

## Use of lemon juice to increase crack cocaine solubility for intravenous use.

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## Letters to the Editor

### USE OF LEMON JUICE TO INCREASE CRACK COCAINE SOLUBILITY FOR INTRAVENOUS USE

#### To the Editor:

Crack cocaine is not only being smoked, but it is also being dissolved and injected by some drug users (1). In its non-ionized form, crack cocaine is not readily dissolved for intravenous use. The addition of weak acids (lemon juice, lime juice, vinegar, and ascorbic acid) to the crack cocaine increases its solubility and allows for injection (2). We describe a case of infection and abscess formation in a woman after skin popping with crack cocaine and lemon juice.

#### CASE REPORT

A 46-year-old woman was admitted through the Emergency Department (ED) with bilateral lower extremity skin abscesses. They had been present for 1 month, but were worse for 2 days before evaluation. She complained of pain and fever of 39.4°C (103°F) at home. She reported a previous history of spider bites to both lower extremities, but denied recent illnesses or use of antibiotics. The past medical history was significant for hepatitis B and gastritis. She reported one-half pack per day cigarette use, social alcohol use, and intravenous drug use for 30 years, but initially she strongly denied current drug use.

On physical examination, she was non-toxic in appearance, but she looked somewhat malnourished and anxious. Initial vital signs were: blood pressure 96/60 mm Hg, pulse rate 104 beats/min, respiratory rate 18 breaths/min, oxygen saturation 96% on room air, and temperature 36.4°C (97.5°F). The neck was supple. The cardiac examination demonstrated mild sinus tachycardia with no murmurs. The lungs were clear. The abdomen was soft and non-tender. Examination of the lower extremities uncovered two ulcerated abscesses on the right leg and one abscess on the left leg, with erythema and purulent drainage. Capillary refill and pulses were normal distal to the abscesses.

A chest X-ray study was normal. The electrocardiogram was remarkable only for sinus tachycardia. Labo-

ratory tests were remarkable for an elevated white cell count at 16,530/uL. Blood cultures were negative, but abscess cultures were positive for methacillin-sensitive *staphylococcus aureus* and  $\alpha$ -hemolytic *streptococcus*. Hepatitis and human immunodeficiency virus screens were negative. Transthoracic echocardiogram did not demonstrate endocarditis. A urine drug-of-abuse screen was positive for cocaine metabolite, opiates, and benzodiazepines. The patient admitted to using crack cocaine dissolved with lemon juice and injecting the drug subcutaneously at the abscess sites. The patient was initially started on vancomycin, but quickly transitioned to oral trimethoprim/sulfamethoxazole when culture and sensitivity results became available. The patient's hospital course was unremarkable, and she was discharged on oral antibiotics with a referral to substance abuse rehabilitation.

#### DISCUSSION

Crack cocaine is being injected by a significant number of US drug users (3). One study documents rates as high as 27% of intravenous drug users who reported intravenous use of cocaine within the past year (4). Another small study records 73% (5). The phenomenon is particularly worrisome because it is associated with more high-risk behavior, such as sharing needles and having unprotected sex, than other intravenous drugs (4,6,7). Cocaine is processed from the *Coca* (*Erythroxylon*) plant, and has been used for thousands of years as a central nervous system stimulant, for treatment of altitude sickness, and as an appetite suppressant. Historically, cocaine was taken by either smoking the leaves or sucking on a wad (quid) of leaves. *Coca* leaves typically contain < 1% cocaine by weight, which can be extracted and purified as a positively charged salt. In this powder form, cocaine is ionized, hydrophilic, and water soluble. Because it readily dissolves on moist mucous membranes, it can be snorted intranasally. It also can be injected intravenously or subcutaneously, referred to as “skin popping.”

Free-base and crack cocaine were modifications designed to produce a form of cocaine that could be smoked. Smoking cocaine leads to a more rapid and intense euphoria after use. Such cocaine formulations are easily vaporized at

high temperatures without losing their pharmacologic properties. They can be smoked in a water pipe to produce an intense high within seconds after smoking. It is, however, not very soluble in water, making oral, intranasal, intravenous, or subcutaneous use less possible. Crack is a form of free-base cocaine prepared by heating an ionized cocaine solution with sodium bicarbonate (baking soda). This process generates the cracking sound, which is the basis for the name, when water and carbon dioxide are produced as the cocaine is heated. The resulting compound forms solid chunks that can be broken into “rocks.” Crack, being non-ionized, is usually smoked, and produces the intense, short-lived euphoria that cocaine abusers seek (8).

Because cocaine exists in equilibrium as the acid salt (powdered cocaine) and as a free base (crack cocaine), the predominant form depends on the pH of the solution. In its free-base form, the molecule is uncharged and does not readily dissolve in an aqueous solution like water. When the free base reacts with an acid solution, it accepts a hydrogen ion (H<sup>+</sup>) and forms the charged polarized salt, which is water soluble.

