Utility of a Handheld Blood Ketone Meter as a Postmortem Indicator of Diabetic Ketoacidosis

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Outline
- Research question
- Biochemistry review: ketone bodies; DKA
- Methods
- Present data collected at the Jefferson County OCME
- Discussion of findings
- Two CME/SAMs questions

Research questions
- Can a commercially available blood ketone meter reliably measure post-mortem blood ketone levels such that an accurate diagnosis of antemortem DKA can be made?
- What implications would such a test have for medical examiners’ and coroners’ offices?
During life, blood glucose levels may be reliably tested using commercially-available blood glucose meters; in a living patient with DKA, blood glucose levels may be significantly deranged (>250 mg/dL).

Postmortem blood glucose changes

In life, blood solutes equilibrate with the vitreous humor.

Postmortem vitreous glucose stability

“Gold standard” for postmortem DKA diagnosis when taking clinical picture, PMH into consideration.

Testing may be technically challenging or expensive, particularly in smaller or rural offices

During times of starvation, nutritional deficiency, or “pseudostarvation” (e.g. uncontrolled diabetes mellitus,) the body produces metabolic fuel by catabolism:

Three ketone bodies:
Postmortem blood ketone values, in contrast with blood glucose values, remain relatively stable.

Blood glucose meters; blood ketone meters for in vivo DKA screening.

Blood ketone meters analyze blood concentration of beta-hydroxybutyrate, the most prevalent ketone in the body in setting of DKA.

Per packaged instructions, ketone levels >1.5 mmol/L are concerning for DKA.

Methods

Brief retrospective pilot study; gas chromatography detected blood acetone in selected decedents. Post-mortem blood assayed for ketones.

Follow-up: Controls and suspected DKA cases were prospectively chosen; decedents’ blood samples were analyzed for ketones (screen) and vitreous samples for glucose (confirmatory).

Causes of death in retrospect:

- Arteriosclerotic CVD
- Hypertensive heart disease
- Drowning
- Other

Cause of death, retrospective pilot study.
Average vitreous glucose and blood ketones by COD, prospective study

Conclusions/Discussion

- Retrospective pilot study results – Post-mortem ketone testing is sensitive but not specific for DKA for retrospectively collected samples; vitreous remains most specific gold standard.
- Prospective study: Post-mortem ketone testing is sensitive and, in this small sample, specific for DKA. All decedents dying of DKA had values > 2.6 mmol/L; all others had values < 1 mmol/L (ULN: 1.5 mmol/L).
- Ramifications for OC/Mes
- The art of post-mortem diagnosis

CME Question 1

Question 1: Which of the following is the most prevalent ketone body in the blood in the setting of acute diabetic ketoacidosis?

Answer A: Acetone
- Answer B: β-Ketopentanoate
- Answer C: Acetoacetate
- Answer D: Dihydropteroate
- Answer E: β-Hydroxybutyrate
CME Question 2

- **Question 2:** Which of the following blood ketone values warrants further work-up for diabetic ketoacidosis?
  - **Answer A:** 0 mmol/L
  - **Answer B:** 0.06 - 0.6 mmol/L
  - **Answer C:** 0.6 - 1.0 mmol/L
  - **Answer D:** 1.0 - 1.5 mmol/L
  - **Answer E:** Greater than 1.5 mmol/L

CME Question references

1. Laffel L. Ketone bodies: a review of physiology, pathophysiology and application of monitoring to diabetes. Diabetes/Metabolism Research and Reviews 1999; 15:412.

Questions?