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TAWAM HOSPITAL IN-PATIENT GLYCEMIC CONTROL: IT'S TIME TO STOP SLIDING

Basma Beiram

Tawam Hospital In-Patient Glycemic Control, Basma Beiram, P.O Box 69310, Al-AIN, UAE

***Corresponding author e-mail:** bbeiram@tawamhospital.ae

ABSTRACT

The objective of the present work is to develop best practice for enabling targeted glycemic control in the medical and surgical setting considering the multiple factors contributing to hypo/hyperglycemia. A randomized trial comparing the safety and efficacy of a basal-bolus (BB) insulin regimen with glargine insulin once daily and aspart insulin before meals (n = 60) to sliding scale regular insulin (SSI) with regular insulin four times daily (n = 90) in patients with type 2 diabetes mellitus admitted to the medical and general surgery ward. Outcomes included differences in daily blood glucose, hospital length of stay and hypoglycemia/hyperglycemia occurrences. There was a 27% and 15% reduction in the average length of stay in the medical and surgical wards respectively post implementation of new regimen. Secondly 68% and 902% reductions in the hypoglycemic episodes per 100 patient days in the medical and surgical ward respectively post implementation of the new regimen. Basal-bolus treatment with glargine insulin once daily plus aspart insulin before meals improved glycemic control and reduced hospital complications compared with SSI in general surgery patients. Our study indicates that a basal-bolus insulin regimen is preferred over SSI in the hospital management of medical and surgery patients with type 2 diabetes.

Keywords: Insulin, inpatient, sliding scale, glycemic control

INTRODUCTION

The prevalence of diabetes among citizens of the United Arab Emirates (UAE) is the second highest in the entire world. Recent studies estimate that the percentage of people suffering from diabetes in the UAE rises with increasing age reaching as high as 40 percent in the age group of 60 and above. Hence, diabetes prevention and management is one of the key priorities of the Ministry of Health in the UAE as well as Tawam Hospital.[1]

Diabetes increases the risk for disorders that predispose patients to be hospitalized whether for cardiovascular diseases, nephropathy, infection, hyperglycemia or surgeries such as lower extremity amputations. According to the literature, diabetes has been reported to be the fourth most common comorbid condition listed on all hospital discharges.[2,3,6] Glycemic control in hospitalized patients presents a unique challenge; however it continues to be deficient and is frequently overlooked in critically ill patients and in general medicine and surgery services in spite of solid evidence supporting it. Several aspects could explain the physician's indolence in addressing in-hospital hyperglycemia.[2,3] Firstly, hyperglycemia is rarely the focus of care during the hospital stay, because the overwhelming majority of hospitalizations in patients with hyperglycemia occur for comorbid conditions.[2,3] Secondly, fear of hypoglycemia creates a major barrier against the efforts for improving glycemic control in hospitalized patients, especially in patients with poor caloric intake. Thirdly, in the presence of an altered nutrition and an associated medical illness, physicians frequently hold a patient's previous outpatient diabetes regimen and initiate sliding scale coverage with regular insulin.[2,3,6] Finally, the specific morbidities due to secondary causes of hyperglycemia, such as steroid-exacerbated hyperglycemia, remain largely unknown.[2,3,6] Hospital care of patients with diabetes

and hyperglycemia is complex; involving multi-disciplinary system approach with recognizable hospital supporters can help guide significant improvement away from clinical inertia and towards safe glycemic control, insulin management, and hypoglycemia prevention.[4,5,7]

Time to Stop Sliding: Sliding scale is no longer recommended as the sole treatment option for glycemic control in hospitalized patients. Sliding scale was a safe and easy protocol that caused hypo and hyperglycemia. Hyperglycemia was ignored in the acute phase and was perceived as less dramatic than hypoglycemia. However, the literature has revealed that at any given time, 12% to 25% of hospitalized patients have diabetes or some degree of hyperglycemia. Patients who experience hyperglycemia during a hospitalization is associated with increased morbidity and mortality, ICU admissions, prolonged length of stay, and increased medical costs. In turn hyperglycemia causes physiological changes that can exacerbate acute illness such as decreased immune function and increased oxidative stress, which leads to a cycle of worsening the acute illness, prolonging the recovery period, extended hospital stay therefore resulting in chronic complications. Many factors lead to in-hospital hyper and hypoglycemia; including inaccurate estimation of insulin initial dosing and adjustments, inaccurate timings of nutritional intake, inaccurate blood glucose level documentation, poor nursing meal documentation, no HbA1c to determine the appropriate therapy and poor documentation of patient's medication history of anti-diabetic agents.[6, 8,9]

