ORIGINAL ARTICLE

Inpatient management of diabetes: survey in a tertiary care centre

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Submitted 26 January 2003
Accepted 18 May 2003
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Aims: Good glycaemic control in hospitalised patients with diabetes mellitus improves wellbeing and aids recovery. This survey aimed to: (1) assess glycaemic control in patients with diabetes admitted to hospital for reasons other than diabetes, (2) compare the glycaemic control in patients treated in medical and surgical units, and (3) see the impact of specialists' input on glycaemic control.
Methods: The first 150 patients admitted to hospital were identified; those with acute metabolic complications of diabetes mellitus, acute myocardial infarction, pregestational or gestational diabetes, and patients in different intensive care units were excluded. Case notes were reviewed with particular attention to glycaemic control, frequency of blood monitoring, complications, and the actions taken to improve glycaemic control.
Results: Four of the 150 patients died in hospital. When subcutaneous insulin was used glycaemic control was good in 48%, suboptimal in 15%, and poor in 37% of patients. The results were not significantly different with subcutaneous or intravenous insulin. There was also no difference in glycaemic control among medical and surgical patients. Patients managed by designated specialists had better control than those managed by physicians (p<0.001). Hypoglycaemia was documented in 20% and two patients developed non-ketotic hyperosmolar coma while in hospital. In a few cases treatment at discharge was not changed despite poor control while in hospital.
Conclusion: More attention should be given to improving glycaemic control in patients hospitalised for reasons other than diabetes. Particular care should be taken to modify the dose of insulin needed to get good glycaemic control; control was better with specialists' input. A follow up survey will be conducted.

I t is clear from recent epidemiological studies that globally the burden of diabetes mellitus is increasing.[1] Glycaemic control is important in patients with type 1 and 2 diabetes to prevent chronic complications.[2–4] At the same time it is also important to avoid acute metabolic complications, as they are potentially life threatening unless active intervention is taken at the right time. People with diabetes mellitus being admitted to hospitals is common.[5] Glycaemic control plays a paramount part in patients admitted to the hospital for reasons not directly related to diabetes for general wellbeing, to reduce the risk of infection (particularly in the post-operative period), to prevent acute metabolic complications like hypoglycaemia, to speed up the recovery, and for early discharge.[5–9] The aims and objectives of this study were to assess the adequacy of glycaemic control in patients with diabetes during hospital admission, to compare the glycaemic control in patients treated in the medical and surgical units and to compare the control in patients treated by physicians and specialists in the field of diabetes in our hospital.

PATIENTS AND METHODS
Manipal Hospital, Bangalore is situated in South India and has 800 beds. The first 150 patients with diabetes admitted to the hospital in the year 2002 were identified at the time of discharge. For the purpose of the study we excluded patients admitted with diabetic emergencies (diabetic ketoacidosis, hypoglycemia, non-ketotic hyperosmolar coma (NKHC)), diabetic pregnancies whether gestational or pre-gestational, patients admitted with acute myocardial infarction, and patients admitted in the intensive care units of the hospital. Patients staying in the hospital for less than 72 hours were also excluded from the study. There are five designated specialists in the Department of Diabetes and Endocrinology, including two paediatric endocrinologists, and so far as the

inpatient management of diabetes is concerned there is no given policy of referral—that is, the referral to specialists or physician for diabetes management depends on the consultant in charge of a particular patient.

Data were extracted from case records using particularly the nursing records, blood glucose monitoring/insulin prescription chart, the general prescription chart, discharge card, and the case notes. Age, sex, type, duration and treatment of diabetes, blood pressure, lipids, and weight were recorded along with their duration of hospital stay, reason for admission and type of operation, if any. Any requirements for intravenous or subcutaneous insulin or an increase in dose, acute complications of diabetes, and change of treatment during hospital stay or at the time of discharge were noted. For the purpose of this study we defined good control as 80% or more blood glucose results, suboptimal control as 40%–80% of the results, and poor control as less than 40% of the blood glucose results within the target range of 4.5 and 10 mmol/l. This is in accordance with the parameters used by one of the authors in another study.[10] Particular attention was paid to the alteration of treatment when blood glucose was persistently recorded as out of the target range, either low or high. Glycated haemoglobin (HbA1C) was recorded if it had been checked in the current admission.

