

Assessment Points

| Systems | Effects | Assessment by Hx | PE | Test |
|---------|------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| HEENT | Aspiration | Coughing, choking, speech and voice changes | Oral motor sensory exam, saliva management, food and liquid administration | Clinical bedside swallow exam, VSS, or FEES |
| CV | Dehydration | Skin, orthostatic vital signs | UO | |
| RESP | Pneumonia | Cough, sputum production | Fever | CXR, clinical bedside swallow exam, video swallow exam |
| GI | Dysphagia | Recurrent pneumonia, weight loss Heartburn, food impaction, regurgitation of food, odynophagia | Hoarseness (reflux), frequent throat clearing, laryngeal exam for signs of laryngo-esophageal reflux | Swallow screening, BaS, endoscopy, esophageal manometry, pH monitoring |
| CNS | Cranial nerves dysfunction and mental status changes | Hoarseness, motor speech, voice changes, decreased arousal | Oral motor sensory exam, level of arousal | Swallow screen |
| MS | Sarcopenia, cachexia | Weight loss, fatigue | Proximal muscle strength | VSS, FEES |

Key References: Mirzakhani H, Williams J-N, Mello J, et al.: Muscle weakness predicts pharyngeal dysfunction and symptomatic aspiration in long-term ventilated patients, *Anesthesiology* 119(2):389–397, 2013; D'Angelo OM, Diaz-Gil D, Nunn D, et al.: Anesthesia and increased hypercarbic drive impair the coordination between breathing and swallowing, *Anesthesiology* 121(6):1175–1183, 2014.

Perioperative Implications

Preoperative Preparation

- Consider performing an aspiration risk screening tool or more comprehensive swallowing evaluation if there are any concerns for dysphagia, as detailed in the Assessment Points table.

Monitoring

- Assess dyspnea and desaturation.
- Closely monitor ventilatory drive (hypercapnia decreases hypopharyngeal pressure) because of increased risk of pathologic swallowing (swallowing on inhalation).

Airway

- Consider upper body elevation to decrease aspiration risk.

Induction

- Anesthesia disrupts the physiologic coordination between breathing and swallowing.
- Gentle (or absence of) mask ventilation helps avoid gastric insufflation.

Maintenance

- Ensure airway is clear of secretions due to the decreased frequency of swallowing.

Extubation

- Goal is an awake pt with no residual paralysis, as this will affect swallowing stability and ability to protect airway.
- Closely monitor ventilatory drive because hypercapnia increases the incidence of pathologic swallows

Adjuncts

- Consider clinical bedside evaluation after extubation if pt failed swallowing screening.

Postoperative Period

- Monitor changes in pulm function closely.
- Ensure ability to maintain enteral nutrition.
- Monitor for changes in mental status to ensure swallow stability across time.

Anticipated Problems/Concerns

- Residual paralysis and sedation
- Inability to manage own secretions

Syndrome of Inappropriate Antidiuretic Hormone Secretion

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Risk

- Elderly pts
- Nursing home residents
- Planned major operations, especially neurosurgical procedures
- Pts receiving exogenous hormone therapy, especially desmopressin
- CNS disorders including psychiatric diseases
- Cancer, especially small-cell lung cancer
- Lung disease

Perioperative Risks

- Hyponatremia
- Cerebral edema causing altered mentation, seizures, and coma
- Acute water intoxication and fluid overload

Worry About

- Other causes of hyponatremia, such as heart failure, liver failure, renal failure, or pseudo-hyponatremia (e.g., hyperglycemia) (see Hyponatremia).
- Acuity and magnitude of hyponatremia influences the risk of CNS complications.
- Osmotic demyelination syndrome is caused by rapid correction of hyponatremia.

Overview

- Hyponatremia is the most common electrolyte disorder in hospitalized pts (affects 15%), and SIADH is the most frequent cause of hyponatremia, but other causes of hyponatremia should be excluded before making a Dx of SIADH.
- Normally, increased serum osmolarity, hypovolemia, or hypotension triggers thirst and ADH release. ADH increases aquaporin-2 channels on the luminal

surface of the distal tubules and collecting duct and acts to promote free water reabsorption. Thirst, free water intake, or hypotonic fluid administration combined with ADH-induced free water retention causes hyponatremia.

