Risks of Electronic Cigarettes Include Unintentional Ingestion of Liquid Nicotine

BY JEFF BAUER

A recent case report of a 6-year-old girl who developed severe toxicity and required intubation after an unintentional exposure to liquid nicotine emphasizes a potential danger of commercially available liquid nicotine, which is highly concentrated, unreliably packaged, and poorly regulated.

Liquid nicotine is commonly sold in concentrated "refill" solutions intended for electronic cigarette users to dilute themselves. Previous studies have found that these refill products have unreliable commercial labeling, and that the actual nicotine concentration of these solutions can vary widely from the advertised concentration.

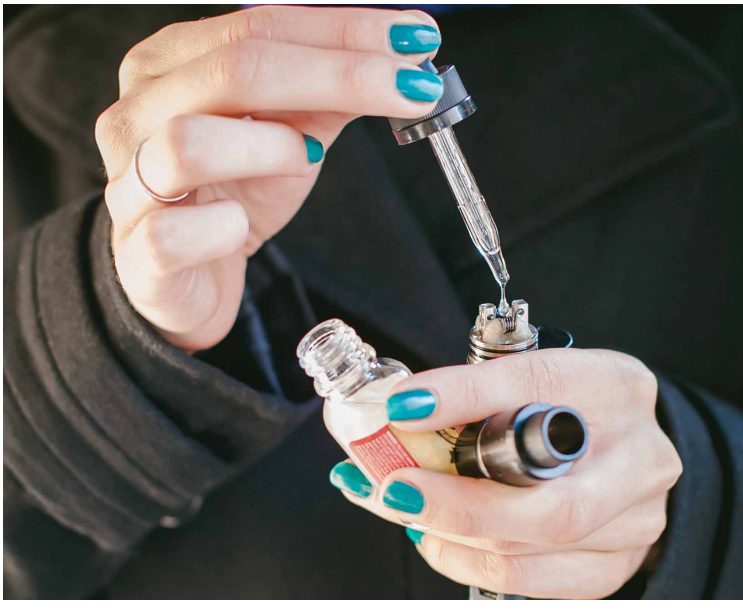
In this case report, the girl's mother had purchased a concentrated nicotine solution online and had used an empty ibuprofen bottle, which she relabeled as "NIC," to dilute the solution. Afterward, the patient's father gave his daughter a 10-mL dose of the liquid from the repurposed bottle, believing it to be ibuprofen. Immediately upon consumption, the girl experienced a burning sensation in her mouth and throat. When the father tasted the liquid, he realized it contained the nicotine solution.

Within 5 minutes of the ingestion, the patient's father called the regional poison control center and emergency medical services, while the girl's mother attempted to manually induce vomiting, which produced only a small amount of emesis. When the paramedics arrived, the girl was conscious and breathing spontaneously, but she did not respond to questions or follow commands. The only intervention the paramedics performed was insertion of a peripheral intravenous line.

The girl arrived at the ED approximately 25 minutes after having ingested the nicotine. Her vital signs were: temperature, 95.4°F; heart rate (HR), 140 to 150 beats/min; and blood pressure, 93/70 mm Hg. Oxygen saturation was 95% on room air. She was alternately agitated and unresponsive. Her HR decreased to 60 beats/min, and she developed vomiting, diaphoresis, fasciculations, obtundation, and copious secretions. She was given ondansetron (0.1 mg/kg) and lorazepam (0.05 mg/kg), and within 6 minutes from arrival, she was sedated and intubated. Activated charcoal (25 g) was administered via nasogastric tube, and she was admitted to the pediatric intensive care unit.

Laboratory results from blood drawn upon the girl's arrival at the ED indicated elevated lactate, creatinine, and potassium levels. A serum sample obtained 60 minutes after the girl had ingested the liquid was notable for elevated levels of nicotine (348 ng/mL). With the parents' permission, the liquid in the ibuprofen container was analyzed and found to contain nicotine, 70.3 mg/mL, which meant the girl had consumed 703 mg of nicotine, or 35 mg/kg. A recent review suggested a fatal nicotine dose of 500 to 1,000 mg in adults. Assuming the mother had correctly diluted the liquid nicotine by half as she had intended to, the original product's nicotine concentration was 140.6 mg/mL, or 234% of the amount listed on the package (60 mg/mL).

