PERSPECTIVES IN PRACTICE

Why Won't the Sliding Scale Go Away?

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ABSTRACT

Basal–bolus–supplement insulin is the standard way patients on a multiple daily injection (MDI) insulin program take insulin at home. However, in many hospitals, this physiological approach to insulin delivery is supplanted by sliding-scale insulin, wherein fast- or rapid-acting insulin only is given subcutaneously and only in response to particularly high blood glucose levels. Evidence has mounted that sliding-scale insulin leads to an increase in blood glucose and an increase in serious hospital morbidity compared to basal–bolus–supplement. To highlight this evidence, the Vancouver Island Health Authority has tried an educational approach, combined with changes to clinical order sets, in an effort to replace sliding-scale insulin with basal–bolus–supplement. Initial results have been disappointing, and on-going efforts are required to understand why the sliding scale appears so deeply entrenched.

KEYWORDS: hospital management, insulin ordering, sliding scale

RÉSUMÉ

Le schéma basal-bolus est typique chez les patients dont l'insulinothérapie prévoit des injections quotidiennes multiples d'insuline. Toutefois, dans de nombreux hôpitaux, cette approche physiologique d'administration de l'insuline est supplantée par l'insulinothérapie à doses variables : seule de l'insuline à action rapide est administrée par voie sous-cutanée et seulement quand la glycémie est particulièrement élevée. Toutefois, de plus en plus de données démontrent que l'insulinothérapie à doses variables entraîne une augmentation de la glycémie ainsi que de graves troubles morbides en milieu hospitalier par rapport au schéma basal-bolus. Compte tenu de ces données, l'Autorité sanitaire de l'île de Vancouver a mis à l'essai un programme d'éducation associé à des changements des ensembles de prescriptions cliniques et axé sur le remplacement de l'insulinothérapie à doses variables par le schéma basal-bolus. Les résultats initiaux ont été décevants et il faudra continuer de chercher à déterminer pourquoi l'insulinothérapie à doses variables semble être aussi solidement enracinée.

INTRODUCTION

The idea of evidence-based in-hospital care for people with diabetes is relatively new. The randomized clinical trial evidence only goes back to the first publication of the Diabetes Mellitus Insulin-Glucose Infusion in Acute Myocardial Infarction (DIGAMI) study in 1995 (1), although the study did not become widely discussed until the publication of longer-term results in 1997 (2). The discussion of sliding-scale insulin leading to worse, rather than better, glycemic outcomes also only goes back to 1997 (3). Since then, multiple publications have discussed the reasons why sliding-scale insulin is bad medicine (4-6), and guidelines from both the American Diabetes Association (7,8) and the Canadian Diabetes Association (9) have recommended against its use. Nevertheless, sliding-scale insulin is still often the first—and sometimes the only—method of inpatient insulin management that medical students and postgraduate trainees are taught. Indeed, while trainees are generally well taught how to manage patients with diabetic ketoacidosis (DKA), the much more common task of ordering insulin for a patient who is not in DKA and not critically ill is very poorly taught.

When patients on multiple daily injections (MDI) of insulin talk about a sliding scale, they are referring to an insulin supplement: extra fast- or rapid-acting insulin taken in addition to their usual dose of preprandial insulin, if their blood glucose is above target at the time of dosing. This is the standard of care in a post-Diabetes Control and Complications Trial era (10). Basal–bolus–supplement is clearly the most physiological insulin regimen and leads to reduced complications in patients with type 1 diabetes (11). So why not do the same thing for hospitalized patients? What physicians typically refer to as sliding-scale insulin is fast- or rapid-acting insulin only, given subcutaneously, typically at meal times and sometimes bedtime, but only when blood glucose in above a threshold, usually 10 mmol/L.

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No basal insulin is given, usually resulting in an elevated blood glucose each morning, which is then chased throughout the day, with the cycle repeated the next day. I have seen patients with type 1 diabetes taken off of their basal–bolus–supplement insulin when hospitalized and sliding-scale insulin ordered instead. This risks triggering DKA or worse. If we can teach patients how to use a basal–bolus supplement insulin program, why can't we teach our colleagues and students?

