Anaesthesia for Spinal Muscular Atrophy
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Citation

Abstract
Spinal Muscular Atrophy (SMA) comprises of a group of neuromuscular disorders due to degeneration of anterior horns cells of spinal cords and brain stem. We report the anaesthetic management of a patient for laparoscopic Nissen Fundoplication due to gastroesophageal reflux disease. We used total intravenous anaesthesia with propofol and fentanyl. No muscle relaxant was used.

ANAESTHETIC MANAGEMENT
A 5-years old female patient weighing 14 kg, a known case of Spinal Muscular Atrophy type I with gastroesophageal reflux disease (GERD) was scheduled for elective laparoscopic Nissen Fundoplication and gastrostomy.

She was diagnosed as a case of Spinal Muscular Atrophy at the age of 6 month with muscle biopsy. Her two elder sisters died due to the same disease. She had also history of repeated admission to hospital due to recurrent pneumonia.

She was receiving pantoprazole 15 mg orally once a day, domperidone 1.2 mg orally four times a day, pulmicort inhaler 500 µg three times a day, injection ceforoxime 470 mg intravenously three times a day and heparin flush intravenously three times a day.

On physical examination, she was bed ridden but well oriented in time, space and person.

She was unable to hold her neck. She never started walking. Upper limb power was grade 3/5 and lower limbs 1/5. Muscles of upper and lower limbs were flaccid and atrophied. Sensory system was intact. Both knees and hip joints were held in flexion position. There was equinovalvarus deformity of both feet. Palmar surface of both feet was at 90° facing medially. There was tibial extortion as well. She had kyphoscoliosis of spinal column. Anterior rib cage and sternum were protruding out as shown in the figure 1.

Anatomy of the air way was clear apart from fasciculations of tongue. Examination of other systems was unremarkable. All investigations were fairly within normal limits. On leaving the patient's holding area to operating room, she brought her hand to anterior chest to shake hand with his father.

She was brought to operating room accompanied by her father. Monitors were applied. Preoxygenation with 100% oxygen started and she was intubated with fentanyl 50 µg
and propofol 40 mg with cricoid pressure. Anaesthesia was
maintained with oxygen, air and propofol infusion 10-15
mg/kg/hour with intermittent boluses of fentanyl. After 90
minutes procedure was converted to open Nissen
Fundoplication and gastrostomy. All procedure took 3 hours.
A total dose of propofol 500 mg and fentanyl 225 µg was
consumed. No muscle relaxant was used. Her trachea was
extubated on the table and then transferred to Pediatric ICU
uneventfully.

DISCUSSION
The Spinal Muscular Atrophy (SMA) comprises a group of
autosomal-recessive disorders characterized by progressive
weakness of the lower motor neurons. Spinal muscular
atrophy is anatomically characterized by the loss of lower
(alpha) motor neurons in the entire spinal cord and some
times in brainstem motor nuclei (nuclei of cranial nerves V,
VII, IX, and XII). Molecular and genetic studies revealed
mutations in the survival motor neuron, or SMN, gene in
chromosome sub-bands 5q11.2-13.3. The incidence of SMA
is 7.8-10 cases per 100,000 live births. Patients with SMA
present with weakness and muscle wasting in the limbs,
respiratory, and bulbar or brainstem muscles. They have no
evidence of cerebral or other CNS dysfunction. Patients with
SMA often have above-average intelligence quotients (IQs)
and demonstrate high degrees of intelligence. Several types
SMA have been described on the basis of the age when
accompanying clinical features appear. The clinical
manifestations of each particular form of SMA are discussed
below:

SMA type I - Acute infantile or Werdnig-Hoffman disease.
Patients present before 6 months of age, with 95% of
patients having signs and symptoms by 3 months. They have
severe, progressive muscle weakness and flaccid or reduced
muscle tone (hypotonia). Bulbar dysfunction includes poor
sucking ability, reduced swallowing, and respiratory failure.
Patients have no involvement of the extraocular muscles,
and facial weakness is often minimal or absent. They have no
evidence of cerebral or other CNS dysfunction. Patients with
SMA type II may overlap types I and III. Most children present
between the ages of 6 to 18 months. The most common
manifestation that parents and physicians note is
developmental motor delay. Infants with SMA type II often
have difficulties with sitting independently or failure to
stand by 1 year of age. An unusual feature of the disease is a
postural tremor affecting the fingers. This is thought to be
related to fasciculations in the skeletal muscles.

