Adrenal Insufficiency

The hypothalamic pituitary adrenal axis is responsible for generating the stress response to acute illness, trauma and surgery. Defects along this axis may impair a patient's ability to adequately compensate for the stress of the perioperative period.

ANESTHETIC CONSIDERATIONS:

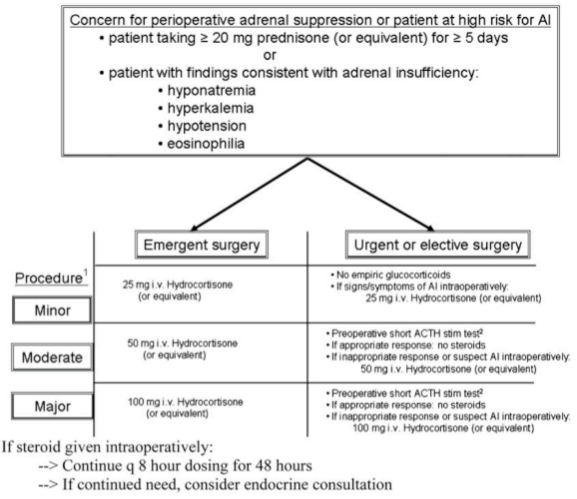
1. Risk of perioperative adrenal insufficiency and addisonian crisis
    - Shock: hypotension
    - Decreased response to circulating catecholamines
    - Dehydration
    - Nausea and vomiting
    - Abdominal pain and anorexia
    - Electrolyte imbalance (hypoNa, **hyper K – caution with succinylcholine**, hypoglycemia)
2. Perioperative steroid supplementation (should be continued x 48h postoperatively)
    - Minor surgery – 25mg hydrocortisone
    - Moderate surgery – 50mg hydrocortisone
    - Major surgery – 100mg hydrocortisone
    - If elective surgery, preoperative ACTH stim test (250 mcg IV cosyntropin with random cortisol 30 min post; positive result – increase in plasma cortisol by 450-500 nmol/L)
3. Associated autoimmune dysfunction and associated diseases (thyroid disease, diabetes)
4. Avoid medication induced exacerbation of adrenal insufficiency (etomidate)
5. Side effects of long term corticosteroid use if tertiary adrenal insufficiency
    - Buffalo hump
    - Friable tissues
    - Poor wound healing
    - Glucose intolerance
    - Psychosis
    - Weight gain
    - Moon facies
    - Hypertension
    - Na retention, K loss
    - Myopathy and peripheral muscle weakness

ANESTHETIC GOALS:

- Ensure preoperative optimization of adrenal function and appropriate perioperative steroid supplementation
- Correct dehydration and correct electrolyte and metabolic derangements
- Retain a high index of suspicion for perioperative adrenal insufficiency and adrenal crisis when presented with: hypotension, nausea, orthostatic blood pressure changes, hyponatremia, hyperkalemia or level of consciousness changes
- Avoid exacerbation of adrenal dysfunction with medications i.e. etomidate

PRIORITY

- If urgent or emergent surgery: may empirically give perioperative steroid supplementation
- If elective surgery: preoperative ACTH stimulation test



Kohl and schwartz. How to manage perioperative endocrine insufficiency. Anesth Clin N America. 2010 (28) 139-155/

TABLE 16-13 -- Steroid (Hydrocortisone) Supplementation (Stoelting pg 397)

Give baseline therapy +

Superficial surgery Dental surgery, biopsy	None

Minor surgery Inguinal hernia repair, endoscopy	25 mg IV
Moderate surgery Cholecystectomy, colon resection	50–75 mg IV, taper 1–2 days
Severe surgery CV surgery, esophagectomy, whipples	100–150 mg IV, taper 1–2 days
Intensive care unit sepsis	50–100 mg q 6–8 hr for 2 days to 1 wk, taper

NB: if giving >100mg/day of hydrocortisone switch to methylprednisolone as ↓mineralcorticoid effects (fluid retention, edema, ↓K) 20mg of hydrocortisone = 4mg methylprednisolone

RESUSCITATION

- Fluid replacement
- Perioperative steroid replacement
- Correction of life threatening electrolyte abnormalities
- Correction of precipitating factors

HISTORY:

- WHO IS AT RISK?
  - > 20 mg per day of prednisone (or equivalent) for more than 5 days may be considered at risk for HPA axis suppression
  - Those on 5-20 mg/day of prednisone for 4 weeks or more may be considered to have HPA axis suppression
  - Those on 5-20mg/day for more than 3 weeks have equivocal effects on HPA axis
  - > 2g/day topically or 0.8mg/day inhaled
  - Risk of perioperative adrenal insufficiency remains up to 1 year after cessation of steroid therapy

- HEENT – severe dental caries (pain, loose teeth)
- CVS – hypotension, hypovolemia (orthostatic symptoms), cardiopenia, ↓ response to catecholamines, arrhythmias if ↑ K^+
- RESP – possible respiratory muscle weakness (exercise tolerance)
- GI – dehydration, hypovolemia, abdominal pain / cramping (nausea, emesis, diarrhea, orthostatic symptoms)
- RENAL – azotemia
- ENDO - ↓ Na, ↓ Cl, ↓ glucose, ↑ K
- HEME – Hemoconcentration, lymphocytosis / eosinophilia
- CNS – nervous / mental irritability
- MSK – muscle weakness, weight loss (fatigue, anorexia)

