

# Complex suicide – ripping the smokescreen

## Abstract

Complex suicides involve two or more discrete method adopted to take one's own life. Compared to death by simple suicide, cases of complex suicide often go unnoticed. As, these medico-legal cases are sent for toxicological analysis to ascertain cause of death, forensic science plays a vital role of in establishing complex suicide cases. We here focus on two cases of suicide by hanging where the deceased adopted complex life threatening combination for suicide. Chemical examination to ascertain presence of intoxicant in visceral tissues was carried out with the help of chemical tests, GC-HS, FTIR and GC-MS analysis. The toxicological investigation revealed presence naphthalene in stomach as well as asphyxia due to hanging as cause of death under the influence of alcohol. Thus, the method of suicide was more toward planned complex suicide that was revealed only after forensic examination. Complex suicide attempts need austere consideration from several segments of the society and all evidences must be given sufficient thoughtfulness as they play vital role in establishing death.

**Keywords:** complex suicide, toxicological, naphthalene, forensic

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**Abbreviations:** GC-HS-FID, head space gas chromatography flame ionization detector; FTIR, fourier transform infrared spectroscopy; GC-MS, gas chromatography mass spectrophotometry; NCRB, national crime records bureau

## Introduction

Suicides contribute as a major global public health issue among which hanging falls under the most common category of unnatural death.<sup>1</sup> The most probable anticipated reason to use hanging as a means to suicide is certain, rapid death with effortless accessibility of required materials.<sup>2</sup> In India, as per NCRB data, 53.6 % of total cases of suicide committed resort to hanging as the first option.<sup>3,4</sup> According to World Health Organization report, India has highest rate of suicide among south-east Asian countries with highest mortality rate of 16.3% compared to a global average of 10.6%.<sup>5</sup>

The decision to commit suicide when carefully planned is called 'complex suicide' rather than impulsive maneuvering of the act of suicide.<sup>6-12</sup> In Complex suicide the decease ensures negligible survival by subjecting to different modes of suicide to effectively end life. Courage to instigate suicidal act, fear of potential attempt failure and its unanticipated repercussions forces individuals to implement such complex methods to certain complete painless death.

Investigations under such complexity of circumstances is challenging for forensic analyst and medical officer where each of their role in determining the cause of death cannot be underrated. We present two cases of complex suicide with detailed toxicological analysis and medico-legal aspects of hanging as observed by medical practitioners to meticulously understand the role of forensic analyst, medical officer and investigating agency to collect evidences without fail.

## Case I

A 24-year-old male had hanged himself from ceiling fan inside his shop at around 4.30pm and was declared brought dead by doctors at emergency. No foul play was suspected by his family and friends.

## Autopsy finding

Autopsy was conducted two days later. Detailed findings of the report showed oblique ligature mark on neck with mouth closed

and nail beds having bluish discolouration in both hands. Multiple petechial haemorrhages were present in heart. Stomach had food contents with mucosa of stomach showing congestion. One solid spherical material with peculiar smell was noticed during toxicological analysis in stomach.

## Case II

A 28-year-old businessman had hanged himself in house at around 2.30pm and was declared brought dead by doctors at emergency. No foul play was suspected by his family and friends.

## Autopsy finding

Autopsy was conducted after one day. Detailed findings of the report showed oblique ligature mark on neck with mouth closed and nail beds having bluish discolouration in both hands. Brain, liver, spleen and kidney showed congestion and multiple petechial haemorrhages were present in heart and lungs. Stomach had food contents with mucosa of stomach showing congestion. A solid spherical material was observed in between the semi digested food contents during toxicological analysis in stomach.

## Methodology

The autopsy samples were received in sealed condition at Forensic Science Laboratory, Delhi to rule out any intoxication and poisoning in both the medico-legal cases. Basic screening for toxicological analysis was carried out as per our laboratory protocol. The samples were analysed using HS-GC-FID, GC-MS and FTIR instrument to rule out any intoxication.

## Material and method

### Materials required

Acetone, Picric Acid, Anhydrous Sodium sulphate, Hexane used was of Analytical Grade (AR) purchased from Merck. All glassware used was from Borosil.

### Sample preparation

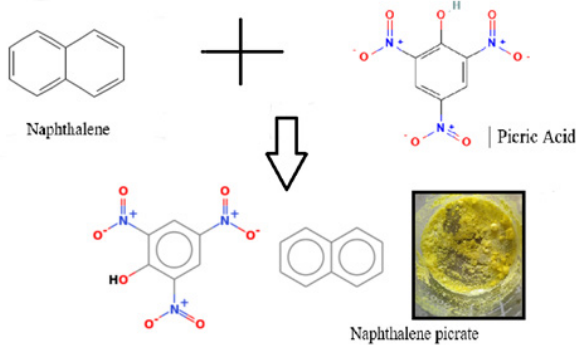
All visceral samples (pieces of stomach, intestines, liver, spleen, and kidney) were homogenised using a tissue homogeniser and subjected to chemical analysis along with post-mortem blood sample.

