

Hyperglycaemia management of Type 2 Diabetes Mellitus inpatients in surgical wards at Livingstone Hospital

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Introduction

Three-and-a-half million South Africans (about 6% of the population) suffer from diabetes mellitus (DM) with many more possibly undiagnosed.¹

People with diabetes are more than twice as likely to be admitted to hospital as those without the condition.^{2,3} The

prevalence of in-patients with diabetes has been steadily increasing worldwide.⁴ Hyperglycaemia is associated with prolonged hospital stays, infection, and disability after hospital discharge, higher incidence of systemic infections, urinary tract infections, acute renal failure, increased cardiac morbidity and death.^{5,6} In surgical wards, postoperative wound infections have been shown to be the most common nosocomial infection and a leading contributor to morbidity and mortality.^{7,8}

Increasing evidence indicates that the development of hyperglycaemia during acute medical or surgical illness is not a physiological or benign condition, but rather is a marker of poor clinical outcome and mortality.^{4,9}

A meta-analysis of 19 studies (9 randomized control studies and 10 observational studies) reported that intensive glycaemic control in the general wards was associated with a 59% reduction in the risk of infections.¹⁰

It is stated that the targets recommended for *critically ill* patients are derived from the available evidence. However, with respect to *non-critically ill* patients, there are no prospective, randomised, controlled trial data available and recommendations are based on clinical experience and judgement.¹¹

Table 1: Recommendations by the American Diabetes Association (ADA) for pre-prandial blood glucose (BG). For avoidance of hypoglycaemia, it is recommended that antidiabetic therapy be reassessed when BG values fall below 5.6 mmol/L.⁵

Pre-Prandial BG Target	Post-Prandial BG Target
6.1-7.2 mmol/L (< 7.8 mmol/L)	7.8-10 mmol/L (< 10 mmol/L)

Basal bolus (BB) is a regimen that involves taking a longer acting insulin to keep blood glucose (BG) levels stable through periods of fasting (basal) and separate injections of shorter acting insulin to prevent rises in BG levels resulting from meals (bolus). BB is ideal for the management of in-hospital hyperglycaemia (IHH) because it deals with both the basal requirements as well as the prandial glucose fluctuations. The term "sliding scale" refers to the progressive increase in the pre-meal or night-time insulin dose and is based on pre-defined blood glucose ranges.^{3,7}

No studies to date have shown any clinical benefit from the use of sliding scale insulin (SSI), while an increased number of episodes of uncontrolled hyperglycaemia and hypoglycaemia during its use are widely reported.^{7,12}

SSI is reactive in its approach to dealing with IHH because hyperglycaemia is only treated *after* it has occurred. The Randomized Study of Basal Bolus Insulin Therapy in the Inpatient Management of Patients with Type 2 Diabetes Undergoing General Surgery (RABBIT 2 Surgery) demonstrated that the BB regimen is associated with better glycaemic control and lower frequency of hospital complications than SSI, without increasing the number of severe hypo/hyperglycaemic events.^{8,13}

The addition of short-acting nutritional and correctional insulin to a basal long-acting insulin are current best-practice recommendations.^{11,14}

From a pilot study among 15 inpatients at Livingstone Hospital (LVH) it became apparent that SSI (sliding scale insulin) is mostly used to control hyperglycaemia in surgical wards.

Research methodology

The primary outcomes of the study were mean glucose readings per day and incidence of hypo/hyperglycaemia. The study population comprised of 63 previously or newly diagnosed diabetes mellitus type 2 inpatients who had undergone a surgical procedure.

Outcome Measures and Study Population

Any BG readings above or below defined targets were considered as out of range. Antidiabetic therapy should be reassessed when BG values fall below 5.6 mmol/L, a value considerably higher than the minimum target used in this study which further highlights the incidence of hyperglycaemic events.