The girl remained sedated and intubated overnight without requiring additional medication or treatment. She was extubated the next morning. Her lactate, creatinine, and potassium levels returned to normal, and electrocardiography and chest radiography results were normal. She was discharged home in stable condition. The Department of Human Services conducted a brief



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investigation, which they closed when the patient was discharged.

The authors of this case report concluded that emergency physicians (EPs) should be aware of the widespread availability of liquid nicotine products, and the potential of severe toxicity from ingestion of liquid nicotine.

Noble MJ, Longstreet B, Hendrickson RG, Gerona R. Unintentional pediatric ingestion of electronic cigarette nicotine refill liquid necessitating intubation. *Ann Emerg Med*. 2017;69(1):94-97. doi:10.1016/j.annemergmed.2016.08.448.

Emergency Radiologists' Job Satisfaction Tied to How Often They Have to Work Overnight Shifts

BY JEFF BAUER

According to a recent survey of emergency radiologists, those who frequently work overnight shifts are less likely to be satisfied with their job than counterparts who work fewer or no overnight shifts.

Approximately 1,100 emergency radiologists received an e-mail invitation to complete an online survey; 327 did so (29.6% response rate). Seventy-three percent of respondents were male, 69% were age 40 years or older, and 87% practiced full-time. Respondents were asked to rate statements such as "I enjoy my job" and "At times I feel overwhelmed at work" on a Likert scale from "disagree or strongly disagree" to "agree or strongly agree."

Overall, 81% of respondents reported some measure of job enjoyment. There was an association between the average number of overnight shifts performed per year and job enjoyment. Emergency radiologists who did no overnight shifts were 2.21 times more likely to report enjoying their job than those who worked 17 weeks or more of overnight shifts a year.

Hanna TN, Shekhani H, Lamoureux C, et al. Emergency radiology practice patterns: shifts, schedules, and job satisfaction. *J Am Coll Radiol*. 2016. Dec 4. [Epub ahead of print]. doi:10.1016/j.jacr.2016.09.018.

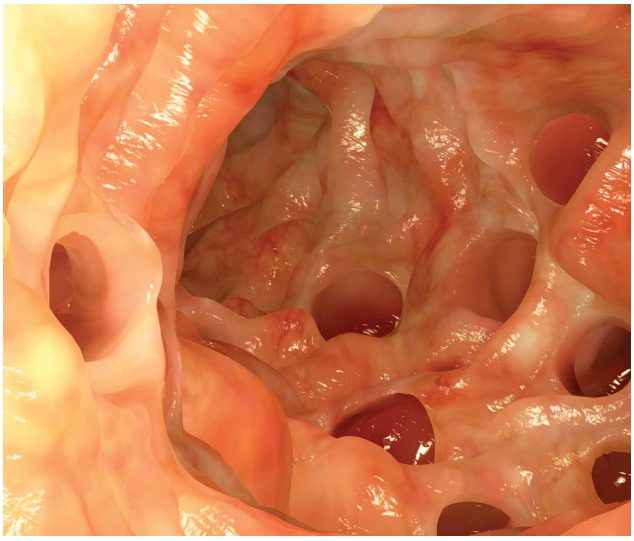
Discharging Select Diverticulitis Patients From the ED May Be Acceptable

DOUG BRUNK

FRONTLINE MEDICAL NEWS

Among patients diagnosed with diverticulitis via computed tomography (CT) scan in the ED who were discharged home, only 13% required a return visit to the hospital, results from a long-term retrospective analysis demonstrated.

"In select patients whose assessment includes a CT scan, discharge to home from the emergency department with treatment for diverticulitis is safe," study author Anne-Marie Sirany, MD, said at the annual meeting of the Western Surgical Association.



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According to Dr Sirany, a general surgery resident at Hennepin County Medical Center, Minneapolis, diverticulitis accounts for about 150,000 hospital admissions per year in the United States, and only 15% of these patients require surgical intervention. However, between 2006 and 2011, ED visits for diverticulitis increased by 21%, and the annual direct medical cost related to the condition is estimated to exceed $1.8 billion. At the same time, medical literature regarding uncomplicated diverticulitis is scarce. "Most of the literature focuses on complicated diverticulitis, which includes episodes associated with extraluminal air, free perforation, abscess, fistula, obstruction, and stricture," Dr Sirany said.

