Endocrine emergencies

- Hypoglycemia
- Adrenal crisis: acute adrenal insufficiency
- Diabetic ketoacidosis
- Nonketotic hyperosmolar coma
- Thyroid emergencies: storm and myxedema coma
- Calcium emergencies: severe hypercalcemia and hypocalcemia

Hypoglycemia

- Can be immediately life-threatening
- Most commonly a consequence of insulin therapy but can occur with sulfonylurea overdose or with sulfonylureas + renal insufficiency
- Defined as glucose <60 mg/dl with symptoms
- Symptoms/signs
  - Sweaty, cool, pale, tachycardia, decreased mental attention
  - ↓ consciousness, irritable and confused => coma
  - Seizures

Hypoglycemia: Treatment

- If conscious =>
  - Treat with 15 g oral fast acting glucose (glucose tablets or gel, juice)
  - Retest in 15 minutes
  - Can administer even if NPO unless recent intestinal surgery
  - Retest in 15 minutes

Hypoglycemia: assess the cause

- Once resolved, identify why - prevent the next one
- Usual causes
  - Too much insulin-dose needs to be changed because of recent change in activity, weight or diet, decreased renal function
  - Inappropriate timing-giving insulin too long before or after meal
  - Unpredictable absorption of insulin-lipodystrophy
  - New disease-pregnancy, hypo- or hyperthyroidism, Addison’s, renal insufficiency
  - Change in other medicines-decreased steroid dose
  - Autonomic neuropathy-gastroparesis
Acute adrenal insufficiency or adrenal crisis

- Can be life-threatening if not treated promptly
- Consequence of recent adrenal suppression or adrenal insufficiency, diagnosed or not, and acute stress
- Usual presentation: nausea, vomiting, abdominal pain, joint pain, fever=>$hypotension=>$shock=>$coma
- Accompanying features: hyperkalemia, prerenal azotemia, low SVR, eosinophilia, basophilia, hypercalcemia

Acute adrenal insufficiency: treatment

- Draw cortisol and ACTH first! (red + purple top on ice)
- Hydrocortisone 100 mg iv stat followed by 50 mg Q6h or 100 mg Q8h until adrenal insufficiency and inciting cause resolved/resolving then switch to oral and taper
- Hydrocortisone preferred (mineralocorticoid content)
- ACTH and cortisol values distinguish primary from secondary cause: Cortisol should be $>20 mg/dl during acute stress

Acute adrenal insufficiency: assess the cause

- Patient educated when to increase steroids to prevent acute adrenal insufficiency and recognize and treat early
- Dex injection kit prescribed for home use when can’t keep steroids down
- Medic-alert bracelet
- Steroids increased for fever, any stress including dental procedures, outpatient surgery, severe heat or cold exposure, physical exhaustion, severe emotional stress (death of close family member)

Clinical case

- During acute shock, cortisol drawn and reported at 20.
- ACTH 30 IU/ml (normal 20-50).
- Is this adrenal insufficiency or not?
- If so, does this look like primary or secondary adrenal failure?
- Is this consistent with previous adrenal suppression?

Diabetic ketoacidosis (DKA)

- Usually type 1 DM but can occur in type 2 with severe insulin deficiency
- Results from insulin deficiency alone (as with severe noncompliance) or insulin deficiency + stress
  - Infection most common cause (pneumonia, viral, otitis, wound infection, PID, UTI/pyelonephritis)
  - Other: post-op with inadequate insulin administration, severe sunburn, pregnancy/labor, pancreatitis, acute MI
- Identify cause: DKA will not resolve if inciting cause not treated; morbidity/mortality largely due to the inciting cause (e.g., silent MI)

DKA: Pathophysiology

- Stress => epinephrine secretion => lipolysis=>$release of FFA=>$liver
- FFA transported across mitochondrial membrane by carnitine acyltransferase
- Carnitine acyltransferase activity normally suppressed by malonyl CoA (stimulated by insulin)
- In absence of insulin => carnitine availability and FFA transport enhanced => increased ketone production
- β-OH-butyrate <=> acetoacetate <=>acetone
  - Most abundant
  - Measured in ketone test
  - Excreted or excreted through skin
DKA: presentation

