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

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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?

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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

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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

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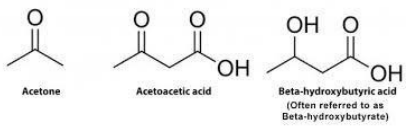
Biochemistry: Glucose and ketones 3

- During times of starvation, nutritional deficiency, or "pseudostarvation" (e.g. uncontrolled diabetes mellitus,) the body produces metabolic fuel by catabolism:
  - Three ketone bodies:



Acetone | Acetoacetic acid | Beta-hydroxybutyric acid (Often referred to as Beta-hydroxybutyrate)

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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 *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.**

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Methods

- Brief retrospective pilot study; gas chromatography detected blood acetone in selected decedents ❼ 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).

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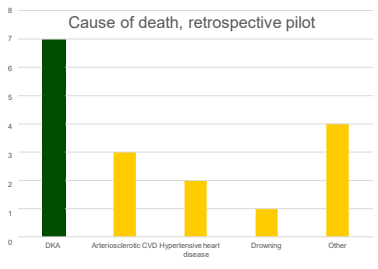
Causes of death in retrospective pilot (n=17)



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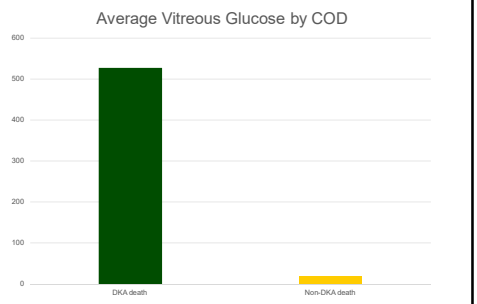
Average vitreous glucose by COD in retrospective pilot



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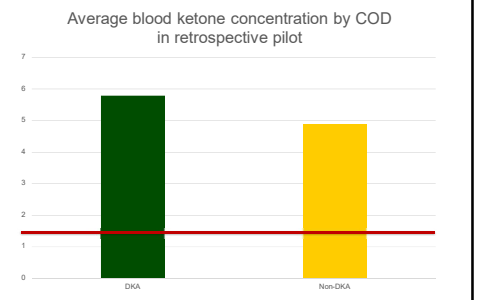
Average blood ketones by COD in retrospective pilot



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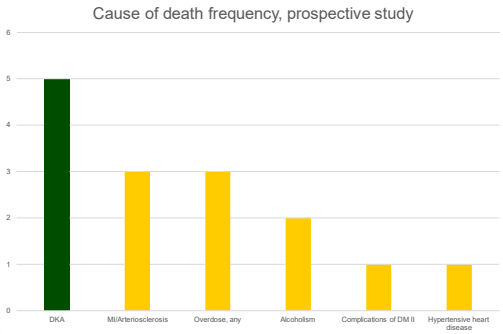
Causes of death in prospective study (n=15)



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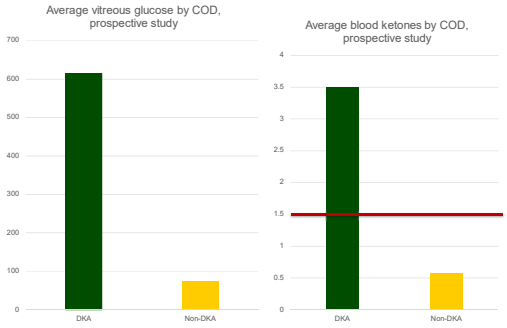
Average vitreous glucose and blood ketones by COD, prospective study



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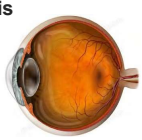
Conclusions/Discussion

- **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**



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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

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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

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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.
2. Charles RA, Bee YM, Eng PHK, et al. Point-of-care blood ketone testing: screening for diabetic ketoacidosis at the emergency department. Singapore Medical Journal 2007; 48:986.

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Questions?

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