

# Basal-Bolus Insulin Therapy in the Inpatient Management of Patients With Type 2 Diabetes

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## Citation

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## Abstract

**Objective:** We sought to study the optimal management of hyperglycemia in non-intensive care unit patients with type 2 diabetes, as few studies so far have focused on this subject. **Materials & Methods:** We conducted a retrospective study to compare the efficacy and safety of a basal-bolus insulin regimen with that of sliding-scale regular insulin (SSI) in patients with type 2 diabetes. A total of 104 patients were included in this study. **Results:** Patients treated with basal insulin regimen had better glycemic control than those treated with SSI. The mean hospital length of stay was shorter in patients treated with basal-bolus as compared to the SSI-treated group. The mean glucose concentration during the last day of hospitalization was significantly higher in patients treated with SSI compared with those treated with the basal-bolus regimen. At the same time, mean daily dose of insulin was significantly higher in the basal-bolus regimen compared with that in the SSI treatment group. **Conclusion:** Treatment with basal bolus insulin regimen resulted in significant improvement in glycemic control compared with that achieved with the use of SSI alone. Our study indicates that a basal-bolus insulin regimen should be preferred over SSI in the management of non-critically ill, hospitalized patients with type 2 diabetes.

## INTRODUCTION

Hyperglycemia in hospitalized patients is a common, serious, and costly health care problem with profound medical consequences. Extensive evidence from observational studies indicates that in hospitalized patients with critical illness, hyperglycemia is associated with an increased risk of complications and mortality<sup>1-7</sup>.

Many Clinical randomized trials in hospitalized patients have shown that intensive glucose control reduces the risk of multi-organ failure, systemic infections, and short- and long-term mortality. Effective management of hyperglycemia is also associated with a decreased length of intensive care unit and hospital stay<sup>8</sup>.

In patients, the presence of hyperglycemia has been associated with prolonged hospital stay, multiple infections, increased disability after hospital discharge, and death<sup>9</sup>. More recently, studies in patients with community-acquired pneumonia reported that hyperglycemia was associated with increased risk of in-hospital complications and mortality<sup>10, 11</sup>.

Insulin, given either intravenously as a continuous infusion or subcutaneously, is the most effective agent for immediate

control of hyperglycemia in the hospital. In the critical care setting, a variety of continuous insulin infusion protocols have been shown to be effective in achieving glycemic control, with a low rate of hypoglycemic events, and in improving hospital outcomes<sup>12</sup>.

In general medicine, however, hyperglycemia is frequently overlooked and inadequately addressed. Several reports from academic institutions have shown that most patients are treated with SSI and basal insulin is prescribed in less than one-half of patients<sup>13, 14</sup>. Few clinical trials have focused on the optimal management of inpatient hyperglycemia in the noncritical setting.

Accordingly, we conducted this retrospective study to compare the efficacy and safety of a basal-bolus insulin regimen with that of SSI in patients with type 2 diabetes admitted to general medicine wards.

## MATERIALS AND METHODS

All consecutive patients treated with SSI or basal bolus regimen from July 1, 2009, through January 1, 2010, were evaluated retrospectively with a thorough review of the medical records.

Inclusion criteria:

1. Age 18 years or more;
2. Minimum 3-day length of stay;
3. At least 2 blood glucose measurements greater than 150 mg/dL within the first 48 hours of admission;
4. No admission to a critical care unit anytime during the hospital stay; and
5. Receipt of nothing by mouth as well as no parenteral/enteral nutrition.

Exclusion criteria:

1. SSI patients who received oral hypoglycemics, insulin aspart mix, insulin detemir, insulin glargine, insulin glulisine, insulin NPH, or insulin 70/30; or
2. Basal bolus insulin regimen patients who received oral hypoglycemics, insulin aspart mix, insulin detemir, insulin glulisine, insulin NPH, or insulin 70/30.

The SS regimen was based on physician preference and is not standardized. The Basal bolus regimen was an evidence-based algorithm. A total daily dose (TDD) of insulin is determined based on patient-specific parameters. The TDD is then divided into a long-acting insulin (insulin glargine [ $0.4 \times \text{TDD}$ ]) and a short-acting insulin (insulin aspart [ $0.2 \times \text{TDD}$ ] or regular insulin [ $0.15 \times \text{TDD}$ ]). A target range of 80–150 mg/dL was established in an effort to achieve tight control of blood glucose without increasing the risk of hypoglycemia. All blood glucose measurements were determined by point-of-care testing.

### DATA COLLECTION

Data collected included demographics, co-morbidities, admitting and discharge diagnosis, medications for blood glucose management, patient location pre- and post-discharge, hemoglobin A1c (A1C), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) on admission and discharge; blood glucose measurements; final blood glucose measurement on discharge; and amount of insulin administered.

Clinical sequela for hypoglycemia was defined as a clinical situation that required more than oral glucose or 50 mL of

50% dextrose in water. Internal medicine residents collected the data.