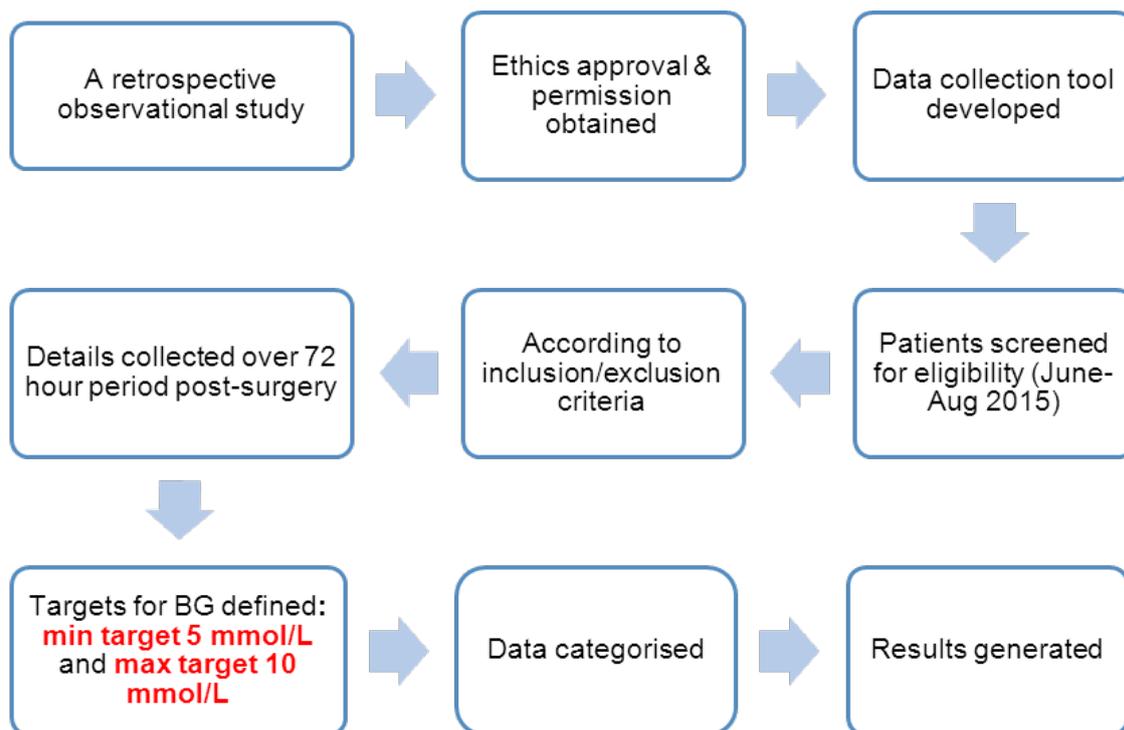


Figure 1: Summary of research design

Table 2: Inclusion and exclusion criteria used in the study

Included	Excluded
Adult patients with type 2 diabetes mellitus admitted to the surgical wards - not required for ICU admission	Hyperglycaemia without a known history of diabetes/proper diagnosis
Treated with any combination of antidiabetic agents before admission	Hepatic disease
	Impaired renal function

Results and discussion

From June to August 2015, 63 patients in surgical wards at LVH were found to be eligible to participate in the study according to the inclusion criteria. From Table 3, it can be seen that a total of 50 patients were managed on the relevant SSI regimen post-surgery and only 3 patients were on the BB regimen, the recommended protocol by the American Diabetes Association (ADA).

Table 3: Diabetic treatment of the patients used in the study (n=63). Note: a patient could be on more than one treatment e.g. Oral hypoglycaemic + insulin.

Treatment at hospital:	No. of patients
NPH- (Protaphane®)	3
Regular insulin (Actrapid®)	3
Regular- NPH 30/70 (Actraphane®)	8
Sliding scale insulin	50
Supplemental sliding scale insulin	2
Oral hypoglycaemics	2

The data collected over 72-hours were divided into 24 hour periods and BG readings were subdivided into two broad categories, namely; fasting BG readings taken between 05:00-07:00 and random BG readings taken throughout the day and average used.

Figure 2 shows that both the average fasting BG readings (10.16 mmol/L) as well as the average random BG readings (10.19) taken over the first 24 hours were higher than the maximum target of 10 mmol/L.

Figure 3 shows that once more, both the average fasting BG readings (10.26 mmol/L) as well as the average random BG readings (10.13) taken over the second 24-hour period were higher than the maximum target of 10 mmol/L. Of more concern is the fact that the average fasting BG reading was found to be higher than the average random BG reading.