MATERIALS AND METHODS

Study design: Retrospective chart review
Sample size: 150 **(See Table 1.)**
Inclusion criteria: All adult patients admitted to the medical and surgical wards that had a history of diabetes for more than 3 months, 18–80 years old, treated with diet alone, any combination of oral anti-diabetic agents, or low dose insulin therapy at a daily dose ≤0.4 units/kg before admission. Those of who received insulin sliding scale solely during the study period.

Exclusion criteria: Diabetic ketoacidosis, patients on more than 3units/kg/day, cystic fibrosis patients, type 1 DM with eating disorder, type 1 DM sensitive to insulin, short stay patients (defined as less than 4days), patients on steroid therapy, dialysis patients, pregnancy, pediatric patients, intensive care unit patients and emergency patients.

Study period: 01/January/2013- 1/June/2014
A literature review comprehensive search was performed for the relevant English language published literature using validated electronic databases (MEDLINE, Cochrane library). The literature search focused on the new evidence published in 2006 or later. The next step to evaluate the relevant literature and developed hospital specific guidelines. Finally a pilot study was conducted of the old traditional sliding scale protocol that was widely used in Tawam Hospital against the new basal bolus booster regimen that has been widely used for year across many international countries.

This study was conducted at Tawam Hospital, a 461-bed tertiary care facility located in Al-Ain, Abu Dhabi; one of the largest hospitals in the United Arab Emirates. A team from the pharmacy, endocrinology and information technology departments created a dose calculator for the basal bolus regimen and was fed in the system so that physicians can easily prescribe the new regimen. The basal bolus regimen was defined as Basal; Insulin glargine 0.2units/kg subcutaneous at bedtime, Bolus (nutritional); insulin aspart 0.08units/kg subcutaneous three times daily or insulin lispro 0.08units/kg subcutaneous three times, Booster (correctional); insulin aspart 2-4units subcutaneous every 6 hours or insulin lispro 2-4units subcutaneous every 6 hours. An HbA1c reading within 3months of admission is required; if the reading is not available then it should be measured upon admission. A blood glucose reading must be taken and documented pre and post-surgery. Management of the insulin regimen was directed by the specialised team. A teaching endocrinologist rounded daily with the residents, clinical pharmacist and diabetic educator, the team was available for diabetes care consultation in both the surgical and medical ward.

Patients were contacted by telephone or returned for an outpatient visit within 1 month after discharge to determine the difference in the diabetes management between this admission and their last admission (if any) before the basal bolus regimen was implemented. The goal of insulin therapy was to maintain fasting and pre-meal blood glucose between 3.9mmol/l and 11.1mmol/l.

Data for the sliding scale and basal bolus regimen was collected through Cerner from June/2012- June /2014, the data was randomized and filtered according to the inclusion and exclusion criteria.

RESULTS

1. *Surgical (see Table2.):* Sixty patients were collected according to the inclusion criteria from the surgical ward from both the sliding scale group and thirty patients from the basal bolus group. Patients from the sliding scale group had total number of admission days of 620 days, and an average length of stay of 10 days; while the basal bolus group had total admission days of 265 days, and an average LOS of 8 days.31 out of 60 patients (52%) did not have their HbA1C done within 3 month before surgery pre-implementation of the new basal bolus regimen; while only 10 out of 30 patients (33%) did not have their HbA1c checked within 3 month before surgery post implementation of the new guidelines. 18 out of 60 patients (30%) did not have their blood glucose level checked before surgery; while only 3 out of 30 patients (10%) did not have their blood glucose checked before surgery post implementation of new guidelines.18 out of 60 patients (30%) had a BGL > 11 post surgery (hyperglycemia)**;** while only 6 out of 30 patients (20%) had a BGL >11 post surgery (hyperglycemia) post implementation of new guidelines.9 out of 60 patients (16%) had one or more episodes of hypoglycemia during their admission, a total of 29 episodes, with an average of 3.7% hypo episodes per 100 patient admission days; while only 1 out of 30 patients (3%) had a single episode of hypoglycemia during his admission, with an average of 0.4% hypo episodes per 100 patient admission days post basal bolus implementation.48 out of 60 (80%) experienced one or more episodes of hyperglycemia, a total of hyper 288 episodes; while 21 out of 30 patients (70%) experienced one or more hyperglycemia episodes, a total of 70 hyper episodes post implementation of basal bolus regimen.