The solid spherical material obtained from stomach tissue sample was kept separate for analysis. The material was initially checked for solubility in various solvents and then dissolved in Acetone. The filtered solution was marked as ‘S’, and then subjected for chemical test and instrumental analysis.

**Chemical test for sample ‘S’<sup>13</sup> Figure 1**

**Alcohol analysis**

Peripheral blood from femoral vein is sent as post-mortem blood sample which was used for alcohol analysis by Headspace gas chromatography with flame ionization detector.



**Figure 1** Schematic representation colour test reaction showing yellow crystals of naphthalene picrate.

**ATR-FTIR- analysis**

ATR-FTIR spectrometer model No Alpha II (Bruker, Germany) was used for analysis of samples. Spectral measurements were acquired in continuous scan mode for 64 scans over range 600 to 4000 cm<sup>-1</sup> at 4 cm<sup>-1</sup> resolution. Samples are placed directly on the diamond crystal plate using pipette and images obtained through Infrared Focal Plane Array (FPA) detector. Spectra were processed using OPUS software (from Bruker) for performing data analysis operations. Background measurements were carried out before each sample analysis.

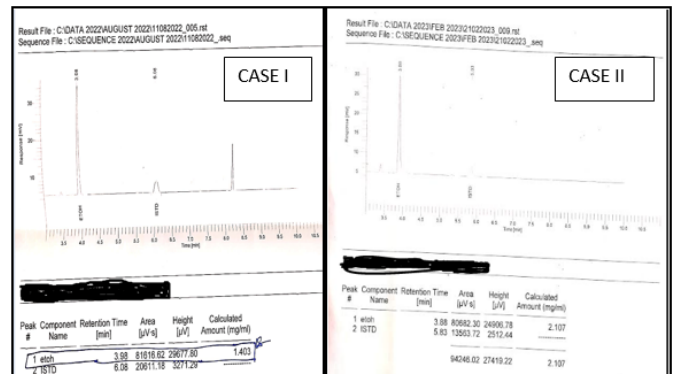
**GC-MS analysis**

Analytical conditions - Varian 450GC with 240 Ion Trap Mass Analyser was used to analyse all the exhibits. The setting of the instrument is as described: Column- VF-5MS (30m x 0.25mm x 0.25µ). Oven temperature 70°C for 2 minutes and then 25°C per min to 150°C and further to 200°C at the rate of 3°C per min and increased to 280°C at the rate of 8°C with final hold time for 7 min. Injection Temp-280°C, Injection volume - 1µL, Mode – Split-less, Carrier Gas – Helium, Flow Rate – 70.9 ml/min., MSD parameters included EI tune type, temperature of MS source – 300°C, temperature of MS Quad- 150°C, scan range from mass- 35.00 to 500. Total run time for a cycle was 35 min. The samples were analysed by galaxy software and readings were compared with the NIST library Version 11.2.

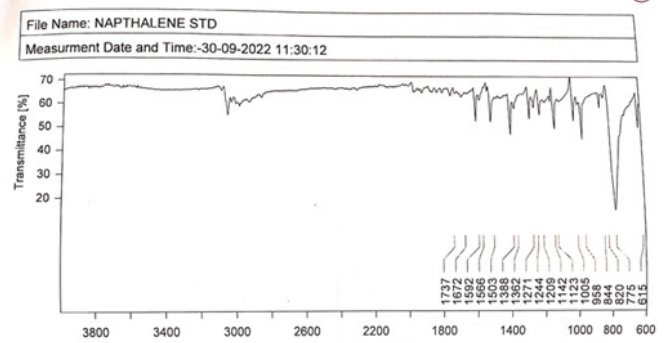
**Results**

The visceral tissues and blood samples from cases I and II were subjected to different toxicological examination as per laboratory protocol and the results are presented here. Post mortem Blood Alcohol concentration was found to be 140.30 mg/100ml of blood in case I and 210.70 mg/100ml of blood in case II (Figure 2). Colour tests conducted on stomach visceral tissues and sample ‘S’ showed positive results for naphthalene (Figure 1). The IR spectrum for the same was obtained by scanning the samples in the range 600 to 4000 cm<sup>-1</sup> with characteristics peaks at wave number 1737, 1672, 1591, 1566, 1503, 1388, 1271, 1243, 1209, 1141, 1122, 1005, 958,

