Hypothyroidism

Most often a slowly progressive disease characterized by insufficient circulating thyroid hormones. Primary failure of the thyroid gland accounts for 95% of cases with most due to an autoimmune process or previous radioactive iodine ablation therapy.

ANESTHETIC CONSIDERATIONS:

- Hypothyroidism
  - Euthyroid for elective surgery
  - Continue medications (however, most have long half-lives)
  - Potential for myxedema coma (T_4 < 1 mg/dL) → thyroid hormone treatment unless CAD
  - Potential difficult airway (**macroglossia, goiter**)
  - **Aspiration** risk (delayed gastric emptying)
  - Respiratory: **sensitivity to respiratory depressants**, pleural effusions
  - Cardiac Involvement
    - Autonomic & pericardial dysfunction
    - **Systolic and diastolic dysfunction** → low output CHF
  - **Relative adrenal suppression** → stress dose corticosteroid
  - Emergence may be delayed (impaired mentation, hypothermia, slowed drug biotransformation, respiratory depression)
- Co-existing disease
  - Obesity

ANESTHETIC GOALS:

- Preoperative optimization:
  - Euthyroid state if possible prior to surgery
- Hemodynamic stability in hypodynamic state
- Judicious/careful hormone replacement in myxedema coma if co-existing CAD

HISTORY

- AMPLE
- GENERAL
  - History of thyroid disease, autoimmune disease, thyroidectomy, etc.
  - Cold intolerance
  - Weight gain
- Hypothyroid
  - HEENT – snoring (large tongue)
  - CVS – palpitations, angina, SOB, SOBOE, edema, orthopnea, PND (failure solely 2° to low T_4 is uncommon)
  - GI – constipation (ileus / decreased gastric emptying)
  - RENAL – fluid retention, edema
  - CNS – obtundation, mental slowing, weakness, lethargy, depression

PHYSICAL

- GENERAL - Coarse hair, dry and scaly skin, edema, peripherally "shut down"
- Hypothyroid
  - HEENT – enlarged tongue/airway assessment
  - CVS – bradycardia, extra heart sounds, weak pulses
  - RESP – adequacy of respirations, pleural effusion, crackles of CHF
  - GI – decreased BS
  - RENAL – edema
  - CNS – decreased DTR, impaired mental status exam

INVESTIGATIONS

- **Labs**
  - Hypothyroid
    - CBC (anemia), e-lytes (**hyponatremia**, hyperkalemia), glucose (**hypoglycemia**)
    - TSH (distinguishes primary vs. secondary), free T_4
    - ABG if respiratory depression (T_4 needed for surfactant production)
- **Imaging**
  - EKG
    - Low voltage, prolonged PR, QRS and QT
    - Conduction abnormalities – a.fib
  - CXR
    - Pleural and pericardial **effusions**
  - ECHO – to evaluate contractility/effusion
    - Severe hypothyroidism typically displays systolic and diastolic dysfunction
  - CT neck, neck films if tracheomalacia suspected
- **Special**
  - Consults – Endocrinology, Cardiology

OPTIMIZATION

- Cancel elective surgery

- Endocrinology consult
- Volume depletion may require repletion
- Consider steroid stress dose
- **Hypothyroid**
    - Ensure patient warm
    - Aspiration prophylaxis
    - Avoid sedation
    - Replacement therapy
        - Mild-moderate:
            - Thyroxine 0.1-0.2 mg (1-3 mcg/kg) PO OD
            - Treatment takes 6-8 wks (T½ 6-8 days)
        - Myxedema coma:
            - IV T_4 (levothyroxine) IV 200-300 mcg load & 100 mcg IV daily
            - IV T_3 (L-triiodothyronine) can be used / has more rapid onset: 0.2-0.3 mcg/kg IV q6h – T½ 1.5 days, so give to patient a.m. of surgery
            - NB: requires continuous ECG (r/o ischemia, arrhythmias)
            - Controversy in patient w/ CAD and initiation of replacement, theoretical risk of angina, however clinically often improvement in angina, cautious introduction recommended; if angina develops / worsens may require revascularization prior to replacement therapy
            - IV hydrocortisone 0.5-1 mg/kg q8h (concomitant adrenal suppression)

ANESTHETIC OPTIONS

- Elective case - Safer to postpone and aim for euthyroid state
- Emergency surgery –supplement with T_3, hydrocortisone
- **Severe hyper- / hypothyroidism** likely to necessitate **GA for airway and ventilatory support**
    - **Controlled ventilation recommended – patients tend to hypoventilate**
- **Regional** is acceptable option if CNS, ventilation, and cardiac status appropriate and no coagulopathy
    - Maintain intravascular volume
    - Metabolism of amide local anesthetics slowed – lower maximum dose for regional

ANESTHETIC SETUP

- **Drugs**
    - Standard emergency drugs
    - L-triiodothyronine, levothyroxine and hydrocortisone preoperatively as indicated
- **Equipment**
    - CAS monitors + temperature + 5 lead EKG
    - Difficult airway cart if large tongue, goiter etc.
    - Invasive monitors d/t LV dysfunction
        - Arterial line
        - PAC / TEE indicated if ischemia and / or CHF
    - Warming strategies (forced air, hotline, etc.)
    - PNS – may be inaccurate in hypothyroidism

