

A study on the presence of soot particles in fatal flame burns cases in Tamil Nadu

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Abstract

Aim: Fixing the presence of soot particles in the airway and upper gastrointestinal tract as a reliable indicator of the ante mortem flame burns was attempted. **Materials and Methods:** 100 fatal victims of flame burns cases were selected based on the duration of survival and naked eye examination was done in the upper airway, lower airway, oesophagus, and stomach for the presence of soot particles. **Results and Observations:** Soot particles were present in the upper airway (70%), lower airway (67%), oesophagus (5%) and in the stomach (3%) **Conclusion:** From this study it can be concluded that presence of the soot particles in the lower airway could be taken as a reliable indicator of the ante mortem flame burns.

Keywords: flame burns, soot particles, airway, ante mortem.

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INTRODUCTION

Injuries generally have continued to attract the attention of researchers all over the world. Burn injuries rank among the most severe types of injuries suffered by the human body with an attendant high mortality and morbidity rate. Burns constitute a major public health problem globally, especially in low and middle-income countries where over 95% of all burn deaths occur. Fire-related burns alone account for over 300,000 deaths per year. Burn deaths are classified among the 15 leading cause of deaths in India¹. Death due to burns may be the result of neurogenic shock due to pain, hypovolemic shock due to fluid loss, toxemia due to absorption of toxic material from burnt site or septicemic shock due to infection² When a fire results in fatality, there should be

allow threshold for treating the death with caution, in view of the potential for there to have been an attempt made to conceal a homicide by 'burning the evidence'³. Postmortem burning of corpses is supposed to be one of the ways to hide a crime⁴. What is important is differentiating peri mortem thermal trauma from that of postmortem thermal taphonomy to unearth homicide cases⁵. Every time a body comes to autopsy with a history of on-the-spot death due to burns, it poses a challenge to the Forensic Pathologist whether it's an ante-mortem or postmortem burn. Their postmortem findings in these cases give vital clues to the police investigators. The ignorance, lack of experience or misinterpretation by the doctor conducting the post-mortem can lead to misguiding of the investigation agencies⁶. It may be possible on naked eye examination that a burn is ante mortem in origin if it shows evidence of an inflammatory reaction. For instance, if a vesicle caused by a burn contains pus it may be assumed that the burn was produced before death. In most cases, however, naked eye appearances cannot be relied upon, and the only method of distinguishing between ante mortem and a post mortem burn is a histological examination for evidence of tissue reaction⁷. The respiratory tract is the most important organ system for the diagnosis of vitality. Where fire fumes were inhaled, deposits of soot particles will be

found⁸. The presence of fine carbon particles (soot) in the trachea and bronchi, often intimately mixed with mucus, provides indisputable evidence that the victim had inhaled smoke and had thus been alive in the fire. Carbon impregnated mucus may be swallowed and be found in the stomach⁹. Soot particles may enter the open mouth of a corpse, stain the tongue and pharynx, and may even passively reach the glottis. No significant amount can pass the vocal cords and enter the trachea after death, however, so carbon in the lower respiratory tract is a certain indicator of breathing during the fire¹⁰. Similarly, though soot may be found in the mouth and throat in a dead person not alive during the fire, swallowing could not take place and therefore soot particles could not be carried to the lower oesophagus and into the stomach, as is commonly found in victims of conflagrations¹¹. Presence of carbon monoxide in blood is a valuable indicator that person was alive when the fire began and suggests ante mortem nature of burns¹². A blood sample (from anywhere in the body) must be taken for estimating the carboxyhaemoglobin (COHb) level. Smokers may have a COHb level of up to 10% (although this could be as high as 20% in heavy cigar smokers), but a level of over 50% is good evidence that the deceased was alive at the time the fire started, and was able to breathe in the smoke and fumes generated by the fire¹³. Also, it is assumed that apart from inhalation of carbon monoxide, the blood which is coming into direct contact of burning fumes may further absorb the carbon monoxide and thus may give rise to false increased level of carboxyhaemoglobin. It is also not uncommon that the death occurring as a result of ante mortem burn is subsequently followed by postmortem burns resulting into severe charring, as well as in known cases of postmortem incineration the carboxyhaemoglobin level is seen remarkably high like ante mortem burns¹⁴. Along with the above mentioned parameters, the cutaneous reaction to heat and flame leading to vital reaction (red-flare/red-line), vesication / blisters and microscopic examination of the tissues from the burnt area has been considered very important¹⁵. Nevertheless, doing histopathological examination of the burnt site and estimation of the carboxyhaemoglobin level in blood is often cumbersome and delays the postmortem report. Hence, the naked eye examination of the airway and the upper gastrointestinal tract for the presence of soot (carbonaceous) particles is always an easy and simple method to decide the ante mortem nature of death in fatal burns cases especially in charred and decomposed bodies.

