

Inpatient hyperglycaemia, and impact on morbidity, mortality and re-hospitalisation rates

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ABSTRACT

Introduction

Hyperglycaemia is related to poorer outcomes among hospital inpatients. We investigated the impact of hyperglycaemia at admission on length of hospital stay, readmission rate and mortality rate.

Method

We retrospectively analysed the records of 1,132 patients admitted to hospital in January 2019, April 2019, August 2019 and April 2020.

Results

Hyperglycaemia was present in 14.1% of patients. New-onset hyperglycaemia on admission (in 3.9% of patients) was related to a higher mortality rate than in patients known to have diabetes admitted with hyperglycaemia (43.3% vs 17.9%; $p=0.006$). Mortality at 90 days and 1 year increased with higher admission glucose levels ($p=0.03$ and $p=0.005$, respectively), severe hyperglycaemia (>20 mmol/L) having a 1-year mortality of 34.3%. After accounting for confounding variables, admission glucose and length of stay remained significant predictors of 1-year mortality ($p=0.034$ and $p=0.003$, respectively).

Conclusion

Hyperglycaemia is an important prognostic marker and may indicate a more severe illness. These patients should be highlighted for a greater level of care.

KEYWORDS: hyperglycaemia, morbidity, mortality, diabetes mellitus

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Introduction

The Maltese European Health Examination Survey found that the prevalence of raised plasma glucose in the Maltese islands steeply

rises in the older population, with 21.6% of those aged above 60 years having hyperglycaemia.¹ Hyperglycaemia (a fasting plasma glucose of ≥ 7 mmol/L or a random plasma glucose of ≥ 11.1 mmol/L) is frequent among all hospital patients, with and without diabetes mellitus. It may be related to traumatic injury, parenteral nutrition, medications (such as glucocorticoids) or infection. Past studies show that uncontrolled plasma glucose increases mortality, morbidity, length of stay and overall complications. Specifically, dysglycaemia increases the risk for infections, thrombosis and slower wound healing.^{2–9} Guidelines such as the American Diabetes Association (ADA) guidelines and the Endocrine Society guidelines emphasise the importance of inpatient glucose control.^{10,11}

The purpose of our study was to investigate the impact of hyperglycaemia at hospital admission in patients with and without diabetes mellitus on length of hospital stay, 1-year readmission rate and mortality rate.

Methods

The electronic records of 1,132 random patients admitted to the central National Health Service (NHS) hospital in Malta (Mater Dei Hospital) during the third weeks of January 2019, April 2019, August 2019 and April 2020 were retrospectively analysed. The patients were followed until discharge or until mortality, whichever occurred first.

Items evaluated were age, gender, past medical history, reason for hospitalisation, random plasma glucose at admission, glycated haemoglobin (HbA_{1c}), renal profile, length of stay, mortality within 90 days and 1 year, and re-hospitalisation rate within 1 year. Exclusion criteria were <18 years of age, elective admissions and foreign patients not residing in Malta due to limited follow-up data.

The data were obtained by accessing electronic patient records that contain patient demographic details, laboratory results and case summaries of past hospital admissions. No patients were approached or contacted during the study, and no unique identifying patient information was collected.

The diagnosis of hyperglycaemia was confirmed by a diabetologist in accordance with the American Diabetes Association diagnostic criteria of hyperglycaemia. In-hospital hyperglycaemia was defined as a random plasma glucose of >11.0 mmol/L. Patients were divided into four groups, determined by their plasma glucose level on admission: <6.5 mmol/L, 6.5–10.9 mmol/L, 11.0–19.9 mmol/L and ≥ 20.0 mmol/L. The normoglycaemic group (patients with a random plasma glucose

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of <11.0 mmol/L) was further subdivided into patients known to suffer from diabetes and those with no pre-existing diagnosis of diabetes. The hyperglycaemic group (defined in this study as a random plasma glucose \geq 11.0 mmol/L) was also subdivided into patients with a previous diagnosis of diabetes and those without.

This study was approved by the University of Malta ethics committee.

Statistical methods

Statistical analyses were performed using SPSS version 27 (IBM, Armonk, USA). Since not all patients had a random plasma glucose level available on admission, the entire cohort was included in data analysis to evaluate other indices than random plasma glucose level, which may also affect the mortality rate. As the dataset was non-parametric, the Mann–Whitney *U* test was used to determine the relationship between the continuous variables and mortality at 90 days, mortality at 1 year and re-hospitalisation within 1 year. The chi-squared test was used to assess the statistical significance of categorical variables to mortality and re-hospitalisation, accepting a $p \leq 0.05$ as significant. To establish the presence of relationships between variables, a linear regression model was fitted to the data. Spearman's rank correlation was run to determine the nature of these relationships.

