, and smoke.

In the present study, asphyxia due to inhalation of irrespirable gases in air that is carbon

dioxide, hydrogen sulphide, methane was the cause in 11 cases. Only carbon monoxide and carbon dioxide inhalation watch found in 6 cases (4 cases of gas geyser and 2 cases of death in car).

***Carbon monoxide*:** More than 10% of carboxy haemoglobin in FSL is diagnostic of carbon monoxide exposure. In this study it ranged from 10% to 70%. Although more than 50% of carboxy haemoglobin is supposed to be fatal, even with 10% COHb death had occurred which could be due to delayed testing. Carbon monoxide of 5,000 PPM in an air is lethal to humans if he inhales for 5 minutes. Carbon monoxide combines with haemoglobin (85%) and myoglobin (15%).

Affinity of carbon monoxide is 230 to 270 times more than oxygen and displaced to form Carboxy haemoglobin. It interferes with cellular respiration by inactivating cytochrome oxidase and may cause myocardial toxicity also[4].

The classical features seen are cherry red colour (blood, tissues and skin, cutaneous blisters, retinal haemorrhage)[5] and ECG changes of ischemia[6].

Alcohol intoxicated, exhausted, anaemic, IHD and COPD patients are more susceptible for sudden death[7].
Hyperbaric oxygen therapy may be useful in cases who are lucky enough to reach hospital[8].
Post-mortem finding include: cherry red colour, blister, pulmonary oedema, firm white matter of brain[5]. Blood in sodium fluoride with glass/ plastic bottle in wax topped container. Rebreathing of exhaust gas of car can result in death as in our study where two people were found dead in a car parked in garage with door closed[9].

Malfunctioning LPG gas geyser, gas cloth dryers, charcoal stoves and poorly ventilated sleeping place are common source of carbon monoxide poisoning[10].

Most of the cause of carbon monoxide occur accidentally in most of the cases, rarely homicidal.

***HCN*:** HCN is colourless, flammable gas with a faint bitter almond odour. Used in industries, agricultures, in labs and for suicide and homicide.Produces toxic effect by histotoxic anoxia by inhibition of cytochrome oxidase[11].
Bright red cyanosis of a skin, mucous membrane, froth at mouth and nostril, pulmonary and cerebral oedema[12].

Industrial and laboratory mishaps are not frequently reported as other asphyxiants. One case of HCN inhalation in a factory was found in our study.

SEWER GASES: contains ammonia, hydrogen sulphide, methane, carbon dioxide, S_2O, etc.
***Ammonia*:** inhalation of more than 2500 PPM is fatal, due to RADS (reactive airways dysfunction syndrome) or irritant included asthma and severe bronchospasm.

***Hydrogen sulphide*:** has rotten egg smell, heavier than air and collects at the bottom. Hydrogen sulphide adheres to the cytochrome C Oxidase and inhibits its action. Cellular respiration comes to a halt. Toxicity and rapidity of action are compared with HCN which cause sudden unconsciousness and shows knockdown effect (knockdown gas). 750 to 2000 PPM may cause immediate unconsciousness, respiratory failure and cardiac arrhythmia.

Diagnosis: increase blood sulphide level and thiosulfide levels[14]. (Normal: <0.05mg/L)[13].

***Methane*:** colourless, odourless, inflammable gas. It can cause headache, dizziness, and incoordination of muscle.

***Carbon dioxide*:** Colourless and odourless gas, present in smoke, ill ventilated places and sewer gas.

Source of CO_2: combustion of firewood, exhaust of vehicles and sewer gas. More than 10% CO_2 in air inhaled rapidly is fatal[15].It can cause convulsion, coma and respiratory failures.It dissolves in blood to form carbonic acid which leads to respiratory acidosis and stimulates ventilation in viscous cycle and can cause total incapacitation. More than 800 to 1,000 ppm of severe gas will cause immediate unconsciousness, breathing difficulty and death.

Legal aspects: All the above cases were booked under suspicious death (u/s 174 "c" CrPC) or 304 (A) IPC- negligence of the employer in providing safe working environment and provision of Manual Scavenging and Rehabilitation Act 2013.

Conclusion:

Deaths due to inhalation of poisonous gases are still not uncommon now a days in city like Bangalore. Proper study and knowledge about properties, action, and sequels along with post-mortem changes is very much essential in forensic diagnosis of such cases. Proper collection, processing and testing of biological samples help in the correct identification of the culprit agent. Visit to the scene of crime can be of vital importance in the diagnosing such cases. Proper precautions like installing gas geyser in the ventilated places, providing safety gear, cross ventilation in factories and prevention of manual scavenging can avoid such deaths (public education).

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