2. *Medical (See Table 3.):* Thirty patients were collected according to the inclusion criteria from the medical ward from both the sliding scale group and the basal bolus group. Patients from the sliding scale group had total admission days of 237 days, with an average length of stay of 8 days; while the basal bolus group had total admission days of 321 days, and an average length of stay of 11 days.7 out of 30 patients (24%) did not have their HbA1c done within 3months of admission; while5 out of 30 patients (17%) did not have their HBA1c done within 3months of admission post implementation of new guidelines. 2 out of the 30 patients (7%) had one or more episodes of hypoglycemia during their admission, a total of 4 episodes, with an average of 1.3% hypo episodes per 100 patient admission days; while 1 out of 30 patients (3%) had one or more episodes of hypoglycemia during his admission, a total of 3 episodes, with an average of 0.75% hypoglycemia episodes per 100 patient admission days post implementation of basal bolus regimen. 27 out of 30 patients (90%) had one or more episodes of hyperglycemia during their admission, a total of 121 episodes, with an average of 51% hyper episodes per 100 patient admission days; while 24 out of the 30 patients (80%) had one or more episodes of hyperglycemia during their admission, a total of 78 episodes, with an average of 19.5% hyper episodes per 100 patient admission days post implementation of basal bolus regimen.(See Figure1.)

DISCUSSION

The results of the medical ward were interpreted as follows: Firstly a 27% reduction in the average length of stay post implementation of the new regimen was detected. Secondly 68% reductions in the hypoglycemic episodes per 100 patient days post implementation of the new regimen. A 62% reduction in the hyperglycemic episodes per 100 patient days was found. And finally there was a 6% improvement in the percentage of the patient's tests for HbA1c within 3 months of admission.

The results of the surgical ward were interpreted as follows: Firstly a 15% reduction in the average length of stay post implementation of the new regimen was detected. Secondly a 29% improvement in the monitoring of blood glucose levels pre-op post implementation of the new regimen. There was also a 33% reduction in the blood glucose levels post-op post implementation of the new regimen. 37% improvement in the number of patients tested for HbA1c within 3months of admission. And finally there was a 90% decrease in the number of hypoglycemia episodes per 100 patient days.

This retrospective, randomized clinical trial compared the glycemic efficacy and safety of a basal bolus regimen with insulin glargine once daily and insulin aspart every 6 hours before meals to the sliding scale insulin in surgery and medical ward patients with type 2 diabetes mellitus. It was observed that basal bolus treatment significantly improved glycemic control measured as mean daily glucose levels, decreased the number of hypoglycemia and hyperglycemia episodes and decreased the length of stay. We conclude that basal-bolus insulin regimen is preferred over the sliding scale insulin in the hospital management of surgery and medical patients.

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DISCLOSURE

The author has nothing to disclose.

Table1. DATA collection methods

	Surgical		Medical	
	SS Sliding Scale	**BB Basal Bolus**	**SS Sliding Scale**	**BB Basal Bolus**
Study design	**Retrospective chart review**			
Case selection	**Randomized**			
Sample size	**60**	**30**	**30**	**30**
Inclusion criteria	Surgical patients prescribed only SSI	Surgical patients prescribed only BB regimen	Medical patients prescribed only SSI	Medical patients prescribed only BB regimen
Exclusion criteria	Diabetic ketoacidosis, patients on more than 3units/kg/day, cystic fibrosis patients, type 1 DM with eating disorder, type 1 DM sensitive to insulin, short stay patients (defined as less than 4days), patients on steroid therapy, dialysis patients, pregnancy, pediatric patients, intensive care unit patients and emergency patients			
Study period	Jan/2013-Jan/2014	Jan/2014-June/2014	June/2012-June/2013	June/2013-June/2014

