Low-dose intensive insulin therapy in patients with Acute Coronary Syndrome accompanied by Left Ventricular Failure: Audit of two UK hospitals.

ABSTRACT (WORD COUNT 296)

Aims & Objectives: To determine whether a low-dose intravenous insulin regimen reduces blood glucose levels at a timely rate and associated side effects among patients with Acute Coronary Syndrome and Left Ventricular Failure.

Background: Induced hypoglycaemia and the associated risks have questioned the benefits of intensive insulin therapy in patients presenting with raised blood glucose levels and Acute Coronary Syndromes. Local audit data identified that patients with Acute Coronary Syndrome and Left Ventricular Failure experienced more hypoglycaemic episodes than those with Acute Coronary Syndrome alone. Consequently, a new regimen of low-dose insulin for this group was implemented and audited over 12 months.

Design: Audit

Methods: 36 consecutive patient notes with a diagnosis of Acute Coronary Syndrome and blood glucose of ≥10 mmol/L treated with a new insulin therapy regimen were analysed. Data were extracted using a standardised form and entered into Excel spreadsheet for analysis.

Results: The mean age of the sample was 70 years with 66% of subjects being men and 50% presenting with Acute Coronary Syndrome and Left Ventricular Failure. The low-dose regimen was effective in achieving normoglycaemia, (range 4-8mmol/L) for a consecutive six hour period. This was achieved in 72% of patients and within a median time of 13 hours.

Conclusion: The audit suggests that a low-dose insulin regimen can effectively stabilise blood glucose in patients presenting with both Acute Coronary Syndrome and Left Ventricular Failure. The importance of regularly monitoring blood sugar levels is vital and highlights the role of nurses in minimising patient risk and promoting safety.

Relevance to practice: Nurses are instrumental in the safe implementation of intensive insulin guidelines. Close monitoring of patients is essential, enabling timely adjustments to treatments and ensuring patient safety. Regular audits allow nurses to evaluate care provision and continue to drive practice forward.

WHAT DOES THIS PAPER CONTRIBUTE TO THE WIDER GLOBAL CLINICAL COMMUNITY?

- Practice audits are a way of increasing nurses awareness of care provision and subsequently raising standards
- Low-dose insulin regimens may be useful for Acute Coronary Syndrome (ACS) patients at high risk of hypoglycaemia
- Reinforces the role of the nurse as pivotal in promoting patient safety and minimising risk through their skills in monitoring and making timely adjustments to maintain therapeutic goals

INTRODUCTION

Contradictory findings (National Institute for Health and Clinical Excellence (NICE) 2013, Ryden *et al.* 2013) relating to the benefits of intensive insulin therapy (an intravenous infusion of insulin and glucose with or without potassium) for individuals presenting with Acute Coronary Syndromes (ACS) and hyperglycaemia has resulted in a lack of clear guidance for optimising management of these patients. The European Society of Cardiology (ESC) (Ryden *et al.* 2013) state that patients with diabetes and ACS can benefit from an insulin infusion if hyperglycaemia is >10 mmol/L. In the United Kingdom (UK) The National Institute for health and Clinical Excellence(National Institute for Health and Clinical Excellence (NICE) 2013) (NICE) recommend maintaining blood glucose below 11.0mmol/L in ACS patients, however advise that intensive insulin therapy should only be prescribed where clinically indicated.

This paper discusses how two UK hospitals adapted the delivery of intensive insulin therapy in ACS patients at high risk of hypoglycaemia through the development and implementation of a new intensive insulin regimen. In addition, the implications for nurses working in this area of practice are considered.