To further analyse the relationship of random plasma glucose on admission to outcomes, patients were stratified according to pre-specified plasma glucose ranges: <6.5 mmol/L, 6.5–10.9 mmol/L, 11.0–19.9 mmol/L and \geq 20 mmol/L. The statistical significance of these plasma glucose ranges related to readmission and mortality was assessed using the chi-squared test. The patient cohort was further divided depending on pre-existing history of diabetes and plasma glucose on admission.

To address the limitations of univariate analysis and to account for confounding predictors of mortality, a multivariate logistic regression model was fitted to relate mortality outcomes to the predictors of mortality identified using univariate analysis. Other predictors yielding $p > 0.05$ were excluded.

Results

During the study period, 1,132 patient admissions to Mater Dei Hospital were considered, 52.0% ($n=589$) of which were men.

The median age of patients admitted was 72 years (interquartile range (IQR) 56–82). Patients with a previously documented history of diabetes formed 28.5% ($n=323$) of the patient cohort. The median hospital length of stay was 4 days (IQR 2–8). Sixty-eight per cent ($n=764$) of the total patient cohort had a plasma glucose measurement on admission.

Eleven point seven per cent ($n=132$) of patients died within 90 days of admission. When considering the patients' plasma glucose on admission, patients with a higher plasma glucose level were statistically more likely to die within 90 days of hospital admission ($p=0.03$). There was a statistically significant difference in the age of admission between those who died and those who survived at 90 days (median 80 years vs 71 years, respectively; $p \leq 0.001$). A longer inpatient course was also associated with a higher mortality ($p \leq 0.001$). There is also a significant difference in the median concentrations of sodium, urea, creatinine and estimated glomerular filtration rate (eGFR) on admission between the two patient cohorts (Table 1).

The total patient cohort had a 1-year mortality of 20.3% ($n=230$). Once again, patients with a higher plasma glucose level were statistically more likely to die within 1 year following hospital admission ($p=0.005$). An older age on admission was associated with higher mortality ($p \leq 0.001$), as was a longer inpatient course ($p \leq 0.001$). There is also a significant difference in the median concentrations of sodium, urea, creatinine, chloride, osmolality and eGFR on admission between the two patient cohorts (Table 2). Those patients suffering from chronic obstructive pulmonary disease (COPD; $p=0.011$) and congestive heart failure (CHF; $p \leq 0.001$) were found to have a higher mortality at 1 year following admission.

At 1 year following admission, 46.4% ($n=526$) of the total patient cohort was re-admitted to hospital. The median number of readmissions was two readmissions within 1 year (IQR 1–3). Patients suffering from diabetes mellitus ($p \leq 0.001$), COPD ($p \leq 0.001$) and hypertension ($p=0.001$) were statistically more likely to be re-admitted to hospital within 1 year. Older patients were more likely to be re-admitted ($p \leq 0.001$) and a longer hospital length of stay was significantly associated with a higher likelihood of readmission ($p=0.001$). There is also a significant difference in the median concentrations of urea, creatinine, chloride and eGFR on admission between those re-admitted within 1 year and those who remained out of hospital (Table 3).

Table 1. Continuous variables significantly related with mortality at 90 days (analysed using Mann–Whitney *U* test)

	Mortality at 90 days, median (IQR)	No mortality at 90 days, median (IQR)	p-value
Age on admission, years	80.0 (52.5–81.0)	71.0 (71.0–87.0)	<0.001
Length of stay in hospital, days	6.0 (3.0–14.0)	4.0 (2.0–7.0)	<0.001
Plasma glucose on admission, mmol/L	6.8 (6.0–9.4)	6.6 (5.5–8.6)	0.030
Creatinine, μ mol/L	95.0 (66.0–137.8)	82.0 (65.0–108.0)	0.002
Urea, mmol/L	9.1 (6.7–16.0)	6.7 (5.0–9.8)	<0.001
Estimated GFR, mL/min/1.73 m ²	63.0 (37.0–93.5)	78.0 (54.0–101.0)	<0.001
Sodium, mmol/L	137.0 (133.0–140.0)	139.0 (136.0–141.0)	0.001

IQR = interquartile range; GFR = glomerular filtration rate.

