

Summary

As a prevalent disease diabetes is relevant to both medical and surgical disciplines in the inpatient environment. It has therefore become imperative that all medical and nursing staff should know the implications of diabetes and glycaemic control on the outcome of patients they see. The staff should also be equipped to manage diabetic inpatients appropriately. This thesis attempts to answer a number of questions related to the management of diabetic inpatients and the management of diabetic ketoacidosis.

Chapter 1 Covers the current knowledge of inpatient management of patients with diabetes. The fact that diabetic patients are more prone to be admitted to hospital and the disease related increase in cost of inpatient management is highlighted. The important issue of which glycaemic targets to aim for in diabetic inpatients is discussed. Current evidence regarding inpatients in specific situations is explored. A number of additional issues related to inpatient management are discussed such as glucose monitoring, nutritional care and discharge planning.

Chapter 2 reports on an inpatient audit exploring the situation in Kalafong hospital prior to the institution of an inpatient diabetes management plan. The major finding of this audit of 164 diabetic patient admissions was that glycaemic monitoring in hospitalised patients was irregular and erratic in 60.8% of patients, 37.2% of patients had regular four or six hourly blood glucose monitoring and that only 2% of patients had meal related glucose monitoring. What was striking was that only 1.9% of patients received supplemental insulin to their usual insulin regimen. The glycaemic control treatment schedule was appropriate in only 19.5% of cases. From the results of this study we conclude that the management and monitoring of blood glucose in diabetic inpatients at Kalafong hospital was inadequate and an intervention was needed to improve the quality of care.

Chapter 3 evaluated the perceptions, knowledge and attitudes of health care providers at Kalafong hospital regarding care of diabetic inpatients. A survey of 54 doctors and 61 nurses taking care of inpatients (response rate of 82%), using the DAS3 scale and the diabetes knowledge questionnaire of O'Brien, indicated that 80.9% felt that special training for management of diabetic patients is needed, 90.5% realised that diabetes is a serious condition and 92.2% valued the importance of tight glycaemic control. Despite this perception of importance,, the knowledge of doctors and nurses caring for diabetic inpatients were suboptimal.

Chapter 4 reports on the results of an intervention to improve the quality of inpatient diabetes management. This intervention consisted of a physician and nurse training programme as well as the introduction of a structured inpatient management protocol for all diabetic inpatients. The results of this intervention were assessed by a second audit. From the first audit 150 patient admissions and from the second audit 183 patient admissions were included. The mean blood glucose on day one of the second audit was significantly higher than that of the first audit (1.72 mmol/L higher, $p < 0.001$). A significant improvement from day 1 to day 7 was seen in audit 2 (-1.88 mmol/L, $p < 0.001$), which was not significant in audit 1 (-0.88 mmol/L, $p = 0.33$). The proportion of patients that achieved glycaemic control, defined as a mean daily blood glucose of less than 10 mmol/L did not significantly differ between the two audits (43.0% versus 43.7%, $p = 0.97$). Even after adjustment for baseline differences between the two audits no difference in glycaemic control was evident after the introduction of the education programme and structured management protocol. The number of hypoglycaemic events were more after implementation of the structured management protocol (19.6 versus 17.2 events per 100 patient days, $p = 0.048$).

Chapter 5 reviews the most frequent hyperglycaemic complication of diabetes namely ketoacidosis. It discusses the diagnosis, grading of severity and precipitating events. The current view on the management is discussed with

special mention of fluid replacement, insulin therapy and replacement of associated electrolyte deficiencies. Lastly this chapter address DKA in special populations: Children, Adolescents, Elderly and during pregnant women.

Chapter 6 reports on a double blind randomised controlled trial to assess if Ringer's lactate solution is superior to 0.9% Sodium chloride solution in the normalisation of pH in patients with diabetic ketoacidosis. The study enrolled 57 patients with mild to moderate diabetic ketoacidosis of which 27 patients could be analysed in each arm. The time to normalisation of venous pH ($\text{pH} > 7.32$) was not significantly different between the two arms of the study (HR: 1.863, CI: 0.937 to 3.705). The median time for the 0.9% Sodium chloride solution group to reach a pH of 7.32 was 683 minutes and for the Ringer's lactate group 540 minutes. The time to reach a blood glucose of 14 mmol/L was significantly longer in the Ringer's lactate group (410 minutes) in comparison to the 0.9% Sodium chloride group (300 minutes) ($p = 0.044$). Patients treated with the Ringers lactate group needed significantly more insulin during the first six hours of treatment (44 units versus 36 units, $p = 0.02$). No difference between the two groups could be demonstrated in time to resolution of DKA based on the ADA criteria for resolution of DKA) ($p = 0.758$). The overall conclusion of this study is that there is no significant benefit in using Ringer's lactate solution as initial resuscitation fluid when compared to the currently advised 0.9% Sodium chloride solution.

Concluding remarks

Currently inpatient management of diabetes is severely neglected in South Africa. Firstly, there is a significant paucity of data on information on the prevalence of hospital admissions of diabetic patients. Secondly, no information is available regarding problems in inpatient diabetes management. Thirdly, no information is available regarding knowledge and skills of medical and nursing staff caring for diabetic inpatients. And lastly, there is no knowledge of processes implemented in local South African hospitals to improve inpatient diabetes management.

This thesis was based on research to answer four questions, which was to a large extent successfully answered.

The first question: What are the current practices in diabetes inpatient glycaemic management in Kalafong hospital and how well are glucose levels controlled during hospitalisation?

The study answered conclusively that the glycaemic management was inadequate with regards to inpatient monitoring as well as the methods used to control blood glucose.

The second question: What are the attitude and perceptions of medical and nursing staff towards diabetic inpatients and their management, and how well are they equipped to face this challenging task?

Medical and Nursing staff realised that diabetes is a serious condition and that training in diabetes care are needed, they also realised that diabetes has a significant psychosocial impact on the lives of diabetic patients. The knowledge of health care providers, however, was suboptimal and thus they were poorly equipped to manage diabetic inpatients.

The third question: Will the implementation of a structured inpatient management protocol improve the glycaemic control of inpatients with diabetes?

No conclusive evidence could be found to demonstrate that the implementation of a structured inpatient diabetes management protocol will improve glycaemic control. A structured management plan did result in a small but significant reduction in hypoglycaemic events.

The researcher has gained insight in the complexity of not just inpatient diabetes management, but also in the problems related to the logistics and effort needed by medical and nursing staff to make a difference in improving glycaemic control. The methods currently utilised in Kalafong hospital are not working, and the researcher is certain that similar problems exist in nearly all hospitals in South Africa. We need to consider novel methods to get staff motivated in an attempt to make a difference in caring for diabetic patients and to improve the quality of the care. The researcher believes that one such a solution is to ensure that all staff is trained in the management of diabetic inpatients. Each hospital should have a properly designed and well followed inpatient management protocol. However, each hospital should preferably have a diabetes management team who are equipped to give advice and help in the treatment of difficult cases. An important challenge in the management of diabetic inpatients is the additional time burden placed on already thinly stretched staff; to monitor blood glucose, inject insulin whilst also attempting to train patients to manage their own disease. All diabetic patients admitted to hospital gives an ideal opportunity for patient diabetes education, this opportunity is often missed due to excessive work load on staff and educators (seldom available for inpatients).

Thus, how can the current situation be improved? A few possibilities are mentioned, although further research on each of these is required:

- Staff should know how to treat and manage diabetic patients; they should have access to inpatient management protocols and should follow it.

- All patients should have a follow up plan before discharge.
- All patients should know who to contact if they encounter problems with disease management.
- Patients who are healthy enough should be allowed to make diabetes treatment decisions themselves whilst under supervision of ward staff. This includes testing blood glucose and administering insulin treatment themselves.
- Having diabetes group training sessions for all diabetic patients in a ward or unit.
- Often in-hospital insulin regimens could be simplified, if the availability of insulin analogues could be improved.
- The support of a dietician is invaluable in diabetic inpatients.
- Diabetes should be seen as a disease that needs a team approach with the doctor, nurse, and dietician and if available a psychologist and diabetes educator as members. Each team member should know what to expect of the other members. Messages regarding diabetes, given to patients by all the team members, should be similar.
- A model that should be considered in management of inpatients with diabetes is a diabetes expert team. Such a team can see all diabetic inpatients, give advice on management and train patients to manage themselves. The team can also ensure that all patients have follow up arrangements made before discharge for the long term care of their diabetes.
- Regular monitoring and evaluation of the quality of diabetes inpatient management should be done. It would probably be best if a formal monitoring and evaluation programme could be implemented in each hospital.

The greatest stumbling block in the improvement of inpatient diabetes care is the inertia of staff to change old habits. Staff will often say they want to be trained, but new knowledge is meaningless if it does not lead to improvement of actions and better habits.

The fourth question relates to the acute management of patients with diabetic ketoacidosis (DKA): Does it make a difference if 0.9% Sodium chloride solution or Ringer's lactate solution is used as primary resuscitation fluid in the time to normalisation of pH, blood glucose and resolution of DKA? This question was answered in chapter 6 of this thesis.

With regards to time to normalisation of pH, no conclusive evidence to prove any benefit of using Ringer's lactate solution in comparison to 0.9% Sodium chloride solution could be found. For time to reach blood glucose of 14 mmol/L 0.9% Sodium chloride solution was superior to Ringer's lactate solution. However, for resolution of DKA there was no benefit demonstrated in using either of the two resuscitation solutions.

This study indicated that there are advantages and disadvantages in using each of the two resuscitation fluids. Perhaps it should be investigated which patients will benefit more from Ringer's lactate solution and which patients from 0.9% sodium chloride solution eg. patients with less severe hyperglycaemia and normo- or hypokalaemia may benefit more from Ringer's lactate solution.