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A COMPARATIVE STUDY ON SLIDING SCALE VERSUS BASAL BOLUS INSULIN IN THE MANAGEMENT OF HYPERGLYCEMIA INTYPE 2 DIABETES MELLITUS (DM) PATIENTS IN A TERTIARY CARE HOSPITAL

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ABSTRACT
Sliding-Scale and Basal-Bolus Insulin are two options available for the treatment of severe oracute hyperglycemia in Type 2 Diabetes Mellitus patients. The study aims to compare the glycemic control achieved by using the Sliding-Scale and Basal-Bolus Insulin regimen and the primary objective was to analyse the factors associated with the selection of insulin therapy. A retrospective comparative study was conducted using the medical records of the patient with Type 2 Diabetes Mellitus admitted to Intensive Care Unit of a tertiary care hospital. A total of 140 patient satisfying inclusion criteria were analyzed. Difference between GRBS levels at the time of admission and discharge were calculated. The mean average GRBS difference due to Basal-Bolus Insulin therapy is more than Sliding- Scale Insulin therapy. Study showed that treating diabetic patients in Intensive Care Unit with a Basal-Bolus Insulin regimen resulted in superior blood glucose management, when compared with Sliding-Scale Insulin regimen.

KEYWORDS: Sliding-Scale Insulin (SSI), Basal-Bolus Insulin (BBI), Diabetes Mellitus (DM), General Random blood sugar (GRBS), Intensive Care Unit (ICU).

INTRODUCTION
Diabetes Mellitus (DM) is probably one of the oldest diseases known to man. It was first reported in Egyptian manuscript about 3000 years ago.[1] Diabetes is a non-contagious chronic human disorder. It is a group of metabolic disorder characterized by chronic hyperglycemia which results from defects in insulin secretion, insulin action, or both and Metabolic abnormalities in carbohydrates, lipids, and proteins. Decreased levels of Insulin to achieve adequate response or insulin resistance of target tissues, mainly skeletal muscles, adipose tissue, and to a lesser extent liver, at the level of insulin receptors, signal transduction system, or effecter enzymes or genes are responsible for these metabolic abnormalities.[2] The lifestyle factors and the genetic factors have a greater impact on the development of Type 2 DM.[1]

There are various pharmacological and non pharmacological measures to treat Diabetes Mellitus. Insulin therapy have an important role. Insulin is an anabolic hormone and is the most effective in lowering the glucose level. For patients with Type 2 Diabetes and who are not able to achieve the glycemic goals, health care providers should rapidly initiate insulin therapy.[3]

Designing an insulin regimen aims to mimic how the body normally releases insulin. For Type 2 Diabetes, there are two main ways to replace insulin. Intensive Insulin Therapy and Conventional or Sliding Scale Insulin Therapy. Intensive insulin Therapy closely mimics the natural insulin production and deliver replacement insulin using the concepts of Basal and band deliver replacement insulin using the concepts of Basal and Bolus Insulin coverage.[4]

Sliding Scale Insulin (SSI) regimens are prescribed for the majority of the In Patients with Diabetes.[5] The term “Sliding Scale” refers to the progressive increase in the pre-meal or night time Insulin dose, based on pre-defined blood glucose ranges.[4]

Table 1: Standard Sliding Scale Insulin protocol for patients with Diabetes Mellitus.

Blood glucose (mg/dl)	Insulin (units)
61-150	0
151-200	3
201-250	5
251-300	8
301-350	10
351-400	12
>400	15

Basal Bolus Insulin therapy is safe and effective in the management of hyperglycemia in hospitalized patients. The Basal Bolus Insulin regulates rise in blood glucose due to endogenous glucose production through the processes of gluconeogenesis and glycogenolysis. The Bolus Insulin prevents the meal related rise in blood glucose level. The regimen for Basal Bolus Insulin implies the use of one or two doses of intermittent or long acting (Basal) insulin and three or rarely four doses of short acting insulin (Bolus or prandial).[6]

Aim of the study was to compare the glycemic control achieved by using Sliding Scale and Basal Bolus regimen for the management of severe or acute hyperglycemia in patient with Type 2 Diabetes Mellitus. The main objective of the study was:

- To analyze the factors associated with the selection of insulin therapy used in the management of severe or acute hyperglycemia in patient at Intensive Care Unit.

