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

F Aziz, S Dutta, R Khanal, S Pasula, S Ghimire, S Penupolu, S Reddy

**Citation**

F Aziz, S Dutta, R Khanal, S Pasula, S Ghimire, S Penupolu, S Reddy. *Basal-Bolus Insulin Therapy in the Inpatient Management of Patients With Type 2 Diabetes*. The Internet Journal of Endocrinology. 2009 Volume 6 Number 1.

**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 mortality1-7.

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 stay8.

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

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 12.

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 13, 14. 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 × TDD]) and a short-acting insulin (insulin aspart [0.2 × TDD] or regular insulin [0.15 × 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 c2 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

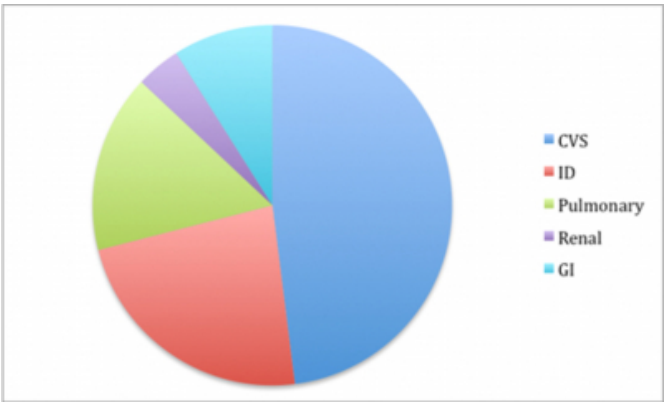
A total of 104 patients with type 2 diabetes admitted to general medicine services were taken in this study. Of these, 34 patients received basal insulin regimen and 70 received SSI.

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 ± 6 days in patients treated with basal-bolus and 5.1 ± 4 days in the SSI-treated group.

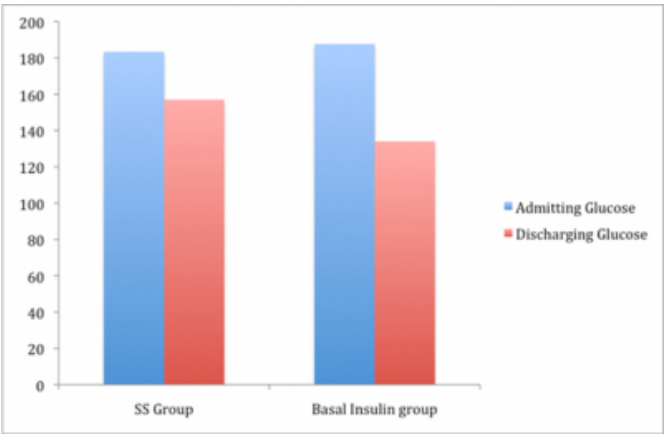
Patients treated with basal insulin regimen had greater improvement in glycemic control than those treated with SSI ($P < 0.01$).

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 ± 2 units. Patients treated with SSI received a mean daily dose of 12.5 ± 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