BACKGROUND

Hypoglycaemia is considered a serious side effect of intensive insulin therapy with evidence linking hypoglycaemia to adverse outcomes in ACS patients. One study involving 713 patients with ACS and diabetes managed with a range of treatments (including IV insulin) reported that a hypoglycaemic episode (<3.0mmol/L) during admission was an independent predictor of death within two years (HR 1.93, 95% confidence interval, 1.18 - 3.17) (Svensson *et al.* 2005). A retrospective cohort study of 7820 patients presenting with acute Myocardial Infarction (MI) and hyperglycaemia (Kosiborod *et al.* 2009a) aimed to further explore the link between hypoglycaemia and mortality. The results however indicated that hypoglycaemia was only a predictor of increased mortality in patients not treated with insulin (OR 2.32 95% confidence interval, 1.31 – 4.12). The authors concluded that an increased mortality risk is confined to patients developing hypoglycaemia spontaneously and not as a result of insulin therapy. The publication of conflicting evidence has however questioned the clinical value of intensive insulin therapy in the management of ACS patients presenting with hyperglycaemia.

Local concerns regarding the frequency of hypoglycaemic episodes among ACS patients following initiation of treatment led to a review of the current practice. A preliminary audit of case notes identified that hypoglycaemic episodes affected 13 individuals out of 130. Following further data analysis it appeared that five of the hypoglycaemic episodes occurred in patients presenting with both ACS and Left Ventricular Failure (LVF). There is some evidence to suggest that patients with LVF may be at higher risk of

hypoglycaemia (Kosiborod *et al.* 2009a, Mellbin *et al.* 2009), it was therefore postulated that these patients may benefit from a lower insulin infusion rate to reduce the frequency of iatrogenic hypoglycaemia.

Drawing on initial audit findings and in line with the ESC guidelines (Ryden *et al.* 2013), a redesigned regimen was developed collaboratively by the cardiology and diabetes health specialists. The revised guideline recommended initiation of intravenous intensive insulin therapy in patients admitted with ACS and with blood glucose levels of ≥10 mmol/L. Based on the presence or absence of LVF (figure 1) clinical staff were directed to an appropriate bespoke insulin regimen. Those with ACS were prescribed the standard insulin regimen, those presenting with ACS and LVF were treated with the low-dose insulin regimen. Both regimens utilised an insulin dilution of one unit Actrapid insulin per 1ml of normal saline (0.9%) and required hourly capillary blood glucose (CBG) monitoring. The only difference between the regimens was the hourly infusion rate, with the low-dose regimen delivering half the standard regimen rate (Figure 2). The aim of this approach was to reduce treatment induced hypoglycaemia specifically in hospitalised patients presenting with ACS and ACS in conjunction with LVF.

INSERT FIGURE 1 & 2

The revised intensive insulin therapy for ACS guideline (Figure 2) was implemented in clinical practice in December 2012 and was accompanied by a comprehensive teaching programme aimed at medical and nursing staff across

all shifts. Implementation strategy is important to the success of any clinical guideline or protocol (Middleton 2012) as simply providing a new protocol or guideline is unlikely to result in a change in practice (Knowles *et al.* 2014). The local teaching programme content included the rationale behind the guideline change, risks of hypoglycaemia in ACS patients, current European guidelines, determining patient eligibility, guidance on initiating the new regimen and patient monitoring. Posters and evidence based learning resources were made available to staff including contact details for further support. In the weeks following, a team of cardiac and diabetes nurses visited wards where ACS patients would be admitted to ensure understanding and commitment to the revised regimen and answer any questions or aspects of concern

In order to assess the impact of the new guideline a follow-up audit was performed 12 months after implementation. This paper, therefore aims to report on the results of this follow up audit to determine whether the revised intensive insulin regimen led to more stable CBG levels and reduced rates of hypoglycaemic episodes in ACS patients presenting with and without LVF as compared to the original regimen for all ACS patients.

METHODS

Design

The study was a re-audit of practice following implementation of the revised intensive insulin regimen for ACS patients. Audit is a cyclical process and enables nurses and other health professionals to continuously seek to improve patient care (Patel 2010). Considerable effort is required to initiate changes in

practice and it is imperative to measure the success of implementing any new guideline or protocol (Higuchi *et al.* 2011). Audit is an effective way to do this, however in order to be successful audit must be carefully organised and meaningful to both those who conduct it and those who receive the results (Patel 2010). It is vital that nurses administering the care and using the revised guideline are engaged in the process as successful audit has been noted to improve communication between professional groups, professional satisfaction and knowledge (Johnston *et al.* 2000).