Table 2. Continuous variables significantly related with mortality at 1 year (analysed using Mann–Whitney *U* test)

	Mortality at 1 year, median (IQR)	No mortality at 1 year, median (IQR)	p-value
Age on admission, years	80.0 (71.0–86.0)	69.0 (49.0–80.0)	<0.001
Length of stay in hospital, days	6.0 (3.0–13.0)	3.0 (2.0–6.0)	<0.001
Plasma glucose on admission, mmol/L	7.0 (5.8–9.8)	6.4 (5.5–8.43)	0.005
Creatinine, $\mu\text{mol/L}$	94.0 (70–142.8)	81.0 (65–105.5)	<0.001
Urea, mmol/L	9.2 (6.7–14.9)	6.5 (4.8–9.3)	<0.001
Estimated GFR, mL/min/1.73 m ²	60.0 (36.0–88.5)	80.0 (56.5–103.0)	<0.001
Sodium, mmol/L	138.0 (135.0–140.0)	139.0 (136.0–141.0)	0.005
Chloride, mmol/L	98.0 (94.2–101.6)	100.2 (97.1–102.6)	<0.001
Osmolality, mOsm/kg	302.2 (294.6–314.0)	300.8 (295.0–307.0)	0.020

IQR = interquartile range; GFR = glomerular filtration rate.

When fitting a linear regression model to the data, plasma glucose on admission ($p \leq 0.001$), eGFR ($p \leq 0.001$), osmolality ($p = 0.024$) and age ($p \leq 0.001$) were all found to be independent predictors of increased hospital length of stay. A Spearman's rank correlation was run to determine the relationship between plasma glucose on admission and other patient variables. Of note, there was a positive correlation between plasma glucose on admission and length of hospital stay ($p = 0.017$; $\rho = 0.087$) as well as with age ($p \leq 0.001$; $\rho = 0.245$). This result supports that increasing plasma glucose on admission correlated with the increasing length of stay. Plasma glucose on admission was found to negatively correlate with sodium levels ($p \leq 0.001$; $\rho = -0.183$) and with eGFR ($p \leq 0.001$; $\rho = -0.140$).

The total patient cohort was divided into four groups determined by their plasma glucose level on admission: < 6.5 mmol/L ($n = 367$), 6.5 – 10.9 mmol/L ($n = 289$), 11.0 – 19.9 mmol/L ($n = 76$) and ≥ 20.0 mmol/L ($n = 32$). There was a statistically significant difference in mortality between these four groups. Mortality is especially high in those patients admitted with a plasma glucose level of ≥ 20.0 mmol/L. For patients with a plasma glucose of ≥ 20 mmol/L, mortality at 1 year was 34.3%, significantly higher than the 1-year mortality of 15.8% for those with a plasma glucose of < 6.5 mmol/L on admission ($p = 0.015$). Patients admitted with a plasma glucose level of ≥ 20.0 mmol/L also had

a higher re-hospitalisation rate, with 71.9% of this group being re-admitted within 1 year ($p = 0.024$; Fig 1).

Table 4 further divides the cohort into four groups. The normoglycemic group (patients with a random plasma glucose of < 11.0 mmol/L) was subdivided into patients with a pre-existing diagnosis of diabetes and those without. The hyperglycaemic group (patients with a random plasma glucose ≥ 11.0 mmol/L) was also subdivided into patients with a previous diagnosis of diabetes and those without. Of the patient cohort, 3.9% ($n = 30$) were patients without a pre-existing diagnosis of diabetes but with a plasma glucose of ≥ 11.0 mmol/L on admission. This group had a 1-year mortality of 43.3%, significantly higher than the 1-year mortality of 17.9% for patients with a known history of diabetes admitted with hyperglycaemia ($p = 0.006$). Patients with a pre-existing history of diabetes (both normoglycemic and hyperglycaemic) had a higher 1-year readmission rate than those without ($p = 0.003$).

Using univariate analysis, 11 variables were significantly related to mortality at 1 year following admission (Table 2). To account for other confounding predictors of mortality, a logistic regression model was fitted to relate mortality outcomes at 1 year to the predictors described earlier. Plasma glucose on admission remained a significant predictor of mortality ($p = 0.034$; odds ratio (OR) 1.035), together with age, male gender, creatinine level and length of stay in hospital (Table 5).

