Preinduction/Induction
- Succinylcholine should be avoided after acute phase (first 24 h after injury).
- Gastroparesis and high residual gastric volumes are common after injury; use aspiration precautions.
- Induction agent doses should be adjusted in the context of hypovolemic shock.

Maintenance
- Requirements for neuromuscular blockers usually increased; attributed to the increased binding sites at extrajunctional receptors.
- Pts may need significantly increased narcotics.
- Keep the OR room temperature at ≥85° F to minimize heat loss and decrease metabolic rate.
- Communicate decreases in core body temperature to surgeons; case may be shortened to prevent severe hypothermia.

Extubation
- Consider extubation in early stages of management cautiously. Emergent reintubation may be very difficult due to edema.

Anticipated Problems/Concerns
- Most common complications include pneumonia, UTI, resp failure, cellulitis, and sepsis.
- Ventilator-associated pneumonia may develop in 70% of pts with inhalation injury.
- Pain management is usually challenging. Opioid doses often significantly exceed recommended standard dosing guidelines. Autograft donor sites are very painful; regional analgesia may be useful.
- ACS is a life-threatening complication caused by high-volume resuscitation. Extremity compartment syndromes can also result from extensive edema formation.
- Incidence of DVT in burn pts is increased (1-23%). Therefore, DVT chemoprophylaxis is routinely used.

Calcium Deficiency/Hypocalcemia

Erin Treasy | Henry Liu

Risk
- Common in critically ill pts and may be as high as 88% in ICU pts

Perioperative Risks
- Neuromuscular instability leading to seizure, laryngospasm, bronchospasm, or resp arrest
- Impaired cardiac function causing heart failure, hypotension, and dysrhythmias

Worry About
- Symptomatic hypocalcemia

Overview
- Normal serum calcium content: 8.5–10.5 mg/dL.
  - With 40–50% bound to plasma proteins (albumin).
  - With 45–50% ionized (physiologically active).
  - With 10–15% nonionized, bound to inorganic anions such as phosphate, citrate, and sulfate.
- Total calcium level related to albumin level and acid-base status affects the ionized calcium level.
- Ionized calcium level is the preferred measurement (normal: 4.75–5.3 mg/dL [1.19–1.33 mol/L]).
- The physiologic role of calcium:
  - Neuromuscular signaling and muscle contraction.
  - Hormone secretion.
  - Cardiac contractility.
  - Blood coagulation.
  - Cell growth.
  - Transport and/or secretion of fluids.

Etiology
- Hormonal
  - Hypoparathyroidism (intentional or unintentional surgical removal, hypomagnesemia, and "hungry bone syndrome")
  - Pseudohypoparathyroidism (decreased response to PTH)
  - Decreased vitamin D production/activity (decreased sunlight, hyperphosphatemia, and anticonvulsants)
- Ca^{2+} chelation (massive transfusion, cell lysis and phosphate release, and pancreatitis)
- Osteoblastic metastasis (prostate and breast cancers)
- Alkalosis (increased calcium binding to proteins)
- Congenital and autoimmune disease
- Most common causes of acute intraop hypocalcemia: Acute hyperventilation (resp alkalosis) and massive infusion of citrated blood products (>1.5 mL/kg/min)
- Can occur with persistent diarrhea and hypomagnesemia due to PPI treatment in a small number of pts

Usual Treatment
- Treat based on ionized calcium, not total calcium level.
- Asymptomatic hypocalcemia rarely requires treatment.
- Symptomatic hypocalcemia requires emergent treatment.
  - IV calcium chloride (300–500 mg) or calcium gluconate.
  - Follow with continuous replacement if needed.
  - Administered slowly because venous irritation can occur, with central venous administration preferred because calcium chloride can cause tissue necrosis if extravasated from a peripheral vein.
- Hypocalcemia often concurs with hypomagnesemia/hyperphosphatemia. Treat as needed.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Involved in cardiac pacemaker activity and generation of cardiac action potential	Hx of dysrhythmia SOB (or other symptoms of heart failure)	Prolonged QT Hypotension Pulmonary vascular congestion	ECG Continuous cardiac monitoring CXR
HEME	Citrate in stored blood products chelates calcium	Massive transfusion of citrated blood products (>1.5 mL/kg/min)		Ionized calcium level
GI	GI smooth muscle spasm	Abdominal cramping		
RESP	Resp smooth muscle contraction/tetany	SOB Laryngospasm Bronchospasm	Hypoxia Stridor Wheezing Resp arrest	Pulse oximetry
NEURO	Essential for all muscular movement Involved in the muscular excitation/contraction coupling	Muscle spasm Seizure Depression Psychosis Neuromuscular irritability Circumoral numbness Tingling in fingers/toes	Facial grimacing Seizure Papilledema (secondary to increased intracranial pressure) Irritability	Chvostek sign (twitch of circumoral muscles with tapping of the facial nerve anterior to the ear) Trousseau sign: Carpal spasm induced by inflation of BP cuff to 20 mm Hg above systolic BP for 3 min
DERM			Dry, scaly skin Brittle nails	

Key References: Khosla S: Hypercalcemia and hypocalcemia. In Kasper D, Fauci A, Hauser S, et al, editors.: *Harrison's principles of internal medicine,* ed 19, New York, 2015, McGraw-Hill; Edwards MR, Grocott MPW: Perioperative fluid and electrolyte therapy. In Miller R editors: *Miller's anesthesia,* ed 8, Philadelphia, 2015, Elsevier, pp 1767–1810.

Perioperative Implications

Preinduction/Induction/Maintenance
- Correct symptomatic hypocalcemia preop.
- Goal of treatment to eliminate symptoms, not necessarily return calcium levels to normal range.

Monitoring
- Serial ionized calcium measurements
- Continuous ECG monitoring

General Anesthesia
- Negative inotropic effects of anesthetic medications may become more pronounced.

Regional Anesthesia
- Hypocalcemia results in increased neuronal membrane irritability/tetany.
- Paresthesia a common finding.

Postoperative Period

- Acute hypocalcemia may develop after thyroidectomy/parathyroidectomy.
- During liver transplantation, especially during anhepatic stage.

Anticipated Problems/Concerns

- Risk of hypocalcemia with massive transfusion of citrated blood products (>1.5 mL/kg/min) may be more severe with hepatic dysfunction due to impaired citrate metabolism.
- Alkalosis increases Ca^{2+} binding to proteins, thereby decreasing ionized calcium.
- Very low levels of ionized calcium may impair coagulation.

Cancer, Bladder

Ashish C. Sinha

Risk

- Primary risk factor is smoking; smokers are more than twice as likely to get bladder cancer compared with nonsmokers.
- Incidence: males 37 per 100,000; females 9 per 100,000.
- No associated increased risk with alcohol or caffeine consumption.
- Median age of diagnosis: 73 y.
- Greater for Caucasian than for African Americans.
- Quitting smoking decreases risk over time (baseline in 5–8 y).
- Incidence on a decline since 1999.

Perioperative Risks

- Risks vary based on surgical procedure and coexisting disease
- Chemotherapy: Pulm fibrosis and renal and cardiac dysfunction
- Fatty infiltration of liver in those with poor nutritional status
- Protein-calorie malnutrition resulting from cancer, metabolism, anorexia, anemia, hypoalbuminemia and dehydration

Overview

- Transitional cell cancer generally a systemic disease at time of Dx; 60% of patients will die of metastatic complications.
- Pts are typically elderly with long Hx of smoking, thereby promoting concurrent diseases: COPD, lung CA, atherosclerosis, angina, CAD, CHF, and Htn.
- Chemotherapy/radiation therapy may be used preop, thus complicating periop period.

Survival and Stage

- Relative survival (%) of 5 y:
  - In situ (only in the layer of cells in which it began): 96.6%
  - Localized (confined to primary site): 73.3%
  - Regional (spread to regional lymph nodes): 36.1%
  - Distant (cancer has metastasized): 5.6%

Worry About

- Significant blood loss (type and cross blood products and large-bore IV access).
- Hyperextension of lumbar spine/pelvis and compression of iliac veins results in reduced venous return of blood volume.
- Adequate padding of peripheral nerves (upper and lower extremities).
- Maintenance of neutral neck position in flexed body position.
- Monitoring of UO difficult after ligation/division of ureters.
- Overall postop morbidity between 30–64%.

Etiology

- Exposure to aromatic amines (arylamines): β-naphthylamine in cigarette smoke causes bladder cancer in mice.
- Work-related exposure: β-naphthylamine and benzene in the manufacture of rubber products, arylamines in synthetic textile and hair dyes, and paint pigments.
- Drivers of diesel trucks are affected.
- "Slow acetylators" (homozygous and autosomal recessive) may be at higher risk; *N*-acetyltransferase may detoxify aromatic amines.

Usual Treatment

- Chemotherapy
- Doxorubicin/bleomycin/cyclophosphamide/cisplatin/methotrexate; 5-fluorouracil/vinblastine/teniposide
- Radiation therapy
- Transurethral fulguration
- Radical cystectomy

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Doxorubicin (Adriamycin) toxicity: Cardiomyopathy	>550 mg/m^2, prior or concurrent mediastinal radiation therapy	Signs of CHF	Endomyocardial biopsy, serial ECHO, radionuclide angiography, DLCO ECG
	5-Fluorouracil: Myocardial ischemia (rare)	Angina		ECG
	Cyclophosphamide: Pericarditis with effusion	CHF	Signs of CHF	ECHO
RESP	Smoking-related injury	Cough, sputum, infections	Wheezes, rhonchi, barrel chest	CXR PFT
	Bleomycin or cyclophosphamide toxicity: Pulm fibrosis	>500 mg (bleomycin), cough, dyspnea	Rales, fever	CXR
	Methotrexate: Inflammation		Pulm edema, effusions, infiltrates	CXR
RENAL	Cisplatin: ATN Methotrexate: Renal failure	Occurs 3–5 d after course		BUN, Cr, proteinuria, hyperuricemia Hematuria, proteinuria
HEPATIC	Methotrexate: Fibrosis			SGPT
CNS	Methotrexate: Encephalopathy	Confusion, somnolence, ataxia, tremors, and focal signs		

Key References: Patel HR, Cerantola Y, Valerio M, et al: Enhanced recovery after surgery: are we ready and can we afford not to implement these pathways for patients undergoing radical cystectomy? *Eur Urol* 65(2):263–266, 2014; Friedrich-Freksa M, Schulz E, Nitzke T, et al: Performing radical cystectomy and urinary diversion in regional anesthesia: potential risk reduction in the treatment of bladder cancer, *Urol Int* 91(1):103–108, 2013; Cerantola Y, Valerio M, Persson B, et al: Guidelines for perioperative care after radical cystectomy for bladder cancer: Enhanced Recovery After Surgery (ERAS®) society recommendations, *Clin Nutr* 32(6):879–887, 2013.

Preoperative Implications

Preoperative Preparation

- Consider rehydration after bowel preparation.
- Use two large-bore IVs or one peripheral IV plus a central line.

Monitoring

- Consider arterial catheterization.
- Renal perfusion difficult to judge after division of ureters. Consider CVP or PAC or TEE.
- Standardize anesthesia technique: no bowel prep, no preop fasting, epidurals (T9-T11), PONV, and DVT prophylaxis.
- Consider combined general-epidural anesthesia to treat postop incisional pain and to reduce blood loss and fluid requirements for cystectomy, as well as less risk of postop ileus.