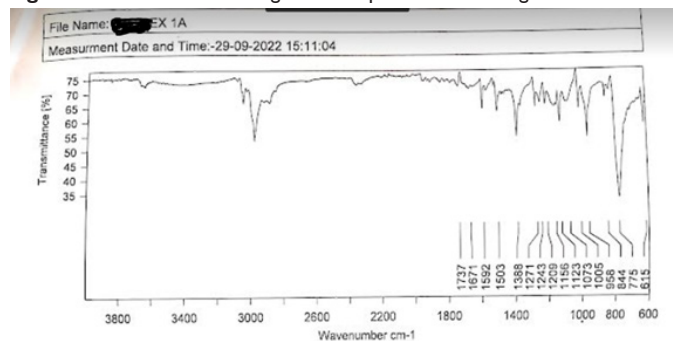
844, 820, 774, 615cm<sup>-1</sup> (Figure 3 & Figure 4) which confirms the presence of Naphthalene. GC-MS analysis of sample ‘S’ and stomach visceral tissue sample showed TIC peaks at RT 11.498 having mass spectrum m/z values 128,102,129 for Naphthalene (Figure 5 & Figure 6). Naphthalene was not detected in other visceral tissues and blood.



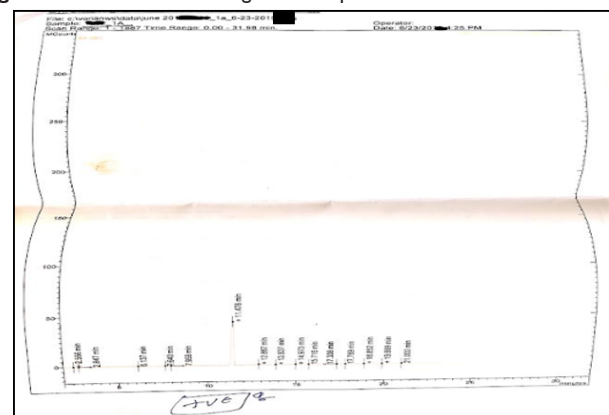
**Figure 2** Illustration peak for ethyl alcohol in blood samples of case I and II.



**Figure 3** FTIR-ATR chromatogram of Naphthalene working standard.



**Figure 4** FTIR-ATR chromatogram of Naphthalene in visceral tissue.



**Figure 5** GC-MS Chromatogram of sample analysed.

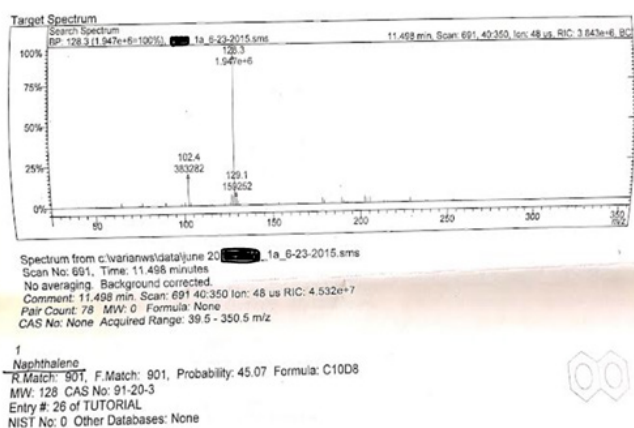


Figure 6 Mass spectra of Naphthalene peak at retention time of 11.48 min.

## Discussion

Various combinations of complex suicides account for about 1.5 – 5% of all suicides cases in forensic autopsies that are often ambiguous to interpret.<sup>10</sup> Literature shows in more than 90% of cases individuals had selected daily used items from home for committing suicide.<sup>14</sup> Victims show preference to less painful methods or involve drinking excessive amount of alcohol, drug overdose or ingestion of toxic substance, probably to evade pain or anxiety.<sup>15</sup> Therefore, the accurate evaluation is highly dependent on medico-legal autopsy and chemical analysis undertaken by forensic scientists. Among the various methods adopted for complex suicides globally,<sup>6-12</sup> our study is not in line with any of these methods adopted. Autopsy report from medical practitioners advocated suicide by hanging with most symptoms of hanging clearly visible in during autopsy. It is important to underline that the incident of crime is strongly supported by toxicological analysis for precise interpretation.

Mythri and Ebenezer reports suicides in India are more often associated with the use of alcohol as well as impulsive behaviour when compared to the Western countries.<sup>16</sup> Our study too supported this fact as both cases contained high amount of alcohol in blood (Figure 2). Toxicology examination of visceral tissues to rule out poisoning by other substances like pesticides or drug overdose were negative.