Table 3. Continuous variables significantly related with re-hospitalisation at 1 year (analysed using Mann–Whitney *U* test)

	Re-hospitalised, median (IQR)	Not re-hospitalised, median (IQR)	p-value
Age on admission, years	76.0 (65.0–83.0)	68.0 (46.0–79.0)	<0.001
Length of stay in hospital, days	4.0 (2.0–8.0)	3.0 (2.0–7.0)	0.001
Creatinine, $\mu\text{mol/L}$	90.0 (69.0–122.0)	79.0 (64.0–101.0)	<0.001
Urea, mmol/L	7.8 (5.6–10.9)	6.2 (4.7–9.2)	<0.001
Estimated GFR, mL/min/1.73 m ²	70.0 (47.0–94.0)	82.0 (58.0–105.0)	<0.001
Chloride, mmol/L	99.6 (95.6–102.20)	100.3 (96.9–102.6)	0.012

IQR = interquartile range; GFR = glomerular filtration rate.

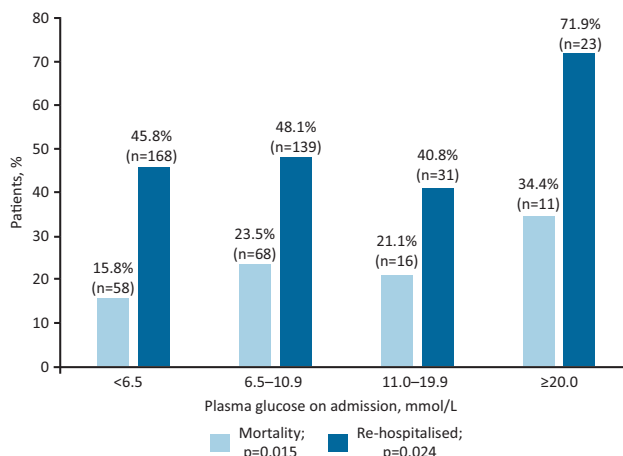


Fig 1. Plasma glucose on admission related with mortality at 1 year and re-hospitalisation at 1 year.

Interestingly, April 2020 had a lower 90-day and 1-year mortality rate than expected (13.1% and 20.5%, respectively) when compared with April 2019 (16.2% and 26.4%, respectively; $p=0.001$ and $p=0.015$, respectively). In April 2019, 8.1% of patients without a previously documented history of diabetes were admitted with new-onset hyperglycaemia, higher than that observed in April 2020 (2.2%; $p=0.012$).

Discussion

It is well-documented that hyperglycaemia leads to adverse outcomes in various hospital settings.²⁻⁸ In our study, 16.5% of patients were admitted with a random glucose level of ≥ 11.0 mmol/L. The link between hyperglycaemia and adverse effects is noted for both hyperglycaemia at admission and the average plasma glucose during hospital stay.⁸ In line with that, patients with a higher plasma glucose level at presentation were more likely to die, both within 90 days and within 1 year of hospital admission. Elevated plasma glucose at hospital admission was also associated with increased length of stay. Patients admitted with severe hyperglycaemia of ≥ 20 mmol/L were twice as likely to die within 1 year, and almost three-quarters of this cohort were re-admitted within a year. After accounting for other variables using multivariate logistic regression, hyperglycaemia remained a significant predictor of 1-year mortality. Despite the prognostic importance of hyperglycaemia, over one-third of patients in this study were admitted without a laboratory plasma glucose reading.

Only 10.2% ($n=116$) of patients had a glycated haemoglobin level taken before discharge.

There is debate about whether hyperglycaemia is independently associated with poor outcomes or indicates a more severe illness.³ Patients can develop hyperglycaemia during an acute medical or surgical illness, even without previous evidence of diabetes (known as stress hyperglycaemia). The human stress response initiates stress hyperglycaemia by activation of the hypothalamic-pituitary-adrenal axis (HPA) and the sympathoadrenal system. These ultimately release cortisol, epinephrine and norepinephrine correlating to the severity of the stressor and aim to bring about haemostasis during stress. Cortisol plays a central role in hyperglycaemia by promoting excessive hepatic gluconeogenesis and decreasing peripheral glucose uptake. Hyperglycaemia itself can trigger an inflammatory response, setting off a cascade of pro-inflammatory cytokines and reactive oxygen species, which may contribute to insulin resistance and further worsen hyperglycaemia. If insulin resistance develops, the effects of altered glucose metabolism may persist.^{3,8,12,13} Mild to moderate stress hyperglycaemia is protective during stress and critical illness by increasing the glucose concentration gradient during periods of low plasma perfusion to ensure glucose reaches essential cells.^{8,13} Given this, it is controversial whether stress hyperglycaemia is beneficial or harmful. Marik *et al* propose that the severity and duration of hyperglycaemia is the determinant.⁸

In 2002, Umpierrez *et al* found that patients admitted with new hyperglycaemia without a pre-existing diagnosis of diabetes were 29% more likely to be admitted to the intensive care unit (ICU). These patients had a longer length of stay and much higher in-hospital mortality than those with a known history of diabetes and those admitted with normoglycemia.³ Our study echoed these results. Patients admitted with new-onset hyperglycaemia had a 1-year mortality rate over two times greater than that of patients with diabetes admitted with hyperglycaemia and all normoglycemic patients. These findings support the belief that hyperglycaemia is a marker for increased severity of illness, independent of a history of diabetes and is linked to increased patient morbidity and mortality.^{4-7,14-20} Existing evidence established that patients presenting with an acute cerebrovascular event found to have hyperglycaemia at admission had a worse prognosis, independent of other variables, including a previous diagnosis of diabetes.^{14,15} Similar conclusions were drawn by studies investigating patients presenting with myocardial infarctions, acute heart failure exacerbations, community-acquired pneumonia and COVID-19 infection.¹⁶⁻¹⁹

Table 4. History of diabetes and plasma glucose on admission related with mortality at 1 year and re-hospitalisation at 1 year

Plasma glucose on admission	Mortality, n (%)	p-value	Re-hospitalised, n (%)	p-value
Known history of diabetes				
<11.0 mmol/L	36 (22.8)	0.006	90 (57.0)	0.003
≥ 11.0 mmol/L	14 (17.9)		44 (56.4)	
No known history of diabetes				
<11.0 mmol/L	90 (18.1)		217 (43.6)	
≥ 11.0 mmol/L	13 (43.3)		10 (33.3)	

Table 5. Predictors of patient mortality at 1 year identified by the logistic regression model

	Odds ratio	95% CI	p-value
Age on admission, years	1.054	1.038–1.071	<0.001
Length of stay in hospital, days	1.037	1.012–1.063	0.003
Men, n	0.584	0.389–0.876	0.009
Plasma glucose on admission, mmol/L	1.035	1.003–1.068	0.034
Creatinine, μ mol/L	1.002	1.000–1.003	0.020

CI = confidence interval.

Hyperglycaemia is associated with increased complication and mortality rates; however, there are few studies on the management of hyperglycaemia conducted on patients in a non-ICU setting. In many studies, close control of inpatient hyperglycaemia did not improve mortality rates and, conversely, the NICE-SUGAR trial demonstrated an increased mortality risk in critically ill patients treated with intensive insulin therapy.^{20,21} A 2012 meta-analysis conducted by Murad *et al* found that strict control of hyperglycaemia was not significantly associated with any benefit in the rate of myocardial infarction, stroke or mortality. There was an increased risk for hypoglycaemia and a decreased risk for infection, mainly in surgical series.²⁰ In a non-ICU setting, whether control of glycaemic variability improves mortality rate is unclear. Glucose targets are controversial, with studies giving conflicting results.^{12,22,23} In 2013, Lanspa *et al* found that a less strict glucose target was associated with increased mortality in ICU patients with new-onset hyperglycaemia but decreased mortality in patients with a known history of diabetes.²⁴

Guidelines, therefore, aim to control hyperglycaemia in inpatients without increasing the risk of hypoglycaemia. The Joint British Diabetes Societies (JBDS) for Inpatient Care group has published guidelines recommending a plasma glucose target range between 6.0–10.0 mmol/L for inpatients with type 2 diabetes mellitus or stress hyperglycaemia, with an acceptable range of 4.0 to 12.0 mmol/L.²⁵ Both the ADA – American Association of Clinical Endocrinologists (AAACE) and the Endocrine Society guidelines recommend aiming for a pre-meal glucose level of less than 7.8 mmol/L and a random plasma glucose level of less than 10.0 mmol/L in non-critically ill patients. In patients in a non-critical care setting, the Endocrine Society guidelines and ADA-AAACE guidelines recommend that glucose ranges up to 11.1 mmol/L may be suitable in the context of a terminally ill patient or a patient with severe comorbidities.¹²

For critically ill patients, the ADA-AAACE task force recommend a target glucose of 7.8–10.0 mmol/L, recommending against targets below 6.1 mmol/L. Insulin is the mainstay of treatment of inpatient hyperglycaemia, with a continuous insulin infusion being the preferred method of administration for inpatients with severe hyperglycaemia or those who are critically ill.¹²