Statistical analysis was done by unpaired Student's *t* test and one way analysis wherever appropriate using the SPSS module (version 6.5).

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Abbreviations: HbA1C, glycated haemoglobin; NKHC, non-ketotic hyperosmolar coma

RESULTS

Case notes of the first 150 patients who have fulfilled the inclusion criteria were reviewed. Nine patients had type 2 diabetes diagnosed for the first time and the rest were known cases of type 2 diabetes (mean duration 10.3 years, range 1–30 years). Eighty eight patients were male (mean age 56.7 (range 27–78) years) and 62 were female (mean age 56.6 (36–78) years). At the time of admission 12 controlled their diabetes by diet, 79 by tablets, 26 were on insulin, and the rest took a combination of insulin and tablets. The top five causes of admission were chest infection and chronic bronchitis (n = 25), peripheral vascular disease (n = 24), malignancy (n = 16), cholecystectomy (n = 12), and prostate problem (n = 11). Blood pressures were recorded in all patients and 99 were hypertensive (25 newly detected). Lipids were checked in 106 patients of whom 23 had newly detected hyperlipidaemia; 14% had a body mass index more than 25. Average stay in hospital was 13.8 days (2–150 days). Four patients died while in hospital, one from septicaemia, two from stroke, and one from malignancy. Diabetes did not seem to contribute to the terminal event in any of these cases.

HbA1C had been checked in 48 patients (32%) (six had excellent control (<7%), four had acceptable control (7.1%–8%), while in the remaining 38 HbA1C was higher than 8%, suggestive of poor control at the time of hospital admission). Glucometer sugar was checked on an average of 2.9 times a day, and was more commonly done by specialists than physicians (3.8 v 2.2, p<0.05). Using subcutaneous insulin, control was good in 48% by our definition, suboptimal in 15%, and poor in 37% of patients. Similar data while on intravenous insulin were 45%, 11%, and 46% where intravenous insulin was used for at least 24 hours (fig 1). Glycaemic control in medical and surgical patients was comparable.

Specialists were involved in the in-hospital diabetes management in 66 cases (44%). Glycaemic control was significantly better when patients were managed by specialists in comparison with those managed by physicians (fig 2) in all three categories (good, p<0.01; suboptimal, p<0.01; and poor control, p<0.001). More noticeably, the number of patients with poor control was significantly higher in the physician managed group at 77% as opposed to those managed by specialists at 23% (p<0.001).

In total 41 episodes of hypoglycemia was noted in 30 patients (15 mild, 26 were moderate, and none had severe hypoglycaemia). Frequency of hypoglycaemia did not differ with physician and specialist management. No documented action was taken in at least 21 episodes to prevent recurrence of hypoglycaemia. However, no patient died of this complication. No episode of diabetic ketoacidosis was recorded but two patients developed NKHC; physicians managed both. Reviewing the notes we felt that no adequate action was taken for persistent hyperglycemia in both the cases before
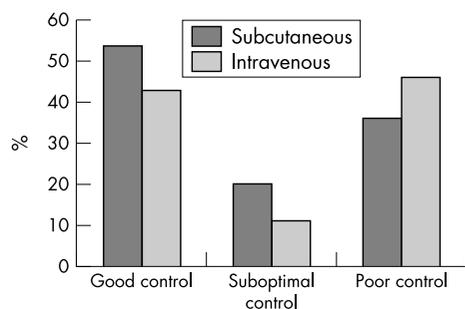

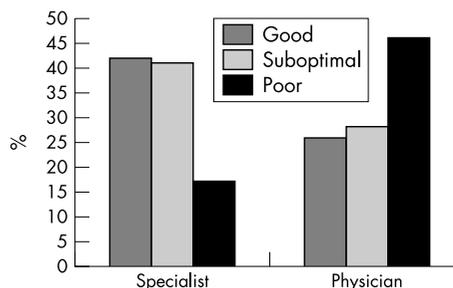**Figure 1** Diabetes control comparing subcutaneous and intravenous insulin.