A few years ago, researchers conducted a randomized trial to evaluate the treatment of uncomplicated diverticulitis. Patients were diagnosed with diverticulitis in the ED and randomized to either hospital admission or outpatient management at home. The investigators found no significant differences between the readmission rates of the inpatient and outpatient groups, but the health care costs were three times lower in the outpatient group. Dr Sirany and her associates set out to compare the outcomes of patients diagnosed with and treated for diverticulitis in the ED who were discharged to home, versus those who were admitted to the hospital. They reviewed the medical records of 240 patients with a primary diagnosis of diverticulitis by CT scan

who were evaluated in the ED at one of four hospitals and one academic medical center from September 2010 to January 2012. The primary outcome was hospital readmission or return to the ED within 30 days, while the secondary outcomes were recurrent diverticulitis or surgical resection for diverticulitis.

The mean age of the 240 patients was 59 years, 45% were men, 22% had a Charlson Comorbidity Index (CCI) of >2, and 7.5% were on corticosteroids or immunosuppressant medications. More than half (62%) were admitted to the hospital, while the remaining 38% were discharged home on oral antibiotics. Compared with patients discharged home, those admitted to the hospital were more likely to be older than 65 years (43% vs 24%, respectively; $P = .003$), have a CCI of 2 or greater (28% vs 13%; $P = .007$), were more likely to be on immunosuppressant or steroid medications (11% vs 1%; $P = .003$), show extraluminal air on CT (30% vs 7%; $P < .001$), or show abscess on CT (19% vs 1%; $P < .001$). "Of note: We did not have any patients who had CT scan findings of pneumoperitoneum who were discharged home, and 48% of patients admitted to the hospital had uncomplicated diverticulitis," she said.

After a median follow-up of 37 months, no significant differences were observed between patients discharged to home and those admitted to the hospital in readmission or return to the ED (13% vs 14%), recurrent diverticulitis (23% in each group), or in colon resection at subsequent encounter (16% vs 19%). "Among patients discharged to home, only one patient required emergency surgery, and this was 20 months after their index admission," Dr Sirany said. "We think that the low rate of readmission in patients discharged home demonstrates that this is a safe approach to management of patients with diverticulitis, when using information from the CT scan."

Closer analysis of patients who were discharged home revealed that six patients had extraluminal air on CT scan, three of whom returned to the ED or were admitted to the hospital. In addition, 11% of those with uncomplicated diverticulitis returned to the ED or were admitted to the hospital.

Dr Sirany acknowledged certain limitations of the study, including its retrospective design, a lack of complete follow-up for all patients, and the fact that it included patients with recurrent diverticulitis. "Despite the limitations, we recommend that young, relatively healthy patients with uncomplicated findings on CT scan can be discharged to home and managed as an outpatient," she said. "In an era where there's increasing attention to health care costs, we need to think more critically about which patients need to be admitted for management of uncomplicated diverticulitis."

Microsensor Perfectly Distinguished Coagulopathy Patients From Controls

AMY KARON

FRONTLINE MEDICAL NEWS

Using less than a drop of blood, a portable microsensor provided a comprehensive coagulation profile in <15 minutes and perfectly distinguished various coagulopathies from normal blood samples—handily beating the results from both activated partial thromboplastin time (aPTT) and prothrombin time (PT).

Dubbed ClotChip, the disposable device detects coagulation factors and platelet activity using dielectric spectroscopy, Evi X. Stavrou, MD, said at the annual meeting of the American Society of Hematology. The development points the way for comprehensive, rapid, point-of-care (POC) assessment of critically ill or severely injured patients and those who need ongoing monitoring to evaluate response to anticoagulant therapy, she added.

Existing POC coagulation assays have several shortcomings, Dr Stavrou, of Case Western Reserve University, Cleveland, said during a press briefing at the conference. They are relatively insensitive, fail to measure platelet activity, or are only approved for specific subgroups of patients, such as those on warfarin, she specified.

To develop an alternative, Dr Stavrou and her associates added a parallel-plate capacitive sensing structure to an inexpensive, disposable microfluidic biochip designed to test 9 microliters (less than one drop) of blood. They built the microsensor from biocompatible and chemically inert materials to minimize the chances of artificial contact activation.

