

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Dry mouth/mucous membranes		Mouth exam	
CV	Tachycardia/hypotension	Orthostatic changes	HR/BP	ECG
CNS	Restlessness, irritability, lethargy, seizures, coma		CNS exam	EEG
GI	N/V, diarrhea			
RENAL	Polyuria	Urinary frequency and color		Serum and urine Na ⁺ , K ⁺ , osmolality

Key References: Sterns RH: Disorders of plasma sodium-causes, consequences, and correction, *N Engl J Med* 372(1):55–65, 2015; Bagshaw SM, Townsend DR, McDermid RC: Disorders of sodium and water balance in hospitalized patients, *Can J Anaesth* 56(2):151–167, 2009.

Perioperative Implications**Preoperative Preparation**

- Correct lytes, replace H₂O deficit in controlled and calculated manner, assess neurologic status.
- Consider delaying elective surgery until serum Na⁺ is normal. If surgery cannot be delayed, care must be taken to avoid rapid correction of Na⁺.

Monitoring

- Electrolytes

Airway

- None

Maintenance

- Restore circulatory volume.
- Maintain urine output.
- Correct lytes.

Extubation

- Assess neurologic status to determine whether the pt is a candidate for extubation.
- Possible muscular weakness.

Adjuvants

- In central DI, vasopressin 5 U IVP will dramatically reduce UOP for 1–2 h, making it possible to catch up on IV fluids.

- Caution must be used to avoid too-rapid correction of Na⁺.

Postoperative Period

- Assess for lethargy, irritability, muscular weakness, and confusion.
- Monitor serum Na⁺.

Anticipated Problems/Concerns

- Too rapid correction and resultant neurologic effects

Hyperparathyroidism

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Risk

- Incidence in USA: 100,000 pts/y; increases with age
- Male:female ratio: 1:2; 0.8% in pregnancy
- Prevalence: 0.7% in general population; up to 3% in postmenopausal women
- Due to malignancy, vitamin D deficiency, sarcoidosis

Perioperative Risks

- Hypovolemia and electrolyte disturbances
- Increased risk of cardiac dysrhythmias secondary to hypercalcemia
- Aspiration from full stomach and/or mental change
- Postop hypocalcemia
- Airway compromise due to hematoma or recurrent laryngeal nerve injury

Worry About

- Signs of hypercalcemia and other electrolyte irregularities
- Intravascular volume changes
- Fluid overload and Na⁺ retention in CV fragile pts
- Renal, cardiac, skeletal, and CNS abnormalities
- Pancreatitis due to hypercalcemia

Overview

- Endocrinopathy associated with elevation in PTH levels.
- Primary problem is hypercalcemia, leading to “moans, groans, and stones.”
- Diagnosis supported by increased PTH level with hypercalcemia.
- Most pts with primary hyperparathyroidism are hypercalcemic but asymptomatic.
- Hyperparathyroidism in pregnancy, leading to high maternal and fetal morbidity (50%) and neonatal hypocalcemia and tetany.

Etiology

- Primary hyperparathyroidism usually due to benign parathyroid adenoma (80–90%), hyperplasia (15%), or parathyroid carcinoma (uncommon).
- May be manifestation of multiple endocrine neoplasia type I or IIa.
- Secondary hyperparathyroidism may be seen in pts with chronic renal disease.

Usual Treatment

- Parathyroidectomy shifting from standard four glands to only pathologic gland(s) removal.
- Advances in nuclear imaging to accurately localize parathyroid tumor(s), quick hormone assays, and radio-guided or video-assisted techniques facilitate minimally invasive parathyroidectomy, possibly under local/regional anesthesia.
- Medical treatment: Saline hydration, furosemide, and phosphate repletion in emergency situations to restore serum Ca²⁺ to a safe level (<14 mg/dL).
- Other Ca²⁺-lowering modalities: calcitonin, cinacalcet, bisphosphonates (inhibit bone resorption), mithramycin (for more resistant hypercalcemia; toxic effects limit use), glucocorticoids, or hemodialysis.
- Pregnant women with primary hyperparathyroidism should be treated with parathyroidectomy, ideally in the second trimester.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Htn, dysrhythmias	Palpitation, headache	Abnormal HR, rhythm, increased BP	ECG, lytes, total and ionized Ca ²⁺ , QT _c * interval
RESP	Decreased bronchial clearance of secretions	Cough	Adventitious sounds	
GI	Peptic ulcers, pancreatitis	Constipation, anorexia, N/V, epigastric pain		
RENAL	Nephrocalcinosis, nephrolithiasis, leading to renal abnormalities	Polyuria, polydipsia, hematuria		BUN, Cr
CNS	EEG abnormalities, seizures Lethargy	Depression, personality change, psychomotor retardation, memory impairment	Psychosis, disorientation Obtundation, coma	
MS	Hyporeflexia, osteopenia, osteitis fibrosa cystica	Weakness, bone pain	Muscular atrophy, arthritis Pathologic fractures	Bone density

*QT_c = $\frac{QT}{\sqrt{R-R}}$; R-R, R-R interval.

Key References: Kelz RR, Fraker DL: Hyperparathyroidism: what preoperative imaging is necessary? *Adv Surg* 49:247–262, 2015; Nahrwold ML, Nahrwold DA: Hyperparathyroidism. In Fleisher LA, Roizen MF, editors: *Essence of anesthesia practice*, ed 3, Philadelphia, PA, 2011, Elsevier.