Sample

The Myocardial Ischaemia National Audit Project (MINAP) database was used to identify eligible patients. MINAP is a multi-centre prospective registry held by the National Institute for Cardiovascular Outcomes Research (NICOR). All UK hospitals are required to submit MINAP data on patients admitted with ACS, with each entry providing comprehensive details of the patient journey (Alabas *et al.* 2014). Within the two study hospitals, the cardiology teams are responsible for the accuracy of clinical data entered for each case. The MINAP database was therefore considered the most accurate source of obtaining the sample for this audit.

During the audit period (December 2012- December 2013), 619 patient episodes were entered in the local MINAP database. Of these, 137 had admission blood glucose levels of ≥10 mmol/L, the criteria for intensive insulin therapy regimen eligibility. Intensive insulin therapy was indicated in 47 of the 137 episodes. Of the 47 medical notes, six were unavailable, and five patients

were excluded from analysis as alternative intensive insulin therapy regimens were prescribed. In total 36 notes were analysed for audit purposes. The final sample included ACS patients both with and without LVF treated with the standard regimen and with the revised low-dose intensive insulin therapy regimen.

Data collection

Data was extracted from the medical notes by two cardiology audit nurses using a standardised form. The form was designed by MINAP for use in the Trial of Insulin Therapy to Achieve Normoglycaemia in ACS (TITAN-ACS) study (Myocardial Ischaemia National Audit Project (MINAP) 2010) and had been used in the original audit to ensure comparability of results, therefore it was not piloted in this follow-up audit. Data collection included demographic variables, diabetic history, clinical diagnosis, the type of insulin regimen administered; length of time intensive insulin therapy was prescribed for; CBG levels measures at different time points and recorded episodes of hypoglycaemia. Additional fields specific to the local guideline were added to widen the scope of the audit, examples included; any documented changes to the prescribed regimen, correct prescription of the regimen and the presence of nurses signatures on monitoring records. Normoglycaemia was defined as CBG within range 4-8mmol/L and maintained for a six hour period. All CBG measurements were performed by trained staff using the Abbot Optium Exceed glucose meter, which was calibrated daily. A hypoglycaemic episode was defined as a CBG level of ≤3 mmol/L.

Data Analysis

The data was manually entered into an Excel (2010) spreadsheet and descriptive statistical analysis included median and mean scores. Analysis of demographics included gender, age, ethnicity, previous medical history and diabetic status on admission. Response to the regimen was assessed by median times to achieve normoglycaemia as defined above and mean CBG levels during the first 24 hours following initiation of insulin therapy.   Mean values have been reported partly to facilitate comparisons with other published studies in the field (Cheung *et al.* 2006, Goldberg *et al. 2004,* Kosiborod *et al.* 2009b). Additionally if median CBG levels over the initial 24 hour period are plotted there is an equal symmetrical pattern as for mean values, therefore the use of the latter has been applied. Patient monitoring, adjustments to treatments and incidence of hypoglycaemia were also analysed.

RESULTS

Baseline Characteristics

Table 1 provides demographics of the re-audit study sample (n=36). The low-dose insulin regimen group (Group A) comprised of 18 patients, with a mean age of 72 years and of these eight were women. The remaining 18 subjects (Group B) received the standard insulin regimen, had a mean age of 68 years and of these four were women. Those in Group A had higher CBG levels on admission (18.5 mmol/L vs. 15.6 mmol/L), a history of previous Myocardial Infarction (MI) (39% vs. 17%) and heart failure (28% vs. 17%) when compared

to patients in Group B. At the initiation of their respective intensive insulin

regimens, mean CBG levels were similar, as seen in table 1.

