



## K73 Death Due to Acute Nicotine Intoxication

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**Learning Overview:** After attending this presentation, attendees will be familiar with the toxic and lethal effects of nicotine, as well as the challenges in toxicological analysis of nicotine.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by highlighting the significant toxicity associated with liquid nicotine used to manufacture electronic cigarettes.

**Background:** Nicotine is a lipid soluble alkaloid substance that is extracted from the leaves of the *Nicotiana* plant.<sup>1</sup> Most commonly, nicotine is used in tobacco products such as cigarettes and chewing tobacco; it is found in some pesticides as well.<sup>2</sup> Nicotine is one of the most toxic and popular drugs of abuse; however, it rarely causes fatalities.<sup>1</sup> Electronic cigarettes were first introduced in 2004 and have gained significant popularity in recent years.<sup>3</sup> They are advertised to satisfy nicotine addiction without all the health hazards of inhaling tar and other carcinogens known to be present in traditional cigarettes. Liquid nicotine, the key ingredient in electronic cigarettes, poses a significant toxicological concern in that a very small ingested amount can be poisonous and life threatening.<sup>1-3</sup>

**Case:** A 23-year-old male was found by his roommate unresponsive, covered in vomit, in the bathroom of their residence. Emergency medical services were dispatched to the scene and resuscitative attempts were made for approximately 30 minutes before the subject was pronounced deceased. His roommate reported that he had seen the subject about 1 hour and 45 minutes prior and he did not appear to be intoxicated at the time. Of note, the subject had a bag which contained commercially available "stress relief-eucalyptus and spearmint" bath salts and three empty and apparently unused syringes that were, therefore, not collected for analysis. A nearly full package of cigarettes was found near the decedent, but no other nicotine products were identified at the scene. Autopsy revealed marked pulmonary edema and congestion of the kidneys and liver. There was no evidence of trauma identified. A drug screen performed on heart blood was positive for nicotine and amphetamines. Toxicological analysis of femoral blood revealed nicotine at a concentration of 2,400ng/ml and cotinine (a metabolite of nicotine) at a level of 210ng/ml, (limit of detection for nicotine and cotinine is 5.0ng/mL and 10.0ng/mL, respectively); these concentrations support the acute nature of the intoxication. Ethanol was also detected at a level of 13mg/dL. Amphetamines were not confirmed by liquid chromatography/mass spectrometry with a limit of detection at 10ng/mL. A novel psychoactive substances screen for bath salts was performed by National Medical Services (NMS) lab and was negative.

**Conclusion:** Liquid nicotine, used to fill electronic cigarettes, contains very high concentrations of nicotine, up to 36.6mg/mL in a refill solution, which can be toxic or lethal when consumed in even a small dose.<sup>4</sup> It is of great toxicological concern due to the ease of access to the substance with no strict control over distribution.<sup>1</sup> The estimated lethal dose of nicotine is about 30mg–60mg in an adult.<sup>5</sup> Effects of nicotine on the body are complex, with small doses causing a stimulatory effect (nausea, vomiting, dizziness, miosis, tachycardia, hypertension, sweating, and salivation) and lethal doses causing a depressive effect (prostration, convulsions, respiratory paralysis, and cardiac arrhythmias).<sup>5</sup> Other nicotine-related fatalities have been reported, primarily due to accidental exposure related to harvesting nicotine from the plant.<sup>2</sup> Few case reports have described ingestion of liquid nicotine to commit suicide, although the majority of these cases have other substances in addition to nicotine detected postmortem; most commonly a significant amount of alcohol and/or opioids, which contributes to the depressive effect on the central nervous system.<sup>1</sup> Although liquid nicotine was not located on scene, based on a literature review, the most likely method of sustaining such a high nicotine level in such a short period of time is either by ingestion or injection of a concentrated form of nicotine, as found in e-cigarette refills. This case is interesting in that the scene investigation suggests that the subject may have injected the nicotine (which is extremely rare), as opposed to ingesting it.

### Reference(s):

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### Nicotine Intoxication, Electronic Cigarette, Liquid Nicotine