- Dx of SIADH: Symptoms include serum osmolarity less than 275 mOsm/L, urine osmolarity >100 mOsm/L, urine sodium >40 mEq/L, euolemia, normal thyroid and adrenal function, and absence of diuretic therapy.
- SIADH can be classified as follows: Type A is unregulated secretion of ADH, type B is elevated basal secretion, type C is reset osmostat, and type D is undetectable ADH.

Etiology

- Malignant diseases causing ectopic ADH secretion: Lung cancer (especially small-cell and mesothelioma), brain tumors, cancer of the duodenum, pancreas, head and neck, GU tract, lymphoma, and sarcomas.
- Pulm disorders: Infections, asthma, cystic fibrosis.
- CNS disorders: Infection, masses, head trauma, intracranial bleed, MS, Guillain-Barré syndrome, Shy-Drager syndrome, delirium tremens, and acute intermittent porphyria.
- Immune compromised states like HIV with associated pulm infections or malignancies.
- Drugs include, but are not limited to, chlorpropamide, carbamazepine, cyclophosphamide, SSRIs, TCAs, clofibrate, nicotine, NSAIDs, antipsychotics, narcotics, arginine vasopressin analogues (DDAVP, oxytocin, and vasopressin).
- Major surgery: Pain, stress, general anesthesia, PPV, neurosurgery.

- SIADH may be hereditary, with a mutation of gene for renal vasopressin-2 receptor and a mutation for gene affecting osmolarity sensing in the hypothalamus.

Usual Treatment

- The decision to treat depends on acuity and severity of hyponatremia or the presence of symptoms.
- Treat underlying causes for SIADH when possible.
- Water should be restricted to 500–1000 mL per day for asymptomatic or chronic SIADH.
- Normal saline (0.9%, 154 mEq/L) infusion and furosemide (20 mg) for hyponatremia of unknown duration or moderate CNS symptoms. The goal is to increase Na⁺ by 8–10 mEq/L in first 24 h. Measure Na⁺ every 4 h.
- Hypertonic saline (3%, 513 mEq/L) at 1–2 mL/kg per h infusion and furosemide (20 mg) for acute hyponatremia associated with coma or seizures. The goal is to increase Na⁺ by 2 mEq/L per h until symptoms improve. Measure Na⁺ every 2 h.
- Demeclocycline 300–600 mg PO bid to diminish responsiveness of collecting tubule to ADH for persistent hyponatremia unresponsive to other therapy.
- Vasopressin-receptor antagonist such as conivaptan (20–40 mg IV qd) or tolvaptan (15–60 mg PO qd) as an adjunct to increase free water clearance and Na⁺.
- Urea, 15–30 mg tid or qid to enhance water excretion in chronic SIADH.
- Infusion rate (mL/hr) = $\frac{[TBW \times (Na_{target} - Na_{current}) / (Na_{infusion})] \times (1000 \text{ mL/L}) \times (1/t)}{}$, where TBW = total body water (0.6 × body weight); Na_{target} = target Na⁺; Na_{current} = current Na⁺; Na_{infusion} = Na⁺ of saline infusion; t = time to achieve target Na⁺ in h.

| Assessment Points | | | | |
|-------------------|-----------------------------|-------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| System | Effect | Assessment by Hx | PE | Test |
| CNS | Cerebral edema | Headache, confusion, coma, seizures, difficulty concentrating, lethargy | Decerebrate posturing, altered level of consciousness | CT (brain) MRI (brain) EEG |
| GI | Increased free water intake | N/V, anorexia | | |
| RENAL | Free water retention | Concentrated urine | No edema | Serum Na ⁺ <130 mEq/L, serum Osm <275 mOsm/L, urine Osm >100 mOsm/L, urine Na ⁺ >40 mEq/L |
| NM | Fatigue, lethargy | Muscle cramps, falls | Motor weakness | |

Key References: Ellison DH, Berl T: Clinical practice. The syndrome of inappropriate antidiuresis, *N Engl J Med* 356(20):2064–2072, 2007; Cornforth BM: SIADH following laparoscopic cholecystectomy, *Can J Anaesth* 45(3):223–225, 1998.

