Management of Spinal Deformities in Spinal Muscular Atrophy

Samuel R. Rosenfeld, M.D.
CHOC CHILDREN’S HOSPITAL
UNIVERSITY of CALIFORNIA, IRVINE
Disclosure

• Consultant MediCrea Spine
• Consultant OrthoPeditrics Spine

• I have no potential conflicts with this presentation
• Chest wall deformities and scoliosis contribute to restrictive pulmonary disease.

• Pulmonary complications cause morbidity and mortality.

• Weak intercostal muscles and unopposed diaphragmatic function may result in the bell shaped chest (parasol rib deformity).

• Symptoms include poor management of airway secretions, hypoventilation during sleep, poor chest wall development, recurrent pulmonary infections, skin pressure areas, back and buttock pain.
• Scoliosis occurs in greater than 50% of patients with SMA 1 and 2.

• Non-ambulatory patients are at greater risk for scoliosis.

• Pelvic obliquity and kyphosis are often associated with this spinal deformity.

• Because of the progression of the scoliosis and pulmonary compromise, early intervention is important.
What are the goals of treatment?

- Improve sitting balance/tolerance
- Decrease likelihood of decubiti, aspiration
- Relief of pain in hips and back
- Decrease need for assistance
- Eliminate use upper extremities for support
- Facilitate positioning/transfers
- Improve pulmonary function or pulmonary growth
Nonsurgical Management

• Careful observation for mild deformity.

• Orthotic management (avoid further constriction of thorax leading to impaired pulmonary function)

• Wheelchair seating systems to maintain sitting posture and accommodate pelvic obliquity.

• Orthoses may slow scoliosis progression; however, discontinue if there is progressive spinal deformity.
Surgical Management in Skeletal immaturity (<10 years of age)

• Growing rod constructs without arthrodesis
  – Distraction based systems:
    • Vertical Expandable Prosthetic Titanium Rib (VEPTR)
    • MAGEC Rods
  – Guided growth systems:
    • Luque trolley
    • Shilla

Complications: infection, anchor displacement, laminar fracture, implant prominence, rod failure, premature arthrodesis, multiple surgical procedures.
MAGEC Rod
MAGEC Rod
Surgery age 4 years
6 years post op
Surgery age 7 years
6 years post op
Surgical Management in Skeletal Maturity (>10 years of age)

• Posterior spinal arthrodesis, osteotomies to correct deformity, with segmental spinal instrumentation, pelvic fixation, and autologous / allograft bone graft.

• Complications: pseudoarthrosis, infection, functional deterioration, blood loss / transfusion, implant failure, thromboembolic phenomenon.
Halo Traction

• Large rigid curves where spinal balance cannot be safely obtained via Anterior + Posterior procedure

• Halo-pelvic, Halo-femoral, Halo-gravity
  ✓ Keep head/trunk elevated, sit up

• Traction applied before or between staged anterior and posterior procedure

• Must be able to tolerate traction
  ✓ Normal Cervical spine – no instability
  ✓ Monitor neuro status every shift
    cranial n (esp Abducens), cervical chain


Halo Traction

- Large rigid curves where spinal balance cannot be safely obtained via Anterior + Posterior procedure
- Halo-pelvic, Halo-femoral, Halo-gravity
  - Keep head/trunk elevated, sit up
- Traction applied before or between staged anterior and posterior procedure
- Must be able to tolerate traction
  - Normal Cervical spine – no instability
  - Monitor neuro status every shift cranial n (esp Abduccens), cervical chain

Intrathecal Administration of Medication with Spinal Deformities

- Guided placement of intrathecal catheter: ultrasound, fluoroscopy, interventional radiologist
- Procedural sedation, cumulative effects of anesthesia
- Laminotomy, laminectomy to facilitate guided placement of needle, catheter
- Indwelling catheter, reservoir, infusion pump to deliver medications without repetitive dural puncture
- Planning long term intrathecal access at the time of spinal reconstructive procedures
Safe Surgery

- Pre-op pulmonary / cardiology evaluation
- Total intravenous anesthetic technique
- Potassium supplementation
- Replace blood loss
- Cell-Saver
- Aminocaproic acid / Tranexamic acid
- Thromboembolic prophylaxis
- Steroid prep
- Malignant Hyperthermia Precautions
Spinal Cord Monitoring

- Somatosensory evoked potentials
- Motor evoked potentials
- EMG
Autologous Blood Tranfusion

- Pre donation
- Cell-saver
- Constavac reinfusion
Pulmonary Management / Intervention

- Volume recruitment
- Ventilators
- Tracheostomy
- Mechanical insufflator / exsufflator
- Mucus mobilization devices
- Pneumococcal, influenza immunizations
Cardiac Management

- Evaluation: ECG, ECHO, Holter
- Intervention: angiotensin-converting-enzyme inhibitor (ACE inhibitor) i.e. enalapril
- Beta-blockers (carvedilol)
Gastroenterology / Nutrition

- Swallowing evaluation
- Diet control
- Supplementation
- Gastrostomy
- Pharmacologic
- Constipation management
- GERD management
Dietary supplements

- Calcium citrate (better absorbed than Calcium carbonate)
  age 5 to 10  up to 600 mg./day
  age 11 to adult  more than 1300 mg./day (in divided dosage)
- Vitamin D3 (better absorbed than D2)
  age 5 to 10  at least 800 I.U./day
  age 11 to adult  over 5000 I.U./day
Wheelchair Indications

• Prevent muscle fatigue
• Appropriate seating system
• Part-time use for long distance mobility; encourage short distance ambulation and transfers
Wheelchair Specifications

- Rigid seat and back
- Jay or Roho seating systems
- Appropriate trunk support, head control
- Tilt-in-space >> reclining
- Power assist modifications / controls
- Accommodate ventilatory support and growth adjustments