- New onset DM with recent weight loss, polyuria, polydipsia or
- Established diabetes with recent polyuria, hyperglycemia (>250 mg/dl)
  - Early: nausea, abdominal pain but no fever unless infection present=> should prompt home ketone testing, frequent glucose testing, and immediate and repeated insulin injections
  - Later: Vomiting=> if present will need iv hydration
  - Late: Kussmaul breathing, fruity odor, decreased level of consciousness
- Use of very long acting analogs (Lantus) has decreased frequency, particularly in adolescents
- Use of only very short analogs (Humalog, Novolog in pump) increases risk because of potential speed of onset if infusion interrupted

Clinical case

- 24 year old with type 1 diabetes calls because she woke up feeling ill and blood sugar over 400
- She measures urine ketones and they are moderate.
- What should she do?

DKA treatment: Hypovolemia

- 0.9% NaCl until BP stable (1-2 L) =>
- 0.45% 250-1000 ml/h (Most of fluid losses are hypotonic)
- Total volume deficit usually 6-10L.
- Monitor I/O closely first 24h
- Be sure kidneys are working!

DKA treatment: Hyperglycemia

1. Insulin analog (Humalog, Novolog) 10 u SQ/h if home and DKA mild or in hospital and iv cannot be established
2. Regular insulin infusion 10 u iv bolus then 10u/h or 0.1-0.15u/kg/h until BS <250 mg/dl then add D5W to prevent hypoglycemia and consider decreasing rate; if glucose doesn’t respond to initial dose in 1 hour=> double rate
3. DEM iv insulin protocol: 10 u/h, ↓ as BS ↓
   - Do not need to start D5W to avoid hypoglycemia
   - Restart SQ when resistance resolves
Monitor BS hourly until on SQ insulin

DKA treatment: Acidosis

- Always confirm DKA with serum ketones; if significant acidosis and few ketones, consider other causes (e.g., lactate)
- Treated by both fluids and insulin
- No data to show that iv bicarb improves outcomes
- Never correct acidosis to neutral pH with iv bicarb as will cause paradoxical CNS acidosis
- Consider 1 amp bicarb for pH<6.9; repeat pH in 30 minutes before additional doses
- Without bicarb therapy, check ketones or serum bicarb 2-4h after initiation of fluids/insulin to demonstrate trend then in 24h to demonstrate resolution of acidosis

DKA treatment: K+ replacement

- Severity of depletion determined by K+ concentration at outset. If acidosis present, and
  - Potassium level suggests K+ Deficiency
    - High
      - Minimal
    - Normal
      - Moderate
    - Low
      - Severe
- Begin K+ (KCl) replacement (20-30 meq/h) as soon as urine output established and K+ falls below 4.0 meq/L
- Give in iv fluid or separately if fluids administered more rapidly than 1L/hour
- Check K+ Q4h or more frequently if deficiency severe at outset
DKA treatment: Hypophosphatemia

- Not observed until 18-24h after admission: do not need to check until next day
- No evidence that iv replacement improves outcomes; too often over-replaced => hypocalcemia
- No need to replace if eating within 24h and not severe (phosphate>1.5)
- Consider oral or iv replacement if very low, evidence of accompanying morbidity (hemolysis, cardiac or respiratory failure) or unable to eat immediately

DKA: sample orders/flow sheet

- Hourly I/O
- Glucose by fingerstick hourly
- Insulin infusion rate
- ABG: at outset, do not need to repeat unless acidosis severe (pH < 7.0H), additional respiratory disease, other causes of acidosis such as intoxication
- Serum ketones: at outset, can repeat in 2h or use change in serum bicarb and glucose as substitute for resolution; repeat in 24h(or before discontinuation of iv insulin)
- BMP at outset, repeat in 2h if K+ low initially; otherwise Q 4h until K+ and renal function stable
- Serum phosphate at outset then 24h

DKA: When to restart SQ insulin?