Table2. SURGICAL ward demographics

Clinical characteristics	**Sliding scale Group**	**Basal Bolus Group**
Number of patients	60	30
Male/female	27M/31F	14M/16/F
Mean Age (years)	60	68
Mean BMI (kg/m2)	30	27
Liver disease (Y/N)	7Y/51N	5Y/25N
Kidney disease (Y/N)	6Y/52N	2Y/28N
Cardiac disease (Y/N)	17Y/41N	21Y/9N
Total LOS (no. of days)	620	265
Average LOS (no. of days)	10	8
Type of surgery		
Cancer	18	9
GI	11	11
Vascular	19	4
Ortho	8	6
Others	4	0
Mean BG values		
Admission (mg/dl)	10.5	8.6
HbA1C- pre-op	7.7	6

(within 3 months of admission)		
Pre-surgery BLG	9.7	9.1
Post-surgery BLG	12.2	8.0
Diabetic treatment upon discharge		
Same therapy before admission	19	21
New therapy started	7	9
No prescription upon discharge	30	0
Referral to diabetes clinic (Y/N)	15Y/43N	26Y/4N

Table3. MEDICAL ward demographics

Clinical characteristics	Sliding scale Group	Basal Bolus Group
Number of patients	30	30
Male/female	14M/16F	14M/16/F
Mean Age (years)	67	41
Mean BMI (kg/m2)	25	30
Liver disease (Y/N)	2Y/28N	5Y/25N
Kidney disease (Y/N)	4Y/26N	2Y/28N
Cardiac disease (Y/N)	17Y/13N	21Y/9N
Total LOS (no. of days)	237	401
Average LOS (no. of days)	8	11
Reason for admission		
Hyperglycemia	2	2
Chest pain	9	18
Abdominal pain	6	3
Fever	4	4
Others	9	3
Mean BG values		
Admission (mg/dl)	12.0	11.8
HbA1C- pre-op (within 3 months of admission)	6.2	8.1
Diabetic treatment upon discharge		
Same therapy before admission	25	27
New therapy started	5	3
No prescription upon discharge	0	0
Referral to diabetes clinic (Y/N)	25Y/5N	28Y/2N

Table4. BLOOD glucose standard values. [7]

Blood glucose measurements	Target values
Premeal	<140mg/dl (7.8mmol/l)
Random	<180mg/dl (10.0mmol/l)
Minimal acceptable	90mg/dl - 100mg/dl (5.0-5.6mmol/l)
Hyperglycemia	>200mg/dl (11.1mmol/l)
Mild hypoglycemia	<70mg/dl (3.9mmol/l)
Severe hypoglycemia	<40mg/dl (2.2mmol/l)

