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Management of *Diabetes mellitus* in an Acute Care Setting

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Abstract. The aim of this study was to evaluate the efficacy of the addition of twice daily doses of intermediate acting insulin to the conventional sliding scale in patients with Type 2 diabetes admitted for medical illness other than diabetes. Fifty patients were started on conventional sliding scale and the other fifty were treated by the same sliding scale with the addition of twice daily intermediate acting insulin. Twenty-five (50%) patients assigned to conventional sliding scale showed poor blood sugar results, >250 mg/dl (mean 276 mg/dl); whereas, only two patients on the conventional sliding scale with addition of intermediate acting insulin showed poor blood sugar control. Blood sugar results > 180 < 250 were found in 15 (30%) patients on sliding scale patients whereas only in 8 (16%) patients on NPH insulin. Good blood sugar results, <180 mg/dl, were obtained in 40 (80%) patients with addition of NPH but only 10 (20%) patients on sliding scale alone showed good control. We conclude that the addition of intermediate acting insulin to the conventional sliding scale revealed significant improvement in blood glucose control (P-value > 0.2) compared with conventional sliding scale alone in patients with diabetes mellitus during acute medical illness.

Keywords: Conventional sliding scale, *Diabetes mellitus*, Blood sugar levels.

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Introduction

Patients with Type I or Type II *diabetes mellitus* (DM) are frequently admitted to the hospital, usually for treatment of conditions other than diabetes[1,2]. However, the presence of diabetes precipitates admission of a patient who would otherwise be treated as an outpatient[3]. Glycemic control is likely to become unstable in the patient, not only because of the stress of the illness, but also because of the concomitant changes in dietary intake and physical activity. For these reasons we have to hold the outpatient treatment for DM and to start on short action insulin according to blood sugar level (conventional sliding scale). The main goals of treatment in such cases in respect to diabetes itself are to minimize disruption of the metabolic state, prevent an untoward result, and return the patient to a stable glycemic balance as quickly as possible[4]. The patients in this study treated by conventional sliding scale were observed having poor glycemic control but when the researchers added fixed doses of intermediate action insulin twice a day observations revealed better glycemic control with minimal increase in the incidence of hypoglycemia. We performed this study to evaluate the efficacy of the addition of intermediate action insulin and observed that this treatment showed better glycemic control with minimal side effects.

Patients and Results

One hundred (100) patients with Type 2 diabetes who had been admitted to either the Intensive Care Unit (ICU) or the medical wards at King Abdulaziz University Hospital (KAUH) and Dr. Soliman Fakeeh Hospital in Jeddah were involved in the study. Forty (40%) patients had cardiac problems, 26 (26%) patients had chest infections, 24 (24%) patients had suffered strokes and 10 (10%) patients had other medical illnesses. All were treated by oral anti-diabetic drugs or insulin or both which were stopped during admission. Patients on steroids, patients on nasogastric feeding, patients not allowed to take food per mouth (NPO), patients required high doses of insulin for treatment of diabetes in outpatients (> 100 unit of insulin/day), patients treated only by diet and Type 1 diabetes were excluded from this study. During hospitalization, the patients were treated either by conventional sliding scale according to blood sugar level (Table 1), or with the same sliding scale with an additional fixed dose, (14 unit) of intermediate action insulin twice-a-day. There was no direct selection for which patients received the additional intermediate action insulin; treatment was assigned according to admission sequences. The first patient was started on sliding scale alone, where as the fixed dose of NPH was added to the second patient's treatment and so on consecutively for the 100 patients, 50 patients received sliding insulin alone, and the remaining 50 patients were given the sliding scale insulin with the addition of 14 units of NPH twice a day.

Table 1. Conventional sliding scale insulin used.

Blood Sugar	Insulin Dose
< 150 mg/dl	No insulin
151-200 mg/dl	4 units
201-250 mg/dl	6 units
251-300 mg/dl	8 units
300 mg/dl >	10 units

Note: To convert to mmol/L multiply by 0.056

Blood sugar levels were checked at the time of admission and repeated every 4 hours thereafter for 5 days. Optimum equipment for checking capillary blood sugar was used. We divided the patients into three groups, according to the main blood sugar level during hospitalization. Group One patients had a blood sugar level of less than 180 mg/dl, group two had blood sugar results >180 mg/dl < 250 mg/dl and Group Three had blood sugar levels of 250 mg/dl or more. At admission the blood sugar levels were badly controlled in 30 (30%) patients whose blood sugars results showed levels of more than 250 mg /dl and the mean was 280 mg/dl, in 35 patients, the blood sugar levels were less than 250 mg/dl and > 180 mg/dl and 35 patients revealed good control at admission with blood sugar result less than 180 mg/dl.