EVIDENCE AGAINST THE SLIDING SCALE

The science around why sliding-scale insulin is bad medicine is compelling. In that first 1997 paper, Queale and colleagues found sliding-scale insulin tripled the rate of hyperglycemia (very generously defined as blood glucose >16 mmol/L), and that once written, sliding-scale insulin orders were left unchanged for the duration of hospitalization in 75% of cases (3). A subsequent review by Umpierrez (5) looked at 52 publications and found none of them demonstrated any benefit to the use of sliding-scale insulin. A retrospective study of patients with pneumonia admitted to a clinical teaching unit at McMaster University, Hamilton, Ontario, demonstrated statistically and clinically significant increases in adverse outcomes (such as sepsis or admission to the intensive care unit) when sliding-scale insulin was used vs. any other insulin program (12).

The Randomized Study of Basal-Bolus Insulin Therapy in the Inpatient Management of Patients with Type 2 Diabetes (RABBIT 2) trial compared glycemic outcomes of a basal–bolus supplement with a sliding-scale insulin program for the first time in a randomized trial (13). Patients in this study had been admitted to a medical ward and were not previously treated with insulin. It came as no surprise that the patients assigned to the basal–bolus supplement insulin did better, experiencing lower average blood glucose levels without an increase in hypoglycemic events. There has been discussion about the RABBIT 2 trial and the fact that the patients assigned to sliding-scale insulin did not receive as much insulin as the basal–bolus supplement patients (14); however, the interventions, and specifically the way the sliding-scale insulin was ordered in the trial, was typical (or even a bit more aggressive, with insulin given if blood glucose was >7.7 mmol/L) of what I see in hospital.

Subsequently, the same authors studied patients admitted to a surgical ward, but with the same randomization to basal–bolus supplement versus sliding-scale insulin (15). The reduction in blood glucose seen in the RABBIT 2 surgical trial with basal–bolus supplement insulin was similar to that seen in the earlier RABBIT 2 trial. The RABBIT 2 surgical trial showed a small increase in hypoglycemic events with basal–bolus supplement; however, the regimen also demonstrated a significant reduction in the composite primary outcome (most of which were infectious in nature). So now we have clinical trial evidence of improved glycemia and, at least in surgical patients, of reduced adverse outcomes with the use of basal–bolus supplement insulin compared with sliding-scale insulin.

BANNING THE SLIDING SCALE: THE VIHA EXPERIENCE

Within the Vancouver Island Health Authority (VIHA), we have undertaken an extensive educational campaign to "ban the sliding scale." There have been on-going continuing health education events for physicians, nurses and trainees for the past 5 years. Although these events have been targeted to their audience, they have been consistent in messaging: sliding-scale insulin is never the best option. Previously written sliding-scale insulin protocols have been removed from the wards and replaced with a prepared order set using basal–bolus supplement insulin (Figure 1); these basal–bolus supplement orders can be completed in less than 1 minute. The clinical order set contains a suggested insulin dose for patients not previously on insulin which is consistent with published research (13,15). The order set states: "orders should always include basal insulin." Unfortunately, we have not found a way to enforce this recommendation and often the order set is used to order supplemental insulin only.

Despite these efforts, however, physicians and trainees are still writing insulin orders calling for fast- or rapid-acting insulin before meals and at bedtime based solely on the bedside blood glucose recording at the time—the classic sliding scale. Or, they use only the supplement part of the order set, which, when used without basal insulin, is just a sliding scale. A recent audit of 3 hospitals within the VIHA (Nanaimo Regional General, Royal Jubilee and Victoria General) revealed that, depending on the physician group doing the ordering, sliding-scale insulin only was used for 40% to 60% of inpatients prescribed insulin. Trainees, specifically, ordered sliding-scale insulin 60% of the time. The reasons given for continued sliding scale use typically came back to two themes: historical practice habits and fear of hypoglycemia. Neither of these reasons are compelling. Practice habits can and should change with new evidence and recommendations. Efforts should be made to minimize hypoglycemia and protocols should be in place for nursing staff to treat hypoglycemia promptly and appropriately (16). However, all of the evidence points to hyperglycemia as the cause of in-hospital morbidity, not mild-to-moderate hypoglycemia. The RABBIT 2 trial demonstrated improved glycemia, without any increase in hypoglycemia, with a weight-based dosing algorithm and close, daily follow up.