



Pittsburgh Regional Healthcare Initiative

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Glycemic control protocol: VA Pittsburgh Healthcare System

Can controlling blood glucose reduce post-surgical infections?

Despite vigorous attempts to control the bacterial 'seed' of infection by asepsis and antibiotics, infection is still the greatest enemy of surgeons. Hence, more attention is now being focused on the 'soil' or host factors and their contribution to postoperative infection. Numerous works have confirmed hyperglycemia as a metabolic response to operative stress.

Kowli SS, Parikh SK, Shirahatti RG, Relekar RR, Bhalerao RA. Insulin and sepsis. *J Postgrad Med* 1985;31:11-5

It has recently been recognized that hyperglycemia is a significant risk factor for postoperative infectious complications. Hyperglycemia in the postoperative patient occurs on the basis of postoperative insulin resistance, a transient state of reduced sensitivity to the anabolic effects of insulin. This state, similar to type 2 diabetes mellitus, is not traditionally treated in routine perioperative care. Development of methods to attenuate postoperative insulin resistance may improve outcome of surgical care.

Soop, Mattias, Effects of perioperative nutrition on insulin action in postoperative metabolism. Fredagen den 16 maj 2003, kl. 9.00, Ersta Sköndals aula, Stigbergsgatan 30, Stockholm. ISBN: 91-7349-529-8

The majority of hospitalizations for patients with diabetes are due to co-morbid conditions, and diabetes management is not a focus during inpatient stays. However, inpatient hyperglycemia has been associated with nosocomial infections, increased mortality and increased length of stay.

Baldwin D, McNutt R, Villanueva G, Bhatnagar S. *Diabetes Care* 2005; 28:1008-1011

Healthcare System (VAPHS) have tested a dynamic, easy-to-use program to administer the post-surgical insulin protocol with encouraging results.

Dr. Rao outlined the problem. For decades, a single formula or "sliding scale" has been used to determine the insulin drip rate for every patient in every situation in an attempt to achieve the target BG of 80-110. The simple formula often takes the current BG number, minus 80, times 0.03-.05.

Sliding scale limitations

"This formula is completely empirical, based on a regression line drawn years ago. The target is rarely, if ever, achieved," said Dr. Rao, "because

it doesn't take into account changes in the glucose reading over time." Figure 1 shows an example of the formula's shortcomings: each patient in the example has had different spikes in prior BG readings and should receive different doses of insulin, yet the formula dictates the same amount.

Asked Dr. Rao, "This formula applies to every patient, but in reality does it apply to even one?"

Complex formula-easy to use

Peter Perreiah, Managing Director of PRHI, developed an

In his April 18 presentation to the region's cardiac surgery teams, Harsha Rao, M.D., Professor of Medicine and Chief of Endocrinology at the VA, discussed how to achieve tight control of insulin in post-operative cardiac surgery patients. The objective is to control blood glucose (BG) between 80 and 110 mg/unit in an effort to eliminate post-surgical infections. Of particular interest is preventing the deep sternal wound infection known as mediastinitis. Clinicians in the Surgical Intensive Care Unit (SICU) at the Veterans Administration Pittsburgh

Excel-based user interface which enables a nurse to use a sophisticated algorithm developed by Dr Rao and his team at the VA to determine exactly how much insulin each patient needs at any given time. This allows constant, precise alteration of the insulin drip to enable tight BG control.

The goals of the VAPHS' insulin protocol are to:

1. Prevent hypoglycemia. Although clinically, hyperglycemia is a much bigger threat to patients' health, nurses' training generally leads to a bigger fear of hypoglycemia. The emphasis on preventing hypoglycemia is a way to overcome nurses' discomfort, addressing a cultural barrier in a clinical way.
2. Bring BG into the 80-110 mg/dL range within four hours of protocol use.
3. Maintain glucose in the 80-110 mg/dL range, avoiding swings in BG often seen in ICU patients.

The wizard then displays the recommended drip rate, when to check again, and any other alerts.

Heeding the voice of the nurse

The nurses, who are responsible for implementing the protocol, give constant feedback about the

utility of the software and how to improve it based on floor use. The VAPHS is on the 17th version of the software, with ever-improving results. Of the 93 patients placed on the protocol post-surgically, only one developed an infection—traced to a deviation in the protocol.

Says Candace Cunningham, RN, SICU Team Leader, "In the beginning, the nurses thought that constant attention to the protocol would be frustrating. Now, they are expressing frustration when they can't get the patient's blood glucose to stay in the target range. The protocol lets them concentrate on the patient."

Cunningham adds, "When we say we want blood glucose between 80 and 110, we mean 80 to 110. Before, we would have felt good about 150; now that's unacceptable."

Problems arose when, once BG readings were within the target range, physicians would stop the insulin drip, assuming the hyperglycemia to be "resolved." However, BG readings often rose again and began fluctuating wildly once the insulin was stopped. Now, termination of the drip protocol is not left to the physician, unless the patient has uncontrolled hyper- or hypoglycemia.

Step-down challenges

When a patient moves to the Step-Down Unit, a transitional insulin protocol is needed that takes into account the increased patient-nurse ratio. (In the SICU the ratio is one-to-one for the first 12 hours, then two patients per nurse thereafter until transfer to the Step-Down unit, where the ratio is four patients to one nurse). When a patient in the Step-Down Unit begins to eat, monitoring insulin levels can become more complicated. Actually, food consumption posed two new considerations:

1. The post-op cardiac diet specified no caffeine or salt, but did not specify the carbohydrate count. Once alerted, VAPHS dieticians quickly ensured a standardized carbohydrate count for each cardiac post-op tray.

Current, time-honored formula does not take into account BG readings over time

Examples:

BG 150 each of past 2 hours
Drip rate: $(150-80) \times 0.03 = 2.1\text{u/ hr}$

BG 150 now, was 240 last hour
Drip rate: $(150-80) \times 0.03 = 2.1\text{u/ hr}$

BG 150 now, was 100 last hour
Drip rate: $(150-80) \times 0.03 = 2.1\text{u/ hr}$

Figure 1. "Sliding Scale" formula has shortcomings. Can all of these eventualities require the same drip rate?

2. Busy nurses needed to assess how much each patient consumed after each meal so that insulin could be administered after meal consumption. Giving insulin after the meal allows them to base the dose on a straightforward formula per 15 grams of carbohydrates consumed.

“I was delighted to realize that asking nurses to estimate food consumption did not add to their work loads,” said Dr. Rao. “They are already trained from nursing school to assess how much the patient has eaten.” Now that bit of data they already collect increases in importance.

Figure 2. Ease of administration on the “front end.”

Again, the dynamic transitional protocol is capable of sophisticated calculations needed to meet each patient’s need and is easy to use. The result shows exactly how much insulin and in what form to give, as well as other necessary information. Like the SICU protocol, the transitional protocol is under continuous development and improvement.

New frontiers

The next frontier in glucose control is further upstream, in the operating room (OR). There, yet another version of the insulin protocol software is being developed and refined. The hope is that preventing swings in patients’ BG levels from the start of surgery may further help reduce post-surgical infections.

The final frontier is for the patient to carry the concept of tight glycemic control home when he or she is discharged from the hospital. The wound is only partially healed when this happens, so that the potential for complications is still very real, particularly because patients often have little or no support for aggressive diabetes management at a time when they are struggling to adapt to post-operative life outside the hospital following such a major surgical procedure. Conquering this problem will require a different approach, involving the provision of adequate resources to enable far more frequent contact between the diabetes care team and the patient.