Subcutaneous insulin is the treatment of choice in a non-critical care setting. The use of sliding scale insulin in patients with hyperglycaemia is widely used in many centres, however, its prolonged use should be avoided. Sliding scale regimens are associated with hyperglycaemia and act as a reactive treatment

for hyperglycaemia, without supplementing the patient's basal insulin requirement.^{12,25,26} Instead, a basal-bolus approach or a basal-plus approach has been shown to offer better glycaemic control. The basal-bolus approach (consisting of basal insulin (typically glargine) together with pre-meal rapid-acting insulin) is associated with a decrease in complication rate, however, it carries a risk of iatrogenic hypoglycaemia.^{12,25} In cases of mild hyperglycaemia, a basal-plus approach (consisting of basal insulin with corrective doses of insulin with or without non-insulin agents) may be preferred. Pre-mixed insulin is not recommended for inpatient control of hyperglycaemia as it is associated with an unacceptably high rate of hypoglycaemia.¹²

In 2015, a national cross-sectional study found that diabetes contributes to approximately 3.65% of Malta's total annual health expenditure through both direct and indirect expenses. This value includes the cost burden for both patients known to have diabetes and those not yet diagnosed. In the case of patients known to suffer from diabetes, the annual health cost burden is approximately double the cost for those yet undiagnosed.²⁷ Extending these inferences, we found that patients known to be suffering from diabetes had a significantly higher 1-year hospital readmission rate than those without, with over half of this cohort re-hospitalised within 1 year.

In April 2020, a critical confounding variable came into the picture. On the 11 March 2020, the World Health Organization declared COVID-19 a global pandemic. During the initial stages of the pandemic, there was a significant decrease in Maltese patients presenting to the emergency department (ED) with acute cardiac events and acute exacerbations of COPD.^{28,29} We postulate that a delay in presentation, presumably due to fear, played a pivotal role in this redistribution in mortality. This avoidance behaviour was noted in various centres worldwide and a similar phenomenon was documented in Hong Kong during the H1N1 pandemic in 2010.^{30–32} This fear of exposure may explain the drop in patients presenting to hospital with new-onset hyperglycaemia in April 2020 in our study. We hypothesise that some of those patients with a severe enough illness to result in stress hyperglycaemia did not present to the hospital in April 2020. In fact, in the third week of April 2020, there were 471 patient admissions through the ED, compared with 621 in April 2019.

Limitations

Few studies examine the effect on mortality of glycaemic control in a non-ICU setting, with evidence mainly driven by studies conducted in surgical settings.²⁰ We tried to analyse these factors by analysing an undifferentiated sequential cohort of hospital admissions in a large general hospital, although we did not have further data on the glycaemic control during the admission. Another limitation is that this study relied on retrospective, electronic data, relying on accurate and detailed electronic patient documentation.

Conclusion

Hyperglycaemia was found to be a significant predictor of mortality at 1 year. Higher plasma glucose levels were associated with a higher mortality rate and a longer length of hospital stay. Patients with severe hyperglycaemia had a significantly higher mortality rate, especially true in the case of patients presenting

with new-onset hyperglycaemia. Plasma glucose is an important prognostic marker rather than a history of diabetes and may indicate a more severe illness. We, therefore, recommend that these patients be highlighted for a greater level of care. An HbA_{1c} level taken at admission in cases of new-onset hyperglycaemia can aid differentiation between stress hyperglycaemia and undiagnosed diabetes. ■

Summary

What is known

Hyperglycaemia is related to poorer outcomes among hospital inpatients, including an increased mortality rate, length of stay and overall complication rate. Studies have shown that new-onset hyperglycaemia in a patient with no documented history of diabetes mellitus is related to more severe illness, a longer length of stay and a significantly higher mortality rate.

What is the question

There is an ongoing debate whether hyperglycaemia is independently associated with poor outcomes or is indicative of a more severe illness.

What was found and what is the implication for practice?

Plasma glucose is an important prognostic marker, rather than a history of diabetes. These patients should be highlighted for a greater level of care, and an HbA_{1c} level taken at admission in cases of new-onset hyperglycaemia can aid differentiation between stress hyperglycaemia and undiagnosed diabetes.

Supplementary material

Additional supplementary material may be found in the online version of this article at www.rcpjournals.org/clinmedicine: S1 – Spearman's correlation coefficient between plasma glucose on admission, age, length of stay and different biochemical variables.

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