Figure 2 Diabetes control comparing specialists and physicians.

the episode of NKHC. However, once diagnosed, treatment was satisfactory and both survived. Of the 54 patients with poor glycaemic control (less than 40% of glucose readings between 4.5 and 10 mmol/l) diabetic treatment was not changed at the time of discharge in 28 patients (five managed by specialists).

DISCUSSION

Glycaemic control in patients with known or previously unknown diabetes is extremely important for a successful outcome. Soler and Frank observed that patients with the highest glucose values after an acute myocardial infarction also had the highest mortality rates.[11] The DIGAMI (Diabetes Insulin Glucose in Acute Myocardial Infarction) study showed that for every nine persons receiving intensive glucose control, one life was saved.[12] One year after admission, a 30% reduction in mortality was observed in the patients who received intensive treatment for diabetes as opposed to those who received conventional care.[12] Strict glycaemic control in the intensive care unit has been shown to reduce the need for ventilatory support, renal replacement therapy, and blood transfusion.[13] Above all, not only did the patients have reduced episodes of septicaemia but also, cost of care came down remarkably.[13] Kalin and colleagues compared the outcome of 400 patients with diabetes and 876 non-diabetics who had a coronary artery bypass graft. The tightly controlled diabetics had a hospital mortality of 1.75% comparable to the non-diabetics who had a mortality of 1.71%.[14] Pomposelli et al found that among 97 patients with diabetes undergoing surgery, a first postoperative day glucose value more than 220 mg/dl (12.2 mmol/l) was a good predictor of increased risk of nosocomial infections.[7] Furnary and colleagues compared the outcomes of patients receiving subcutaneous insulin injections to those receiving intravenous insulin initiated perioperatively.[15] The incidence of deep sternal wounds was 0.8% in the group receiving intravenous insulin compared with 2.0% in patients receiving intermittent subcutaneous insulin.

In spite of studies advocating good inpatient glycaemic control, we know of no national or international standard of classifying glucose control in hospitalised patients. Diabetes UK (formerly the British Diabetic Association) published standards of care that patients with diabetes mellitus admitted to the hospital should expect.[16] It is clearly stated that good diabetic control is important for speedy recovery and early discharge. We have defined the control as good if four out of five glucose values were within the target range (between 4.5 and 10 mmol/l), as poor if less than two out of five were within the target range, and as suboptimal those in between. In our survey of 150 consecutive patients admitted for reasons not directly related to diabetes, glycaemic control was not good in a significant number of cases and hypoglycaemia was found to be common. With respect to hyperglycaemia, good glucose control was achieved in less than half of the patients in both medical and surgical wards

and the results were worse when they received intravenous insulin. In spite of recording blood glucose values persistently well above 10 mmol/l, the rate or dose of insulin was not changed in many of the cases. We think the primary reasons for this is the common habit of not changing the scale of insulin infusion and prescribing a whole week's subcutaneous insulin on the very first day. Emphasis should be placed on prescribing the dose of insulin clearly on a daily basis while the patient is on subcutaneous insulin and to reviewing the intravenous insulin scale several times a day. In a significant number of patients, treatment was not changed at discharge despite poor glycaemic control.

We have clearly documented that specialists' involvement is better for management of diabetes in hospital. A reduced length of hospital stay has been reported when units that are specialised in diabetes management are available to both medical and surgical patients.[6] Not only are there improved outcomes resulting from consultations by diabetes specialty teams, but studies have also demonstrated the beneficial impact in which patients with both primary and secondary diabetes benefit from care by nurses and other medical staff with specialised training in diabetes.[9] We would strongly recommend that specialists' input must be sought if available in the hospital. In our survey the better control of glycaemic state by specialists was not compromised with more frequent hypoglycaemic episodes, which is very encouraging. Hospitalisation for whatever reason should be taken as an opportunity to educate patients regarding diet, glycaemic control, insulin injection technique, glucometer checking, foot care, etc. Also it is a unique opportunity to identify other conditions commonly associated with type 2 diabetes—that is, hypertension, hyperlipidaemia, and obesity.

In conclusion, inpatient management of diabetes needs more attention. Glycaemic control was not found to be optimal in a number of patients in our hospital. It is necessary to standardise intervention of inpatients who were admitted with diabetes as a secondary medical problem. It was also evident from our study that standards of care need to be established. The result of this survey was shared with the medical and nursing staff of our hospital and the areas that need improvement were highlighted. We feel that involving staff will increase their trust, interest, and commitment to improve standards of care. A future survey in the light of this one will be performed to see the improvement in the quality of diabetic care in our hospital.

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REFERENCES
1 **King H**, Aubert RE, Herman WH. Global burden of diabetes, 1995–2025. *Diabetes Care* 1998;**21**:914–31.
2 **UK Prospective Diabetes Study Group**. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;**352**:837–53.
3 **Diabetes Control and Complication Trial (DCCT) Research Group**. Effect of intensive diabetes management on macrovascular events and risk factors in the Diabetes Control and Complications Trial. *Am J Cardiol* 1995;**75**:894–903.
4 **Jorgension HS**, Nakayama H, Raaschou HO. Stroke in patients with diabetes. The Copenhagen Stroke Study. *Stroke* 1994;**25**:1977–84.
5 **Levetan CS**, Passaro M, Jablonski K. Unrecognized diabetes among hospitalized patients. *Diabetes Care* 1997;**21**:246–9.
6 **Koproski J**, Pretto Z, Poretsky L, et al. Effects of an intervention by a diabetes team in hospitalized patients with diabetes. *Diabetes Care* 1997;**20**:1553–5.
7 **Pomposelli II**, Baxter IK III, Babineau TL. Early postoperative glucose control predicts nosocomial infection rate in diabetic patients. *Journal of Parenteral and Enteral Nutrition* 1998;**22**:77–81.
8 **Capes SE**, Hunt D, Malmberg K. Stress hyperglycemia and increased risk of death after myocardial infarction in patients with or without diabetes. A systemic overview. *Lancet* 2000;**355**:733–8.
9 **Korytkowski MY**, Abrams M, Weschle J, et al. Impact of peri-event glycemic control on morbidity and hospital length of stay in patients with diabetes (abstract). *Diabetes* 1999;**48**(suppl 1):371A.
10 **Bhattacharyya A**, Christodoulides C, Kaushal K, et al. Glucose control during inpatient management of diabetes. *Diabet Med* 2002;**19**:412–16.
11 **Soler A**, Frank S. Value of glycosylated hemoglobin measurements after acute myocardial infarction. *JAMA* 1981;**246**:1690–3.
12 **Malmberg K for the DIGAMI (Diabetes Mellitus Insulin Glucose infusions in Acute Myocardial Infarction) study group**. Prospective randomized study of intensive insulin treatment on long-term survival after acute myocardial infarction in patients with diabetes. *BMJ* 1997;**314**:1515–21.
13 **Van Den Berghe G**, Wonters P, Weckers F, et al. Intensive insulin therapy in critically ill patients. *N Engl J Med* 2001;**345**:1359–67.
14 **Kalin MF**, Tranbaugh RS, Salas J. Intensive intervention by a diabetes team, diminishes excess hospital mortality in patients with diabetes who under go coronary artery by-pass graft (abstract). *Diabetes* 1998;**47**(suppl 1):A87.
15 **Furnary AP**, Zerr KJ, Grunkemeier GL. Continuous intravenous insulin infusion reduces the incidence of deep sternal wound infection in diabetic patients after cardiac surgical procedures. *Ann Thorac Surg* 1999;**67**:352–62.
16 **Diabetes UK**. *What diabetes care to expect*. London: Diabetes UK, June 2000:15–7.