American diabetes association

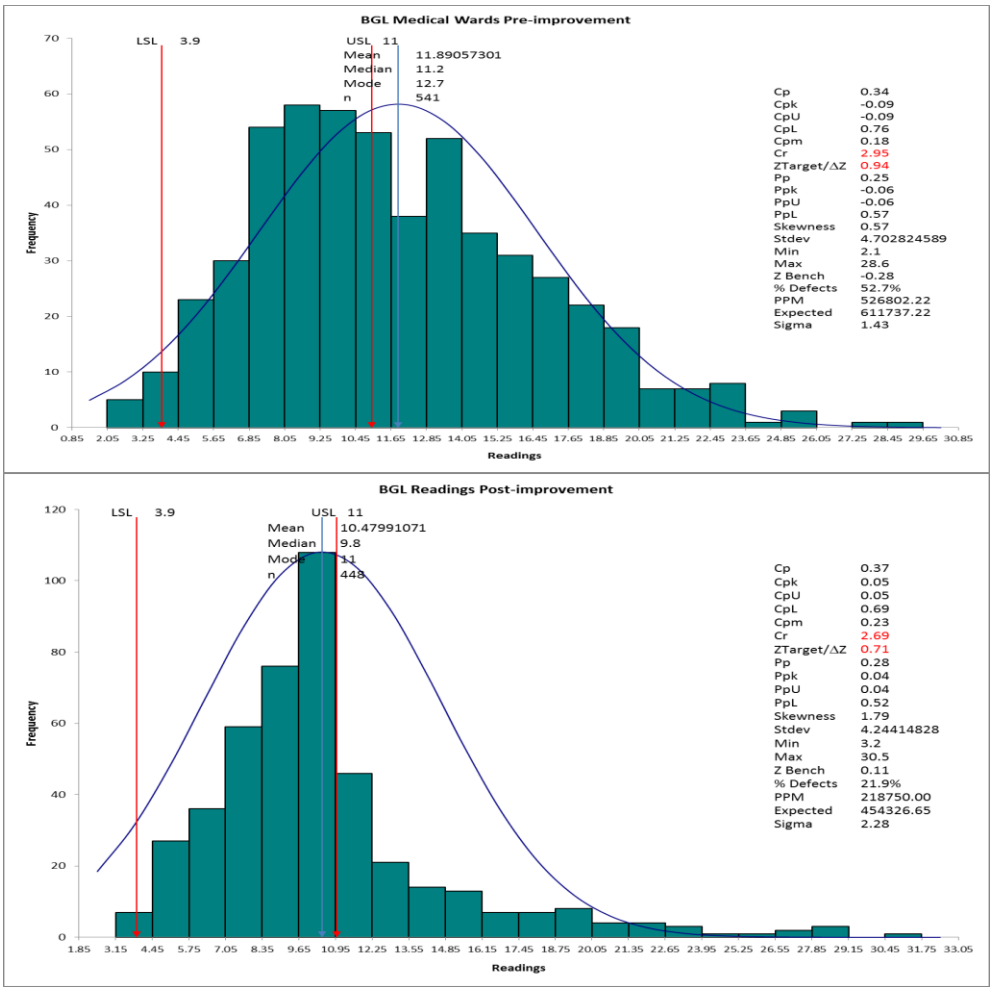

Figure1. Blood Glucose Readings in Medical wards, Pre and post implementation of new guidelines

