IMPACT OF ELECTIVE HOSPITALIZATION OF POORLY CONTROLLED DIABETIC PATIENTS ON SHORT TERM GLYCEAMIC CONTROL

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The primary aim of this study was to determine whether elective admission of poorly controlled diabetic patients to the hospital for glycaemic control through medical therapy and education has an impact on the short-term glycaemic control up to six months post hospital discharge. The secondary objective is to determine the length of hospital stay (days) and the effect of inpatient management on the body weight (kilograms) and the incidence of severe post hospital discharge hypoglycaemia. This is a retrospective study of 55 poorly controlled type 1 and type 2 diabetic patients who were electively admitted for glycaemic control under the care of the endocrine service at King Faisal Specialist Hospital and Research Center (KFSH & RC), Riyadh Saudi, Arabia, from the period 1996-2000. Only those with HbA1c > 8.5% and have follow up data up to 6 months post discharge (mean 3.4 ± 2.2 months) were included. Patients with acute metabolic complications, gestational and newly diagnosed diabetes mellitus and those receiving insulin analogs were excluded. Paired t-test is used to compare the result of baseline and post discharge HbA1c, body weight (Kg). HbA1c was decreased significantly in the whole group from a baseline value of 13.5 ± 2.4 to 11.4 ± 2.1%, within a mean period of3.4 ± 2.2 months post hospital discharge (p < 0.0001). In type 1 DM, HbA1c decreased from a baseline value of 14.8 ± 3.0 to 12.5 ± 3.0 (p = 0.006). Similarly in type 2 DM, HbA1c fell from a baseline value of 13.1 ± 2.0 to 11.1 ± 2.0 (p 0.0001). On the other hand the body weight increased from a baseline value of 70.9 ± 16.5 Kg to 72.8 ± 16.5 Kg (p < 0.0001). The increase in body weight was obvious in both type 1 and type 2 DM with a baseline value of 65.7 ± 17 Kg and 72.4 ± 16.2 Kg to 67 ± 17.45 Kg and 74.6 ± 16 Kg respectively during the study period. The length of hospital stay was 4.6 ± 2.39 days for type 1 DM and 5.3 ± 2.2 days for type 2 DM patients. Elective hospitalisation of uncontrolled type 1 or type 2 DM under the care of multidisciplinary team had a significant positive impact on glycaemic control with a significant reduction of baseline mean HbA1c of 2.1% in the short term. This is more obvious in patients who had increase in their diabetic medication(s) or who were switched to insulin therapy.

The prevalence of diabetes mellitus (DM) has increased dramatically through out the world.[1-3] Such increase spanned all ages including children and adolescents. It is estimated that 15-20% of the adult population in Saudi Arabia suffers from DM.[4-6] Diabetes mellitus is a major cause of mortality and morbidity in contemporary societies and with this increase in prevalence; the major acute and chronic complications are expected to increase. Unless drastic measures are taken to contain this epidemic and control the existing pool of diabetic patients soon, the extra burden on local services and financial resources including hospital bed availability will be detrimental.[7,8]

Data from Diabetes Control and Complication Trial (DCCT),[9] United Kingdom Prospective Diabetes Study (UKPDS)[10,11] and Kumamoto Study (12) had proved the importance of intensive long-term glycaemic control in preventing or delaying micro vascular complications of both type 1 and type 2 DM respectively. Microvascular complications were reduced by 57-65% in DM1 in the DCCT study. UKPDS demonstrated that improved glycaemic control reduced the risk of overall micro vascular complication by 25% and the risk of fatal and non-fatal myocardial infarction by 16% in type2 diabetics. On the other hand cost savings associated with a 0.5% decrease in HbA1c have been established.[13,14]

Patients with DM and specifically those requiring insulin should be managed by a multidisplinary team including physicians, nurses, dietitian, pharmacist and mental health professional, but above all it requires a motivated and capable patient for successful management. The two major management goals are to achieve normal or near

normal metabolic control and to prevent or delay microvascular and to treat risk factors for macrovascular complications. The decision whether to admit a patient with poor glycaemic control to hospital or to refer him to the day-care unit or outpatient diabetic clinic for glycaemic control may depend on the available resources in the institution and factors such as the stability of home situation, level of education, degree of motivation, the difficulty to control diabetes in outpatient setting and the cost.

In this study we set out to determine whether elective admission of uncontrolled diabetic patients to the hospital for blood glucose control under the care of multidisciplinary team has an impact on the short-term glycaemic control.

