Perioperative Implications

Preoperative Preparation
- Consider antibiotic therapy.
- Work up any indication of infection.
- Optimize any underlying organ dysfunction and volume status.

Monitoring
- Consider invasive hemodynamic monitoring in debilitated pts.

Airway
- Strict aseptic technique
- Universal precautions
- May encounter difficult intubation in pts with associated rheumatoid arthritis

Induction
- Hypotension secondary to hypovolemia and/or decreased cardiac reserve
- Wheezing allergies relatively resistant to conventional therapy

Maintenance
- May require high inspired O_2.
- Regional anesthesia and careful titration of anesthetic agents due to potential underlying CV and pulm diseases.
- Use only thoroughly washed RBC transfusions.

Extubation
- Careful assessment of neuromuscular function due to potential drug-drug interaction

Adjuvants
- Depend on organ dysfunction

Postoperative Period
- May require intensive pulmonary therapy.
- Maintain strict antiseptic precaution.
- Increased suspicion of bacterial infection.

Anticipated Problems or Concerns
- Anaphylactic reaction from transfusions of blood or blood products containing IgA to individual with IgA antibodies.
- Asthmatic pt with IgA deficiency is relatively resistant to treatment.
- Increased risk of nosocomial infection.

Immune Suppression

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Risk
- The incidence of HIV infection has been stable in USA, at approximately 20–30 newly diagnosed infections per 100,000 population per y.
- 20–25% of HIV infected pts will require surgery.
- Major risk factors: Neutropenia, yeast overgrowth, and/or nosocomial colonization of skin and mucosa.

Perioperative Risks
- In one study of AIDS pts undergoing intraabdominal surgery, 22.2% 30-d mortality was reported.
- Mortality is greatest at the extremes of age.
- Greatest source of morbidity and mortality is secondary to infection.
- Pneumonia accounts for approximately 40% of all deaths.
- Increased incidence of postop pneumonia, wound infection, postop sepsis, respiratory insufficiency, SIRS, and hypotension due to cardiovascular instability.
- Increased healing time.

Worry About
- Nosocomial transmission of infection
- Interactions with other drugs (IV recreational drugs, antiviral agents)
- Transmission of pathogenic drug-resistant strains of microbial agents to medical personnel (e.g., new strains of tuberculosis)
- Decreased pulm reserve due to repeated infections
- Decreased myocardial reserve secondary to underlying disease and generalized poor health
- Translocation of intestinal bacteria due to severe mucositis

Overview
- Immune suppression can arise from multiple causes, both primary and acquired.
- In the intraop period, surgical trauma, anesthetic agents, blood transfusion with or without severe hemorrhage decreases the immune response.

Etiology
- Primary immune deficiency (most are familial).
- The very young have immature immune systems.
- Aging alters some cellular immune responses.
- Acquired:
  - Malnutrition, drugs (glucocorticoids, chemotherapy, antiviral), massive burns, or trauma
  - Cancers (leukemia, lymphoma, and multiple myeloma)
  - Infections (HIV stages 2–4, influenza, sepsis)
  - Smoking decreases respiratory defense mechanisms

Usual Treatment
- Selective use of antibiotic prophylaxis, antivirals (e.g., acyclovir), antifungal agents (e.g., fluconazole), or immune enhancement (e.g., immune globulin)
- Strict sterile procedures and universal precautions
- Fastidious personal hygiene

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEME	Anemia, neutropenia, lymphopenia, recurrent bacteremia, coagulation abnormality, and thrombocytopenia	Easily fatigued, recurrent fever, sweats and chills	Pale Presence of petechiae or purpura	Hct/ Hgb, WBC, plts, plasma proteins, coagulation studies, special lymphocyte counts (e.g., $CD4^+$ cells)
CV	Subacute bacterial endocarditis, decreased reserve, hypovolemia, drug-induced injury (e.g., arabinomycin), mycotic aneurysms, pericardial effusion, vasculitis, pulm Htn	Decreased exercise tolerance, dyspnea on exertion	Murmurs, orthostatic hypotension, abnormal heart rate	ECG, transthoracic ECHO
RESP	Recurrent acute pulm infections, pulm fibrosis, obstruction, chronic tuberculosis and/or fungal infections	Decreased exercise tolerance, dyspnea on exertion	Airway lesions, pneumonia	CXR and spirometry
GI	Chronic gastroenteritis, chronic malnutrition, severe mucositis, parasitic infections	Severe "cramping," dysphagia, odynophagia diarrhea	Cachexia, leukoplakia	Lytes, albumin, blood cultures
RENAL	Chronic pyelonephritis, bladder infections, chronic cystitis, drug-induced nephropathy (e.g., cyclosporine), end-stage renal pathology	Recurrent UTIs, frequency	Hematuria, pyuria	BUN, Cr, pyelogram, spiral CT imaging
CNS	Mycotic infarcts, AIDS, dementia, encephalopathy	Minor strokes	Focal deficits, decreased mental function	CT imaging of the head
MS	Osteomyelitis	Deep pain located over involved area	Point tenderness	X-ray imaging