To test the device, the researchers used calcium dichloride to induce coagulation in whole blood samples from 11 controls with normal aPTT and PT values. Time curves of output from the microsensor showed that coagulation consistently peaked within 4.5 to 6 minutes.

Next, the investigators tested blood from 12 patients with coagulopathies, including hemophilia A, hemophilia B, acquired von Willebrand factor defect, and congenital hypodysfibrinogenemia. These samples all yielded abnormal curves, with prolonged times to peak

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that ranged between 7 and 15 minutes—significantly exceeding those of healthy controls ($P = .002$).

By plotting rates of true positives against rates of true negatives, the researchers obtained areas under the receiver-operating curves of 100% for ClotChip, 78% for aPTT, and 57% for PT. In other words, ClotChip correctly identified all cases and controls in this small patient cohort, while neither aPTT nor PT did.

Finally, the researchers used the microsensor to measure coagulation activity in normal blood samples that they treated with prostaglandin E_2 to inhibit platelet aggregation. Normalized permittivity (an electrical measure) was significantly lower than in untreated control samples ($P = .03$), but time-to-peak values were the same in both groups. This finding confirms the chip can identify abnormal platelet function, Dr Stavrou said. "ClotChip is sensitive to the complete hemostasis process, exhibits better sensitivity and specificity than conventional coagulation assays, and discriminates between coagulation and platelet defects," she concluded.

The investigators are recruiting volunteers for an expanded round of testing for the device, and are working to optimize construction to further enhance its sensitivity.

Survey: Overprescribing Is the Cause of the Opioid Crisis

M. ALEXANDER OTTO
FRONTLINE MEDICAL NEWS

Almost a third of doctors blamed overprescribing as the cause of the opioid crisis, according to a survey of 225 US primary care, emergency medicine, and pain management physicians by InCrowd, an online physician survey company.

Respondents said their and other physicians' overprescribing is the single biggest factor fueling the leap in opioid abuse over the past 5 years.

"We were told…that [opioids] wouldn't be addictive in the great majority of patients. This was obviously wrong," said a Utah EP in practice for 38 years. Meanwhile, 24% of the respondents cited aggressive patient drug-seeking as the primary cause, and 18% blamed drug dealers.

In short, the survey pointed out what front-line doctors think needs to be fixed as the nation combats prescription opioid abuse and the subsequent heroin epidemic. Their insights "should be a rallying cry" for changes in 2017, said epidemiologist Diane Hayes, PhD, president and cofounder of InCrowd.

Making pain the "fifth vital sign" and allowing patients to downgrade doctors on surveys if they don't prescribe or refill opioid prescriptions compounded the situation. Lengthy waits for specialists with better pain options, many of whom are not covered by Medicaid or the Affordable Care Act, also added to the problem, survey respondents said.

"We're caught in the middle" between the Joint Commission on Accreditation of Healthcare Organization's fifth vital sign and overprescribing, a primary care physician (PCP) said.

Seventy-three percent of survey respondents said that they want opioid alternatives, noting exasperation with nonsteroidal anti-inflammatory drugs, physical therapy, and exercise. About half recommend behavioral health interventions, while 20% recommend vitamin and herbal supplements. Only 10% recommend medical marijuana, probably because it is inaccessible to most US patients.

Meanwhile, the respondents said they want opioid prescribing "hemmed in." Almost two-thirds wanted refill limits and more frequent refill evaluations, and many agreed that there needs to be a weaning protocol before the drugs are even started. Some wanted to limit advertising.

Easton Jackson, MD, a PCP in West Valley City, Utah, who answered the survey, helped make the answers real by sharing his thoughts.

"We need to recognize that…people don't set out to get addicted to opioids….We need to educate [patients] and assist them with their expectations. They need to understand that they're going to have pain from surgery and injuries. Our goal isn't to make them pain-free. It's to manage their pain," he said.

"We as physicians need to write for fewer pills and in lower doses. We need to see our patients back sooner. If it's not working, stop increasing the dose and instead taper the patient off the medication. We need to be familiar with the adjuvant therapies. As easy as it is to say, 'send them all to the pain specialist,' there simply aren't enough of them around," Dr Jackson said.

