

Nutrient Deprivation I

DRUNKOREXIA

Saturday night, and the club was packed. Brenda Devereux and her fellow interns at the investment bank, Claire Yee and Lily Palmer, were having their usual girls' night out. All three were wearing their tightest jeans and their tallest shoes and doing Bacardi 151 shots to celebrate the end of the week. "Brenda, you look so skinny," Claire gushed. "How do you do it? These drinks have a ton of calories, and you never gain an ounce."

Brenda smirked, tipping back another shot. "My secret."

"Let's go dance," Lily suggested. Brenda shook her head, earrings swaying. "I need another one of these before I can get out there and shake my fat behind." Lily made a face; she had less patience than Claire for Brenda's constant fussing about her weight. After another round of shots, they hit the dance floor.

"Excuse me, Porky," Brenda snapped suddenly as a short, curvy girl brushed past her. The girl glared at her, and Claire laughed. "Okay, you wanna know how I did it?" Brenda said loudly so the girl could hear. "I just don't eat before I go out. Like, anything. I haven't eaten for four days, so I can drink as many high-calorie drinks as I want, and I don't have to worry about bulging over my jeans like some people." This time—it was a couple of shots later—both her friends laughed. The girl they were mocking looked disgusted and went to dance where she couldn't see them. "That's right, cow, we didn't want to look at you anyway," Brenda giggled, and they all tipped back another round.

Brenda laid her shot glass down on the counter, and it rattled loudly. "Whoa," Lily said, "you're shaking. Are you okay? Maybe we better make this our last one."

"No, I'm good, I'm good," Brenda slurred. "It's still early. Just a little head rush is all. Whoa, where did you guys go?"

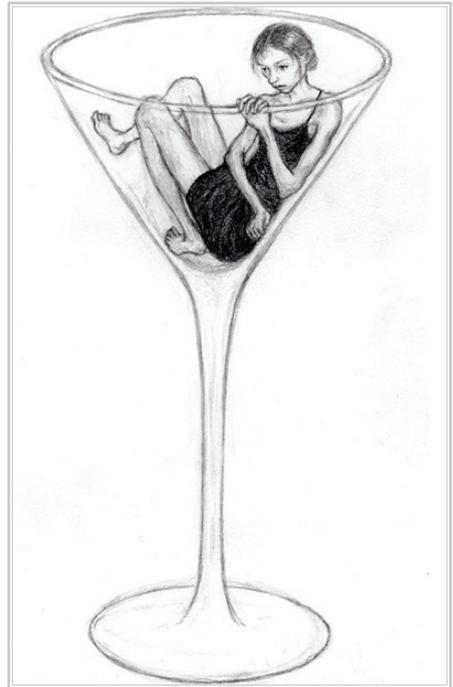
The other two women, drunk as they were, looked at her with concern. "We're right here, Brenda," Claire said. "We didn't go anywhere."

"Maybe she needs to throw up," Lily offered.

"Maybe she just needs another drink," Claire suggested. "Miss, could you get us another round?"

The bartender raised her eyebrows. "No," she said, "but I can get you a cab."

On the way out to the cab, Brenda could barely keep on her feet. The walk to the cab left her out of breath, and she kept complaining that her heart was pounding a mile a minute. They all got out at Claire's building and managed to wrangle Brenda upstairs with the help of the long-suffering doorman. "She just



needs to sleep it off,” Lily suggested.

“Well, you guys should stay here. Just stay here. Don’t leave me alone with her, Lily, please? She’s freaking me out.”

That was at eleven at night. At two in the morning, Lily and Claire were awakened by the sound of something heavy falling. Claire fumbled for the light switch. Brenda had fallen off the couch and was lying, twitching, on the floor. As her friends watched, still half-drunk and confused, the twitching stopped. Lily knelt down next to her. “Brenda. Brenda.” Brenda didn’t move.

“Oh god,” Claire whimpered, and Lily whispered, “I think we need to call an ambulance ... I can’t feel a pulse ... I think she might be dead.”

Scientific Connection

You, of course, are much too smart to do what killed Brenda, but more than one person has died this way. Sometimes referred to as “drunkorexia,” the practice of avoiding food (fasting) so that you can consume alcoholic beverages at a later time is likely to give your night out a deadly ending. Because of its effects on glucose homeostasis, alcohol (ethanol) can be a lethal poison depending on how long it has been since the last time you ate. The amount of ethanol required to kill in this case would not be excessive and may be significantly less than is required for getting drunk. The smaller the individual, the less ethanol would be required to produce the lethal effects.

Glucose homeostasis is essential to the functioning of the brain. Glucose is the primary nutrient used by the brain for energy (synthesis of ATP). Sufficiently low blood glucose (hypoglycemia) will cause the brain to die by literally starving it of energy. Security is tight in the brain and glucose is one of the few molecules that can make its way in from the blood. In the brain, glucose is effectively the sole source of electrons harvested by the Krebs cycle and passed through the electron transport chain in oxidative phosphorylation. No glucose means no oxidative phosphorylation and certainly no ATP. The cells of the brain that conduct electrical signals are known as neurons and they work extremely hard. In order to do this work they need a constant supply of ATP, which means a constant supply of glucose as well. If their ATP production drops then they will stop working and die rapidly. Even short periods of hypoglycemia can lead to irreversible brain damage or death. The brain controls and coordinates the vital functions of the body like respiration and how fast your heart beats. If the brain dies then these vital functions will cease and the rest of the body will die as well.

You may have heard someone complain that they’re irritable or have trouble focusing because of “low blood sugar,” meaning they haven’t eaten in a while. Under normal circumstances, your blood “sugar” levels never really change and are kept within strict limits. Insulin prevents your blood glucose from ever getting too high while the counter-regulatory hormones (adrenaline, cortisol, and glucagon) prevent it from getting too low. If you are fasting, the counter-regulatory hormones

maintain your glucose levels by causing a constant release of glucose into your blood from the liver. Two processes are responsible for maintaining your blood glucose during a fast: breakdown of glycogen stores (glucose stored for a fast) and gluconeogenesis (synthesizing glucose from amino acids and other sugars). The body uses its glycogen stores, which can last between 10 and 36 hours, before turning to gluconeogenesis—the only option once the stored glycogen is gone. Ethanol interferes with gluconeogenesis, so consuming alcohol can lead a rapid drop in blood glucose if an individual's glycogen stores have been depleted.

An individual like Brenda who fasted for four days would have exhausted her glycogen stores long ago. By the time she started drinking she would be solely dependent on gluconeogenesis to maintain her blood glucose levels (and brain health). Consuming a beverage that was almost entirely ethanol would inhibit gluconeogenesis very quickly and cause a precipitous drop in blood sugar that could be lethal. The dizziness, anxiousness, jitteriness, sweating, rapid breathing and increased heart rate that Brenda exhibited were caused by the counter-regulatory hormone adrenaline, which was secreted into her blood in a vain attempt to get her liver to break down glycogen and release glucose into the blood. When Brenda's hypoglycemic episode continued, she lost consciousness and suffered seizures—signs that her brain was beginning to die and that even if doctors had been able to revive her, she might have suffered permanent brain damage. Eventually her starved brain could no longer control her vital functions and she was pronounced dead. This story is all too common, especially among younger drinkers. Usually individuals with alcoholic hypoglycemia are brought to the emergency room late at night and are very sleepy from the effects of alcohol intoxication. The next morning the sleepiness abruptly breaks as the affected individual goes into a seizure.

↪ **Take Home Message** ◀

Consuming alcohol after a prolonged fast can result in hypoglycemia which can destroy the brain and result in rapid death or lasting damage.