

Etiology

- Hypothyroidism (decreased thyroid hormone secretion) most often results from primary disease of thyroid gland (most commonly autoimmune thyroiditis). Less frequently, it results from disorders of the pituitary gland or hypothalamus.
- Previous treatment for hyperthyroidism and previous total thyroidectomy are also relatively common causes of hypothyroidism.
- Pts with critical illness may have reduced T_4 and T_3 despite normal TSH concentrations (nonthyroidal illness syndrome) but usually do not require thyroid hormone replacement.

- Primary TSH deficiency may result from pituitary tumors and cysts or their treatment (either surgery or radiation), pituitary infiltration, necrosis, or infarction; secondary TSH deficiency may result from congenital deficiency of TRH, radiation therapy, infections, or tumors or cysts that impinge on the hypothalamic-pituitary portal circulation.

Usual Treatment

- Maintenance outpatient therapy for adults consists of oral T_4 0.1–0.2 mg (0.8–2 mcg/kg) daily.
- There may be a delay of up to 4 wk for TSH to stabilize after T_4 dosage adjustment ($T_{1/2}$ of T_4 about a wk).

- Chronic rifampin, carbamazepine, phenobarbital, and phenytoin, and increase T_4 dosage requirements by increasing metabolism or clearance of T_4 .
- Pts with CAD should have T_4 replacement initiated at a reduced dose and only cautiously increased to avoid precipitating increased anginal symptoms.
- Myxedema coma may require use of IV T_3 (liothyronine) 0.15–0.3 mcg/kg every 6 h and IV hydrocortisone 0.5–1 mg/kg every 8 h to cover for possible hypothyroid-impaired adrenal response to stress.
- IV T_3 may also be indicated in other circumstances when peripheral conversion of T_4 – T_3 is impaired (e.g., hypothermic cardiopulmonary bypass).

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Puffiness below eyes, enlarged tongue	Snoring	Enlarged tongue	TSH, T_4 (or T_3) concentrations
CV	Bradycardia, decreased BP, heart failure	Palpitations, myocardial ischemia, arrhythmias, peripheral edema	Bradycardia, tachycardia	TSH, T_4 (or T_3) concentrations, ECG
RESP	Hypoventilation			TSH, T_4 (or T_3) concentrations, arterial P_{CO_2} , or venous HCO_3^-
GI	Ileus, weight gain	Constipation, ascites	Decreased bowel sounds	TSH, T_4 (or T_3) concentrations
RENAL	Decreased free water clearance	Fluid retention, edema	Edema	TSH, T_4 (or T_3) concentrations; serum Na^+ concentration
CNS	Obtundation, depression, muscular weakness, cold intolerance	Lethargy, weakness, mental slowness	Decreased deep tendon reflexes, impaired mental status examination	TSH, T_4 (or T_3) concentrations

Key References: Biondi B, Wartofsky L: Treatment with thyroid hormone. *Endocr Rev* 35(3):433–512, 2014; Fliers E, Bianco AC, Langouche L, et al.: Thyroid function in critically ill patients. *Lancet Diabetes Endocrinol* 3(10):816–825, 2015; Hennessey JW: The emergence of levothyroxine as a treatment for hypothyroidism. *Endocrine* 55(1):6–18, 2017.

Perioperative Implications**Preoperative Preparation**

- Chronic thyroid replacement to maintain euthyroid state.
- Hypothyroid pts who are inadequately treated require different periop management from those who receive adequate maintenance T_4 therapy.
- If pt is receiving chronic thyroid replacement and is euthyroid, likely no additional concerns.
- Long $T_{1/2}$ of T_4 (approximately a week) permits oral T_4 to be withheld safely for several NPO days.

Monitoring

- Temperature
- Other monitors as indicated by surgery

Airway

- Rare cause of macroglossia with congenital hypothyroidism

Maintenance

- No effect of hypothyroidism on MAC for inhaled anesthetics.
- Keep the pt warm.
- Potential increased periop risk of heart failure, hypotension, and GI dysfunction (controversial).

Extubation

- Weaning from mechanical ventilation may be impaired with inadequate hormone replacement.

Adjuvants

- None needed (except in cases of myxedema coma, in which IV liothyronine and hydrocortisone may be indicated)

Anticipated Problems/Concerns

- Only those hypothyroid pts who have been inadequately treated with T_4 carry risks; those who chronically receive an appropriate dose of T_4 have almost no increased risk compared with other pts.
- Inadequately treated hypothyroidism can lead to lethargy and fatigue, weight gain, dementia, heart failure, respiratory insufficiency, fluid retention and edema, hyponatremia, clotting abnormalities, and generalized weakness.

Hypoxemia

Ana Fernandez-Bustamante

Risk

- All pts undergoing anesthesia and surgery (7–35% in large series have $PaO_2 < 60$ mm Hg in OR or PACU).
- Pts with pulm disease, difficult airway management, severe hemodynamic instability.

Perioperative Risks

- Hypoxemia may lead to hypoxia and eventual severe neurologic/cardiac sequelae or death.

Worry About

- Inadequate delivery of O_2 to lungs and blood is the greatest concern to the anesthesiologist because it will lead to tissue hypoxia.
- Differential Dx is critical for successful causal treatment.
- Misinterpretation of certain clinical manifestations of hypoxemia (anxiety, tachycardia, dysrhythmias).

Overview

- Hypoxemia denotes low PaO_2 in blood (vs. hypoxia, which refers to inadequate delivery of O_2 to tissues).
- Hypoxemia is defined as resting PO_2 greater than two SD below normal for age and FIO_2 and SpO_2 less than 90%, PaO_2 less than 60 mm Hg on room air, and/or a fall in SpO_2 greater than 5%.
- Multiple symptoms and vital signs that should be considered possibly related to hypoxemia.

