- Associated with myasthenia gravis.
- CNS symptoms: Meningoencephalitis (particularly in immunocompromised pts).

Worry About

- LV dysfunction and CHF: Chagas myocarditis, refractory heart failure. Most often biventricular in nature, right >left. Sudden cardiac death associated with 55–65% deaths; precipitated by exercise, VTach, VFIB, asystole, AVB.
- Conduction abnormalities (complete AV block, RBBB, LAFB)
- Ventricular arrhythmias (VT, AFIB)
- Ventricular aneurysms (posterolateral, inferior basal, apical)
- Megaesophagus, achalasia, risk of pulm aspiration
- Blood transmission and infections
- Thromboembolism, stroke

Overview

- Acute infection mostly in pediatric population; asymptomatic in two-thirds of pts, followed by chronic disease after latency of more than 2–3 decades.
- In endemic areas, mild forms of disease are common, with a benign course.
- Pathogenesis to chronic progressive end-organ disease poorly understood; autoimmunity, microvascular dysfunction, autonomic neuropathy implicated.
- Cardiac involvement most serious end-organ manifestation; colon and esophagus also affected.
- Mechanisms proposed for cardiac involvement unclear but include neurogenic mechanisms, parasite-dependent inflammation, microvascular disease, and immune-mediated injury.
- In USA, the diagnosis is usually not considered; presentation as CAD or dilated cardiomyopathy, or with AV heart block, CHF, ECG conduction abnormalities, sustained VTach.
- Serologic test for diagnosis based on hemagglutination, immunofluorescence, ELISA, PCR; these are usually negative during first wk. Therefore Dx depends on detection of circulating parasites.
- Continues to cardiac involvement: Decapillarization of the myocardium.
- Downregulation of the nicotinic Ach receptors and associated myasthenia gravis symptomatology.

Etiology

- Protozoan infection: *Trypanosoma cruzi*.
- Transmission to humans by reduviid bug, the "kissing bug."
- Transmission by blood transfusion, organ transplantation, vector, lab accident, reactivation of chronic disease during immunosuppression. Recently oral chagasic infection via food contamination (sugar and acai juices) also found possible, with more severe clinical course.
- Central and South America are endemic areas.

Usual Treatment

- Nifurtimox (limited efficacy, poor oral bioavailability) for acute disease; usefulness for indeterminate phase or chronic disease not established.
- Benzimidazole (similar efficacy as nifurtimox) second agent; not available in USA.
- Recent success with protriptyline in the acute and chronic forms.
- Allopurinol for the cutaneous form.
- No evidence that trypanocide drug therapy cures disease.
- Other treatment related to symptomology: Amiodarone for arrhythmias related to LV dysfunction; also sotalol. Invasive treatment modalities include surgical excision, cath ablation, aneurysmectomy, epicardial mapping.
- Pts at high risk for sudden cardiac death will have an ICD placed.
- Heart transplant, bone marrow cell transplant uncertain.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	Conduction abnormalities, LV dysfunction and aneurysm	Syncope, DOE, orthopnea, fatigue, atypical angina	JVD, edema, rales, cardiomegaly Murmurs, TR, MR, wide split S_2, prominent diffuse apical thrust	ECG ECHO MUGA Cardiac cath CXR for possible cardiomegaly
	Ventricular arrhythmias	Syncope, palpitations	Biventricular enlargement	Holter electrophysiologic study, TTE, TEE
GI	Megaesophagus, megacolon	Dysphagia, GE reflux, constipation	Abdominal distention	Barium studies, CXR, endoscopy

Key Reference: Leckie RS, Leckie S, Mahmood F: Perioperative management of a patient with Chagas disease having mitral valve surgery, *J Clin Anesth* 21(4):282–285, 2009.

Perioperative Implications

Preoperative Preparation

- LV function optimization with diuretics, ACE inhibitors; consider beta-blockers and Ca^{2+}-channel blockers. Consider amiodarone in cases of VTach/VFIB.
- Prophylaxis against pulm aspiration
- Assessment of conduction abnormalities, arrhythmias.

