Yukon-Kuskokwim HEALTH CORPORATION

Treatment Protocol

Pediatric Endocrine Emergency Protocols

Hypoglycemia

If low BG and cause unknown, ***GET CRITICAL SAMPLE PRIOR TO TREATMENT!***

Labs tested during hypoglycemia are critical to identifying cause and preventing recurrence.

- Serum critical sample:
  - CMP, insulin, c-peptide, Beta-hydroxybutyrate, Lactate, Cortisol, Growth Hormone
  - Free fatty acids,
  - Ammonia, total and free carnitine, acylcarnitine profile
- Urine – as quickly after hypoglycemia as possible
  - Urine ketones
  - Urine organic acids
- If suspect hyperinsulinism, perform glucagon stimulation test (administer 1 mg IV/IM/SQ) and measure POC glucose at 10, 20, 30, and 40 minutes. If BG does not rise by 20mg/dl within 20min after glucagon, end test early. At end of test (either 20min or 40min as above), feed patient and/or resume IV dextrose
    - Risk of vomiting and rebound hypoglycemia up to 60-90 min after glucagon

Acute Treatment: obtain critical sample and correct hypoglycemia within 10-15 minutes.

- Glucose gel per eCHAM guidelines.
- IV or IO dextrose bolus (D10% or D25%) followed by continuous infusion of dextrose IVF and frequent blood sugar checks (Q1-2h or more frequently initially)
  - D25%: 2-4 mL/kg; D10%: 5-10 mL/kg. (For neonates, give D10% 2 mL/kg.)
- If known to be insulin-mediated, treat with glucagon (for patients < 20 kg give 0.5 mg IM and for patients > 20 kg give 1 mg IM).

**Diagnostic Fast and Critical Sample pathway (CHOP): https://www.chop.edu/clinical-pathway/persistent-hypoglycemia-newborn-niicu-diagnostic-fast

Adrenal Insufficiency

Critical Sample before treatment if no known disease: cortisol

- If suspect primary adrenal insufficiency, include ACTH, renin, aldosterone.
- If suspect CAH, include 17OH-progesterone or CAH-Pediatric Profile Six – Comprehensive Screen (test code 500175, LabCorp).
- Also check BMP, CBC, U/A.

Treat while awaiting results.

- Normal Saline Bolus 20 mL/kg.
- Hydrocortisone 50-100 mg/m^2 IV bolus (lower end of range if less sick, higher end of range if more sick) followed by 50-100 mg/m^2/day, divided q6h
  - If no IV access, SoluCortef IM or Dexamethasone IM
  - SoluCortef 50-100 mg/m^2 IV/IM – short acting – needs another dose in 6 hours
    - At this dose, adequate mineralocorticoid activity to replace moderate doses of oral fludrocortisone (80 mg HC = 0.2 mg fludrocortisone)
  - Dexamethasone 1.5-2 mg/m^2 IV/IM—long acting
    - *No mineralocorticoid activity*
    - Does not cross react with cortisol in lab assay so can use Dex if unable to get cortisol before treatment and then do Cortrosyn stimulation test after treatment
  - SoluMedrol 10-15 mg/m^2 IV/IM–intermediate acting
    - *No mineralocorticoid activity*
- For milder presentation, ex. known diagnosis with flu symptoms, but hemodynamically stable, can skip load, use 50-65/m^2/day, divided every 6 hours.

Known adrenal insufficiency (ie CAH or hypopituitarism) and adrenal crisis

- Loading dose hydrocortisone IV or IM 50-100 mg/m^2 x1 then 50-100 mg/m^2/day IV divided q6h
- If BSA unknown or for more rapid dosing, can use age:

  <0-2 y.o.: 25 mg IM/IV bolus followed by 25-30mg/day IV divided q6h

  2-10 y.o.: 50 mg IM/IV bolus followed by 50-60mg/day IV divided q6h

  >10 y.o.: 100 mg IM/IV bolus followed by 100mg/day IV divided q6h

- If severely ill or unable to take PO due to continued emesis, but no IV, can give SoluCortef 50 mg/m^2 IM (better for CAH because has fludrocortisone activity at high doses, but only lasts about 6 hours), or Dexamethasone 1.5-2 mg/m^2 IM.
- If less ill (ie, not in crisis but needs stress doses because of fever or vomiting), can give oral stress doses hydrocortisone 50mg/m2/day PO divided q8hrs
- Normal saline bolus 20 mL/kg/ IV then D5NS or D10NS (depending on blood sugar) at 1.5 x maintenance.
- Monitor electrolytes, BP.
- For anesthesia: begin oral stress doses the night before the procedure, then ~50 mg/m^2 IV or IM on call to the OR prior to anesthesia; and continue oral or IV stress doing for 24 hours after procedure.

**Adrenal Insufficiency Clinical Pathway (CHOP): https://www.chop.edu/clinical-pathway/steroid-stress-dosing-and-weaning-clinical-pathway

Hypercalcemia

Critical sample before treatment: Ca, Phos, iPTH
- Other labs: 25-OH-D, 1,25 $(OH)_2$ D, urine Ca/Cr, CBC

Treatment for severe hypercalcemia (Ca >14): same initial treatment independent of the cause
- Saline diuresis: NS bolus 20ml/kg followed by 2.5-3 L/m^2/day
  - Saline diuresis generally works rapidly, but only as long as it is continued, and usually does not normalize calcium.
- Bisphosphonate IV may be needed (pamidronate or zoledronate)
- Consider calcitonin 4 units/kg IV/IM/SQ q12h
  - Tachyphylaxis common (often 2nd-line therapy y
  - Common side effects: nausea, vomiting, flushing
- Discontinue any medications known to cause or worsen hypercalcemia (ie, vitamin D, calcitriol)
- Low calcium formula (CalciLo XD)
- Avoid immobilization.

If mild/moderate (Ca <13-14) and no contraindication to PO: 2-3 L/day water plus PO salt to promote Ca excretion.

Therapy specific for underlying disorder
- Hyperparathyroidism – parathyroidectomy
- Glucocorticoids – effective if associated with hematologic malignancy or diseases with increased 1,25 $(OH)_2$ vitamin D.

Hypocalcemia

Critical sample before treatment: Calcium, Phosphorus, Magnesium, intact PTH.
- Ca and iPTH need to be simultaneous, and PTH *MUST* be obtained while Ca is low.
- Collect urine Ca/Cr while Ca low if possible.
- If there is reason to suspect low albumin, check ionized calcium or calculate corrected calcium using albumin
  - Corr Ca = measured calcium + [0.8 (4-albumin)]
- Other useful labs: CMP (kidney, liver, bone function, albumin), 25-OH-D, 1,25 $(OH)_2$ D, spot/random urine Ca/Cr.

Treatment if Symptomatic – muscle spasms, tetany, seizure, apnea, stridor, laryngospasm, hypotension, prolonged QTc, heart failure.
- *Slow* (<1 ml/min) IV infusion 10% Ca gluconate 1 mL/kg = 100mg/kg/dose (max 3000mg/dose), over 4 hours
  - 100 mg/ml Ca Gluconate = 9 mg/mL elemental Ca
  - Cardiac monitoring (bradycardia, shortened QT_c); close attention to infusion site if not central IV (risk of tissue necrosis if peripheral IV infiltration)
  - Repeat calcium 2 hours after completion of calcium gluconate infusion; May repeat dose if calcium remains <7 mg/dL
  - Begin oral calcium while calcium gluconate is infusing
- If Mg low, replace with 0.1-0.2 mL/kg 50% Mg Sulfate

If not acutely symptomatic, can do more comprehensive evaluation first to determine cause and appropriate oral treatment (doses below)
- Oral Calcium doses: neonates 50-150mg elemental Ca/kg/day in 4-6 divided dose, max 1g/day; infants/children 45-65 mg/kg/day in 4 divided doses
- Calcitriol 0.025mcg/kg/day in 2-3 divided doses (PO or IV)

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Treatment Protocol

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Thyroid Storm (Thyrotoxic Crisis)

Score ≥45: highly suggestive of thyroid storm; 25–44: thyroid storm; and <25: thyroid storm unlikely.

