Diabetic Ketoacidosis

(DKA)

Case Presentation

- 14 year old known diabetic
- Admits to poor control and not taking insulin
- Mild headache initially
- Fatigue, drowsiness
- No vomiting, diarrhea, fever, rash urinary or URTI symptoms
- Denies drugs and alcohol

Examination

- Afebrile, HR 112, BP 105/74
- Sleepy, alert and oriented, non-distressed
- Neurological exam normal
- Poor peripheral perfusion
- Deep respirations

Investigations

Blood glucose 23

Gas showed a metabolic acidosis

pH 6.93

CO2 10, bicarb 5

Urinalysis: ketones, glucose >55

Lytes, CBC, Cr/BUN

(Cultures, CXR)

What is DKA

- Diabetic ketoacidosis
- Diabetic- mainly occurs in type 1 (almost all pediatric diabetes)
- Primary problem is insulin insufficiency
- High blood glucose but unable to get into cells where needed
- Alternative energy production- fats and proteins metabolized to ketones

- Ketones are acids
- 3 types: acetoacetate, acetone, β hydroxybutyrate
- Ketone testing usually measures 1st 2 only
- Early on may get more β-HB and as acidosis corrects, more acetoacetate and acetone (so it may look like ketones are getting worse when they're improving)

- Hyperglycemia- glucose lost through kidneys drags a lot of water and electolytes with it
- Hypovolemia results- poor perfusion and lactic acid build up (contributes to acidosis)
- Electrolyte shifts- complex and mainly correct with fluid replacement, insulin and acidosis correction
- But in severe DKA rapid correction may cause cerebral edema

DKA: Approach

- ABCs
- Airway and breathing:
  - May need intubation for airway protection if GCS low
  - Vomiting- potential for aspiration
  - NPO (until bicarbonate >18)
  - Oxygen
  - Kussmaul respirations
    - Type of hyperventilation
    - Compensation for acidosis (blowing off CO_2)

Circulation

- Fluids usually first priority
- Hypotensive: 20mL/kg normal saline bolus, repeat 10mL/kg if necessary
- If persistent may need FFP/ albumin, inotropic support

- No hypotension:
- IV 0.45% saline with 40mmol/L KCl at 2x maintenance initially
- Then calculate appropriate rate based on maintenance, estimated deficits and ongoing losses
- Aim to replace 75% of deficit in first 24hrs (half of this in first 8hrs, half in next 16hrs)

- Do NOT give more than twice maintenance (if not hypotensive) during first 24 hours of treatment
- Excessive fluids may contribute to cerebral edema development during treatment
- Dextrose should be added to fluids once blood glucose 13-17mmol/L

Insulin

- Mild DKA- subcutaneous
- Insulin infusion:
  - Moderate or severe DKA
  - Illness or surgery in Type 1 diabetic where expected to be NPO >24hrs. (+ IV fluids with dextrose)

Insulin infusions

- Can only give rapid acting (soluble) insulin IV (ie. Humulin R, Novolin GE Toronto)
- Not intermediate or long acting
- Insulin binds to walls of plastic tubing and containers, flush approx 50mls of insulin solution through the tubing prior to infusing
- Standard insulin concentration of 10 units insulin per 100mls 0.9%NaCl recommended to minimise errors

Approximate dosage

- Ketoacidosis:
  - 0.1units/kg/hr (infusion rate=weight kg)
  - Eg. 20kg child, 20ml/hr=2u/hr=0.1u/kg/hr
- Ketosis and hyperglycemia, no acidosis:
  - 0.05units/kg/hr
  - Eg. 20kg child, 10ml/hr=1u/hr=0.05u/kg/hr
- Maintenance of normal blood sugar
  - 0.02-0.05units/kg/hr

Glucose

- Chemstrips Q2hrs initially
- Change to D5/0.45NaCl when BGL approaches 13-17mmol/L to avoid hypoglycemia
- Then titrate glucose in fluids and insulin infusion to maintain BGL 7-10mmol/L until stable enough for insulin sub-cu

Infection/Complications

- Causes of death in DKA
  - Shock
  - Infection
  - Cerebral edema

Infection

- May be trigger for decompensation
- Search for infection (cultures etc.)
- Treat aggressively

Cerebral Edema

- Uncommon
- Often fatal
- Initial improvement (clinical and labs)
- Headache, hypertension, obtundation/neurological deterioration
- Early aggressive medical management (fluid restriction, mannitol)

Monitoring

- Fluids: ins and outs
- PR, BP, RR, temp, hydration, CNS Q2-4hrs
- Chemstrips Q2hrs
- BGL, lytes, BUN, Cr, cap gas Q4hrs
- Until stable
- Daily weight
- Flow sheet

Scenarios 1

- 7yr old boy
- 2 wk history of malaise, polyuria, polydipsia, weight loss
- Sent to emerg by GP
- BGL 23
- Ketones and glucose in urine

- New diagnosis presenting with DKA

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- 3 y.o. girl
- Dx T1DM 4 months ago
- 2 days of vomiting
- BSLs erratic at home but mainly high
- Parents reducing insulin because of low oral intake (has had an episode of hypoglycemia in the past)

- Intercurrent illness (gastro), need education re sick day management

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- 15y.o. girl
- 1 day vomiting, lethargy
- Fought with parents over going to a party
- Denies missing insulin
- BGLs high, usual insulin doses only

- Adolescence a difficult time in chronic disease- developing autonomy etc.
- Non-compliance vs intercurrent illness (eg. UTI)
- Psychological issues may need addressing as well as diabetes education

Clinical Presentation

- Polyuria
- Polydipsia
- Polyphagia
- Weight loss
- Fatigue
- Abdominal pain
- Vomiting
- Acetone breath
- Kussmaul resps
- Obtundation
- Dehydration

Precipitating factors

- Stress
- Trauma
- Infection
- Psychological problems
- Insulin dosage/activity

Final Words

- Common presentation
- Can be life threatening
- Often a sign of poor control
- Important to try to prevent recurrence
- EDUCATION