Perioperative Implications

Preoperative Preparation

- Medical evaluation for duration and other causes of hyponatremia.
- Neurologic assessment for symptomatic hyponatremia.

Monitoring

- Periop measurement of serum Na⁺
- CVP or pulm artery cath if necessary to maintain euvoolemia

Induction

- Avoid drugs that may potentiate SIADH.

Maintenance

- Hyponatremia reduces MAC.
- Avoid hypotonic IV fluids.

Extubation

- Symptomatic hyponatremia may contribute to delayed emergence from anesthesia.
- Hyponatremia can cause obtundation and diminished ability to protect the airway.

Adjuvants

- Normal saline (0.9%, 154 mEq/L) and furosemide to maintain euvoolemia and normal Na⁺.

Postoperative Period

- Free water restriction, and avoid hypotonic fluids.

- Monitor serum Na⁺.

- Assess for CNS signs of hyponatremia: Lethargy, confusion, and seizures.

Anticipated Problems/Concerns

- Major surgery causes increased ADH release.
- Acute symptomatic postop hyponatremia is a medical emergency.
- The practice of using hypotonic maintenance fluids in pediatrics is controversial.
- Most reported cases of ODS were assoc with rapid correction of hyponatremia at rates over 12 mEq/L per day but may occur at slower rates of correction.

Syndrome X

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Risk

- True incidence unknown
- Postmenopausal or posthysterectomy women most often at risk
- Common cause of chest pain in women with angiographically normal coronary arteries
- Linked to adverse cardiovascular outcomes and a poor quality of life
- No diagnostic test

Perioperative Risks

- Acute withdrawal of sex hormone replacement can potentially lead to symptoms.
- Preop angina can delay procedures.

Worry About

- Discontinuation of medications (HRT) can precipitate symptoms

Overview

- Characterized by angina with or without ST-segment changes, with or without reversible perfusion defects on stress test, and with normal coronary arteriograms.
- Poorly understood multifactorial etiology makes specific treatment difficult.
- Some studies have found an increased risk of other vasospastic disorders in pts with cardiac syndrome X, such as migraine and Raynaud phenomenon.
- A multimodal approach to reducing oxidative stress and improving endothelial function may be beneficial.

Etiology

- Etiology unproved but thought to be due to endothelial dysfunction, ± vasospasm and abnormal cardiac

nociception, with systemic inflammation (increased CRP) playing a role.

- Bioavailability of NO plays a role.
- Acute withdrawal of estrogen appears to be a more significant factor than chronic withdrawal.

Usual Treatment

- Treatment includes lifestyle modification, anti-anginal, antiatherosclerotic, and antiischemic medications.
- Nonpharmacologic options include cognitive behavioral therapy, enhanced external counterpulsation, neurostimulation, and stellate ganglionectomy.
- Estrogen patch has been found to significantly improve exercise tolerance and alleviate chest pain.

Assessment Points

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| CV | Angina (chest pain) Inflammation | Hx of exertional angina Hx of evaluations leading to catheterization Hx of hormone replacement therapy | | Normal coronary angiogram in presence of chest pain Elevated CRP |

Key References: Lim TK, Choy AJ, Khan F, et al.: Therapeutic development in cardiac syndrome X: a need to target the underlying pathophysiology, *Cardiovasc Ther* 27(1):49–58, 2009; Agrawal S, Mehta PK, Bairey Merz CN: Cardiac syndrome X: update, *Heart Fail Clin* 12(1):141–156, 2016.

Perioperative Implications

Preoperative Preparation

- Estrogens are withdrawn owing to the threat of pro-coagulant activity. Pts with this syndrome may experience significant angina upon such withdrawal.
- Distinguish chest pain due to this syndrome from chest pain due to coronary insufficiency from other causes.
- Continue preop medications with appropriate thromboembolic prophylaxis.

Monitoring

- ST-segment analysis, usual ASA monitors
- Invasive as appropriate for procedure

Preinduction/Induction

- Contingent upon type of surgery; may consider maintaining usual medications with use of beta-blockers as appropriate.
- No data as to preferred anesthetic technique or agents.

Anticipated Problems/Concerns

- Angina preop or periop in a pt with known clear coronary arteries.
- Continuation of HRT can increase coagulability.
- Continuation of beta-blockers and CCBs can lead to expected use of vasopressors.