Lethal poisons found in household is conveniently exploited for suicide due to its easy availability, carelessly stored and their property to cause harm.<sup>17</sup> The presence of naphthalene in stomach tissues (Figure 3–6) calls for attention in similar line and their presence often go unnoticed. Naphthalene commonly called as moth balls is a polycyclic aromatic hydrocarbon with characteristic detectable odour and its poisoning is not highly prevalent. However, being easily available in homes, its ingestion can cause serious complications causing nausea, diarrhoea, abdominal pain.<sup>18</sup> It is soluble in alcohol and presence of alcohol in blood is one strong reason why naphthalene could be easily detected in stomach tissues.<sup>19</sup> Before it could be further absorbed and metabolised, the victim resorted to hanging arresting all other process of metabolism. The solubility reduces further with presence of food in stomach at the same time this could only delay absorption and metabolism process clarifying its prevalence in stomach tissues. The cause of naphthalene poisoning is intentional in 65% of cases and accidental in 35% of cases as Memar et al.,<sup>20</sup> points out from a study conducted in Iran.<sup>20</sup> Naphthalene poisoning is rare and its toxicity results only after 48-96 hrs of exposure depending on dose where the lethal dose for acute naphthalene toxicity is 5-15gm

for adults.<sup>21</sup> As only one ball of naphthalene was traced in stomach tissues in both the cases and with no medical history of any other symptoms, it could be concluded that the victim was unaware about the detailed toxicity of naphthalene.

Two uncorrelated techniques GC-MS and FTIR were used for accurate detection in forensic samples. GC-MS, considered as golden technique in forensic analysis depends on m/z values of the substance identified whereas FTIR is best suitable technique for chemical identification depending on spectral wave numbers. This imaging technique is widely used due to its efficiency in spectral measurement to provide clear representation of sample's exact chemical composition. The method of death in both cases was more towards conscious planned complex suicide with naphthalene intake under the influence of alcohol followed by hanging. Minute observation during toxicological examination, at forensic science laboratory will further strengthen the investigation of complex cases of suicide from forensic point of view. Another interpreted reason for complex suicide here can also be the pandemic effect. Covid pandemic has had significant impact on mental health during worldwide lockdown. Social distancing has created a feeling of isolation, anxiety, depression and uncertainty among individuals which has led to a rise in suicide cases during covid in India.<sup>22</sup> Pandemic has even resulted in economic disruptions in the society where individuals are struggling to meet ends and failure leads to suicide.<sup>22,23</sup>

In most complex suicide, the first method employed is relatively painless and less cumbersome followed by second or third thinking that the first one is comparatively ineffective. Here also, victim under the influence of alcohol could have taken naphthalene ball and seeing no effect further subjected him to hanging. All these attempted methods synergistically played their own part in hastening death. Hence, a vigilant examination to rule out additional likelihood of doubts rose as homicide or suicide or complex suicide is mandatory as the chemical results are valuable evidence in court of law and sometimes needs expert testimonial support too. It is difficult to establish the exact reason behind death in complex cases of suicide as the victim involves two or more methods and therefore careful chemical examination plays a vital role in justice delivery. The circumstantial evidences need more emphasis as those are exclusive evidences observed during scene of crime investigation to differentiate between homicide and suicide. This can change the course of investigation. The primary goal of any research or case study is to present dependable evidence that may be of further guidance in decision making, if similar cases are ever come across by forensic scientist. This was kept in mind while sample analysis by involving two entirely different instrumental techniques. The m/z values from GC-MS and the wavenumbers from FTIR are unique and repeatable, if the substance of analysis is same, even when the sample size is very small. The statistical conclusion validity holds adequate in this case study and scientific evidences identified thus can be presented in court of law. The main threat occurs during chemical examination, identification of different poisons, corroborate evidences that can alter the course of investigation. Complex suicides have not received much attention in India and thus, there is lack of statistical data. Though some efforts have been made by individual authors in international arena to pen down their own experience but due to lack of any government initiative, there is a large void.<sup>24,25</sup>

## Conclusion

Forensic investigation of complex suicide is a challenging to deal with as they can often be mistaken for homicide. In our case the deceased resorted to less lethal method under the influence of alcohol and then attempted suicide by hanging. The importance of



forensic toxicological analysis cannot be underestimated in complex suicides. Only after chemical analysis can contributing factors to the end of life can be established, thus providing a complete history of the individual's decisions and actions just prior to death. A detailed investigation from diverse perspective becomes mandatory to find out the exact cause of death. The role of forensic scientist is of utmost importance particularly the chemical analysis data to provide quality information about the crime committed.

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## Conflicts of interest

The authors declare that there is no conflict of interest.

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