Perioperative Implications**Preoperative Preparation**

- Assess total and ionized Ca^{2+} levels. No intervention for Ca^{2+} level <12 mg/dL.
- Reduce serum total calcium to <14 mg/dL.
- For higher Ca^{2+} levels use saline hydration, furosemide (rapid action), phosphate repletion, and consider calcitonin (acts in 1–2 h), mithramycin (acts in 6–12 h), cinacalcet, bisphosphonates, glucocorticoids, or hemodialysis.
- Consider H_2 -receptor antagonists, nonparticulate antacids, and metoclopramide.

Monitoring

- Routine; pay attention to changes in QT_c interval (QT_c by itself poorly correlated with ionized Ca^{2+} , but changes correlate).
- Intraop calcium and PTH level.

Airway

- Possibility of pathologic fractures requires careful positioning for laryngoscopy.

Preinduction/Induction

- No preferred agents or techniques.
- Avoid ketamine in pts with psychosis due to hypercalcemia.
- Hypovolemia can lead to hemodynamic instability if usual dose of induction agents is given.
- Minimally invasive procedures can be performed using local or regional anesthesia.

Maintenance

- No preferred agents or techniques. Possibility of pathologic fractures requires careful positioning and padding of pressure points.
- Weakness may warrant smaller dose of nondepolarizers.

Extubation

- Airway edema, surgical site hematoma, or recurrent laryngeal nerve injury may cause airway compromise.

Adjuvants

- Response to NM blockers may be unpredictable if Ca^{2+} level elevated.

Anticipated Problems/Concerns

- Cardiac arrhythmias due to hypercalcemia
- Postop airway compromise secondary to bleeding or recurrent laryngeal nerve injury
- Pneumothorax secondary to surgical procedure
- Fluid overload and lyte abnormalities from too aggressive hydration

Hypertension

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Risk

- In USA about 77.9 million (1:3) adults have high BP.
- Incidence of Htn increases with advancing age. Half of people 60–69 y and three-quarters of people >70 y are affected.
- There is a continuous relationship between BP and the risk of CVD, including MI, heart failure, stroke, and kidney disease. For people 40–70 y, an increase of 20 mm Hg in systolic pressure or of 10 mm Hg in diastolic pressure doubles the risk of CVD across the entire range of BPs.

Perioperative Risks

- BPs of up to 180/100 mm Hg are not independently associated with an increased risk of periop complications. Limited data suggest that BPs greater than this may be associated with an increased risk of such complications.
- In cardiac surgery, high preop pulse pressures have been associated with a threefold increase in periop mortality, an increased incidence of renal impairment, and reduced long-term survival.
- Isolated systolic Htn (>180 mm Hg, or marked increase to >200 mm Hg) has been associated with increased risk in noncardiac surgery in some studies.
- Intraop CV lability, especially hypotension, poses risks that may precipitate myocardial ischemia or predispose a pt to stroke.

Worry About

- Markedly elevated BP ($>180/110$ mm Hg)
- Possible second-degree Htn

- Myocardial ischemia and MI
- CVA

Overview

- Approx 95% of people with elevated BP have essential Htn: in 5% of people, an underlying cause for Htn can be identified.
- The aim of the long-term medical management of Htn is to reduce the burden of CV morbidity and mortality associated with chronically raised BP.
- The primary concern of the anesthetist in managing a hypertensive pt through the periop period is to prevent or curtail myocardial ischemia and labile BP that have been associated with anesthesia and surgery in Htn pts.
- Target-organ damage associated with Htn may of itself increase periop risk.
 - Ischemic heart disease
 - Heart failure
 - Cerebrovascular disease
 - Renal impairment
 - Peripheral vascular and aortic disease
- Recent JNC 8 recommendations for blood pressure treatment advocate lower blood pressure goals than previously

Etiology

- Essential Htn appears to be a complex, multifactorial condition; a single cause has not been identified. Factors that play a role in the development of essential Htn include genetics, race (increased prevalence and severity in African Americans), age, sedentary lifestyle, obesity (in particular visceral obesity),

sodium intake, alcohol intake, childhood influences (birth weight, BP tracking). Htn is part of the constellation of disorders that constitute the metabolic syndrome.

- Secondary Htn is found in approx 5% of people with raised BP. Identifiable causes of Htn incl sleep apnea, drug-induced Htn, chronic renal disease, renovascular disease, primary aldosteronism, Cushing syndrome, chronic steroid treatment, pheochromocytoma, and thyroid/parathyroid disease.
- Many pts who are found to have elevated BP at presentation for surgery will be found to not to be hypertensive when the BP is rechecked in a less stressful setting.

Usual Treatment

- Lifestyle modification should be encouraged in all pts with elevated BP.
- In the general population above age 60, the current goal of pharmacologic treatment is to establish a goal of <150 mm Hg for systolic BP and <90 mm Hg for diastolic BP.
- BP reduction is more important than the choice of drug in the primary prevention of CV complications. There is evidence to support ACEIs, ARBs, calcium channel blockers, and thiazide diuretics as first-line therapy. Combination therapy is frequently required to achieve and sustain long-term BP control.
- Specific classes of antihypertensive drugs may provide better secondary prevention in pts with compelling indications for BP control based upon race.