- Acute illness resolved
- Iv insulin requirements suggest the patient has returned to usual insulin sensitivity
- Eating normally
- Serum ketones have resolved!
- Make sure SQ insulin started before or simultaneous to iv insulin being stopped

Nonketotic hyperosmolar coma

- Usually a consequence of insulin resistance" pushed over the edge": new infection, new med (steroids, HCTZ, atypical antipsychotic), other stress (acute MI, stroke)
- Compared to DKA
  - More likely type 2 than type 1
  - Usually older
  - More severe dehydration
  - More insulin sensitive (exquisitely so in some cases)
  - Greater risk for prolonged mental status change because of age and hyperosmolality
  - Hypernatremia more severe and can result in central pontine myelinolysis if resolved too quickly
  - May not need longterm DM treatment after resolution

Nonketotic hyperosmolar coma

- Begin iv 0.45%NaCl unless hypotensive; despite severity of fluid deficit, may need to give more slowly because of age and possible comorbidities (CHF, CAD)
- Fluids alone may be adequate to treat hyperglycemia in some cases
- Identify cause xistent to treatment
- K+ replacement as indicated as with DKA
- Regular insulin iv using one of the methods below:
  1. 0.05 u/kg/h
  2. 10 units bolus followed by 5.0 u/h
  3. DEM iv insulin algorithm

Thyroid storm

- Severe hyperthyroidism with evidence of hyperpyrexia, agitation or psychosis, severe tachycardia and/or high output CHF
- Block synthesis and release with PTU 300 mg po TID
- Block conversion of T4 to T3 and cardiac response with beta blockers that may be given iv if CHF present
- Block acute hormone release with iodine (SSKI, ipodoate) after PTU administered
- Block T4 to T3 conversion and treat “relative hypoadrenalism” with iv steroids
- Usually but not always Graves’ disease
Myxedema coma
- Unrecognized severe hypothyroidism + acute stress (e.g., infection, acute MI, acute cold exposure, CNS affecting meds)
- Presentation: Coma; hypothermia; hypotension; CHF with cardiomegaly; cool, doughy, pasty skin; bradycardia; hypoventilation, seizures
- Free T4 low + TSH should be very elevated otherwise consider euthyroid sick and other cause of coma
- Single dose of iv L-thyroxine (0.5 mg), then oral or 0.05-0.1 mg L-thyroxine iv daily until able to take oral meds
- No advantage of iv T3
- Treat underlying precipitating cause; ventilation support and glucose may be needed; external warming not recommended; iv steroids may be added for “relative hypoadrenalism”

Acute hypercalcemia
- Calcium >14, or sudden increase with decreased mental status
- Draw intact PTH at outset (and PTHrP if malignancy considered)
- Initiate high volume saline diuresis (0.9%NaCl 1L/hour initially then 2-4L/d). Can add loop diuretics to enhance calciuresis
- Salmon calcitonin SQ Q12h for effect in 2-4 hours lasting up 3-4d+
- Pamidronate iv may be required for longterm treatment
  - Delayed effect: 24-48 hours
  - Reduce dose with renal insufficiency
  - Zoledronic acid if pamidronate tolerance has occurred
- Steroids effective for hypercalcemia complicating hematologic malignancy, Vit D intoxication, or granulomatous diseases

Acute Hypocalcemia
- Hypocalcemia with carpal, pedal or facial spasms (usually < 7.0 with normal albumin)
- Most common post-parathyroidectomy, or treatment withdrawal of previous hypoparathyroidism; rarely with TPN or following overaggressive iv phosphate therapy
- Rx: oral calcium therapy (1-3 g/d) + iv 1 ampule (10-20 ml) 10% calcium gluconate slowly over 20-30 min every Q4-6 hours as indicated by symptoms and Ca++ concentration
- Telemetry with severe deficiency (<6.5) or arrhythmias
- Replace magnesium deficiency iv or hypocalcemia may not resolve
- Post-parathyroidectomy usually temporary (1-3d) unless all parathyroids removed or longstanding parathyroid hyperplasia (Li++, MEN, tertiary hyperthyroidism secondary to CRF)

The end