Myotonic Dystrophy

A group of hereditary degenerative diseases of skeletal muscle characterized by persistent contraction of muscle after an initiating event such as voluntary, mechanical, electrical, or chemical stimulation of the muscle
It is a muscle wasting disease; peripheral nerves and the neuromuscular junction are not affected.

ANESTHETIC CONSIDERATIONS:

- Aspiration risk
  - Pharyngeal muscle weakness
  - Delayed gastric emptying
- Potential difficult airway
  - Jaw spasm
  - Glossal hypertrophy
- Respiratory muscle atrophy
- Ineffective cough, mild hypoxia and hypercapneic respiratory failure
- Impaired brainstem response to hypoxia and hypercapnea
- Myotonia of respiratory muscles= restrictive lung disease and difficult ventilation
- Cardiac Conduction
  - Conduction abnormalities: A-V block common, atrial tachydysrhythmias
  - Valvular abnormalities: Mitral valve prolapse in 20%
  - LV systolic and diastolic dysfunction
  - Also cardiomyopathy
- Avoid precipitants of myotonia
  - Succinylcholine, neostigmine, surgical manipulation, electrocautery, **nerve stimulation**
  - May treat myotonia with phenytoin, procainamide, quinine, mexiletine,
  - Avoid hypothermia and shivering
- Other
  - Associated diseases: DM, hypothyroidism, adrenal insufficiency
  - Central sleep apnea and Exaggerated respiratory depression with benzodiazepines, propofol, opioids and barbiturates
  - **?MH** link….**non triggering anesthetic'**
  - Exacerbation of disease in pregnancy

ANESTHETIC GOALS:

- Modified Rapid sequence induction (avoid succinylcholine while taking aspiration precautions)
- Avoid precipitants of myotonia in the perioperative period
- Anticipate possible perioperative complications
- Arrange appropriate postoperative disposition
- Appreciate the link to MH in some myotonic syndromes (controversial between references).

HISTORY & PHYSICAL

- Most myotonic patients survive to adulthood with little impairment, and it is common for them to conceal their symptoms so they may present for surgery without the underlying myotonia being appreciated
- History of aspiration, pneumonia, GERD, dysphagia, hypersomnolence, previous apneas
- Functional activity, syncope, dyspnea (myotonia of respiratory muscles), palpitations
- Endocrine gland involvement? Insulin resistance/ DM, hypothyroidism, adrenal insufficiency - addisonism (fatigue, postural hypotension, hyperK, hypoNa, pigmentation)
- Myotonic facies: frontal balding, ptosis, atrophy of masseter/temporalis muscles, open mouth (malocclusion of teeth and mandibular malposition), wasting/atrophy of SCM (swan neck),
- Airway patency and ease of intubation for possible RSI
- Pulmonary exam for chest excursion and cough
- Cardiac examination for MVP (systolic apical click +/- late systolic murmur), arrhythmias, RVH (loud P2), failure
- Developmental delay, neuropsychiatric impairment
- Muscle weakness and wasting (most prominent in the cranial and distal limb musculature), myotonic handgrip (unable to release); slowly progressive with gradual involvement of pharyngeal and laryngeal muscles, proximal limb muscles, and the diaphragm

INVESTIGATIONS

- Endocrine labs as indicated by history and physical
- ECG for conduction abnormalities
- PFTs: restrictive lung disease pattern, mild arterial hypoxemia, and diminished ventilatory responses to hypoxia and hypercapnia
- ABG with respiratory compromise
- CXR if acute symptoms of pulmonary disease are present
- Echocardiography may reveal subclinical evidence of left ventricular systolic and diastolic dysfunction, also valvular disease

OPTIMIZATION

- Cardiology consult for cardiac dysrhythmias (early pacemaker may be required for AV conduction delay)
- Sodium channel blockers, including mexiletine, phenytoin, procainamide, taurine, clomipramine, and imipramine have been used for the treatment of myotonia with less than conclusive results
- Steroids, quinine, and procainamide may relieve myotonic contractions, but there is no cure for these diseases
  - These medications need to be continued perioperatively
  - Quinine and procainamide can worsen cardiac conduction abnormalities

ANAESTHETIC OPTIONS

- Theoretical risk of malignant hyperthermia (controversial); trigger-free anaesthetic recommended
  - Myotonic patients may be susceptible to uncontrolled muscle metabolism and severe rhabdomyolosis in a pattern similar to, but not diagnostic for, malignant hyperthermia
  - It might be prudent to avoid succinylcholine, and possibly inhalational anesthetics