METHODS

Study design: We conducted a retrospective study of fifty-five poorly controlled type 1 and type 2 diabetic patients electively admitted, for glycaemic control under the care of endocrine service in King Faisal Specialty Hospital and Research Center (KFSH & RC), a tertiary care educational hospital, Kingdom of Saudi Arabia, Riyadh, from the period 1996-2000.

Inclusion criteria: Included those with baseline glycosylated haemoglobin HbA1c > 8.5% (normal: 4.8-6%), admission under endocrine services, and have follow up data up to 6 months post discharge. Patients with acute metabolic complications of DM, acute myocardial infarction, pre-gestational, gestational diabetes, surgical, renal failure, chronic liver disease patients, those on supra-physiological doses of glucocorticosteroids, and newly diagnosed diabetics and patients receiving insulin analogs were excluded.

Medical records of 138 electively admitted diabetic patients for glycaemic control were reviewed. Eighty three patients were excluded because they did not fulfill inclusion criteria. Fifty five patients were eligible and were included in the study. Most patients admitted for glycaemic control were referred from other departments in our hospital. Baseline fasting plasma glucose (mmol/1), HbA1c, body weight (Kg), and body mass index (kg/m^2) were measured up to one week prior to or at the time of admission without any change of the previous baseline therapy. Inpatient adjustment of therapy was based on bedside capillary glucose monitoring readings done four times (pre main meals and at bed time) per day in all patients and more frequently when indicated. Every patient is seen individually on daily bases during elective hospitalization for glycaemic control by multidisciplinary team including an endocrinologist, diabetic educator, dietitian and if appropriate social worker and psychiatrist. At the first outpatient clinic visit and upto 6 months after discharge (mean 3.4 ± 2.2 months), FPG, HbA1c, body weight (Kg), home glucose monitoring results if available, assessment of diet control, and history of hospital admission or emergency room visit for acute metabolic complications were recorded.

Statistical analysis: Paired t-test is used to compare the result of baseline and post discharge HbA1c, body weight (Kg). Scatter plot and box and whisker plots are used to examine the relation between baseline and post-hospital discharge HbA1c.

RESULTS

The demographic and clinical characteristics of 55 diabetic patients are shown in Table 1. Data in the text and tables are presented as mean ± SD, unless otherwise indicated. The mean age of the group is 44.9 ± 17.4 years. Thirty-three are female (60%), whereas 22 (40%) are male. Forty-two (76.4%) had type 2 DM, 13 (23.6%) had type 1 DM. The mean duration of diagnosis of DM was 10.7 ± 6.4 years and mean body mass index (BMI) was 27.3 ± 5.4 (kg/m2) in the whole group.

Of type 2 diabetic patients, 28 (67%) were on oral hypoglycaemic agents (OHA), 11 (26%) on

Table 1: *Baseline demographic and clinical characteristics.*

Characteristic	Whole group	Type 1 DM	Type 2 DM
Number of patients (%)	55 (100)	13 (23.6)	42 (76.4)
Male (%)	22 (40)	6 (27)	16 (73)
Female (%)	33 (60)	7 (21)	26 (79)
Mean age – Years (SD)	44.9 ± 17.4	23 ± 9.3	51.6 ± 13.2
Duration of DM – Years (SD)	10.7 ± 6.4	9.7 ± 7.5	11 ± 6.0
BMI – kg/m^2 (SD)	27.3 ± 5.4	24.8 ± 4.9	28 ± 5.3
Body weight – Kg (SD)	70.9 ± 16.5	65.79 ± 17	72.47 ± 16.2
Baseline medication(s)			
Insulin (%)	24 (43.6)	13	11
OHA (%)	28 (51)	0	28
Insulin + OHA (%)	3 (5.4)	0	3

Table 2: *Baseline complications and co-morbid diseases.*

Complications/ Comorbidity	Whole group	Type I DM	Type II DM
Retinopathy	13	1	12
Neuropathy	27	1	26
Nephropathy	9	3	6
Ischaemic heart disease	7	0	7
Hypertension	10	1	9
Dyslipedaemia	14	1	13

Table 3: *Effect of inpatient management on baseline and post-hospital discharge (post) HbA1c, body weight.*