INSERT TABLE 1

Response to regimen

Both groups achieved target CBG levels of 4-8 mmol/L which were maintained

for a six hour period, 73% in Group A achieved this and 71% in Group B. The

median length of time to achieve first CBG within the target range for both

groups was six hours however, median time for Group A was 7.8 hours and 4.5

hours for Group B. The median time to complete a consecutive six hour

normoglycaemic period was 13 hours in both groups.   Figure 3 shows the

response in CBG levels for the first 24 hours following initiation of insulin

therapy. The figure illustrates an overall downward trend of CBG levels,

although at 17 hours following initiation of the insulin therapy, group A patients

experienced a spike in their CBG levels.

INSERT FIGURE 3

Incidence of hypoglycaemic episodes

In the re-audit three (out of 36) patients experienced insulin induced

hypoglycaemia (CBG≤ 3 mmol/L). Of these, two had been diagnosed with ACS

and LVF and were prescribed the low-dose regimen. In both these patients,

presenting CBG levels were >20 mmol/L and hypoglycaemic episodes occurred

>24 hours after the infusion had commenced.

Patient monitoring and regimen adjustments

The frequency of CBG monitoring was recommended to be hourly although in practice this occurred 1-2 hourly. In total 22% of patients (n=8) required adjustment to their insulin regimens. In Group A, four patients required an increase from the low dose to standard regimen due to poor glycaemic control. Through ongoing monitoring of patients by nurses, four in group B required conversion to the low dose regimen, in two instances this was due to persistently low CBG levels on the standard regimen and in the other two cases this was because they developed LVF.

DISCUSSION

This audit of practice reports on the introduction of a low-dose intensive insulin therapy regimen aimed at providing better glycaemic control for patients admitted with ACS with or without LVF. The discussion is structured around four key areas highlighting the implications for practice and the role of coronary care nurses in managing the safety of patients receiving insulin therapy.

Baseline Characteristics

As table 1 highlights Group A patients had a higher incidence of previous MI and heart failure, they also presented with LVF and as a result received the low-dose regimen. Consequently, it is reasonable to suggest that they were at more risk of complications from receiving intensive insulin therapy. It has been reported that the severity of illness can increase the likelihood of hypoglycaemic episodes (Nasraway 2007). Kosiborod et al's (2009a) research identified that

patients experiencing hypoglycaemia were older with multiple co-morbidities. This was further substantiated by a study of 1253 ACS patients treated for hyperglycaemia which reported that patients experiencing hypoglycaemia were those with a more serious prognosis. These patients were older, with low body weight and often had a history of heart failure (Mellbin *et al.* 2009). The authors postulate that hypoglycaemia could in fact be a marker of critical illness rather than a direct cause of adverse events. Recognising patients with a high severity of illness and therefore at higher risk of hypoglycaemia is therefore vital (Nasraway 2007). It has been suggested that a more careful approach to glucose management in order to avoid hypoglycaemia may in fact result in greater patient benefit (Nasraway 2007, Whitehorn 2007, Kosiborod *et al.* 2009a, Kosiborod *et al.* 2009b, Mellbin *et al.* 2009). The use of a low-dose insulin regimen in patients presenting with ACS accompanied by LVF is potentially one solution for enabling CBG levels to be managed in a more controlled manner, however further research would be essential to validate the observations in this paper.

Response to regimen

The aim of intensive insulin therapy is to return a patient's blood glucose level within a normal range in a safe and timely manner as this is associated with positive outcomes (Aragon 2006). However, if unmonitored, hypoglycaemia, a serious side effect of intensive insulin therapy can develop questioning the safety of its use (Goldberg *et al.* 2004, Mellbin *et al.* 2009, Alabas *et al.* 2014). In previous studies a median length of time to achieving the therapeutic target range in patients with ACS of between three to four hours has been reported

(Cheung *et al.* 2006, Kosiborod *et al.* 2009b). In these studies however, patients CBG levels prior to insulin administration ranged between 10.8mmol/L and 12.8mmol/L. In this audit, patients presented with an average baseline CBG of 17 mmol/L (SD 6.8), (see table 1) and this may account for the difference in time to resolution of normal values. Goldberg et al (2004) using an insulin infusion protocol with a sample of medical intensive care patients (n=52) reported mean CBG levels of 16.6mmol/L at insulin initiation and median time to achieving the first target measurement of nine hours. While Goldberg et al's (2004) population comprised of patients admitted to a medical Intensive Care Unit, the combined results with this audit infer that a relationship may exist between CBG level at insulin initiation and time to achieving target CBG values.