MANAGEMENT OF ANESTHESIA

- **Induction**
    - Anticipate hypotension
    - **Ketamine** advocated
    - Ephedrine, DA or Epi for hypotension
    - ?Avoid etomidate (may already have adrenal suppression)
    - Underlying muscle weakness **may produce exaggerated response to relaxants** so ensure full reversal, use PNS
- **Maintenance**
    - **No change in MAC** with hyper- / hypothyroidism
    - Volatiles may cause exaggerated cardiac depression
    - Maintain **normothermia** (↓ temp will decrease MAC)
    - Titrate opioid d/t increased risk of respiratory depression, consider non-narcotic adjuvants for pain control (e.g. ketorolac & other NSAIDs etc.)
    - Treat hypotension with small doses of **ephedrine** (2.5-5 mg):
        - Pure alpha agonist may overwhelm sluggish LV and push into CHF
        - Needs beta agonist also, but pure beta can cause dysrhythmias
- **Emergence**
    - **Anticipate delayed emergence** (consider **hypoglycemia**, **hyponatremia**, hypometabolism of drugs, **respiratory depression, hypothermia!**)

DISPOSITION & MONITORING

- Beware additive respiratory depression from opiates
    - Emphasize non-opiate modalities (NSAIDs, acetaminophen, LAs)
- Ventilate until normothermic and behaving "normally"

COMPLICATIONS

- Thyroidectomy
    - Hematoma – can lead to airway compromise – needs a/w control and evacuation of hematoma
    - RLN palsy – hoarseness (unilateral) or stridor / aphonia (bilateral) – may need intubation / examination fiberoptically
    - Superior laryngeal nerve palsy – decreased phonation intensity

- Bullous glottic edema can require immediate reintubation
- Hypoparathyroid – leading to late hypocalcemia, tetany and **laryngospasm**
- Pneumothorax
- Tracheomalacia requiring intubation for patent a/w

- **Hypothyroid**
  - Delayed emergence (consider hypoglycemia, hyponatremia, hypothermia)
  - Respiratory failure due to weakness and central depression
  - CHF

PREGNANCY

- No significant alterations in practice compared to non-pregnant patient
- Hypothyroidism can be associate with platelet dysfunction
  - Verify normal coagulation on hx, physical and labs before neuraxial techniques
- Response to vasopressors similar to euthyroid patients

PATHOPHYSIOLOGY

- **Physiology of the thyroid**:
  - Iodine from diet → GI tract → active transport into thyroid as iodide ion → converted to iodine again → bound to tyrosine (triiodothyronine [T_3] & thyroxine [T_4]) → protein bound and stored in thyroid
  - More T_4 than T_3 released but T_3 much more potent and less protein bound (most T_3 formed peripherally via deiodination of T_4)
  - Elaborate feedback mechanism → hypothalamus (TRH) → anterior pituitary (TSH) → autoregulation at thyroid via iodine concentration
  - Thyroid hormone:
    - Increases carbohydrate & fat metabolism & growth / metabolic rate
    - Increased metabolic rate increases O_2 consumption & CO_2 production, indirectly increasing MV
    - HR and contractility also increased (adrenergic-receptor physiology altered)
- **Hypothyroidism**
  - Common condition (0.5-0.8% population)
  - Etiologies
    - Primary: (95%) - Autoimmune (i.e. Hashimoto's thyroiditis – most common), thyroidectomy, drug ablative therapy, excess iodide (inhibits release), iodine deficiency
    - Secondary (5%) - failure of hypothalamic-pituitary axis, cretinism (during neonatal development)
  - Clinical manifestations (may be subtle) – anyone with an enlarged gland gets testing
    - Weight gain, cold intolerance, muscle fatigue, lethargy, constipation, hypoactive "hung" reflexes, dull facial expression, depression
  - Subclincal hypothyroidism very common – 5% of population – only increased thyrotropin (TSH)
  - Severe hypothyroidism may have profound physiological effects
    - CVS - decreased HR & myocardial contractility & CO & SV
    - Peripheral vasoconstriction, ↑ SVR, ↑ circulating catecholamines, narrow pulse pressure, and systemic hypertension (particularly diastolic hypertension) in ~ 15%
    - Systolic and diastolic myocardial function is impaired
      - Myocardial depression may be refractory to catecholamines
      - CHF is uncommon and usually indicates coexisting cardiac disease
    - Effusions common (pleural, pericardial, abdominal)
    - Delayed gastric emptying (should receive aspiration prophylaxis)
  - Diagnosis: low free T_4 levels, primary differentiated from secondary by elevated TSH
  - Treatment: oral replacement with thyroid hormone preparation
- **Myxedema coma**
  - Life threatening condition of extreme hypothyroidism (mortality > 50%)
  - Often precipitated by illness, infection, surgery, or trauma
  - **Impaired mentation / coma, loss of deep tendon reflexes, hypoventilation, hypothermia, hyponatremia (↑ ADH), CHF, cardiovascular collapse**
  - Treatment
    - Treat precipitating causes
    - IV T_3 (triiodothyronine) 0.2-0.3 mcg/kg q6h IV which works in 6-24 hours
    - IV levothyroxine 200-300 mcg and infusion (100 mcg/d)
    - Monitor ECG for ischemia and dysrhythmias
    - More cautious / gradual replacement necessary if patient has IHD (may precipitate MI / ischemia and therefore hypothyroid patients with symptomatic CAD may benefit from delaying thyroid therapy until after CABG or PTCA)
    - Hydrocortisone 100 mg bolus then 50mg q6h is routinely given in case of coexisting adrenal gland suppression

REFERENCES

- Lange 3rd Edition: p742-43
- Roizen; Essence of Anesthesia Practice…, p 182 & 190
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