- On the other hand, children with myotonic dystrophy have received succinylcholine without incident
- A recent review of anesthetic techniques and myotonic dystrophy reported that inhalational anesthetics have been used without ill effect on muscle
- Some anesthesiologists treat all myopathic patients as malignant hyperthermia-susceptible, whereas others take special precaution only for those myopathies, including central core disease and myotonia congenita, that have a documented association with malignant hyperthermia

- Hypersomnolence, central sleep apnea and sensitivity to respiratory depressant effects of anaesthetic medications = difficult spontaneous ventilation
- Local/regional anaesthesia preferable for pain control

ANESTHETIC SETUP

- Aspiration prophylaxis
- No preoperative sedation
- Warm room (Cold can trigger myotonic contraction)
- Standard CAS monitors + 5 lead EKG + temperature (think about positioning)
- Peripheral nerve stimulator? Response to nerve stimulator must be carefully interpreted because muscle stimulation may produce myotonia; the myotonic response may be misinterpreted as sustained tetanus when significant neuromuscular blockade still exists
- Appropriate anti-arrhythmic drugs and pacing equipments should be readily available because a third of first-degree atrioventricular blocks may not respond to atropine
- **Lidocaine** IM and mexiletine, **procainamide**, **quinine** or **phenytoin** IV available for myotonic crisis

MANAGEMENT OF ANESTHESIA

Induction

- **Drugs**
  - Avoid succinylcholine
    - Succinylcholine produces exaggerated and prolonged skeletal muscle contraction and its use should be avoided
    - The myotonic response to succinylcholine can be so severe that ventilation and tracheal intubation are difficult or impossible
    - The possibility of latent or unrecognized DMD in young males (<10 years old) may be a reason to avoid succinylcholine in this patient population
  - Response to nondepolarizing neuromuscular blocking drugs is normal
    - However, most patients with myotonic dystrophy develop a chronic myopathy and the response to nondepolarizing muscle relaxants may be enhanced (sporadic instances of increased sensitivity)
    - Careful titration of short- or intermediate-duration nondepolarizing agents should be done
    - Patients receiving quinine may require a smaller dose of a nondepolarizing muscle relaxant
  - Reversal with neostigmine may provoke myotonia
    - Theoretically, reversal of neuromuscular blockade could precipitate skeletal muscle contraction, but adverse responses do not predictably occur with neostigmine use
    - Careful titration of neuromuscular blockade and administration of short-acting nondepolarizing muscle relaxants may obviate the need for reversal of neuromuscular blockade
  - Judicious use of induction agents as exaggerated cardiac depression common
  - Patients with myotonic dystrophy are sensitive to the respiratory depressant effects of opioids, barbiturates, benzodiazepines, propofol and inhaled anesthetics
    - This is most likely due to drug-induced central respiratory depression acting in tandem with weak and/or atrophic respiratory muscles
    - Hypersomnolence and central sleep apnea contribute to the increased sensitivity to respiratory depressant drugs
    - Other agents, including methohexital, etomidate, propofol, may also induce myotonic reactions
- Avoid hypoxia or increasing vagal tone; precipitating dysrhythmias

Maintenance

- No specific anesthetic technique has been shown to be superior for patients with myotonic dystrophy
- Carefully controlled propofol infusions have been used successfully
- Inhaled anesthetics may be used but close monitoring of cardiac rhythm and cardiovascular function is indicated

Emergence

- Local or regional anaesthesia for pain minimize respiratory depressants for both adults and children
- Postoperative mechanical ventilation should be employed until muscle strength and function return

DISPOSITION AND MONITORING

- High dependency unit for several hours of postoperative nursing surveillance, pulse oximetry, continuous EKG and possible post-op ventilation

COMPLICATIONS

- **Treatment of a Myotonic Crisis:**
  - Myotonic contraction during surgical manipulation and/or the use of electrocautery may interfere with surgical access
  - If myotonic contraction occurs, general anesthesia/ regional anesthesia/ neuromuscular blockers are not able to prevent or relieve this skeletal muscle contraction
  - Infiltration of contracted skeletal muscles with local anesthetic (dilute 0.5% lidocaine) may induce relaxation
  - Drugs such as phenytoin (18 mg/kg IV over 20-30 mins) and procainamide (18 mg/kg IV over 20-30 mins), which stabilize skeletal muscle membranes, may be helpful in this situation
  - Quinine (300–600 mg IV) has also been reported to be effective in some cases
  - Increasing the ambient temperature of the operating room decreases the severity of myotonia and the incidence of postoperative shivering, which can precipitate contraction of skeletal muscles
- Postoperative cardiopulmonary complications common
  - Majority of complications pulmonary related and significantly more frequent in patients undergoing upper abdominal operations and those with severe disability, as assessed by the presence of proximal limb weakness
  - The pulmonary complications are the result of hypotonia, chronic aspiration, and central and peripheral hypoventilation
- Anesthesia and surgery could aggravate cardiac conduction problems by increasing vagal tone