Pseudohypertrophy of the gastrocnemius muscle,
musculoskeletal deformities, and respiratory failure can
occur. The lifespan of patients with SMA type II varies from
2 years to the third decade of life. Respiratory infections
account for most deaths. Infants cannot get to a sitting
position on their own, though they may stay upright if placed
in that position. As with SMA type I, SMA type II cause
notable, symmetric proximal weakness, hypotonia, and
fasciculations. Findings on sensory examination are normal,
and long-tract signs are absent. When the patient's hands are
held out, a characteristic fine postural tremor may be
observed.

SMA type II - Chronic infantile form. This is the most
common form of SMA, and some experts believe that SMA
type II may overlap types I and III. Most children present
between the ages of 6 to 18 months. The most common
manifestation that parents and physicians note is
developmental motor delay. Infants with SMA type II often
have difficulties with sitting independently or failure to
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SMA type III - Chronic juvenile or Kugelberg-Welander
syndrome. This is a mild form of autosomal recessive SMA
that appears after the age of 18 months. SMA type III is
characterized by slowly progressive proximal weakness.
Most children with SMA III can stand and walk but have
trouble with motor skills, such as going up and down stairs.

Bulbar dysfunction occurs late in the disease. Patients may
show evidence of pseudohypertrophy, as in patients with
SMA type II. The disease progresses slowly, and the overall
course is mild. Many patients have normal life expectancies.
Children can ambulate, but they have proximal muscle
weakness and various degrees of muscle hypotonia and
wasting. The lower extremities are often more severely
affected than the upper extremities.

SMA type IV - Adult-onset form Onset is typically in the
mid-30s. In many ways, the disease mimics the symptoms of
type III. Overall, the course of the disease is benign, and
patients have a normal life expectancy. Patients are similar
to those with SMA type III in presentation and clinical
findings, though the overall degree of motor weakness is less
severe in type IV than in type III [1].

There are only few reports of anesthetic management of
cases with spinal muscular atrophy in the anesthesia
literature. These cases were successfully managed with spinal [2,3], epidural [4] and general anesthesia with total intravenous anaesthesia (TIVA) [5] and two cases of general anaesthesia [5,6] with the use of non-depolarizing muscle relaxant. In the first case it was used due to laryngospasm and patient recovered very well but in the second case delayed return of skeletal muscle power following non-depolarizing neuromuscular blocking agent was observed. Hajime et al [8] reported a case of difficult airway in a patient with spinal muscular atrophy.

Anesthetic problems include:

1. A possible hypersensitivity to non-depolarizing neuromuscular blocking agents, and succinylcholine induced hyperkalemia.

2. Presence of weak laryngeal reflexes may predispose the patient to aspirate the oropharyngeal or gastric secretions so patients should be given adequate prophylaxis against aspiration syndromes.

3. Chronic weakness of inspiratory respiratory muscles and decreased ability to cough can result in loss of pulmonary reserves and accumulation of secretions that predisposes to recurrent pneumonia. Post operative pulmonary dysfunction must be anticipated and attempts made to facilitate clearance of secretions.

4. Since there is no or minimal muscular activity, chances of deep vein thrombosis are increased so patients should have adequate prophylaxis.

5. Skeletal muscle atrophy can predispose to long bone fractures so there is need to handle these patients care fully and pressure points padded very well.

From our experience gained in this case, we recommend the use of total intravenous anaesthesia (TIVA) without the use of muscle relaxant; general anaesthesia is required in patients suffering from spinal muscular atrophy.

References
6. Astrid G. Stucke and Eckehard A.E. Stuth. Use of rapacuronium in a child with spinal muscular atrophy. Pediatric Anesthesia November 2001; 11 (6), 725-728
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