When assessing maintenance of target ranges, differing reporting methods make comparing data problematic. In this audit, successful blood glucose normalisation was defined as the maintenance of CBG levels within the prescribed target range for a consecutive six hour period in line with the TITAN-ACS study (Myocardial Ischaemia National Audit Project (MINAP) 2010). The sustained six hour period was completed within a median time of 13 hours in both groups. This seems to indicate that despite Group A patients receiving lower doses of insulin, CBG levels continue to normalise at similar rates as those receiving the standard regime.

A rise in CBG measurements at 17 hours from initiation of insulin (see Figure 3) for group A patients merits explanation. Reviewing nursing and medical patient notes the rise in CBG at 17 hours coincides with a meal time. The short-lived

spike in CBG can therefore be attributed the effects of nutritional intake. Sliding scale insulin regimes have been criticised for their inability to individualise insulin demands in relation to types and amounts of food to be consumed, with insulin doses often based on pre-meal CBG levels (Coggins 2012). This indicates that perhaps patients on the low-dose regimen need closer monitoring by nurses around meal times to ensure stable CBG levels.

Incidence of Hypoglycaemic episodes

Hypoglycaemia remains a serious risk and adverse event associated with the initiation of intensive insulin therapy often resulting in a low treatment threshold of patients presenting with ACS and hyperglycaemia (Kosiborod *et al.* 2009a). If a regimen can be shown to reduce the incidence and risk of hypoglycaemic episodes whilst still normalising glucose levels this could have a dramatic effect on preventing adverse events for ACS patients and improving recovery.

Direct comparison of hypoglycaemic rates with other studies is problematic due to definition differences, however some comparisons can be inferred. The Diabetes mellitus, Insulin Glucose infusion in Acute Myocardial Infarction studies (DIGAMI I and II) both define hypoglycaemia as a CBG <3mmol/L and report incidence rates of between 15% (Malmberg *et al.* 1995) and 12% (Malmberg *et al.* 2005). However, the HI-5 study (Cheung *et al.* 2006) reported a 10% incidence of hypoglycaemia with a slightly higher CBG threshold (<3.5mmol/L).

A study by Avanzini et al (Avanzini *et al.* 2009) implemented an intensive insulin therapy nomogram in which calculations accounted for both current CBG value and the percentage change from the previous level, enabling stricter and safer glycaemic control in ACS patients. It was reported that this nurse led intensive insulin therapy protocol was well received, with hypoglycaemia (CBG <4 mmol/L) occurring in 17 out of 91 patients (18.7%). When compared to these studies, the revised regimen presented in this audit was associated with   a lower rate of hypoglycaemic episodes (8%), however caution is required in relation to the data due to our sample size and selection of patients

It is important to recognise that any treatment for hyperglycaemia carries a risk of inducing hypoglycaemia, particularly in patients who are acutely unwell (Kosiborod *et al.* 2009a). The implementation of the new regime resulted in a 2% decrease in hypoglycaemic episodes. While this is not a substantial reduction, without empirical evidence it is difficult to establish whether further progress can be made in this area.

Nursing responsibilities

Our data confirms that hypoglycaemic episodes occurred in the low-dose intensive insulin regimen, however these were the result of protocol violation and avoidable through more consistent CBG monitoring. Nurses play a vital role in ensuring the safe implementation of intensive insulin therapy, and in monitoring the wellbeing of their patients by identifying changes in clinical status and responding appropriately according to evidence base guidelines (Monteiro *et al.* 2009). Nurse workloads continue to increase which can reduce the quality

of care provided and lead to uncompleted tasks (Hinno *et al.* 2012). Regular

CBG monitoring alongside the calculation and titration of insulin infusion rates

further increases the workload and burden on nursing staff (Sauer & Van Horn

2009). A survey of 66 intensive care nurses identified that the majority

understood the importance of glycaemic control but felt that achieving hourly

monitoring to optimise blood glucose was labour intensive and costly (Aragon

2006). It is vital that nurses recognise the importance of their role in managing