Blood sugar results in patients assigned to sliding scale regimen alone showed very bad control in 25 (50%) patients. The blood sugar results in 25 patients were more than 250 mg/dl with a mean of 280 mg/dl. In 15 patients the blood sugar results were more than 180 mg/dl (mean: 240 mg/dl) less than 250 mg/dl. Only ten (10) patients showed good control of the blood sugar and the result was less than 180 mg/dl (mean: 150 mg/dl) (Table 2).

Table 2. The results of blood sugar levels.

	At admission (100 patients)	On sliding scale alone (50 patients)	Plus NPH 14 unit twice per day (50 patients)
Good blood sugar (< 180 mg/dl)	35	10	40
Average control (>180<250 mg/dl)	35	15	8
Very bad control (Equal or >250 mg/dl)	30	25	2

Patients assigned to receive additional intermediate action insulin demonstrated improved control with only two (2) patients showing blood sugar levels of more 250 mg/dl. In 8 patients, the blood sugar levels were between 180-250 mg/dl (mean: 195 mg/dl). In 40 patients, the blood sugar levels were

less than 180 mg/dl (mean: 168 mg/dl). Fourteen of these patients showed better control where the blood sugar levels were between 90-150 mg/dl (mean: 122 mg/dl) (Table 2).

Hypoglycemia was not observed in patients receiving conventional short action sliding scale insulin. However, from the patients receiving intermediate action insulin hypoglycemia was reported in two patients; findings of no significance.

Statistical analysis was done by SPSS program and Q-square was performed to evaluate the difference between the two groups. The difference between the two groups was very significant and the P-value 0.2 (Significant if P-value > 0.005). These findings validated our conjecture that the addition of a fixed dose of insulin to the sliding scale will lead to better control.

Discussion

In severely ill patients with DM, the following goals should be achieved: 1) Avoidance of hypoglycemia; 2) Avoidance of marked hyperglycemia; and 3) Assessment of the comprehensiveness of diabetes care. Hypoglycemia, even when it lasts for only a few minutes can be harmful, possibly causing arrhythmias, other cardiac events, or transient cognitive deficits. The causes of hypoglycemia in the hospital include continued hypoglycemic therapy when caloric intake was stopped or reduced, use of a “sliding scale” of insulin without the consideration of the patients' specific circumstances, or an attempt to provide tight glycemic control[5]. Therefore, measures must be taken to avoid serious hypoglycemia or hyperglycemia in patients admitted to the ward with acute medical illness.

Clinical observations have demonstrated that patients with diabetes are more susceptible to infections[6]. A reasonable glycemic goal must be implemented to achieve blood concentration to levels > 120 mg/dl. A reasonable goal to avoid marked hyperglycemia is to aim for blood glucose concentrations not >250 mg/dl. Hyperglycemia and insulin resistance are common during stress in patients admitted with acute medical illness[7].

It has been observed that good blood sugar control during acute medical illness reduces mortality[8]. Hyperglycemia has shown poor outcomes[9], when widespread use of the sliding scale of insulin administration for stressed patients began during the era of urine glucose testing. This tradition continued after the introduction of rapid capillary blood glucose testing during the last two decades[10]. This method has poor blood sugar control. It can only be useful, if it is individualized and as a supplement to an appropriate baseline regimen. In this study, the recommendation is to start the diabetic patients admitted with

acute medical illness on insulin according to blood sugar levels and check their blood sugar levels more frequently to prevent hypoglycemia or hyperglycemia and to compare it with adding fixed dose of insulin twice a day. Better results may be obtained by adding basal fixed doses of insulin according to out patient treatments. We concluded from our study that adding fixed twice a day doses of intermediate action insulin to conventional sliding scale in treatment of a diabetic admitted for medical illness will lead to significant blood sugar control with minimal risk of hypoglycemia as compared to conventional sliding scale alone.

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ضبط حالات السكري من خلال رعاية بيئة دقيقة

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المستخلص. كثير من المرضى المصابين بمرض السكري يتم تنويمهم بالمستشفى لأسباب لا علاقة لها بهذا المرض، إلا أنه يجب التحكم في معدل السكر بشكل سليم. ولذلك تمت مقارنة الطريقة المتعارف عليها – وذلك بإعطاء المريض جرعة من الأنسولين الصافي على حسب معدل السكر – مع الطريقة الثانية ، والتي تتم بإضافة جرعتين من الأنسولين المعكر في الصباح والمساء. وتم تقسيم المرضى إلى قسمين: القسم الأول: خمسون مريضًا تتم مراقبتهم على الطريقة الأولى. القسم الثاني: خمسون مريضًا تتم مراقبتهم على الطريقة الثانية. وقد ثبت فعالية إضافة أنسولين معكر مرتين في اليوم في التحكم في معدل السكر في الدم.