MATERIALS AND METHODS

This study was conducted in 100 fatal victims of flame burns who died within 3 days of inhalation of

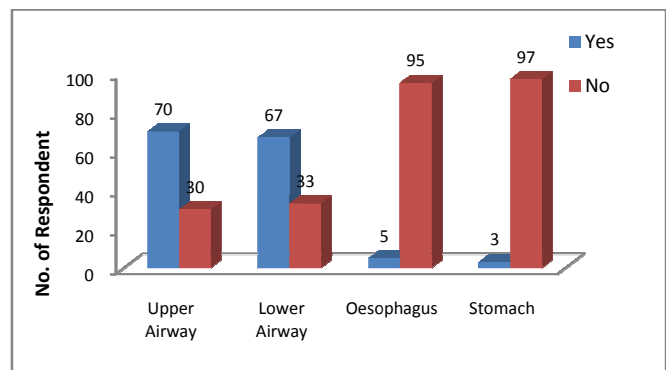
smoke. (Soot can be detected with the naked eye 2 or 3 days after inhalation of smoke¹⁶). In all 100 cases, the oropharynx was examined for the soot particle before removing the organs by Letulle's method. By using the medium sized scissors the oesophagus and the stomach was opened and examined for the presence of the black carbonaceous particle (soot particles). Then the inlet of the larynx, larynx above the vocal cords, larynx below the vocal cords, trachea, main bronchus and both bronchi were examined for the presence of soot particles. For a convenient tabulation, findings of the oropharynx, the inlet of the larynx, larynx above the vocal cords were put under the name of upper airway and the findings of the larynx below the vocal cords, trachea, main bronchus and both bronchi were put under the name of lower airway.

RESULTS AND OBSERVATIONS

In 70 cases (70%) the soot particles were present in the upper airway and in 67 cases (67%) they were present in lower airway. In 5 cases (5%) they were present in the oesophagus and in 3 cases (3%) they were present in the stomach.

Table 1: Soot particles in the airway and the upper gastrointestinal tract

Organs	Yes	No	Total
Upper airway	70	30	100
Lower airway	67	33	100
Oesophagus	5	95	100
Stomach	3	97	100
Total	145	255	400



Graph 1: Presence of Soot Particles

DISCUSSION

In majority of cases soot particles were present in the upper (70%) and lower (67%) airway which makes the importance of examining the airway for the soot particles to decide the ante mortem nature of burns cases. And also this is consistent with the finding quoted in the textbook i.e. "The presence of black carbonaceous material (soot) within the upper and lower airway, easily seen on gross exam, is considered to be a reliable indication that the

deceased was alive prior to the fire”¹⁷. It is presumed that the reason for the absence of soot particles in the upper airway (30%) and lower airway (33%) is the possibility of death due to conflagration or flash fire, or fire at open places. And it is also presumed that the reason for the least presence of the soot in the oesophagus (5%) and in the stomach (3%) is, during the agonal period the act of swallowing might not been taken place.

CONCLUSION

It is concluded that presence of soot particles in the lower airway like larynx below vocal cord, trachea, main bronchus and both bronchi is a reliable indicator for the ante mortem nature of death due to flame burns especially in charred and decomposed bodies. Absence of soot, however does not necessarily mean that the individual was dead prior to the start of fire.

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