MATERIALS AND METHODS

A tertiary care served as the setting for this retrospective comparative study. This study consisted of 140 participants. Patients admitted to Intensive Care Unit with Type 2 Diabetes Mellitus, treated with insulin and with any disease along with severe or acute hyperglycemia were the inclusion criteria.

Since this was a retrospective study, informed consent was not sought. Prior to the trial IEC approval from the hospital was obtained. The demographic characteristics (gender, age) and clinical characteristics (blood glucose level at the time of hospital admission, co morbidity, cause for hospital admission, length of hospital stay) were collected from the medical records.

RESULTS AND DISCUSSION

This retrospective comparative study was carried out for a period of 6 months in the patients admitted to Intensive Care Unit of a tertiary care hospital in Kerala.

The study was conducted to compare the glycemic control achieved by using Sliding Scale and Basal Bolus regimen for the management of severe or acute hyperglycaemia in patient with Type 2 Diabetes Mellitus. A total of 140 patients were selected for our study based on inclusion and exclusion criteria. Demographic details of the study subjects includes their gender and age distribution. Clinical characteristics of the subjects includes Blood Glucose level at the time of hospital admission, Distribution of patients in accordance with the length of hospital stay.

1. Demographic characteristics

1.1 Gender distribution of patients

Table 2

Gender	Frequency(n=140)	Percentage(%)
Male	79	56
Female	61	44
Total	140	100

From the above table, it is seen that 56% of the patients were males and 44% were females. According to the findings of our study, males were more than females. Figure 1 also interprets the same.

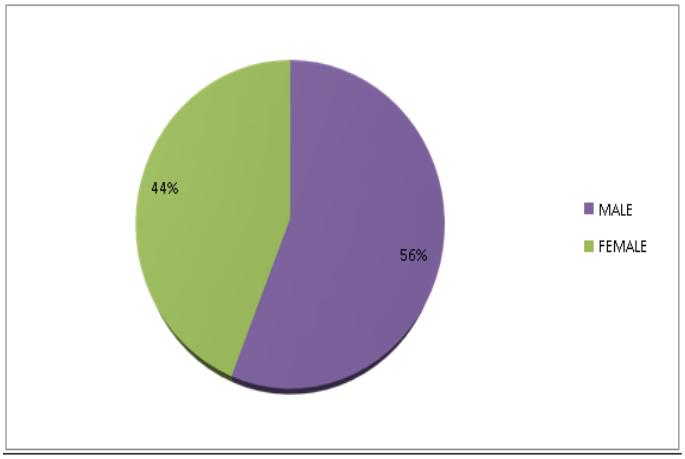

Figure 1: Gender distribution of patients.

1.2 Age

Table 3

Age group (years)	Frequency (n=140)	Percentage (%)
<40	2	1
40-60	56	40
60-80	74	53
>80	8	6
Total	140	100

The above table shows the frequency of patients within each age group. Only 1% were in the age group less than 40, 40% were in the age group 40-60, 53% were in the age group of 60- 80 and 6% were in the age group greater than 80. Majority of the patients, 53% lies in the age group of 60-80 years. In accordance with the study conducted by Dharmarajan *et al*,[8] our study also showed the similar results.

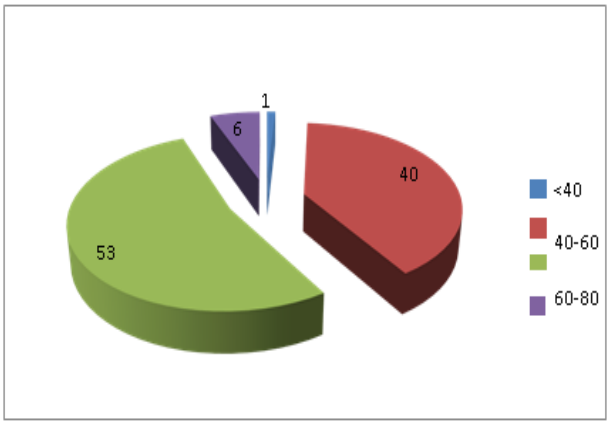

Figure 2: Age distribution of patients.