PATHOPHYSIOLOGY:

- Myotonic dystrophy (MD) is an inherited muscular disorder characterized by progressive muscle weakness and wasting
  - Incidence 1 in 8000, affects both genders
  - Electromyographic findings are diagnostic (prolonged discharges of repetitive muscle action potentials)
  - Secondary to abnormal calcium metabolism
    - Intracellular ATP fails to return Ca to the sarcoplasmic reticulum

        - Unsequestered Ca is available to produce sustained contracture of muscle
    - Myotonic dystrophy type 1 (most common): unstable trinucleotide expansion on chromosome 19q; autosomal dominant inheritance; may have mildly elevated CK levels; all ages
    - Myotonic dystrophy type 2: a quadnucleotide expansion on chromosome 3q; only adult form
    - The severity of the muscle weakness is related to the molecular defect
- Although myotonic dystrophy has not been associated with an increased risk for malignant hyperthermia, some cases of malignant hyperthermia have been reported in patients with myotonia congenita and central core disease

Myotonia Dystrophica

- 2.4-5.5/100,000 (most common)
- Most disabling
- Autosomal dominant, progressive
- Manifests in adulthood (onset of symptoms in 20's-30's, death in 60's)
- Multisystem disease (also affects all muscle types)
- Treatment is symptomatic with quinine and procainamide but can worsen cardiac conduction problems
- Characteristics:
    - Facial weakness, muscle wasting (SCM), dysarthria, dysphagia, myotonia of hand grip
    - *Classic triad:* Mental retardation, frontal baldness and cataracts
    - Endocrine; gonadal atrophy, DM, hypothyroidism, adrenal insufficiency
    - Delayed gastric emptying, intestinal pseudo-obstruction
    - Central sleep apnea
    - Pregnancy exacerbates symptoms; frequent C/S for uterine atony (also retained placenta)
    - Cardiac dysrhythmias (AV block, MV prolapse, occ complete heart block)

Myotonia Congenita

- Autosomal dominant
- Manifests at birth/childhood (Often in offspring of mothers with MD)
- Skeletal muscle only, non-progressive
- Characterized by chloride channel dysfunction
- Multi-system involvement does not occur; Does not cause cardiac abnormalities
- No decrease in life expectancy
- Muscle hypertrophy
- Respond to phenytoin, mexiletine, or quinine (300-600mg IV)
- Characteristics: hypotonia, respiratory insufficiency, and difficulty with feeding
- **MH susceptible**

Paramyotonia Congenita

- Rare, Autosomal dominant
- Manifests in early childhood
- Muscle hypertrophy
- Sustained exercise improves myotonias (opposite of other types)
- 'Warm up phenomenon'
- Cold markedly aggravates and flaccid paralysis may be present when muscles warmed

Schwartz-Jampel Syndrome – Central Core disease???

- Very Rare
- Progressive
- Skeletal muscle stiffness, myotonia, ocular, facial and skeletal abnormalities including micrognathia
- Possible difficult intubation
- MH susceptible

CONSIDERATIONS IN PREGNANCY

- In patients with myotonic dystrophy, symptoms of weakness and myotonia usually remain unchanged; in a minority of women, symptoms worsen during pregnancy dystrophy (exacerbated skeletal muscle weakness and myotonia), but this worsening generally resolves after delivery
    - Congestive heart failure is more likely to occur during pregnancy
- Labor is typically prolonged and there is an increased incidence of postpartum hemorrhage
    - Muscle weakness may result in a prolonged second stage of labor and a higher incidence of instrumental vaginal delivery
        - Poor uterine contractions may result in prolonged labor, uterine atony, retained placenta, and an increased risk of postpartum hemorrhage
    - Prolonged contractions secondary to the intrinsic muscle disorder, is not relieved by spinal or epidural anesthesia
        - However, local infiltration with a local anesthetic agent can relieve the contractions
- Cesarean section is often required because of uterine smooth muscle dysfunction
    - Because opioids or sedatives may precipitate apnea, neuraxial anesthesia is preferred for labor and vaginal or cesarean delivery
    - Some anesthesiologists recommend the cautious administration of intrathecal or epidural opioids for their reported anti-shivering effect
- There may be a higher risk of spontaneous abortion and preterm labor in patients with myotonic dystrophy
- Should preterm labor occur, caution should be used with the administration of pharmacologic tocolysis (ritodrine may provoke symptoms of myotonia)
- The neonate may present with respiratory distress if affected by congenital myotonic dystrophy

REFERENCES:

- Co-Existing Chpt 18
- Barash Pg 416, 624-625
- Miller Chpt 34, 37
- Cote Chpt 22, 41
- Chestnut Chpt 49