Parameter	Whole group N=55	Type 1 DM N=13	Type 2 DM N=42
Baseline – HbA1c % (SD)	13.5 ± 2.4	14.8 ± 3.0	13.1 ± 2.0
Post-HbA1c % (SD)	11.46 ± 2.11	12.5 ± 3.0	11.1 ± 2.0
P Value	<0.0001	0.006	<0.0001
Baseline-body weight Kg (SD)	70.9 ± 16.5	65.7 ± 17	72.4 ± 16.2
Post-body Weight Kg (SD)	72.8 ± 16.5	67 ± 17.45	74.6 ± 16
P Value	<0.0001	0.16	0.0002
Length of hospital stay (Days)	-	4.6 ± 2.39	5.3 ± 2.2

insulin therapy, and 3 (5%) patients on combination of insulin and OHA therapies. All type 1 diabetics were on insulin prior to admission. The vast majority of Type 1 and 2 diabetic patients on baseline insulin therapy received twice-daily doses of a mixture of subcutaneous short and intermediate-acting insulin (NPH) before breakfast and dinner. Occasional patients were on 3 or more doses of insulin therapy per day. A few type 2 diabetic patients were on baseline mixture of (70% isophane / 30% soluble) insulin. Forty-nine patients (89%), already had established microvacular complications of DM. Thirteen patients had retinopathy, whereas 27 had mainly distal sensory neuropathy & 9 patients had nephropathy. Seven patients had ischaemic heart disease. Ten patients showed systemic hypertension and 15 had dyslipidaemia (Table 2).

Inpatient management included initiation of insulin and/or continuation of baseline oral hypoglycaemic agents in 27 (49%) patients with type2 diabetes mellitus, of these insulin alone was initiated in 20 patients while combinations of insulin with continuation of baseline OHA were instituted in another 7 patients. Almost all of them previously failed to respond to maximal doses of OHA (glibenclamide or metformin or both). Baseline medications were increased in 19 (34.5%) patients (10 type 2 and 9 type 1 diabetics), who were previously on insulin therapy. Six (11%) patients, were discharged on the same type and dosage of baseline preadmission medications, based on their optimal inpatients capillary blood glucose levels, of whom 4 patients had type 2 DM and 2 patients had type 1 DM, showing no significant drop of their post hospital discharge mean HbA1c of 11.8 ± 2.1% compared to a baseline mean HbA1c value of 12.5 ± 2.1% (P = 0.45). Three patients (5.4%) had their baseline medications decreased (two had Type 1 and one Type 2 DM), because they experienced hypoglycaemia during inpatient management.

The mean baseline HbA1c of the whole treatment group, type 2 and type 1 diabetic patients decreased significantly from 13.5 ± 2.4% to 11.46 ± 2.1% (P<0.0001), from 13.1 ± 2.0% to 11.1 ± 2.0% (<0.0001) and from 14.8 ± 3.0% to 12.5 ± 3.0% (P<0.006) respectively (table 3, figure 1 and 2). The mean fasting plasma glucose (FPG) of the whole treatment group, type 2 and type 1 diabetic patients decreased from 14.22 ± 3.83 mmol/1 (P<0.0001) to 9.88 ± 4.35 mmol/1, from 13.8 ± 3.5 to 9.0 ± 2.3 mmol/1 (P<0.0001) and from 15.7 ± 5.1 to 11.6 ± 4.8 mmol/1 (P = 0.02), respectively. There was a significant increase in whole treatment group and type 2 diabetic patients baseline mean body weight from 70.9 ± 16.5 to 72.8 ± 16.5 Kg (P<0.0001), and from 72.4 ± 16.2 to 74.6 ± 16 kg (P 0.0002) respectively,

Table 4: *Subgroup analysis of types of inpatient management.*

Type of Management	Number of Patients (%)	Baseline HbA1c % (SD)	Post discharge HbA1c % (SD)	P Value
Initiation of insulin (±OHA)	27 (49)	13.1 ± 1.58	11.1 ± 1.85	<0.0001
Increase baseline medication(s)	19 (34.5)	14.9 ± 3.04	12.1 ± 2.69	<0.0019
Same baseline medication(s)	6 (11)	12.5 ± 2.1	11.8 ± 2.1	0.45

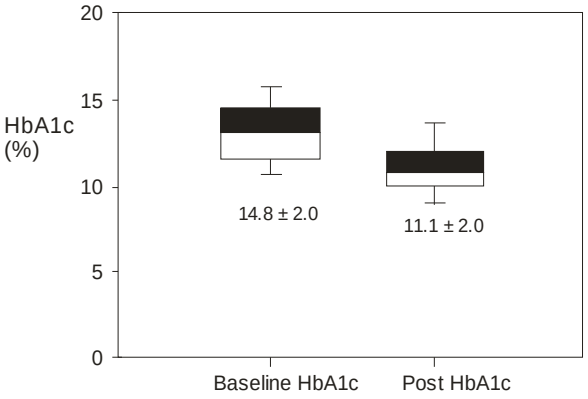

Fig. 1: Box and whisker plot: showing relation between baseline and post-hospital discharge HbA1c in type 2 diabetic patients.