Monitoring

- Dictated by degree of LV dysfunction and proposed procedure; consider PA cath or TEE. On TEE, may see biventricular enlargement, thinning of ventricular walls, apical aneurysm, intramural thrombus.
- ECG during entire periop period. Often seen is a long QT interval, AV block, bundle branch block. Pt may have VTach/VFIB.

Preinduction/Induction

- Consider temporary pacing if symptomatic AV block.
- Caution with negative inotropic drugs.
- Awake or rapid-sequence intubation.
- Consider judicious use of muscle relaxants.

Maintenance

- Technique dictated by preferences, procedure, degree of cardiac involvement.
- Avoid hypoxemia (facilitates ischemic myocardial changes on capillary level, which can further progress to wall thinning and aneurysm formation).

Postoperative Period

- Continued monitoring depends on preexisting LV dysfunction and operative procedure.
- ECG monitoring for ventricular arrhythmias and AV conduction block.

Charcot-Marie-Tooth Disease

Sylvia H. Wilson | Julie R. McSwain

Risk

- Incidence: 1:2500 people
- Peripheral disease severity varying from mild to severe autonomic, motor and sensory neuropathy

Perioperative Risks

- Potential for postop weakness, especially following nondepolarizing neuromuscular blocking agents

Worry About

- Resp insufficiency secondary to diaphragmatic or phrenic nerve dysfunction
- Preexisting vocal cord palsy or paralysis
- Secondary nerve entrapments or injuries with intraop positioning

Overview

- Peripheral neuropathy is caused by peripheral demyelination (altered myelin function or production) or axonal loss (altered axonal structure or function).
- Neuropathies can be autonomic, motor, sensory, or mixed.
- Distal weakness and sensory loss typically develop in the first 2 decades of life, followed by a slowing in disease progression with resultant skeletal deformities (more commonly in feet) and loss of DTRs.
- Most pts remain ambulatory with a normal life span, but quality of life is often affected.
- CMT is diagnosed by electrophysiologic and molecular genetic testing, occasional muscle biopsy.
- Management of the disease process is often multidisciplinary and should include neurologists, physical therapists, orthopedists, and geneticists, among others.
- Surgery aims to preserve or improve quality of life and functional independence.

Etiology

- Most common hereditary, peripheral, motor, and sensory neuropathy
  - Also known as HMSN
  - Over 70 genes identified with at least one CMT phenotype
  - Autosomal dominant and X-linked dominant inheritance more common
- Inheritance: Wide range of genetic heterogeneity
  - Majority of types are autosomal dominant (CMT1 and CMT2)
  - Over 20% of pts without known familial Hx for CMT
  - X-linked recessive and autosomal recessive less common
- Main subtypes
  - Type 1 (CMT1): Demyelinating (altered myelin function/production); autosomal dominant; slow nerve-conduction velocity; most predominant form in Western countries (in those of European descent)
  - Type 2 (CMT2): Axonal loss (altered axonal structure/function); autosomal dominant; preserved nerve-conduction velocity
  - Type 3 (CMT3): Severe early onset (Dejerine-Sottas disease)
  - Type 4 (CMT4): Demyelinating or axonal loss; autosomal recessive
  - X-linked CMT (CMTX)

Usual Treatment

- Effective treatment: None
  - Ascorbic acid (vitamin C): No benefit in clinical trials
  - Creatine supplementation: No benefit in clinical trials
  - Resistance exercise training: Minimal improvement in clinical trials
  - Accurate genetic diagnosis: Now important for accurate prognosis, potential future gene-targeted therapy, and potential antenatal counseling (especially because there is no specific effective treatment)
- Orthopedic surgical procedures: correct skeletal deformities but will not correct preexisting motor or sensory loss
- Surgical treatment to correct foot deformities, which may include soft tissue surgery (e.g., plantar fasciotomy, tendon transfers/releases), osteotomies, and joint fusions
- Supportive therapy such as rehabilitation, pain management, and physical therapy (may be useful and improve pt's mental and physical state, as well as improve quality of life)