PHYSICAL

- **VITALS** – including postural vital signs
- **HEENT** – teeth for structural stability
- **CVS** – standard cardiac exam
- **RESP** – 2-flight walk
- **MSK** – strength (ability) to rise from chair without using hands

INVESTIGATIONS

- **Labs**
  - CBC and differential (eosinophilia)
  - Electrolytes, BUN / Cr
  - ACTH stimulation test
- **Imaging**
  - ECG
  - CXR (cardiopenia)

OPTIMIZATION

- Correct hypovolemia, hyperkalemia, hyponatremia, hypoglycemia
- Stress steroid coverage: up to 300 mg/d hydrocortisone / 70 kg body weight (usual is 100 mg/d)
- For mineralocorticoid treatment: 0.05-0.1 mg PO fludrocortisone
- Benzodiazepine premedication okay
- Management of acute AI:
  - Life-threatening condition!
  - IV fluids (NS or D5/NS) 2-3 L or more
  - Correct electrolytes
  - Hydrocortisone 100 mg IV q6-8h for 24 h then taper to maintenance of 15-20 mg PO q am and 5-10 mg PO q pm
  - Identify and correct precipitating factors
  - Add maintenance fludrocortisone 0.05-0.2 mg PO daily if aldosterone deficient (primary AI)
  - These patients will need increased cortisol doses (2-3 x) under stress (infection, trauma, burns, surgery)

ANESTHETIC OPTIONS

- Local, regional, general

ANESTHETIC SETUP

- **Drugs**
  - Standard emergency drugs
  - Hydrocortisone
  - Fludrocortisone
- **Equipment**

- Standard CAS
- Consider arterial and PAC catheterization if cardiac filling pressures indicated / major surgery

MANAGEMENT OF ANESTHESIA

- **Induction**
  - No specific anesthesia regimen superior
  - Avoid etomidate: causes adrenal suppression
  - Avoid succinylcholine if hyperkalemic
  - Myocardial sensitivity to drugs (narcotics / barbiturates)
  - Muscle weakness / weight loss may require a reduced muscle relaxant dose
- **Maintenance**
  - May not see changes in HR despite decreased SVR
  - Check electrolytes, glucose intraoperatively
- **Emergence**
  - Prolonged emergence possible

DISPOSITION & MONITORING

- Pancreatitis risk with left adrenalectomy
- Perioperative steroids may decrease wound healing, increase infections, increase stress ulcers, increase glucose intolerance and cause HTN
- Postoperative stress greater than intraoperative
  - Consider ICU observation postoperatively due to risk of Addisonian crisis)

COMPLICATIONS

- Adrenal insufficiency crisis (Addisonian crisis / circulatory collapse)
- Cardiac arrhythmias with hyperkalemia

PATHOPHYSIOLOGY

- Primary (Addison's Disease) = adrenal destruction (loss of cortisol and aldosterone) due to:
  - Autoimmunity (70-90 %): isolated or in combination (e.g. Schmidt's syndrome)
  - Infection: TB (7-20 %), fungal, HIV, syphilis, trypanosomiasis
  - Metastatic cancer: lung, breast, stomach, lymphoma
  - Adrenal hemorrhage or infarction: coagulopathy, Waterhouse-Friderichsen syndrome (meningococcal and pseudomonas septicemia)
  - Drugs: ketoconazole, rifampin, phenytoin, barbiturates, megestrol acetate
  - Other: adrenoleukodystrophy, congenital adrenal hyperplasia, familial glucocorticoid deficiency or resistance
- Secondary = deficient pituitary ACTH
  - Invasive (usually primary tumors)
  - Infarction (Sheehan's syndrome)
  - Infiltrative disease (sarcoidosis)
  - Iatrogenic (surgery, radiation)
  - Infectious (syphilis, TB)
  - Injury (head trauma)
  - Immune destruction
  - Idiopathic (e.g. Congenital midline deformities)
- Tertiary AI is due to:
  - Hypothalamic disease (deficient CRF)
  - Iatrogenic HPA suppression due to exogenous cortisol (most common cause of AI in the general population)
  - The production and release of CRF, ACTH, and endogenous cortisol are suppressed, leading to AI during cortisol withdrawal or periods of stress (since the suppressed HPA axis is unable to respond appropriately with increased cortisol production)
- Clinical Features
  - Weakness, fatigue
  - Anorexia
  - Weight loss
  - GI: N&V, constipation, abdominal pain, diarrhea
  - Salt craving
  - Postural dizziness
  - Myalgia
  - Arthralgia
  - Hyperpigmentation
  - Hypotension
  - Vitiligo
  - In secondary AI, hypotension, dehydration and GI symptoms are less and no hyperpigmentation
- Management of acute AI
  - Life-threatening condition!
  - IV fluids (NS or D5/NS) 2-3 L or more
  - Correct electrolytes
  - Hydrocortisone 100 mg IV q6-8h for 24 h then taper to maintenance of 15-20 mg PO q am and 5-10 mg PO q pm
  - Identify and correct precipitating factors
  - Add maintenance fludrocortisone 0.05-0.2 mg PO daily if aldosterone deficient (primary AI)
  - These patients will need increased cortisol doses (2-3 x) under stress (infection, trauma, burns, surgery)

REFERENCES

- Miller 7th Edition Chapter 34; Stoelting's Anesthesia and Coexisiting Disease; Kohl and schwartz. How to manage perioperative endocrine insufficiency. Anesth Clin N America. 2010 (28) 139-155/