2. Clinical characteristics

2.1 Blood glucose level at the time of hospital admission

Table 4

Minimum level	120 mg/dl
Maximum level	580 mg/dl
Mean±standard deviation	282.6±7.73 mg/dl

Blood glucose levels were normally distributed with a Mean ± SD of 282.6 ± 7.73 mg/dL with a minimum of 120mg/dL and a maximum of 580mg/dL were found.

2.2 Length of hospital stay

Table 5

Days in hospital	Frequency (n=140)	Percentage (%)
<5	48	34
5-9	59	42
9-13	22	16
13-17	6	4
>17	5	4
Total	140	100

It was found that 42% of the patient were admitted for 5-9 days followed by 34% for less than 5 days, 16% for 9-13 days, 4% for 13-17 days and 4% were admitted for more than 17 days. Among the 4% of patients, 2 were admitted for 18 days, 2 for 20 days and 1 for 21days.

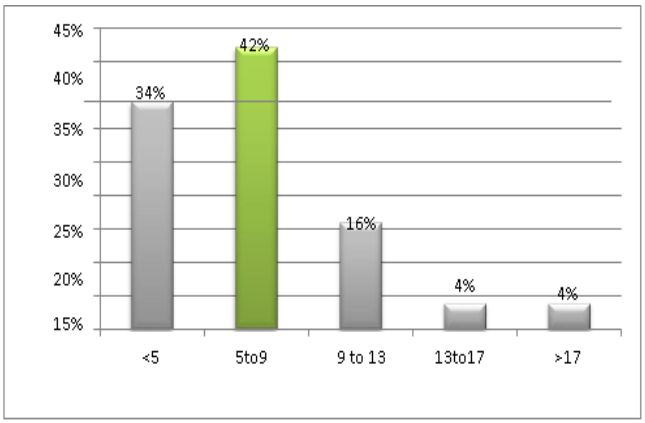

Figure 3: Distribution of patients in accordance with the length of hospital stay.

Table 6

Minimum number of hospital Days	3days
Maximum number of hospital Days	21days
Mean	8days

The minimum and maximum number of hospital days of the 140 patients were found to be 3 days and 21 days respectively. Mean of the number of days in hospital was found to be 8 days.

3. Effectiveness of the insulin regimen

Table 7

Insulin regimen	Mean ± sdof grbs at the time of admission (mg/dl)	Mean ± sdof grbs at the time of discharge (mg/dl)	Mean ± sd of the grbs difference (md/dl)	P value
Basal bolus	307.11± 94.76	188.14 ± 51.51	118.97 ± 85.53	0.035
Sliding scale	258.21 ± 81.66	165.80 ± 46.77	92.41 ± 62.47	

Since the p-value is <0.05, the test is significant at 5% level of significance, which means the average GRBS difference due to Basal-Bolus Insulin Therapy is more than that due to Sliding-Scale Insulin Therapy.

Thus Glycemic control achieved by Basal-Bolus Insulin Therapy is more. Also it is found that, the average of the % GRBS difference for BBI is 39% and that of SSI is 36%.This shows that, BBI had caused a reduction in the GRBS levels from the initial values by 39% and SSI had cause of the reduction. From the initial values of GRBS levels by 36%. Hence, BBI is more efficient than SSI. This study's findings are comparable to those of Huri HZ *et al.*[9]

4. Factors associated with the selection of insulin regimen

4.1 Age of the patient

Table 8

Age group	Bbi	Percentage(%)	Ssi	Percentage(%)	P value
< 40	1	50	1	50	0.715
40-60	25	45	31	55	
60-80	39	53	35	47	
> 80	5	63	3	37	

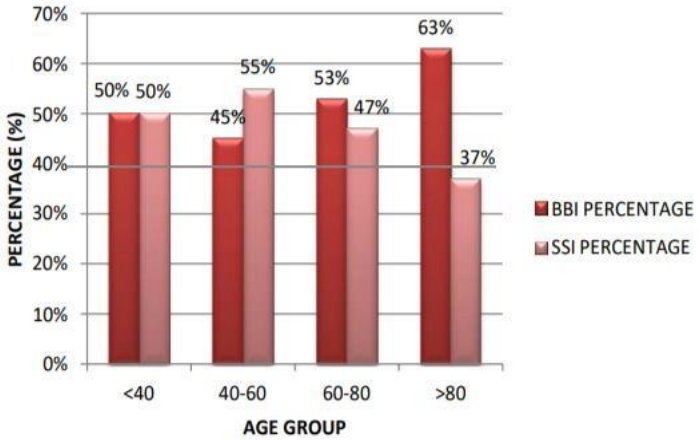

Figure 4: Age wise distribution of insulin regimen.