Etiology

- Decreased FIO_2 : Failure to provide adequate inspired O_2 (e.g., O_2 supply failure, anesthesia machine failure, airway disconnect, pts at high altitude)
- Inadequate alveolar ventilation: Difficult airway management, low minute ventilation (respiratory depression or residual muscle paralysis in spontaneous breathing pt), severe laryngospasm/bronchospasm

- V/Q mismatch: Asthma, COPD, pulmonary embolism, pulm vascular disease, atelectasis, pneumonia, alveoli filled with blood or vomitus, FRC > closing capacity
- Diffusion problems: Very rare cause (massive pulm edema)
- R-to-L cardiac shunts: ASD, VSD (may not respond to increased FIO_2)
- Inadequate delivery of O_2 to tissues: Extremely low cardiac output, severe anemia, extremely decreased release of O_2 from Hb to tissue (left shift Hb dissociation curve: CO intoxication, metHb, severe hypothermia)

Usual Treatment

- Determine cause of decreased O_2 delivery and treat.
- Increase FIO_2 (may not help if hypoxemia is due to R-to-L shunts).

Assessment Points				
System	Effect	Assessment by Hx	PE	Test
CNS	Altered mental status	Anxiety, restlessness Confusion, seizures		
CV	Sympathetic stimulation Htn Arrhythmia Bradycardia (late sign)	Htn	Tachycardia BP	ECG TEE
RESP	Cyanosis Atelectasis, evidence of aspiration, pneumonia		Tachypnea	SpO ₂ ABG, low PaO ₂ CXR

Key References: Blum JM, Fetterman DM, Park PK, et al.: A description of intraoperative ventilator management and ventilation strategies in hypoxic patients, *Anesth Analg* 110(6):1616–1622, 2010; Sanford TJ: Hypoxemia. In Fleisher LA, Roizen MF, editors: *Essence of anesthesia practice*, ed 3, Philadelphia, PA, 2011, Elsevier, p 210.

Perioperative Implications

Monitoring

- Routine: Pulse oximetry is mandatory; ABG if concerns.
- Capnography and hemodynamic monitoring may help with differential Dx.

Airway

- Must ensure patency and intact circuit at all times.

Maintenance

- Adequate FIO₂ and alveolar ventilation
- Adequate O₂ delivery to tissues (CO, Hb)

Anticipate Problems/Concerns

- Must have a high index of suspicion whenever SpO₂ decreases or any of the clinical subjective or objective signs and symptoms are present. Always assume

the decreased SpO₂ does not reflect a problem with the pulse oximeter but signifies a real problem. Stable vital signs may not fully eliminate significant arterial hypoxemia.

IgA Deficiency

Jahan Porhomayon | Paul R. Knight III

Risk

- Most common immunodeficiency disorder.
- Incidence estimated to be 1:100 to 1:1000.
- More prevalent among European descendants.
- Most pts are clinically normal.
- Increased risk of allergies and anaphylaxis.
- Increased risk of malignancies.

Perioperative Risks

- Increased incidence of pulm complications, atopic disorders, and postop infections

Worry About

- Recurrent sinopulmonary infections leading to decreased pulm reserve
- Associated autoimmune disorders (e.g., lupus, DiGeorge syndrome)

- Associated GI disorders leading to volume depletion
- Anaphylactic reactions from transfusion of blood products containing IgA

Overview

- An immunodeficiency syndrome with increased susceptibility to nosocomial infection.
- Cell-mediated immunity is usually normal.
- Coexisting diseases may include atopy, recurrent sinopulmonary infection, GI disease, and autoimmune disease.
- Decreased synthesis or secretion of IgA.

Etiology

- Absence of IgA on mucosal surface.
- Decreased IgA blocking antibodies against environmental antigens.

- Associated with histocompatibility groups HLA-A1, HLA-B8, and HLA-Dw3.
- There have been several reported cases of acquired IgA deficiency.
- Usually decreased rather than absent lymphocyte IgA secretion.
- Overt clinical disease presentation may relate to changes in IgG subclass and/or compensatory IgM secretion.

Usual Treatment

- Do not treat with gamma globulin.
- Increased suspicion of infections and aggressive antibiotic therapy.
- Therapy directed toward specific coexisting disease(s).

Assessment Points				
System	Effect	Assessment by Hx	PE	Test
CV	Decreased reserve, hypovolemia	Dyspnea or exertion	Tachycardia, orthostatic hypotension	ECG, ECHO
RESP	Recurrent sinopulmonary infection, hemosiderosis, asthma	Decreased exercise tolerance	Wheezing, rales	CXR, PFTs, sinus x-rays
GI	Chronic gastroenteritis, malnutrition, malabsorption	Chronic diarrhea	Cachexia	Lytes, BUN, serum albumin
HEME	Nonspecific	Depends on the extent of coexisting diseases		Serum IgA, anti-IgA antibody, Coombs test
RENAL	Nonspecific	Varies in severity depending on the extent of coexisting diseases		BUN, Cr
CNS	Degenerative, demyelinating	Mental retardation associated with ataxia-telangiectasia		MRI

Key References: Tait AR, Knight PR: Anesthetic considerations for the immune compromised patient. In Lema MJ, editor: *Problems in anesthesia: anesthesia and cancer*. Philadelphia, PA, 1993, JB Lippincott, pp 375-391; Out TA, van Munster PJ, De Graeff PA, et al.: Immunological investigations in individuals with selective IgA deficiency, *Clin Exp Immunol* 64(3):510–517, 1986; Yel L: Selective IgA deficiency, *J Clin Immunol* 30(1): 10–16, 2010.