Two forces seem to motivate crack injection, greater availability of crack and the desire for greater psychoactive effects. Injection of cocaine produces an intense exhilarating rush, although the euphoria passes quickly as the liver and plasma esterases rapidly metabolize the drug. Intravenous cocaine leads to a more rapid and prolonged euphoria after use, sometimes lasting over an hour compared to the 10–15 minute high experienced from smoking crack. In addition, intravenous drug users had been mixing a combination of cocaine and heroin together, referred to as “speedball,” to give its user the stimulant feeling of cocaine followed by the depressant effects of heroin. As the availability of powder cocaine began to decrease in many areas, speedball users, left without one of their crucial ingredients, turned to the use of crack cocaine. As previously mentioned, crack cocaine is not very soluble in water, making its use as an intravenous or subcutaneous agent difficult. However, street chemists soon determined that by mixing crack with an appropriate weak acidic solvent, cocaine will regain the positive hydrogen ion and transform into the more hydrophilic salt. Water is added before the solution is injected (5).

Crack injectors employ a wide range of practices and materials to prepare crack for injection (1). Various acidic solutions are used to inject the crack cocaine, including lemon and lime juice, citric acid, vitamin C (ascorbic acid), and vinegar (acetic acid) (9). These solutions can not only be purchased at most supermarkets and convenience stores, but small packets can be obtained free at most fast-food restaurants. As skin abscesses, both infected and sterile, are common sequelae of intravenous drug

abuse, infection control efforts have begun to make packets of sterile ascorbic acid available with needle exchange programs. This is an attempt to not only decrease infection rates, but because ascorbic acid is gentler on the venous circulation than other weak acids, to decrease direct local tissue damage (10,11). Lemon juice when injected has been associated with fungal endocarditis and endophthalmitis (9).

## CONCLUSIONS

There has been an increase in the frequency of injecting crack cocaine by drug users in the United States. Lemon juice, lime juice, vinegar, and vitamin C liquid are common adulterants used by drug users in an attempt to increase the solubility of crack cocaine for subcutaneous or intravenous use. These may increase the frequency of both infection and abscess formation. It is recommended that this entity be considered in the differential diagnosis of abscess formation.

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## □ GIVING A HAND FOR NIAS: A TESTIMONY OF RELIEF WORK DURING THE NIAS EARTHQUAKE DISASTER

### □ To the Editor:

Shukor, the hired driver, stopped the truck and cried. Sweating and breathing fast, he closed his eyes and tried hard to calm down. He was maneuvering a rickety bridge slanting at 40 degrees (Figure 1) as a group of six volunteers from Yayasan Salam, Malaysia made their way to help disaster victims at Teluk Dalam located south of Nias, Western Indonesia 4 days after an earthquake measuring 8.7 on the Richter scale on March 28, 2005. The quake left 200,000 people in need of food and other relief, and 1313 people died (1). We hoped our truck, which was loaded to the roof with rice sacks, water, and medicine, did not topple and add to the number of deaths in this disaster.



Figure 1. Maneuvering the truck through the damaged bridge.

I patted Shukor's back and said, "tenang saja . . . anda pasti bisa" (just calm down . . . you'll make it). Our logistician, Jabez John Milason, was in front guiding the driver to pass the bridge with a river running underneath. A group of villagers, trying to help, clung to one side of the tall truck to provide balance. After 15 min of palpitations, great fear and care, Shukor made it, spent and relieved. The villagers clapped their hands. Syed Hadi Alattas, an Aerospace Engineer, Tunku Azela, an Electrical Engineer, Banker Khairulnizam, and Hospital Matron Hafisah Idris were the other four who made up our group; we were the first to attempt using ground transport to reach Teluk Dalam. A few international non-governmental organization groups reached there by helicopter or ship, and before we left we were told that an Australian helicopter crashed, killing all six on board.

The truck that we used was so dilapidated that one could see the road through its floor next to the accelerator. We brought along a number of planks to pass gaps on the road caused by the earthquake. Shukor had to turn the wheel left and right just to keep it straight, as the wheels were not balanced.

Crossing the bridge, we made our way in the old truck further, only to have a front tire puncture 30 min later. As the wheel was changed we grabbed our medical bags and walked through the village, and found a woman with a clavicle fracture. After an arm sling was applied and painkillers provided, she settled comfortably. Suddenly we were surrounded by patients who showed all their injuries and illnesses. We ran an "instant clinic," trying hard to provide treatment to all of them as soon as possible, as we had to hurry along before dark. Soon we were on our way again. We proceeded . . . only to encounter a child by the roadside who was bleeding from the scalp and was unconscious. He had just been hit by a motorcycle. We got down from the truck and attended the child right away, stabilizing the neck and opening the airway. The child later regained full consciousness, and was able to move all limbs. As Hafisah and Azela were doing the dressing, Hadi saw a villager taking out a knife . . . ready to stab the motorcyclist. Immediately, with the help of Jabez and Nizam, the villagers were calmed down. We prescribed medication, assured the villagers that the child should be alright if he remained alert, and got back on the road again. Along the way we noted poverty and misery. Many houses were collapsed along the cracked road (Figure 2). Graves could be seen in the compound, as it is part of the culture to bury the dead in the house compound. It's ironic to think that the earthquake killed many in their own houses, which had always been the destined graveyard for all of them. After travelling for 7 h along the 105 kilometers of cracked and uneven road, we finally became the first truck to have reached Teluk Dalam, to the amazement of the local