55% of the age group 40-60 were treated with SSI and 63% of the age group >80 were treated with BBI. Since the p-value is greater than 0.05, there is no significant association between age and the type of insulin Regimen. This result differ from those published by Huri H Z *et al*.[9]

4.2 Gender of the patient

Table 11

Gender	Bbi	Percentage (%)	Ssi	Percentage (%)	P value
Male	34	43	45	57	0.044
Female	36	59	25	41	

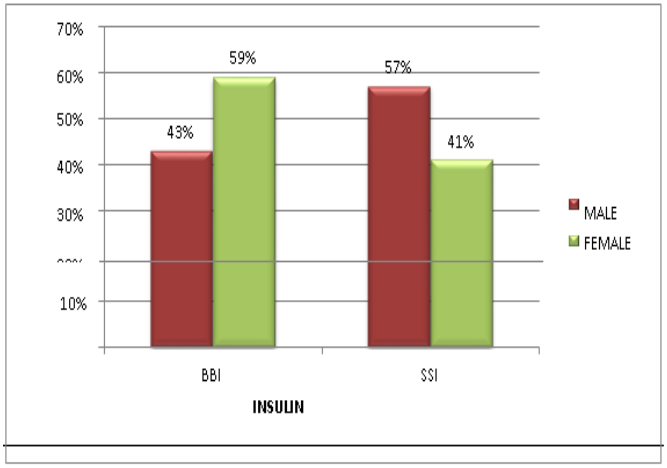

Figure 5: Gender wise distribution of insulin regimen.

Since the p-value is less than 0.05, there is significant association between gender and type of insulin regimen. Majority of the males are treated with Sliding-Scale Insulin and majority of the females are treated with Basal-Bolus Insulin. This is in contrast to Robert G W *et al* results.[7]

4.3 Blood glucose levels at the time of admission

Table 13

Insulin regimen	Mean ± sd of the grbs level (mg/dl)	P value
Bbi	307.11 ± 94.76	0.001
Ssi	258.21 ± 81.66	

Our study showed that patients with high blood glucose level at the time of admission were treated with BBI and those with low were treated with SSI. Since p-value is less than 0.05, we restated the association between GRBS levels at the time of admission and type of insulin regimen used. This is comparable to the findings of Thiruvinvamalai S *et al.*[8]

CONCLUSION

Insulin is the most effective agent in lowering the glucose level. For patients with Type 2 Diabetes Mellitus and who are not able to achieve the glycemic goals, health care providers rapidly initiate insulin therapy. For Type 2 Diabetes Mellitus, there are two main ways to replace insulin. Intensive Insulin Therapy and Sliding Scale Insulin Therapy. Intensive Insulin Therapy use the concept of Basal-Bolus Insulin coverage.

A total of 140 patients were included to compare the effectiveness of BBI and SSI in achieving the glycemic control in patients with Type 2 Diabetes Mellitus admitted to ICU. Our study showed that Basal Bolus Insulin regimen resulted in superior blood glucose management when compared with Sliding Scale Insulin regimen. According to American Diabetic Association, the only acceptable modality of treatment in patients with blood sugar level greater than 180mg/dl is Basal Bolus Insulin therapy and we found that our hospital follows rationale therapy.

We also assessed the factors associated with the selection of insulin regimen and found that gender, blood glucose level (GRBS) at the time of admission has significant association with insulin regimen used. Number of females treated with BBI were more than males and number of males treated with SSI were more than that of females. BBI was opted for patients with high blood glucose level at the time of admission. When we compared the duration of hospital stay, our study showed that patients under SSI had less number of hospital days than patients with BBI.

Overall, this study revealed that lower blood glucose levels were achieved with Basal-Bolus Insulin regimen compared with Sliding-Scale Insulin regimen in the population studied.

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