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 Company, pp 375-391. Fishman JA: Opportunistic infections—coming to the limits of immunosuppression? *Cold Spring Harb Perspect Med* 3(10):a015669, 2013.

Perioperative Implications

Preoperative Preparation
- Continue or initiate antibiotic therapy and immune therapy.
- Assess and optimize underlying organ system dysfunction (HIV-associated cardiomyopathy).
- Assess volume status and lytes due to chronic diarrhea.
- Involved assessment may be required (pulm function tests, transthoracic echocardiography).
- Identify timing of administration of immune suppressive drug(s).

Monitoring
- Consider arterial line, pulm arterial line, or other invasive hemodynamic monitors in severely debilitated pts.

Airway
- Strict aseptic technique and universal precautions when handling the airway

- Examination of upper airway for potentially obstructive lesions (i.e., Kaposi sarcoma)

Induction

- Chronic respiratory injury due to repeated lung infections may cause rapid desaturation.
- Hypotension due to decreased myocardial reserve and/or relative hypovolemia.
- Decreased drug requirements secondary to decreased plasma proteins.

Maintenance

- Increased inspired O_2 may be required due to chronic lung infections.
- Decreased myocardial reserve may require careful selection and titration of anesthetic agents or local or regional anesthesia for peripheral procedures.
- Preemptive pain management may protect against additional immune suppression.

Extubation

- Due to weakness and drug-drug interactions, return of strength should be carefully evaluated.

Adjuvants

- Transplantation and anticancer drug interactions need to be considered (e.g., cyclosporine and barbiturates, narcotics, muscle relaxants); bleomycin and O_2 administration.

Postoperative Period

- Respiratory adequacy should be carefully followed and may require ICU monitoring.
- Maintain careful antisepsis procedures for extended periods.

Anticipated Problems/Concerns

- Greatest intraop risk to these pts is infection; therefore strict hygienic practices are required.
- General state of nutrition, recurrent infections, and the underlying cause of the immune suppression all tend to generally decrease respiratory reserve and cardiovascular stability.
- Risk of transmission of drug-resistant pathogenic microbial agents to medical personnel (needlestick or respiratory [e.g., drug-resistant tuberculosis]). Follow CDC recommendations if exposed

Implantable Cardioverter-Defibrillators

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Epidemiology

- In USA, more than 300,000 people have an ICD and more than 180,000 ICDs are implanted annually, based on CMS registry data.
- Given current implant and survival rates, nearly 700,000 people in USA may have an ICD by the year 2020.
- ICD implant is indicated for any-cause cardiomyopathy with EF ≤35% and without evidence of dysrhythmia; thus some pts undergo ICD implantation for "primary prevention."
- All conventional ICDs can provide pacing for bradycardia; some pts are pacing dependent.
- Some ICDs also have atrial, RV, and LV pacing capability for CRT. LV leads can be transvenous in the coronary sinus or epicardial.
- Newer subcutaneous ICDs use a subcutaneous electrode instead of traditional transvenous or epicardial leads. These devices are less invasive but have limited functionality; for example, they have no permanent antibradycardia pacing capability and cannot deliver antitachycardia pacing.
- Premature ICD failure rates might approach 2%. For the ICD pt without evidence of pacing, determining battery function is difficult.*

Risk

- In USA, 450,000 pts/y suffer SCA; 550,000 new cases/y of CHF.
- ICD therapy for SCA, VT, and VF and primary prevention is superior than medical management.
- Associated diseases include cardiomyopathy, CAD, long QT syndrome, arrhythmogenic right ventricular dysplasia, Brugada syndrome, hypertrophic cardiomyopathy, and LV noncompaction. Some ICD pts also have sinus and/or AV node disease.

