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?
### Biochemistry: Glucose and ketones 1

- 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

### Biochemistry: Glucose and ketones 2

- 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

### Biochemistry: Glucose and ketones 3

- During times of starvation, nutritional deficiency, or "pseudostarvation" (e.g. uncontrolled diabetes mellitus,) the body produces metabolic fuel by catabolism:
  - Three ketone bodies:
    - [Chemical structures of Acetone, Acetoacetic acid, and 3-Hydroxybutyric acid are shown]
Biochemistry: Glucose and ketones 4

- Postmortem blood ketone values, in contrast with blood glucose values, remain relatively stable [source]
- Blood glucose meters; blood ketone meters for \textit{in vivo} DKA screening
- Blood ketone meters analyze blood concentration of \textit{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 retrospective pilot (n=17)
Average vitreous glucose by COD in retrospective pilot

Average blood ketones by COD in retrospective pilot

Causes of death in prospective study (n=15)
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.