patients prescribed intensive insulin therapy as a decrease in vigilance can put

patients as risk of prolonged hypoglycaemia (Whitehorn 2007). This was

demonstrated in a study comparing four Intensive Care Units (ICU) using the

same intensive insulin protocol. Results showed that the ICU measuring CBG

most frequently achieved both the lowest mean blood glucose and the lowest

hypoglycaemia rate (Nasraway 2007). This reinforces the importance of nurses

regularly monitoring CBG to enable timely and appropriate clinical interventions

to be applied before hypoglycaemia occurs. It is through these actions that

nurses contribute to quality of care and to minimising avoidable risks. In the

Avanzini et al study (2009) nurses identified that although the guideline added

to their workload, safety and efficacy results increased their motivation and

reinforced the importance of monitoring. It is therefore vital for areas to

regularly audit compliance with intensive insulin therapy regimens and provide

feedback to frontline nursing staff administering the care. Through this

continuous monitoring and feedback cycle, nurses can remain confident in

providing quality care and patient safety can be ensured.

Limitations

While the sample size of this audit was small and precludes wide recommendations, it has produced some important results. Further research arguably is required to determine the value and efficacy of various insulin regimens for patients with ACS and LVF, who present with a CBG of >10mmol/L. This should include multi-centre randomised control trials comparing low-dose insulin regimens against standard regimens in this group of patients.   As the majority of patients included in this audit were Caucasian, it would be important to ensure other ethnic backgrounds are represented and that the selection of individuals for inclusion is more rigorous to systematically evaluate the role of low-dose insulin regimes. Additionally, use of standardised measures for hypoglycaemia would be helpful too.

The regimen was implemented across two hospitals, with the reduction in reported hypoglycaemia not analysed for statistical significance, therefore care must be taken when applying the findings to the wider population of ACS patients presenting with hyperglycaemia.

CONCLUSION

When managing hyperglycaemia in ACS patients numerous strategies are available and the debate as to which is best will continue until definitive trial data becomes available. In the meantime it is left to individual centres to implement protocols and guidelines that they feel are in the best interest of their patients. Clinical audit is crucial in this process allowing centres to continually evaluate and develop their practice to improve the standards and safety of

patient care. Indeed, this audit of practice has demonstrated that a low-dose insulin regimen for patients with ACS and LVF who present with a blood sugar of >10mmol/L can safely assist the control of blood sugar levels and minimise unwanted risk. However, it is vital that nurses monitor patients closely to enable appropriate adjustments to treatment and ensure optimum blood glucose control.

RELEVANCE TO PRACTICE

The informed application of guidelines is pivotal in promoting excellence in care delivery, promoting patient safety and minimising risk. Nurses because of their clinical expertise and proximity to the patient are instrumental in promoting standards and ensuring that patients do not suffer harm. Using audit data from that continually evaluating care provision is powerful in promoting change and assisting in embedding clinical innovation.

Word count 3576

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FIGURES & TABLES

Figure 1: Patient pathway for intensive insulin regimen

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              │   ACS patient presenting │
              │    with blood glucose    │
              │      ≥10mmol/litre       │
              └─────────────────────────┘
                          │
                          ▼
    ┌──────────────────────────────────────────────┐
    │ Does the patient also have Left Ventricular    │
    │              Failure (LVF)?                     │
    └──────────────────────────────────────────────┘
         YES                          NO
          │                            │
          ▼                            ▼
  ┌────────────────┐          ┌────────────────┐
  │ Commence low-  │          │ Commence       │
  │ dose intensive │          │ standard       │
  │ insulin regimen│          │ intensive      │
  │                │          │ insulin regimen│
  └────────────────┘          └────────────────┘
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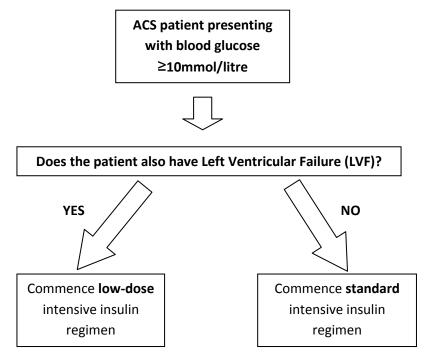
Figure 2: The new ACS and Hyperglycaemia Intensive Insulin Therapy Regimen