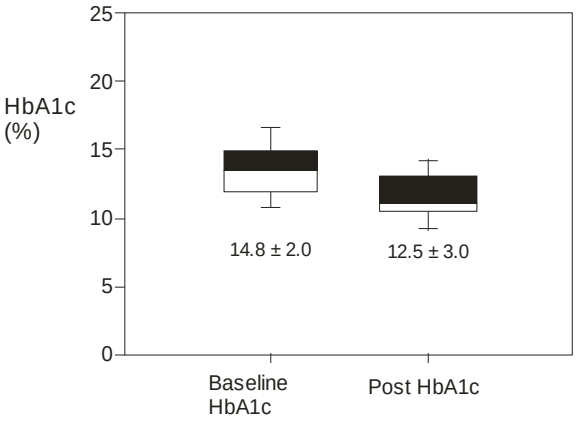

Fig. 2: Box and whisker plot: showing relation between baseline and post-hospital discharge (post) HbA1c in type 1 diabetic patients.

particularly in patients started on insulin, or patients increased their baseline medication(s). No statistically significant increase in body weight in type 1 diabetics post discharge 65.7 ± 17 to 67.0 ± 17 (P 0.16) (table 3 & 4). The median length of hospital stay was 4 days (mean 4.6 ± 2.4) and 5 days (mean 5.3 ± 2.2) for type 1 and type 2 diabetics respectively.

DISCUSSION

Controlling hyperglycaemia in diabetic patients continue to be challenging the clinicians and patients alike. A number of landmark studies over the last decade have highlighted the importance of strict glycaemic control in the prevention of microvascular complications. Hence we should try to achieve management goals that provide minimal morbidity and mortality for all diabetic patients. This can be ascertained by the use of glycated Hb which provides the most objective and reliable information about the patient average glycaemia control over the preceding 2-3 months and can verify the accuracy of self-glucose monitoring.[15-17]

Though lifestyle modification remains to be the initial step in the management of type 2 DM, pharmacological agents are needed eventually to achieve optimal glycaemic targets, In Type 2 DM, a single, double and eventually triple oral hypoglycaemic agents may be needed. At a later stage when there is no further response to insulin secretagogues and/or sensitisers, insulin becomes absolutely necessary to control hyperglycaemia.[10] To achieve this, several settings had been tried including out patient and inpatient management programs. The factors that may affect the decision for admission to hospital or treatment in outpatient setting has been mentioned previously.

Studies of structured outpatients programs for diabetes regulation and self-care including initiation of insulin therapy done in outpatient setting alone[18,19] or when compared with inpatient management,[20-22] are safe, effective and carried out at a significantly lower cost than hospitalization, with significant drop of HbA1c. However this need diabetic care unit or outpatients diabetic clinic for day to day management by experienced nurse/ educator or physician, close communication between the patients and the diabetic staff, adequate equipment and facilities. In hospitals or areas, where such diabetic care units are not available, many diabetic patients with poor glycaemic control, continue to be admitted to the hospital for the initiation of insulin or adjusting current therapy to achieve the desired goal of treatment.

Several studies proved that interventional inpatient programs were effective in improving the long-term glycaemic control and knowledge of diabetes in both type 1 and type 2 diabetics,[21,23-26] and can compensate for deficits in outpatient management.[25] Moreover, patients managed in an inpatient setting were more satisfied with their management than those managed in outpatients setting.[27] Hospitalisation may also afford opportunity, to address a number of issues, including complete medical evaluation, enhanced diabetes self-management education, development of problem-solving skills in various aspects of diabetes management, dietary counselling and supervision, more frequent contact with the patient and care givers.[28] Hence, admission in a controlled setting may shed light on some of the contribution of these parameters.

To the best of our knowledge, this is the first study in Saudi Arabia that has demonstrated the impact of elective hospitalisation of poorly controlled diabetics on short-term glycaemic control

with positive results. Although there are some studies carried out in other countries, these may not be applicable to patients in Arabian Peninsula because of the difference in structure and provision of health care facilities in this region. Other social and cultural differences may also contribute to the lack of applicability of these studies in our patients. Compared to other population studies, our patients with baseline mean HbA1c of 13.5%, constitute a very poorly controlled group. It is unclear whether this is due to non-compliance or disease characteristics. Hence, admission in a controlled setting may shed light on the contribution of these parameters. These groups of patients are just over weight (BMI 27.3 ± 5.4) suggesting that insulin deficiency may play a larger role in their disease manifestation than insulin resistance. Several studies conducted in different regions of Saudi Arabia[29-32] attributed to poor level of knowledge and self-care of diabetes. In a study involving 342 diabetic patients about level of knowledge and self-care, alarming results were witnessed. Only 15% patients were aware of the chronic complications of diabetes and only 6% patients were performing regular self-blood glucose monitoring.[33] Diabetes is poorly controlled in large proportions (45-50%) of diabetic patients, attending primary health care centers, in Riyadh.[34]

