

Clinical Conundrum:

Acute management of nicotine toxicity in children

Background:

Nicotine is one of the most toxic of all known poisons. In addition to smoking cessation adjuncts such as nicotine gum and transdermal patches that have been used (and abused) for decades, the use of e-cigarettes has dramatically increased in the last decade. E-cigarette replacement cartridges contain a **very potent nicotine concentrate** (1.8 % or 1.8 mg/dl). The incidence of pediatric nicotine poisoning has increased significantly with the introduction of **e-cigarettes** and the availability of their high concentration, high volume nicotine refill solutions (often **brightly-colored and fragrant, resembling candy**). Ingesting as little as one teaspoon of these contents could kill a 90 kg adult. In comparison, a small child need only ingest the nicotine contained in a withered butt of a used cigarette in order to experience toxic symptoms.

Findings:

- 1.) A total of 1,700 exposures were reported to U.S. Poison Centers between June 1, 2010 and September 30, 2013. The most frequent age groups were children 5 years or below with 717 (42.2%) exposures and adults ages 20-39 years with 466 (27.4%) exposures. Exposures increased by 9.60 per month from January through September 2013.
- 2.) The **oral** lethal dose of nicotine in humans is less than **5 mg per kg** of body weight.
- 3.) Nicotine poisoning typically produces toxicity in two phases: **stimulation/excitation** (early, 15 mins to 1 hr) followed quickly by **inhibition/depression** (late, 30 mins to 4 hrs). Death may occur within 1 hour after severe exposure.
- 4.) At low concentrations, nicotine causes tremor and increases in heart rate, respiratory rate, blood pressure, and level of alertness. More severe exposures cause **muscle fasciculations, seizures, bronchorrhea, and abnormal heart rhythms; these effects are followed by multi-system organ depression including bradycardia, hypotension, and respiratory muscle paralysis**. Vomiting occurs in more than 50% of symptomatic patients. Death is typically due to **respiratory muscle paralysis, bronchorrhea, and/or cardiovascular collapse**.
- 5.) There is no specific antidote for nicotine poisoning, and treatment is largely **supportive**. **Fluid resuscitation** should be initiated for hypotensive patients, with **vasopressors** ready for refractory cases. **Benzodiazepines** are useful in treating seizures. Respiratory depression/arrest may require **non-invasive mechanical ventilation or endotracheal intubation**. Although specific to muscarinic (rather than nicotinic) acetylcholine receptors, **atropine** (0.2 mg/kg, rather than standard ACLS dosing) has been shown in some cases to improve early cholinergic symptoms. Patients should be **observed for a minimum of 4-6 hours after oral and/or dermal exposure**.

Conclusions:

References

- 1.) Cantrell, Lee. "Nicotine Poisoning." The Official Newsletter of the California Poison Control System. Vol 3, No 2.. Summer 2005.
- 2.) Centers for Disease Control and Prevention. "NICOTINE: Systemic Agent." The Emergency Response Safety and Health Database. http://www.cdc.gov/niosh/ershdb/emergencypresponsecard_29750028.html
- 3.) Bassett R.A., Osterhoudt K., Brabazon T. "Nicotine Poisoning in an Infant." N Engl J Med 2014; 370:2249-2250, June 5, 2014
- 4.) Hardison LS Jr., Holstege CP., Vakkalanka JP. "Epidemiological trends in electronic cigarette exposures reported to U.S. Poison Centers." Clin Toxicol (Phila), 2014 Jun; 52(5):542-8

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Nicotine is one of the most powerful of all known toxins. Yet, its use (and abuse) is ubiquitous throughout society via tobacco products. With the recent advent of e-cigarette use – with their highly concentrated, readily available (often colorful and sweet-smelling) refill solutions – the incidence of toxic pediatric nicotine ingestion has increased significantly. Emergency physicians should be aware of the serious and rapidly fatal potential of these poisonings, requiring careful and adequate observation as well as aggressive symptomatic management.

References

- 1.) Cantrell, Lee. "Nicotine Poisoning," The Official Newsletter of the California Poison Control System. Vol 3, No 2.. Summer 2005.
- 2.) Centers for Disease Control and Prevention. "NICOTINE: Systemic Agent." The Emergency Response Safety and Health Database. http://www.cdc.gov/niosh/ershdb/emergencypresponsecard_29750028.html
- 3.) Bassett R.A., Osterhoudt K., Brabazon T. "Nicotine Poisoning in an Infant." N Engl J Med 2014; 370:2249-2250, June 5, 2014
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