A SPOONFUL OF SUGAR

Insulin is given to severely burned patients to help regulate their blood sugar levels, but disastrous consequences can result when too little or too much is given. How, then, to determine that delicate, “just right” balance? BY ALISA KIM

A severe burn takes a devastating toll on the mind and body. Burn patients endure excruciating pain and undergo a lengthy recovery. Treating these injuries is complicated by the ensuing metabolic disturbances that can last up to one year. The stress response to a burn causes profound changes in the endocrine and immune systems, and an overall hypermetabolic state characterized by increased energy expenditure and body temperature and muscle wasting.
“The greatest metabolic need that you can have is burns,” says Dr. Marc Jeschke, a scientist in the Trauma, Emergency & Critical Care Research Program at Sunnybrook Research Institute and director of the Ross Tilley Burn Centre at Sunnybrook Health Sciences Centre. “It beats any critical illness, any surgery, any trauma. Your metabolic demands are the equivalent of running marathon after marathon without any break.”

Nutrition is a vital part of the treatment of burns, as the energy requirements of thermal injuries are immense. A patient with a burn covering 40% of his total body surface area can lose one-quarter of his weight by the third week after injury, even with substantial oral nutrition. Moreover, because protein is lost through the wounds, burn patients have increased caloric needs for healing. Burn injuries cause protein and muscle catabolism, whereby the body ravages its own protein stores for fuel, resulting in the loss of lean body mass. Without adequate nutrition these patients suffer from poor wound-healing, weight loss and weakened immunity.

Severe burns also damage the liver, preventing patients from properly metabolizing fats. Thus, carbohydrates, which are broken down into glucose, provide burn patients with most of their caloric needs. Due to the stress of frequent interventions and high-carbohydrate feeds, however, these patients are prone to hyperglycemia, or high blood sugar.

Hyperglycemia, which is common in intensive care unit (ICU) patients—even among those who do not have diabetes—is a much-studied phenomenon. It is associated with higher rates of infection, organ failure and even death. Burn patients with high blood sugar experience a prolonged hypermetabolic state, putting them at risk of infection and muscle wasting. When blood sugar levels rise above 160 milligrams (mg) per decilitre of blood, there is protein glycosylation. This occurs when a sugar molecule binds to a protein in an uncontrolled way and the protein is altered. Protein glycosylation can lead to multi-organ failure.

The paradigm of glycemic control in critical care medicine was introduced in 2001 through a practice-changing study published in the New England Journal of Medicine by researchers from the Catholic University of Leuven. Dr. Greet Van den Berghe and colleagues showed insulin given to postoperative surgical patients to keep glucose levels between 80 and 110 mg per decilitre of blood decreased rates of mortality and the incidence of infection, sepsis and organ failure.

Soon after the study’s publication, critical care units worldwide began adopting protocols to keep patients within this tightly controlled range. Within a few years, ICUs and trauma centres reported that intensive insulin therapy targeting glucose levels of 80 to 110 mg per decilitre posed risks of hypoglycemia (low blood sugar), which is just as dangerous as hyperglycemia, if not more so. In the decade following the release of the Leuven study, glycemic control in the care of critically ill patients has been the topic of much controversy.

Not as well documented, hypoglycemia is thought to be lethal for critically ill patients. Burn patients are at risk of low blood sugar as nutrition, which is delivered via a feeding tube, is interrupted due to operations, dressing changes and daily showers to keep wounds clean. Severe hypoglycemia (blood sugar levels under 40 mg per decilitre) is believed to cause brain damage, immune impairment and organ failure, says Jeschke, who is studying the outcomes associated with it in collaboration with researchers from Texas and Germany.

“We know glucose is the main energy source for the body, but too much is not good and too little is not good,” says Jeschke, who is responsible for the care of about 250 burn patients annually, and sees firsthand the dangers of hyperglycemia and hypoglycemia in burn patients.

In 2009, researchers from Australia, New Zealand and Canada (including two from Sunnybrook Research Institute) published a study titled “Normoglycemia in Intensive Care Evaluation–Survival Using Glucose
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