Physician respondents to InCrowd's opioid survey have practiced an average of 25 years, and were scattered around the United States. They filled out the four-question survey during October 27 to 28, 2016. They signed up to receive and answer InCrowd's questions, and were paid nominally for their time.

Half (50%) of respondents estimated that they prescribed opioids to <10% of their patients; 38% said they prescribed to less than half of their patients; and

12% estimated they prescribed opioids to more than half of their patients.

Adding Respiratory Rate to Triage Criteria Improves Accurate Staging of Chest Trauma Patients

MICHELE G. SULLIVAN

FRONTLINE MEDICAL NEWS

Adding respiratory rate (RR) and suspected blunt chest injury to a trauma assessment in the field significantly improved the appropriate triaging of level III trauma patients.

When the assessment specifically evaluated for tachypnea in the setting of blunt chest injury, undertriaging improved by 1.2%, John Yonge, MD, said at the annual clinical congress of the American College of Surgeons.

"When we applied this new criteria to our 10-year study, we identified 661 patients who should have been activated as a level I or level II," but instead were assessed as less critically injured, Dr Yonge said in an interview. This initial misstep significantly extended the time before patients could have critical surgical procedures and was related to higher mortality among them.

Dr Yonge, a surgical fellow at Oregon Health & Science University (OHSU), Portland, and his mentor Martin Schreiber, MD, conducted the retrospective study of 7,880 trauma patients admitted at level III activation from 2004 to 2014. The OHSU trauma system has three activation levels.

- Level I activations are reserved for the most critically injured patients; attending trauma surgeon and anesthesiologist presence is mandatory.
- Level II activations capture moderate-to-severe injuries; trauma surgeon and respiratory therapist presence is mandated.
- Level III activations are designed to capture patients who do not require an immediate lifesaving intervention; the presence of the trauma surgery chief resident and attending emergency medicine physician is mandatory.

Patients were considered undertriaged if they were admitted as level III activations, but then required a critical intervention (chest tube placement, intubation, needle thoracostomy, or intracranial pressure monitoring) in the ED or ultimately met level I or II activation criteria.

Among all the level III patients, 466 (6%) were undertriaged: 390 were undertriaged based on the existing level I or II activation criteria, and 76 were considered undertriaged based on the need for a critical intervention.

Most of the undertriaged patients (65%) met criteria for level I activation; the rest should have been triaged as level II patients. Compared with appropriately staged level III patients, mortality among the undertriaged patients was significantly higher (3.2% vs 0.6%). Undertriaged patients also experienced longer delays before initiation of major emergency surgery: a mean of 147 minutes, compared with 106 minutes for appropriately triaged level I patients and 62 minutes for appropriately triaged level II patients.

Dr Yonge then looked for clinical measures that would improve triage. Tachypnea (RR >20 breaths/min) in the field stood out as a significant factor. Tachypneic patients who had a suspected chest injury were 70% more likely to be undertriaged than were those with a normal RR. Tachypnea was significantly associated with a diagnosis of flail chest, ED intubation, and chest-tube placement.

The team then constructed a new triage criterion for patients with suspected chest injury—tachypnea combined with suspected blunt thoracic injury. By applying that model to their study population of level III patients, they determined that the level III undertriage rate would be reduced by 1.2%.

Tying the physiological marker of tachypnea to a suspected clinical diagnosis is a key factor, Dr Yonge noted. "Just adding tachypnea doesn't help us. In fact, it would overwhelm us, because a trauma patient could very well be tachypneic because he's experiencing panic. But tying it to a suspected clinical diagnosis gives us a meaningful result."

He confirmed this linkage with an additional analysis. "We looked to see how severely injured these patients were and found that 71% of them had an Abbreviated Injury Score (AIS) to the chest of 3 or more, indicating a severe chest injury. Only 29% had an AIS of 2 or less. So this proves that respiratory rate is a valid triage criterion and can be used to identify patients who need a higher level of trauma care."

The challenge now, Dr Yonge said, is incorporating the marker into clinical practice. "It doesn't matter how many statistics you do, if you can't educate the prehospital providers in this, it's useless. They are the crux of the trauma system."

Although national guidelines do recommend assessing RR as part of field triage, it often isn't recorded or is only estimated, Dr Yonge said. That's one reason he used the 20 breaths/min cutoff rate. "It doesn't even take a full minute to assess this, but it can make a big improvement in care."