### STATISTICAL ANALYSIS

Continuous variables were compared by 2-sample Student's t-test and the Mann-Whitney U test. Categorical variables were compared by the  $\chi^2$  test and the Fisher's exact test as appropriate based on data. For all analyses, p values less than 0.05 were considered significant for 2-tailed tests. All calculations were performed using SPSS version 11.0 (SPSS Inc., Chicago, IL).

### RESULTS

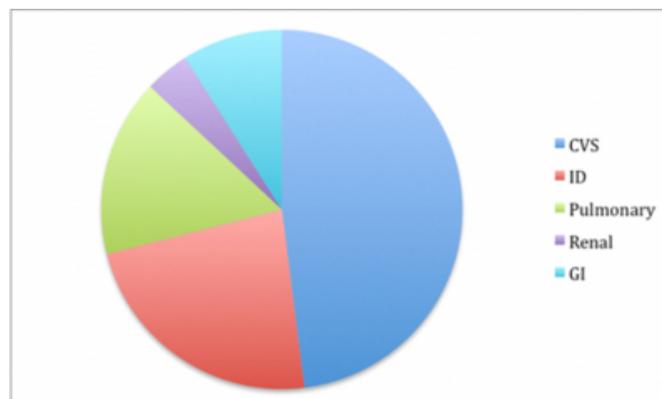
A total of 104 patients with type 2 diabetes admitted to general medicine services were taken in this study. Of these, 34 patients received basal insulin regimen and 70 received SSI.

There were no significant differences in the mean age, racial distribution, BMI, admission blood glucose, or A1C between treatment groups.

The most common admitting illnesses included a variety of cardiovascular (48%), infectious (23%), pulmonary (16%), renal (4%), and gastrointestinal (9%) disorders.

#### Figure 1

Fig 1: Admitting Illness



The mean hospital length of stay was  $5.3 \pm 6$  days in patients treated with basal-bolus and  $5.1 \pm 4$  days in the SSI-treated group.

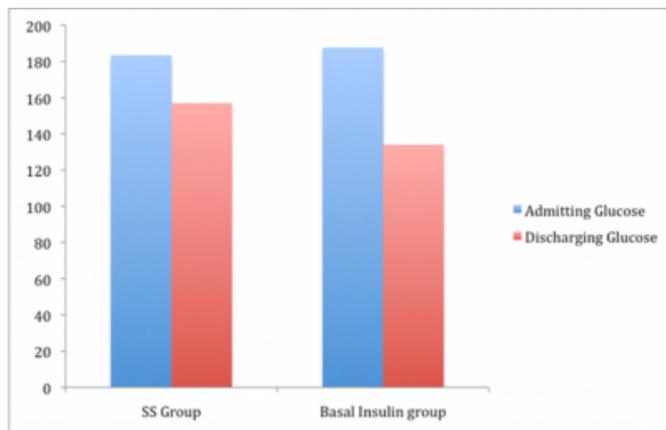
Patients treated with basal insulin regimen had greater improvement in glycemic control than those treated with SSI ( $P < 0.01$ ).

The mean admission glucose values in the basal insulin and SSI treatment groups were 183.4 and 187.65 mg/dl, respectively.

The mean glucose concentration during the last day of hospitalization was significantly higher in patients treated with SSI compared with that in patients treated with the basal-bolus regimen (134 vs. 157 mg/dl).

### Figure 2

Fig 2: Admitting and Discharging BSL in SS VS Basal Insulin group



The percentage of patients within the mean glucose target (<140 mg/dl) was 66% in patients treated with basal insulin versus 38% in those treated with SSI.

14% patients treated with SSI remained with blood glucose >240 mg/dl despite increasing the SSI dose to the maximal units.

The mean insulin daily dose was significantly higher in the basal-bolus regimen compared with that in the SSI treatment group ( $P < 0.001$ ). The mean daily dose of basal insulin was  $22 \pm 2$  units. Patients treated with SSI received a mean daily dose of  $12.5 \pm 2$  units regular insulin/day, with approximately one-half of patients receiving <10 units/day.

Hypoglycemia (defined as blood glucose <60 mg/dl) occurred in two patients in each treatment group. Glucose readings in the basal insulin treatment group, there were only 0.4% glucose values <60 mg/dl and no glucose values <40 mg/dl. Glucose readings in the SSI group, there were only two 0.2% glucose values <60 mg/dl and no glucose values <40 mg/dl.

Hypoglycemia was corrected with oral dextrose, and none of these episodes was associated with adverse outcomes.

### CONCLUSION

This is an interesting retrospective study aimed to compare the efficacy and safety of a basal-bolus insulin regimen with that of SSI in non-critically ill patients with type 2 diabetes.

We observed that treatment with basal bolus insulin regimen results in a significant improvement in glycemic control compared with that resulting from the sole use of SSI. A blood glucose target of

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