Diagnostic criteria for thyroid storm*

Thermoregulatory dysfunction	
Temperature (°F | °C)	
99 to 99.9 | 37.2 to 37.7	5
100 to 100.9 | 37.8 to 38.2	10
101 to 101.9 | 38.3 to 38.8	15
102 to 102.9 | 38.9 to 39.4	20
103 to 103.9 | 39.4 to 39.9	25
≥104.0 | >40.0	30
Central nervous system effects	
Mild	10
Agitation	
Moderate	20
Delirium	
Psychosis	
Extreme lethargy	
Severe	30
Seizure	
Coma	
Gastrointestinal-hepatic dysfunction	
Moderate	10
Diarrhea	
Nausea/vomiting	
Abdominal pain	
Severe	20
Unexplained jaundice	

Cardiovascular dysfunction	
Tachycardia	
99 to 109	5
110 to 119	10
120 to 129	15
130 to 139	20
≥140	25
Atrial fibrillation	10
Heart failure	
Mild	5
Pedal edema	
Moderate	10
Bibasilar rales	
Severe	15
Pulmonary edema	
Precipitant history	
Negative	0
Positive	10

* A score of 45 or more is highly suggestive of thyroid storm, a score of 25 to 44 supports the diagnosis, and a score below 25 makes thyroid storm unlikely.

Adapted from: Burch HB, Wartofsky L. Life-threatening thyrotoxicosis. Thyroid storm. Endocrinol Metab Clin North Am 1993; 22:263.

UpToDate®

Critical Sample: **Free T4 and TSH,** run STAT
- Other labs: TBII, TSI, TPO antibodies
- Useful to measure: CMP (glucose, liver function), CBC (acute infection?), urine pregnancy test

Acute Treatment
- Oxygen
- Adrenergic blockade (if not in CHF) - goal HR<100
  - Propranolol (PO 4 mg/kg/day div q6h (max 40mg/dose) or IV 0.01 mg/kg/dose (max 3mg) over 10-15 min).
    Adolescents: PO 20-40mg q4-6h or IV 0.5-1mg over 10min
    - If contraindication to propranolol (ie asthma), can use atenolol (cardioselective) *with caution*.
- IV fluids (cooled if necessary)
- Cooling blankets
- Antipyretics should be avoided when possible.
- Sedation – phenobarbital stimulated thyroid hormone clearance.
- Hemodynamic support/treat CHF if present.
- Block thyroid hormone synthesis and release
  - Thionamides – block thyroid hormone synthesis
    - PTU (propylthiouracil): 5-10mg/kg/day neonates, 15-20mg/kg/day children (max 1200mg/day) q6-8hrs
      - (black box warning in peds)
    - Methimazole : ~0.4 mg/kg (max 30 mg) every 6 hours
  - High Dose Iodine – blocks release of already formed thyroid hormone
    - Should be delayed until 1-2 hours after thionamide to prevent transient increase in thyroid hormone levels
    - SSKI (50mg/drop) 2-5 drops PO every 6 hours
    - Lugol's solution (8mg/drop) 10 drops PO every 8 hours
    - Use will necessitate delay in radioactive iodine treatment if that is desired
- Block peripheral conversion of T4 to T3
  - Corticosteroids (Hydrocortisone IV100mg/m2 (max 100mg) loading dose then 100mg/m2/day divided q6hrs)
  - Iodinated contrast agents
- Cholestyramine to prevent reabsorption of free thyroid hormone in the gut (off-label): 4g NG q6hr in adults

Identify and treat precipitating event causing severe decompensation.

- Infection, pregnancy, emotional stress, DKA, pulmonary embolism, CVA, trauma, hypoglycemia.

Assess for underlying cause

- Grave's disease, functioning thyroid nodule (hot nodule)

https://www.uptodate.com/contents/thyroid-storm?search=thyroid%20storm&source=search_result&selectedTitle=1~82&usage_type=default&display_rank=1
https://emedicine.medscape.com/article/925147-treatment#d7