## References

1. Finney SJ, Zekveld C, Elia A, Evans TW: Glucose control and mortality in critically ill patients. JAMA 290:2041–2047, 2003
2. Krinsley JS: Association between hyper- glycemia and increased hospital mortality in a heterogeneous population of critically ill patients. Mayo Clin Proc 78:1471– 1478, 2003
3. Clement S, Braithwaite SS, Magee MF, Ahmann A, Smith EP, Schafer RG, Hirsh IB: Management of diabetes and hypergly- cemia in hospitals. Diabetes Care 27:553– 597, 2004
4. Inzucchi SE: Clinical practice: manage- ment of hyperglycemia in the hospital seting. N Engl J Med 355:1903–1911, 2006
5. Umpierrez GE, Kitabchi AE: ICU Care for patients with diabetes. Current Opinions Endocrinol 11:75– 81, 2004
6. Van den Berghe G, Wilmer A, Hermans G, Meersseman W, Wouters PJ, Milants I, Van Wijngaerden E, Bobbaers H, Bouillon R: Intensive insulin therapy in the medical ICU. N Engl J Med 354:449 – 461, 2006
7. van den Berghe G, Wouters P, Weekers F, Verwaest C, Bruyninckx F, Schetz M, Vlasselaers D, Ferdinande P, Lauwers P, Bouillon R: Intensive insulin therapy in the critically ill patients. N Engl J Med 345: 1359 –1367, 2001
8. Furnary AP, Gao G, Grunkemeier GL, Wu Y, Zerr KJ, Bookin SO, Floten HS, Starr A: Continuous insulin infusion reduces mortality in patients with diabetes under- going coronary artery bypass grafting. J Thorac Cardiovasc Surg 125:1007–1021, 2003
9. Pomposelli JJ, Baxter JK 3rd, Babineau TJ, Pomfret EA, Driscoll DF, Forse RA, Bistrian BR: Early postoperative glucose control predicts nosocomial infection rate in diabetic patients. JPEN J Parenter En- teral Nutr 22:77– 81, 1998
10. Falguera M, Pifarre R, Martin A, Sheikh A, Moreno A: Etiology and outcome of com- munity-acquired pneumonia in patients with diabetes mellitus. Chest 128:3233– 3239, 2005
11. McAlister FA, Majumdar SR, Blitz S, Rowe H, Romney J, Marrie TJ: The relation be- tween hyperglycemia and outcomes in 2,471 patients admitted to the hospital with community-acquired pneumonia. Diabetes Care 28:810 – 815, 2005
12. Goldberg PA, Siegel MD, Sherwin RS, Halickman JI, Lee M, Bailey VA, Lee SL, Dziura JD, Inzucchi SE: Implementation of a safe and effective insulin infusion pro- tocol in a medical intensive care unit. Di- abetes Care 27:461– 467, 2004
13. Knecht LAD, Gauthier SM, Castro JC, Schmidt RE, Whitaker MD, Zimmerman RS, Mishark KJ, Cook CB: Diabetes care in the hospital: is there clinical inertia? J Hosp Medicine 1:151–160, 2006
14. Schnipper JL, Barsky EE, Shaykevich S, Fitzmaurice G, Pendergrass ML: Inpatient management of diabetes and hyperglyce- mia among general medicine patients at a large teaching hospital. J Hosp Medicine 1:145–150, 2006
15. Queale WS, Seidler AJ, Brancati FL: Gly- cemic control and sliding scale insulin use in medical inpatients with diabetes mellitus. Arch Intern Med 157:545–552, 1997
16. 1):20 –22, 2006
17. JoslinEP:ADiabeticManualfortheMutual Use of Doctor and Patient. Philadelphia, Lea and Febiger, 1934, p. 108

18. Walford S, Gale EA, Allison SP, Tattersall RB: Self-monitoring of blood-glucose: im- provement of diabetic control. Lancet 1:732–735, 1978
19. Sonksen PH, Judd SL, Lowy C: Home monitoring of blood-glucose: method for improving diabetic control. Lancet 1:729 – 732, 1978
20. Gill G, MacFarlane I: Are sliding-scale in- sulin regimens a recipe for diabetic insta- bility (Letter)? Lancet 349:1555, 1997
21. BaldwinD,VillanuevaG,McNuttR,Bhat- nagar S: Eliminating inpatient sliding- scale insulin: a reeducation project with medical house staff. Diabetes Care 28: 1008 –1011, 2005
22. Robbins L: Let's get the sliding scale out of medicine (Letter). Med Rec Ann 56:201, 1963

## Author Information

**Fahad Aziz, MD**
Jersey City Medical Center

**Simanta Dutta, MD**
Jersey City Medical Center

**Rashmi Khanal, MD**
Jersey City Medical Center

**Smitha Pasula, MD**
Jersey City Medical Center

**Shanker Ghimire, MD**
Jersey City Medical Center

**Sudheer Penupolu, MD**
Jersey City Medical Center

**Swapna Reddy, MD**
Jersey City Medical Center