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	OSA Vocal cord palsy Ocular/bulbar dysfunction	Symptoms of OSA Voice changes Vision changes, dysphagia	Airway exam Hoarseness, stridor, dysphonia Nasal speech, drooling, absent gag reflex	Sleep study Fiberoptic airway exam, laryngeal EMG studies Gag reflex
RESP	Respiratory insufficiency, restrictive lung disease Pneumonia Phrenic nerve palsy	Dyspnea Fever, dyspnea Dyspnea, orthopnea	Tachypnea Lung field consolidation Decreased breath sounds	PFT, ABG CXR, WBC PFT, CXR, conduction studies
CNS	Central sleep apnea Autonomic dysfunction	Daytime somnolence Syncope	None Orthostatic hypotension	Sleep study Tilt table test, Valsalva
PNS	Sensory loss in UE and LE	Numbness, tingling	Neuro exam	EMG
MS	Progressive distal weakness Muscle atrophy of LE Skeletal deformities of LE Scoliosis	Progressive weakness Progressive weakness Gait abnormalities Gait abnormalities	Neuro exam, DTRs Thin distal muscles Pes cavus Spine examination	EMG None Radiologic evaluation Radiologic evaluation
CV	Cardiomyopathy (rare) Arrhythmias (rare)	Dyspnea, chest pain Palpitations, syncope	Crackles, LE edema Irregular heart rate	ECG, ECHO ECG

Key References: Aboussouan LS, Lewis RA, Shy ME: Disorders of pulmonary function, sleep, and the upper airway in Charcot-Marie-Tooth disease. *Lung.* 185(1):1–7, 2007; Pareyson D, Marchesi C: Diagnosis, natural history, and management of Charcot-Marie-Tooth disease. *Lancet Neurol.* 8(7):654–667, 2009.

Perioperative Implications

Preoperative Preparation

- Screen for concomitant diseases (DM, thyroid disorders, and vitamin deficiencies).
  - Concurrent DM associated with more severe neuropathy.
  - Cardiac disturbances (arrhythmias, AV block, and cardiomyopathy) reported but rare.
- Avoid medications that may induce neuropathy when possible: Chemotherapeutic agents, antibiotics (metronidazole), amiodarone, and colchicine.
- Document pt symptoms and preexisting neuro (sensory and motor) deficits.

Regional Anesthesia

- Case reports describe successful use without evidence of disease exacerbation.
  - No controlled studies
  - Neuraxial: Numerous case reports describe successful use
  - Peripheral nerve blocks: Case reports and series describe successful single injections and catheters; nerve stimulation, which may be unreliable; ultrasound guidance, which is recommended and may limit needle manipulations and inadvertent nerve trauma
- Consider decreasing local anesthetic dose because there have been reports of prolonged blockade.

Monitoring

- Neuromuscular blockade monitoring may be difficult or unreliable.
- Additional monitoring should otherwise be guided by other pt comorbidities.

Airway

- Severe forms associated with upper-airway dysfunction and restrictive lung impairment

Preinduction/Induction

- Safe use of succinylcholine reported (peripheral neuropathy, not myopathy); however, theoretical concern of hyperkalemia

Maintenance

- No definitive connection with malignant hyperthermia; however, cases reported.
- Mixed reports regarding duration of nondepolarizing neuromuscular blocking agents.
- Neuromuscular blockade monitoring may be difficult. Consider monitoring TOF at adductor pollicis because upper limbs are usually less affected than lower limbs.
- Neostigmine safe and does not appear paradoxically to worsen neuromuscular transmission.

Extubation

- If nondepolarizing neuromuscular blocking agent given, reversal agents and skeletal muscle strength assessment before extubation (underlying skeletal muscle weakness, including restrictive lung pathology).
- Preexisting vocal cord dysfunction (severe forms of CMT) may lead to airway compromise.

Postoperative Period

- Upper-airway dysfunction and restrictive lung impairment because rib cage changes and phrenic nerve and diaphragmatic involvement are associated with severe forms.
- Potential postoperative respiratory insufficiency and apnea (obstructive and central).
- Consider BiPAP or CPAP in the PACU if concern for upper-airway obstruction exists.

Anticipated Problems/Concerns

- Traditional monitoring of neuromuscular blockade after the use of nondepolarizing neuromuscular blockers may be difficult and/or misleading.
- Pts may be reluctant to accept regional anesthesia for fear of worsening their neuropathy; however, there are several case reports that describe successful use of regional techniques with no exacerbation of symptoms.