Perioperative Risks

- Robust data is lacking; however, the presence of an ICD might increase periop risk.
- Inappropriate HVT can induce tachydysrhythmia, injure the myocardium releasing troponin, and is associated with increased mortality.
- Incorrect interpretation of device type (i.e., confusing an ICD for a pacemaker) or events (i.e., pseudomalfunction) during the periop period might lead to pt harm.
- Risk might also be increased in these pts owing to associated disease(s).

Worry About

- EMI on the ICD's ventricular channel resulting in inappropriate HVT including shock(s) and/or antitachycardia pacing. For the pacing-dependent pt, EMI-induced ventricular oversensing with pacing inhibition can also result in asystole
- Intraop increase in ventricular pacing owing to EMI entering a dual chamber ICD and causing atrial lead oversensing and ventricular tracking
- Intraop increases in pacing rates owing to activation of the "exercise sensor," whether due to direct mechanical stimulation (such as preparation of the chest) or pressure on the device (personnel leaning). The cause of this undesirable tachycardia might be mistaken as inadequate anesthetic depth
- Failure to capture (i.e., pacing output without myocardial depolarization) due to inappropriate programmed parameters (i.e., inadequate safety margin), or abrupt increase in pacing threshold from myocardial ischemia/infarction, drug administration, or lyte shifts. Note that any or all chambers can undergo failure to capture with possible hemodynamic derangement, even without apparent outright pacing failure
- Magnet* placement will never change the pacing mode (i.e., produce asynchronous pacing) of an ICD and will change pacing rates only in ICDs from ELA (Sorin, Milan, Italy). Only Boston Scientific (BOS)§ ICDs emit ongoing tones confirming appropriate magnet placement. No ongoing confirmation of magnet placement is available in Medtronic, St Jude Medical§ (SJM), or Biotronik ICD. ICDs from BOS and St. Jude Medical can have their magnet switch disabled by programming. Indeed, some older ICDs from BOS (with the "GDT" or "CPI" x-ray code) can undergo permanent disabling of HVT by magnet placement
- Disabling HVT during central access procedures in the thorax to prevent inappropriate shocks due to guidewire contact with the RV lead. For 6 weeks after lead implant central venous catheterization in the thorax is relatively contraindicated

Overview

- Indications for initial ICD placement: SCA (including spontaneous or induced VT or VF), cardiomyopathy from any cause with LVEF ≤35%, long QT syndrome, arrhythmogenic RV dysplasia, or Brugada syndrome
- Tachydysrhythmia therapy in most conventional ICDs includes ATP, which uses less battery energy and is better tolerated (sometimes not even noticed) by pts. For ICDs programmed to deliver repetitive ATP, shock can be delayed for periods exceeding 1 min, and distinguishing between repetitive ATP on the monitor versus ventricular tachydysrhythmia can be difficult. Some ICDs will deliver ATP while charging, which will not delay shock
- Codes: The North American Society of Pacing and Electrophysiology (NASPE)/British Pacing and Electrophysiology Group (BPEG) generic defibrillator code has four positions. The first position refers to the chamber(s) shocked (A = atrium, V = ventricle, D = both, O = none). The second position refers to the chamber(s) where ATP is programmed (A, V, D, O). The third position identifies the detection method: either heart rate E = electrogram or hemodynamic (H) (although no hemodynamic sensors are currently in clinical use). The fourth position identifies chambers (A, V, D, O) where pacing for bradycardia has been programmed. The most robust form of this code uses only the first three positions and adds the five-position generic pacemaker code. For example, an ICD with anti–atrial fibrillation therapy and CRT might be DDE-DDDRV

Indications and Usual Treatment

- Primary prevention in a pt with LVEF ≤35% (and more than 40 d from an ischemic event or 3 mo from vascular intervention) who is receiving optimal medical therapy and has a reasonable expectation of survival with good functional capacity for >1 y
- Survivors of cardiac arrest presumably due to VT/VF, not associated with reversible factors, such as acute coronary syndrome
- Pts with inducible VT/VF by EP study and no reversible cause
- Treatment for LV cardiomyopathy should include (unless contraindicated) beta-blocker and ACE inhibitor/angiotensin receptor blocker therapy (see the ACC/AHA Heart Failure Guidelines). Many pts will also have statin, aspirin, antiarrhythmic, diuretic, nitrate, and/or digoxin therapy

*Some ICDs allow demonstration of battery function without interrogation: