

# Suicidal Death by Nicotine Poisoning

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Nicotine is a water-soluble alkaloid extracted from tobacco plants, and most frequently encountered in snuff, chewing tobacco, cigarettes, cigars and pipe tobacco or in a limited number of pesticides. Nicotine overdose or poisoning might be serious or fatal and lead to death; caused by cardiovascular arrest, respiratory muscle paralysis, and/or central respiratory failure due to its toxic effect. Suicide by nicotine ingestion has been rarely reported due to emetic response. We present a case of suicidal nicotine poisoning. A 56-year-old man was found dead and the postmortem examination revealed no injury or disease. We confirmed a high concentration of nicotine in the toxicological test. Through scene investigation, we determined this case as a suicidal nicotine poisoning.

**Key Words** : Nicotine, Suicide, Poisoning

## Introduction

Nicotine is a natural water-soluble alkaloid obtained from the dried leaves and stems of tobacco plants (*Nicotiana tabacum* and *Nicotiana rustica*), with amounts of 0.5%–8% by weight. Because this substance has an addictive potential, leaves or products of tobacco have been sold as snuff, chewing tobacco, cigarettes, cigars and pipe tobacco. Nicotine is also used for therapeutic purposes, such as, in

aiding the relief of withdrawal symptoms after quitting smoking, in gums or patches containing nicotine, or in electronic cigarettes. However, nicotine is also highly toxic. So much so that they are being used as a pesticide. However, in this form it rarely leads to fatalities. Paralysis of the respiratory muscle or cardiovascular collapse is considered as the mechanism of sudden death.<sup>1-3)</sup> Nevertheless, nicotine poisoning cases have been rarely reported for the past 20 years.<sup>2)</sup>

Here, we present a rare case of nicotine intoxication

with other reported cases so that we may review the characteristics and mechanisms of nicotine intoxication.

### Case Report

A 56-year-old man was found dead in his office in the morning by his wife after she hadn't seen him and he couldn't be reached for many hours. His case was reported to the police because of the uncertainty around his death. Police officers investigated the scene and his circumstances. Although they found his access records on his computer, showing that he had searched for information on toxins or drugs on the internet, they couldn't find any evidence suggesting drug ingestion. His case was subsequently consulted to our institute for postmortem examination.

Autopsy was performed three days after his body was found. His height was approximately 170 cm and his weight was approximately 62 kg. Postmortem lividity was seen on the posterior aspect of the body and postmortem rigidity was observed. No injury was identified.

No injury was identified on soft tissue layers, skeleton, and internal organs. Mild edema with congestion was observed on the brain. The heart weighed 470 g with hypertrophy and moderate atherosclerosis was formed in the coronary artery. The



Fig. 1. Gastric contents shows semi-digested food material mixed with brownish fluid.

myocardium didn't show any fibrosis or necrosis. Mild fatty change was identified in the liver. In the stomach, only semi-digested contents were revealed (Fig. 1). The esophageal mucosa showed mild coagulation necrosis, and pinkish mucosal change was also observed over the entire gastric mucosa (Fig. 2).

Blood samples from the heart and the femoral vein, and gastric content samples were collected for toxicological tests. They were analyzed with gas chromatography–mass spectrometry or liquid chromatography tandem–mass spectrometry. Screening for various drugs such as agricultural drugs, cyanide, antidepressants, or sedatives were done but the results were negative for those drugs. Nicotine was detected from blood samples and the gastric contents, and the concentration of nicotine in peripheral blood was 58 mg/L which is assumed as being lethal. Alcohol was detected and the blood alcohol concentration was 0.192% in the peripheral blood.

### Discussion

Nicotine has been one of the critical culprit chemicals for smokers. Because of its dependence and addiction smokers have to absorb about 1 mg per cigarette.<sup>3)</sup> But nicotine can also be one of the most toxic of all of the poisons with a rapid onset of

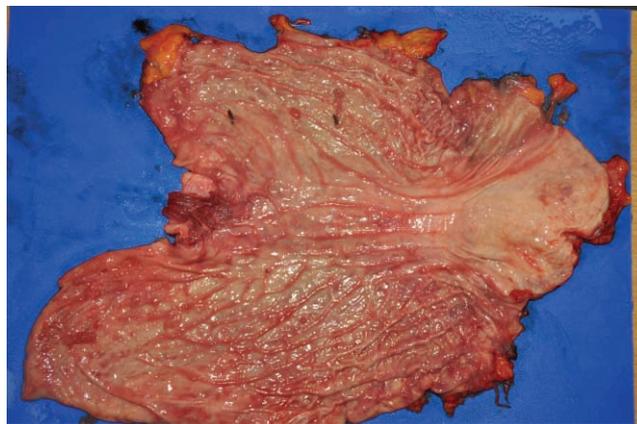


Fig. 2. The esophageal mucosa showed mild coagulation necrosis, and pinkish mucosal change is also observed over the entire gastric mucosa.

symptoms<sup>4,5</sup> which can be fatal deaths, even though death due to the ingestion of nicotine might not be common due to the delayed absorption of nicotine by its emetic effects.

Nicotine can be absorbed following inhalation, ingestion, or dermal contact and then rapidly absorbed through the skin, alveoli, or oropharyngeal mucosa, and the gastrointestinal mucosa. It enters the arterial circulation and quickly moves to the brain. Nicotine readily diffuses into tissue, where it binds to nicotine-acetylcholine receptors and acts mainly on the central nervous system.<sup>1,2,6</sup> Nicotine is transformed with oxidation to inactive metabolites such as cotinine in the liver which has approximately 10 times the half-life of nicotine (20 hours), which can be a better marker than nicotine itself. About 5% of the absorbed nicotine are not modified and excreted in urine within 24 hours.<sup>2,6</sup>

The nicotine dose-response relationship is complex. Nicotine effects stimulant and depressant reactions. Low doses stimulate the neural and cardiovascular systems, whereas high doses have a depressive effect. For example, low doses of nicotine induce central or peripheral nervous system stimulation with arousal and an increase in heart rate or blood pressure. At high doses, nicotine causes ganglionic blockade resulting in bradycardia, hypotension, and depressed mental status. Overdoses can depress respiration and cause death by respiratory failure.<sup>7</sup>

The lethal dose of nicotine for adults has been known as 40–60 mg (0.5–1.0 mg/kg body weight). Fatalities have been reported from ingestion of 30 g tobacco and 0.8 g of snuff. Nicotine poisoning by oral self-administration or intravenous injection of nicotine solution or nicotine liquid used in e-cigarettes, applying transdermal nicotine patches, ingestion of nicotine pesticides, excessive smoking were reported, as well as accidental swallowing or ingestion of tobacco or tobacco products by children, ingestion of salads containing wild tobacco, boiled tobacco water enemas for intestinal parasites, or toxic dermal absorption of tobacco harvesters.<sup>1–3,6</sup> Based on these

cases, unknown bottles or nicotine labeled bottles could be found at the scene, and on postmortem examination, uncertain patches might be identified on external examination or unknown liquid or fine-cut tobaccos might be seen in the stomach. Any specific pathological findings of esophagus or stomach have not been reported but according to an animal experiment with rats, bleeding gastric ulcer with prominent loss of gastric mucosal surface was identified.<sup>8,9</sup> Two to four drops (23–33 mg per drop) of pure nicotine can prove fatal.<sup>1,2</sup> In our case, even though the deceased searched out information on toxins and drugs (including potassium cyanide, castor bean, pyroligneous liquor, paraben, and globefish toxin) police officers couldn't find any consolidating evidence of drug ingestion at the scene. However, based on postmortem findings of esophageal mucosal change with necrosis, gastric contents which were positive for nicotine, no evidence of a needle mark, and high blood concentration of nicotine, the findings suggest nicotine poisoning by oral administration.

Although recipes for extraction of nicotine from tobacco are easily found on the internet<sup>10</sup> and nicotine liquid can be bought easily as refill for e-cigarettes, suicidal nicotine poisoning is rarely reported in our country. We assume that it is because tobacco is such a commonly used substance that it might be regarded as just a harmful chemical related to chronic diseases, but not as a fatal poison leading to sudden death. In addition, it is also reported as a potential chemical weapon because it is highly toxic and can be purchased without restriction.<sup>3</sup> Therefore, careful concern and restriction against uncontrolled administration of high doses of nicotine should be required.

In summary, nicotine is a highly toxic chemical that might be fatal. It is not easy to predict poisoning if there is no evidence of drug ingestions at the scene, even through a thorough and meticulous investigation. It can be also overlooked and considered as a case of sudden cardiac death. Nevertheless, on postmortem examination, if uncertain patches were applied on the

skin, fine-cut cigarettes/butts or smelled liquid were found in the stomach with certain degree of mucosal change, those findings can be helpful in considering the possibility of nicotine poisoning.

#### Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

#### References

1. Corkery JM, Button J, Vento AE, et al. Two UK suicides using nicotine extracted from tobacco employing instructions available on the Internet. *Forensic Sci Int* 2010;199:e9-13.
2. Solarino B, Rosenbaum F, Riesselmann B, et al. Death due to ingestion of nicotine-containing solution: case report and review of the literature. *Forensic Sci Int* 2010;195:e19-22.
3. Cervellin G, Luci M, Bellini C, et al. Bad news about an old poison: a case of nicotine poisoning due to both ingestion

- and injection of the content of an electronic cigarette refill. *Emerg Care J* 2013;9:e18.
4. Eberlein CK, Frieling H, Kohnlein T, et al. Suicide attempt by poisoning using nicotine liquid for use in electronic cigarettes. *Am J Psychiatry* 2014;171:891.
5. Fukumoto M. Nicotine and cotinine. In: Suzuki O, Watanabe K, eds. *Drugs and poisons in humans: a handbook of practical analysis*. Berlin: Springer Verlag, 2005: 499-508.
6. Lardi C, Vogt S, Pollak S, et al. Complex suicide with homemade nicotine patches. *Forensic Sci Int* 2014;236:e14-8.
7. Benowitz NL. Clinical pharmacology of nicotine: implications for understanding, preventing, and treating tobacco addiction. *Clin Pharmacol Ther* 2008;83:531-41.
8. Dettmeyer R. *Forensic histopathology: fundamentals and perspectives*. Berlin: Springer; 2011. p. 128.
9. Chowdhury P, Hosotani R, Chang L, et al. Metabolic and pathologic effects of nicotine on gastrointestinal tract and pancreas of rats. *Pancreas* 1990;5:222-9.
10. Schneider S, Diederich N, Appenzeller B, et al. Internet suicide guidelines: report of a life-threatening poisoning using tobacco extract. *J Emerg Med* 2010;38:610-3.