

The Clinical Significance of Blood Ketone Measurement in Hyperglycaemic in-patients with Insulin Treated Diabetes Mellitus and End Stage Renal Failure

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Introduction

Diabetic ketoacidosis (DKA) is a serious metabolic condition, with ketosis, hyperglycaemia and acidosis. UK guidelines for its management include liberal intravenous fluid replacement and urine or blood ketones monitoring (1). Patients with renal failure need amended guidelines. For example, they may be oliguric (2), so neither require or tolerate the liberal rehydration regimes recommended in DKA or in sick day rules.

Methods

To assess the utility of blood ketone measurement, we measured prospectively the serum beta-hydroxybutyrate of in-patients with renal failure and insulin treated diabetes mellitus, who were admitted as an emergency to our Renal Unit at QEUH from July to September 2016. Acidosis is routinely assessed in our patient cohort by routine measurement of serum bicarbonate.

Results

There were 26 admissions in 24 patients. Only 12 were confirmed to have type 1 diabetes. The median (range) age of T1DM patients was 38 (33-55), and 7 were women. All had CKD5; 11 were on renal replacement therapy and the other had eGFR 10ml/min. Median (range) blood glucose was 21.4 (5.8-78.4)mmol/l and bicarbonate was 19 (9-26)mmol/l.

Only 3 patients had beta-hydroxybutyrate >3mmol/l (severe), of whom 2 had serum bicarbonate <15mmol/l and had omitted insulin doses (blood glucose 32 and 78.4mmol/l). The patient who was not yet on RRT had the lowest bicarbonate level and beta-hydroxybutyrate levels with blood glucose of 32mmol/l. The third was not acidotic, had blood glucose of 23.4mmol/l, and had vomiting attributed to alcoholic gastritis, not DKA.

Spearman's Rho for glucose v.s. beta-hydroxybutyrate v.s change in bicarbonate all indicate no statistical correlation between these factors.

No patients with T2DM had significant ketonaemia despite lab glucose of up to 45.7mmol/l.

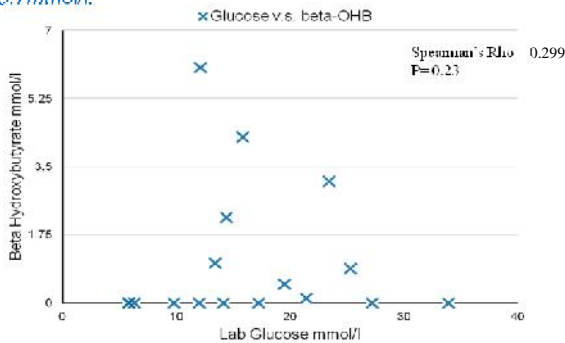


Fig. 1: Glucose v.s. beta-hydroxybutyrate in T1DM

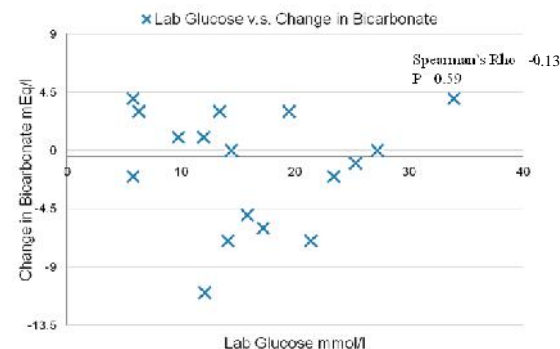


Fig. 2: Glucose v.s. change in bicarbonate in T1DM

Glucose mmol/l	Absent Ketosis (<0.6mmol/l)	Mild Ketosis (0.6-1.5mmol/l)	Moderate Ketosis (1.6-3mmol/l)	Severe Ketosis (>3mmol/l)
4-14	5	1	0	1
>14.1	6	1	1	2

Table 1: Number of T1DM in-patients with different severity of ketosis (3) and hyperglycaemia

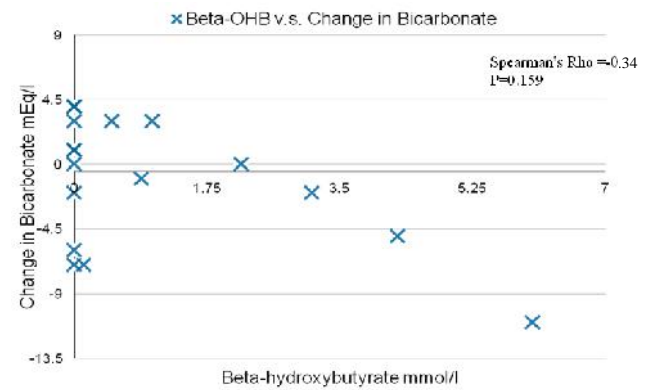


Fig. 3: Beta hydroxybutyrate v.s. change in bicarbonate in T1DM

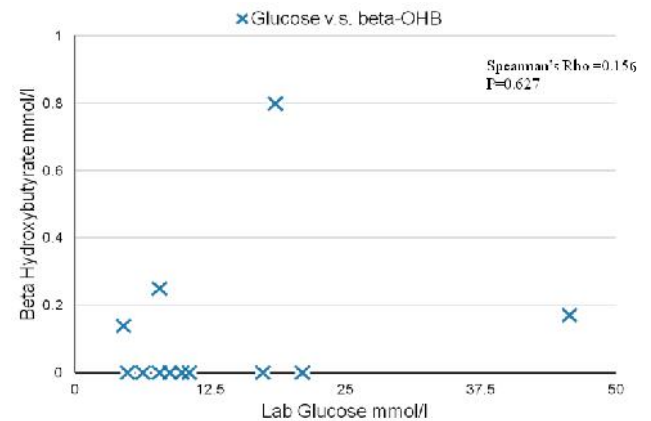


Fig. 4: Glucose v.s. beta-hydroxybutyrate in T2DM

Conclusions

This limited study suggests that routine blood ketone measurement in hyperglycaemic patients with both diabetes and renal failure admitted to renal units is of limited benefit. However, further study is required to confirm this.

References

- 1) Joint British Diabetes Societies guideline for the management of diabetic ketoacidosis. M Savage et al. Diabetes Medicine (2011) 28(5): 508-15
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- 3) Prevalence of ketosis, ketonuria, and ketoacidosis during liberal glycaemic control in critically ill patients with diabetes: an observational study. N Luethi et al. Critical care (2016) 20:297