Inpatients initiation of insulin therapy either alone or in combinations with OHA in our type2 diabetic patients with secondary oral hypoglycaemic failure, with a mean duration of diabetes 10.7 ± 6.41 years and BMI 27.3 ± 5.4 may indicate that they had progressive loss of pancreatic B-cell function and endogenous insulin secretion. This also suggests that insulin deficiency at least is contributing partly to their poor control. Most of our patients require exogenous insulin to achieve optimal glycaemic control; supporting the notion that insulin deficiency is the main culprit for their poor control. We found statistically significant (2 kg) weight gain following insulin therapy in Type 2 DM which is consistent with other studies.[26] HBA1c improved in the whole group by > 2%. This was achieved at the cost of weight gain. Such finding was not totally expected in view of the local impression that poor glycaemic control is related, at least partly to behavioral attitudes rather than due to inadequate antidiabetic medications. Dramatic improvement occurred in patients who are naive to insulin or had insulin therapy previously. This improvement was also seen in Type 1 DM patients in whom 70% required an increase in their insulin dose. Though our patients' baseline HbA1c is higher and the reduction of HbA1c was more or less similar to most studies, it continues to be poor with HbA1c in the region of 11%. Is this a result of patient compliance and education or other factors? The exact reason is not obvious. We also found a statistically significant weight gain in type 2 DM, which could be related to initiation of insulin therapy or noncompliance to lifestyle modification strategies, which is consistent with other studies.[25,35] Our study also showed a trend that the higher baseline HbA1c or body weight was associated with more significant drop of HbA1c post discharge. A few Patients discharged on the same preadmission medications, although they showed small insignificant drop of their post hospital discharge HbA1c. This could be explained by small number of these patients or non-compliance to diet or medications.

The median length of hospital stay in our patients for glycaemic control is less than that found in other inpatient diabetic team interventional studies, showing reduction of the length of hospital stay, the rate of recurrent of hospitalisation and improved glycaemic control.[23,24,33] This may indicate that we achieved a good control at a lower cost (fewer days of hospital stay) with no increase in the incidence of severe post hospital discharge hypoglycemia.

Despite the improvement in hyperglycaemia there was no recorded severe hypoglycaemia requiring hospitalization or emergency intervention. This is not surprising as the majority of our patients had type 2 diabetes, known to suffer less severe hypoglycaemia compared to type 1 diabetes.[10,36] It is possible that condensed inpatient education resulted in improved patients self-care skills which lead to fewer episodes of acute metabolic complications. The possibility remains that these patients may have sought medical advice in another medical institute during follow up period.

Our study also highlighted the well-known prevalence of complications in diabetic patients with 89% of them manifesting with microvascular complications and 13% showing macrovascular complications. About 18% and 25% of these patients they are known to have HTN and dyslipidaemia respectively. This rate is similar to that found in a study of lipid and related parameters in 2835 Saudi type 2 diabetic patients. Twenty eight % patients fell in the high-risk group for development of cardiovascular disease.[37] Diabetes-related complications are frequent among Saudi diabetic patients. In a study of 1000 diabetic patients, the incidence rate for retinopathy, ischaemic heart disease, systemic hypertension and renal insufficiency were 32%, 11.3%, 26% and 6.95% respectively.[38]

Our study had some limitations. Apart from a retrospective study, a significant number of patients admitted for glycaemic controls were ex-

cluded because they did not fulfill inclusion criteria. The vast majority of excluded patients were discharged to their primary physicians in a different hospital in accordance with the policy of endocrine and metabolism section. A few eligible patients had no complete follow up data up to 6 months post discharge. Whether inclusion of those patients would have altered the final result is unknown. The number of included patients is relatively small, but they may represent the same level of glycaemic control in our country.[34]

We **conclude** that elective hospitalisation of poorly controlled type 1 or type 2 DM had a positive impact in fasting plasma glucose control and a significant reduction of the mean HbA1c of 2.1% at a mean period of 3.4 ± 2.2 months after hospital discharge. This was more significant in patients who had increase in their baseline diabetic medications or who were switched to insulin therapy. We do not recommend routine admission of poorly controlled diabetics for glycaemic control to the hospital, provided that adequate facilities are available in outpatient settings. If the latter settings are appropriate and cost-effective, the decision for admission should be individualised.

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