INSULIN INFUSION: adjust according to sliding scale below

ALWAYS ENSURE GLUCOSE IS RUNNING WHILE INSULIN INFUSION IS IN PROGRESS
ACTRAPID 50 units in 50mls of Sodium Chloride 0.9% (i.e. 1 unit/ml)
- Alternative scales may be needed for patients with high insulin requirements. For patients on > 50 units insulin/ day or if capillary blood glucose remains >15mmol for >2 hours use the alternative scale with double the recommended insulin doses (see table below).
- Low dose sliding scale should be used for patients following LVF regimen and/or long-acting insulin analogue continued
- Consider low dose sliding scale insulin in elderly and those on sulphonylureas prior to admission

Usual daily insulin dose in 24 hours: ………..units total	STANDARD	Low dose Patients on LVF regimen or long-acting insulin continued	Usual insulin: 50 to 75 units over 24 hours*	Usual insulin: >75 units over 24 hours*	ALTERNATIVE
Blood glucose Mmol/l	Insulin (units/hr)	Insulin (units/hr)	Insulin (units/hr)	Insulin (units/hr)	Insulin (units/hr)
< 4 mmol/L	Treat hypoglycaemia according to NBT guidelines				
	0.5	0.0	1	1	
4.0-5.9	1	0.5	2	3	
6.0-8.9	2	1.0	4	5	
9.0-10.9	3	1.5	6	7	
11.0-12.9	4	2.0	8	10	
13.0 – 14.9	5	2.5	10	12	
≥ 15.0	6 Call doctor	3 Call doctor	12 Call doctor	14 Call doctor	
Doctors signature					
Date and time					

*Please note: Columns four and five apply only to patients using high doses of insulin as part of their daily regimen. These patients usually require a higher sliding scale rate during an acute episode in order to normalise Capillary Blood Glucose levels.

Table 1 Baseline Characteristics for sample of 36 patients

Characteristic	Whole group	Low-dose regimen ACS & LVF Patients (Group A)	standard regimen ACS only (Group B)
	n= 36 (100%)	n=18 (50%)	n= 18(50%)
Male	24 (67%)	10 (56%)	14 (78%)
Female	12 (33%)	8 (44%)	4 (22%)
White	26 (72%)	13 (72%)	13 (72%)
Black	0	0	0
Asian	0	0	0
Ethnicity not stated	10 (28%)	5 (28%)	5 (28%)
Previous Myocardial Infarction	10 (28%)	7 (39%)	3 (17%)
Previous history of Heart Failure	8 (22%)	5 (28%)	3 (17%)
Mean Age (years) (SD)	70 (10.7)	72 (10.7)	68 (10.6)
Median Age (years)	70	71	70
Mean baseline admission CBG (SD)	17 mmol/L (6.8)	18.5 mmol/L (7.6)	15.6 mmol/L (5.7)
Median admission CBG	15.3 mmol/L	16.8 mmol/L	14.0 mmol/L
Mean CBG on commencement of infusion (SD)	14.25 mmol/L (6.5)	14.1 mmol/L (6.6)	14.4 mmol/L (6.6)
Median CBG on commencement of infusion	12.5 mmol/L	12.3 mmol/L	12.8 mmol/L

Legend: ACS: Acute Coronary Syndrome   LVF: Left Ventricular Failure
SD: Standard deviation   CBG: Capillary Blood glucose

Figure 3: Mean capillary blood glucose levels (mmol/L) over time by regimen

Response to sliding scale regime

Group A (low-dose regime)

Group B (standard dose regime)

Mean Capillary Blood Glucose Levels

hours from commencement of insulin regime