Amyotrophic Lateral Sclerosis (ALS)

Amyotrophic lateral sclerosis is a degenerative disease of the motor ganglia in the anterior horn of the spinal cord and spinal pyramidal tracts. Signs and symptoms of ALS reflect upper and lower motor neuron dysfunction with sparing of sensory tracts – including skeletal muscle atrophy, weakness and fasciculations with eventual progression to respiratory failure and death within 3-5 years on average. Anesthetic considerations include: bulbar dysfunction and increased risk of aspiration, autonomic dysfunction, respiratory muscle weakness and increased risk of postoperative respiratory failure, hyperkalemia secondary to succinylcholine administration and altered responses to neuromuscular blocking agents.

ANESTHETIC CONSIDERATIONS:

- Increased risk of aspiration due to upper airway and pharyngeal muscle dysfunction
- Altered response to neuromuscular blocking agents
  - Hyperkalemic response to succinylcholine administration
  - increased sensitivity to non depolarizing neuromuscular blocking agents
- Increased risk of respiratory muscle weakness and postoperative respiratory failure
  - Decreased VC, MVV, ERV
- Autonomic dysfunction
  - characterized by increased resting HR, orthostatic hypotension, elevated circulating levels of epinephrine and norepinephrine
  - decreased HR response to atropine

ANESTHETIC GOALS:

- Rapid Sequence Induction due to increased risk of pulmonary aspiration
- Strict avoidance of succinylcholine secondary to risk of hyperkalemia
- Preoperative optimization of respiratory status (treatment of concomitant respiratory diseases, treatment of pulmonary infection, bronchodilators and antibiotics as indicated)
- Postoperative disposition: may require postoperative ventilation and high risk of postoperative pulmonary complication
- Vasopressors and inotropes available to deal with exaggerated hemodynamic responses associated with autonomic dysfunction
- Caution with regional anesthesia – may exacerbate the disease (Coexisting)
  - if regional anesthesia is to be used, clear documentation of preexisiting neurologic dysfunction is indicated
  - epidural anesthesia has been successfully administered to patients with ALS without neurologic exacerbation of impairment of pulmonary function

HISTORY

- Standard anesthetic history
  - previous anesthetics and complications
  - medications
  - allergies
  - coexisting cardiac disease
  - coexisting pulmonary dysfunction
    - has been associated with lung carcinoma (Coexisting)
    - decreased VC, MVV, ERV (due to respiratory muscle weakness)
  - degree of neurological impairment and functional disability
  - NPO status/reflux/GI disease/renal disease/endocrine disease
  - signs and symptoms of autonomic dysfunction
- Duration of ALS
  - death usually within 3-5 years of diagnosis
  - 10% of people survive to 10 years
- Signs and symptoms of ALS
  - tongue fasciculation
  - dysarthria
  - dysphagia
  - obvious signs of aspiration
  - pneumonias
  - degree of motor function and disability
- Reason for surgery

PHYSICAL

- **GENERAL**
  - Vitals including evidence of autonomic dysreflexia
    - resting tachycardia
    - orthostatic hypotension
    - decreased R-R variation with respiration
- **CNS**
  - focused neurological exam
    - documentation of neurologic deficits
    - sensory function should be intact
- **CVS**
  - resting heart rate
  - orthostatic hypotension
- **RESP**

- work of breathing
- paradoxical breathing (respiratory muscle dysfunction)

INVESTIGATIONS

- **Labs**
  - as indicated for procedure
  - CK should be normal (distinguishes from polymositis)
- **Imaging**
  - EKG: decreased R-R wave variability
  - CXR: if indicated for surgery
  - PFT/spirometry: FVC, VC, FEV1, MVV, ERV
- **Special**
  - EMG changes resemble myasthenia gravis

OPTIMIZATION

- Optimization of preoperative pulmonary status
- Postoperative disposition

ANESTHETIC OPTIONS

- None
- MAC
- Local/regional techniques
  - caution as this may (or may not) exacerbate the disease
- Neuraxial anesthesia
  - caution as this may or may not exacerbate the disease
  - epidural anesthesia has been used safely in patients with ALS
- GA

ANESTHETIC SETUP

- **Drugs**
  - routine emergency medications
  - consider norepinephrine for management of exaggerated hypotension associated with autonomic dysfunction
  - consider 'downers' (labetalol, esmolol, hydralazine, NTG) for management of exaggerated hypertension associated with autonomic dysfunction
- **Equipment**
  - standard CAS monitors
    - consider temperature probe as these patients may have decreased ability to appropriately vasoconstrict
  - consider foley catheter
  - twitch monitor

MANAGEMENT OF ANESTHESIA

- **Induction**
  - rapid sequence induction
  - avoidance of succinylcholine
  - vasopressors available to treat hypotension associated with induction medications
- **Maintenance**
  - inhalational anesthetics (may worsen neuromuscular function)
  - increased sensitivity to non depolarizing neuromuscular blocking agents (titrate paralysis to twitch monitor)
  - no evidence that a specific anesthetic drug or combination of drugs is best for patienst with ALS
- **Emergence**
  - aspiration precautions

DISPOSITION AND MONITORING

- high risk for postoperative ventilation due to respiratory muscle weakness
- high risk for postoperative pulmonary aspiration and pneumonia due to decreased ability to clear secretions

COMPLICATIONS

- high risk of postoperative pulmonary complications
- regional anesthesia may be associated with worsening of peripheral motor symptoms

PATHOPHYSIOLOGY

- **Epidemiology**
  - most commonly in men > women
  - 40-60 years old
  - death most commonly occurs within 3-5 years of diagnosis with relentless progression of the disease
    - 10% of patients survive for 10 years
    - death usually secondary to respiratory failure
- **Physiology**
  - degenerative disease of upper and motor neurons throughout the central nervous system
  - if limited to motor cortex = primary lateral sclerosis
  - if limited to brain stem nuclei = pseudobulbar palsy
  - if presents within first 3 years of life = Werdnig Hoffman disease
  - etiology unknown: 5-10% hereditary mutation of superoxide dismutase

- ? secondary to glutamate excitotoxicity and oxidative stress?
- ? secondary to environmental exposures or heavy metal exposure?

- **Presentation**
  - typically presenting symptoms include skeletal muscle atrophy, weakness and fasciculations
  - intrinsic muscles of hands commonly affected initially
  - atrophy and weakness of most skeletal muscles
  - bulbar involvement: tongue fasciculations, dysphagia, dysarthria
  - sparing of ocular muscles (unknown as to why)
  - autonomic dysfunction
    - resting tachycardia and orthostatic hypotension
  - cramping and aching sensations in legs with sensory sparing
- **Diagnosis**
  - largely clinical diagnosis
  - ancillary tests may be useful in ruling out other diseases
    - MRI
    - EMG
    - nerve conduction studies
- Management
  - Riluzole (glutamate release inhibitor/ Na channel blocking agent) – only drug currently approved for treatment of ALS
    - side effects include nausea, fatigue, hepatitis
  - Experimental therapies: antioxidants, mitochondrial enhancers, antiapoptotics, immunomodulators, anti inflammatories, proteasome inhibitors

REFERENCES

- Barash 6th ed. p.632-633
- Coexisting 5th Edition: Amyotrophic Lateral Sclerosis