Both the average fasting BG readings (10.65 mmol/L) as well as the average random BG readings (10.39) taken over the final 24-hour period were found to be higher than the maximum target of 10 mmol/L as displayed in Figure 4. More disturbingly, the average fasting BG reading was significantly greater than the average random BG reading.

Out of a total of 183 fasting BG readings recorded over the 72-hour period, ninety-four (51.4%) were out of target range i.e. above 10 mmol/L or below 5 mmol/L as displayed in Figure 5.

Upon further analysis, Figure 6 shows that out of the total number of fasting BG readings out of target range (94), twelve (12.8%) were below the minimum target of 5 mmol/L depicting hypoglycaemic events and 82 (87.2%) were above the maximum target of 10 mmol/L indicating hyperglycaemic events.

It can be seen from Figure 7 that out of a total of 567 random BG readings recorded over the 72-hour period, three-hundred and twenty-seven (57.7%) were out of target range.

Out of the total number of random BG readings out of target range (327), forty (7.05%) were below 5 mmol/L representing hypoglycaemic events and a staggering 287 (50.62%) BG readings were above 10 mmol/L signifying hyperglycaemic events as displayed in Figure 8.

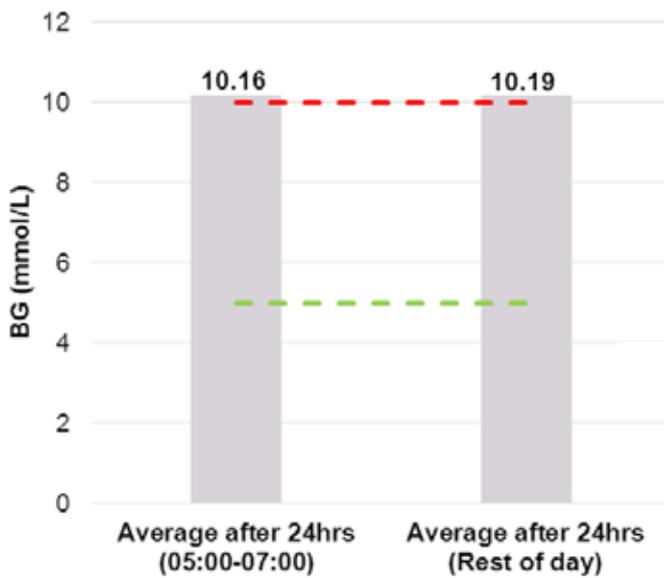


Figure 2: Average BG (blood glucose) in mmol/L after 24 hours

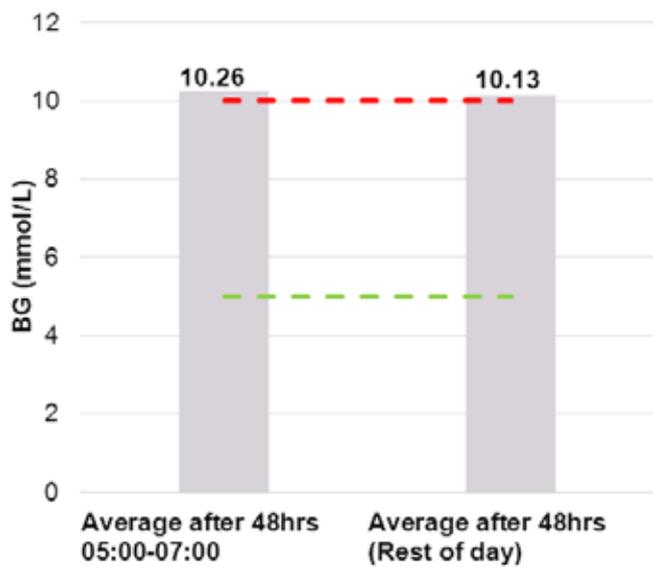


Figure 3: Average BG (blood glucose) in mmol/L after 48 hours

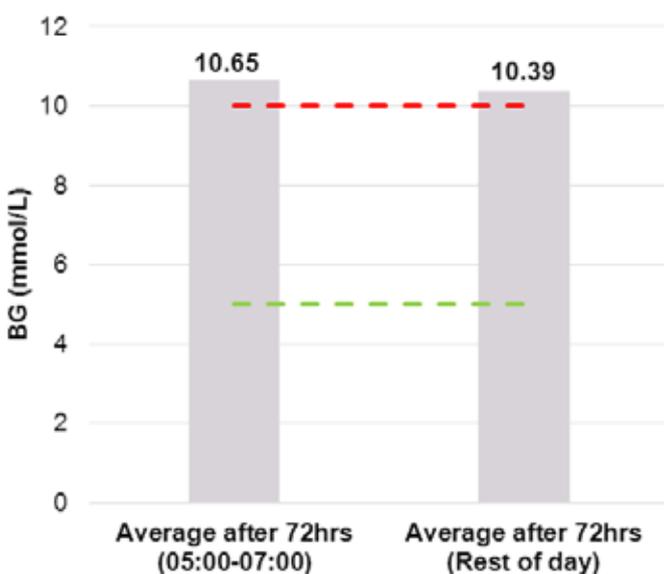


Figure 4: Average BG (blood glucose) in mmol/L after 72 hours

In figures 2,3 & 4:

- Average
- - - Maximum target (10 mmol/L)
- - - Minimum target (5 mmol/L)

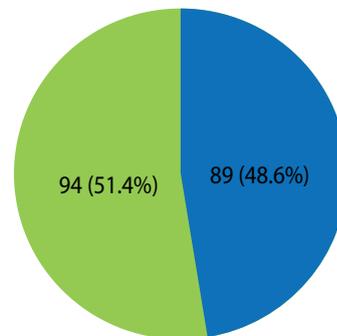


Figure 5: Percentage of fasting BG readings out of target range over a 72-hour period (readings= 83)

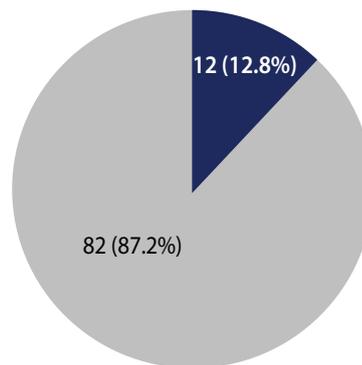


Figure 6: Categorising fasting BG readings out of target range over a 72-hour period (readings= 94)

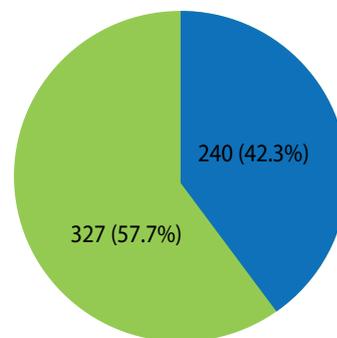


Figure 7: Percentage of random BG readings out of target range over a 72-hour period (readings= 567)

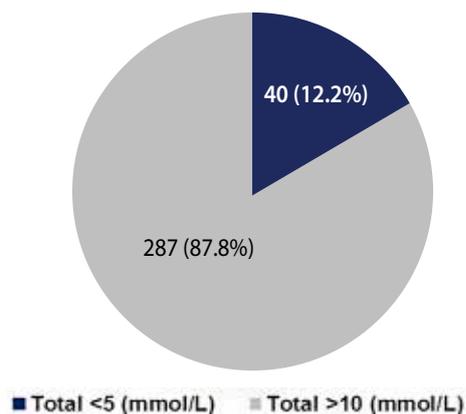


Figure 8: Categorising random BG readings out of target range over a 72-hour period (readings= 327)

Conclusion

Taking these results into consideration, it can be said that in the current setting, hyperglycaemia management post-surgery is not adequately managed with the SSI regimen and in most patients glycaemic control and diabetes management is frequently overlooked. Incidences of hyperglycaemia were abundant therefore SSI therapy is not ideal for hyperglycaemia management in non-critically ill patients with type 2 diabetes.

Limitations to our study included the timeframe allowed to conduct the study, the fact that it was purely an observational study and that data depended on the documents and results available in the ward which led to missing/incomplete information.

We recommend that LVH considers the adoption of a BB insulin approach as it represents a simple and more effective regimen than SSI for the management of general surgery patients with type 2 diabetes mellitus.

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