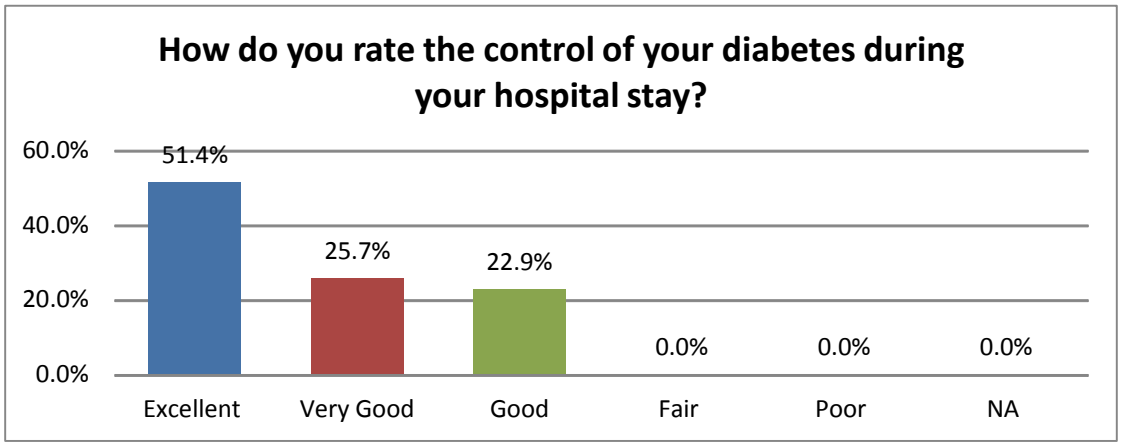

Figure2. Patient satisfaction telephone questionnaire post discharge

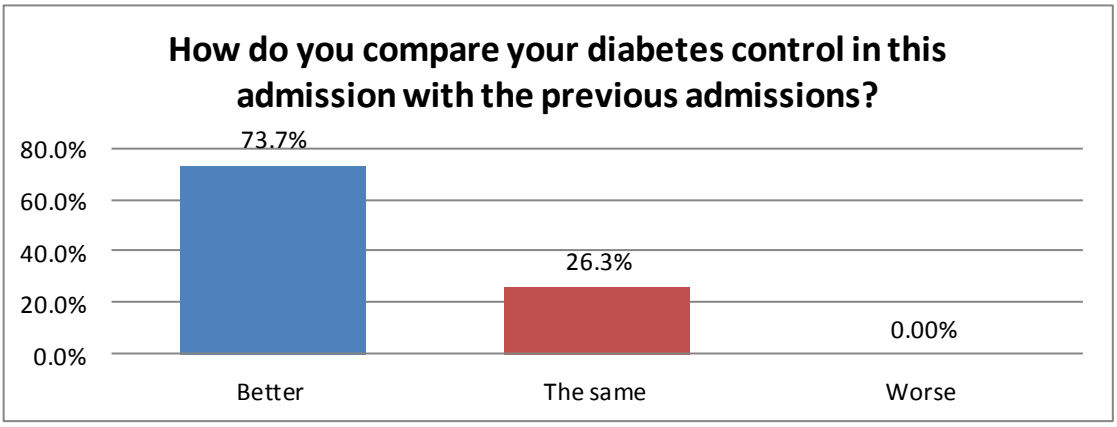

Figure3.Patient satisfaction telephone questionnaire post discharge

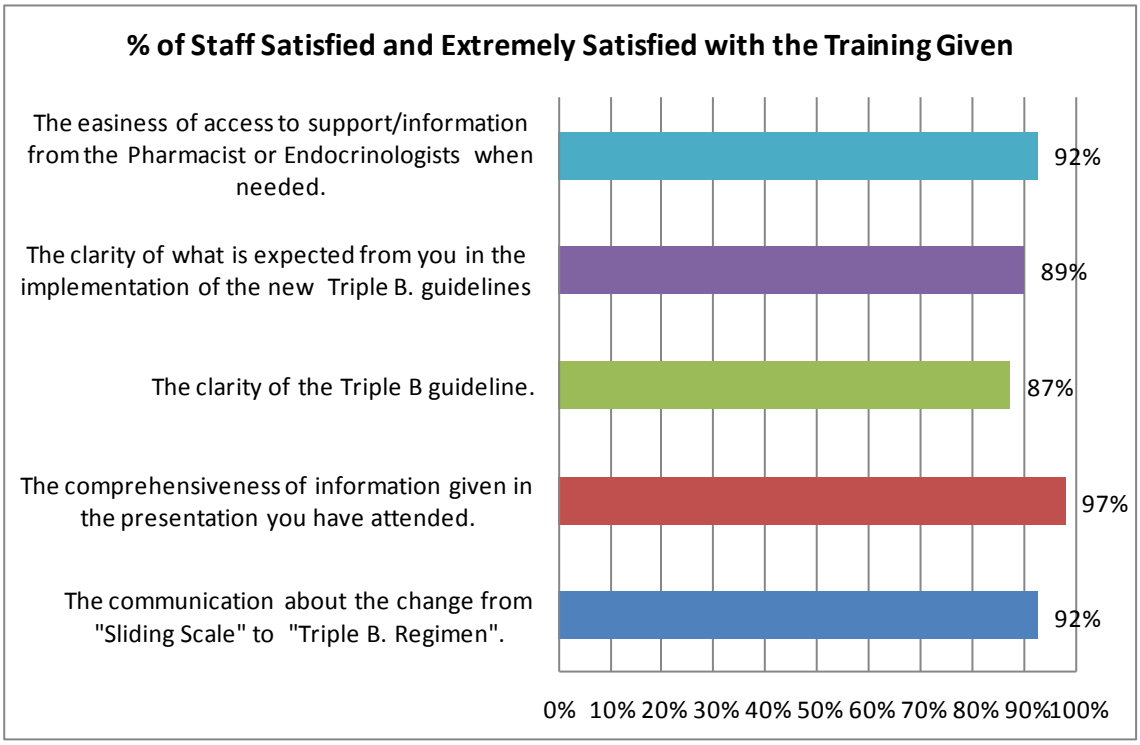

Figure4. Hospital staff survey post training of new basal bolus protocol.

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