Torsion of left main bronchus during general anesthesia for posterior instrumented spinal fusion

Renuka Arumainathan¹, Stephen A. C. Morris² & Marina George¹

¹Department of Anaesthesia, Great Ormond Street Hospital, London, UK
²Orthopaedic and Spinal Surgery Unit, Great Ormond Street Hospital, London, UK

Key Clinical Message
Pulmonary function tests such as flow-volume loops and reconstructive radiological imaging may aid the detection of large airway obstruction prior to corrective surgery for severe scoliosis. Intraoperative use of halo-gravity traction may help to reduce the severity of the scoliosis, and thus the extrinsic compression or torsion of the airways.

Keywords
Neuromuscular scoliosis, bronchial torsion, spinal fusion, halo-gravity traction, pulmonary function test.

Case Presentation
We report the case of a 13-year-old boy with neuromuscular proximal thoracic scoliosis who was found to have significant torsion of the left main bronchus during general anesthesia for posterior instrumented spinal fusion of T2 to L4.

This patient had a background history of multicore myopathy, which resulted in progressive scoliosis. Endotracheal intubation was noted to be difficult on review of a previous anesthetic chart (Grade III on the Cormack and Lehane scale).

This patient reported increasing shortness of breath over the preceding few months, particularly on exertion. As part of his preoperative investigations, spirometry was performed, which showed that the forced vital capacity (FVC) was 36% of predicted (1.09 L) and the forced expiratory volume in 1 sec (FEV1) to FVC ratio was 101%, which was in keeping with a restrictive lung defect. He underwent a level-I sleep study preoperatively which showed normal gas exchange with no significant desaturations or hypercapnoeic episodes. His echocardiogram showed normal cardiac dimensions and good biventricular function.

Anesthesia was induced using a target-controlled infusion (TCI) technique with propofol and remifentanil. The patient’s trachea was intubated using the AirTraq video-laryngoscope (Prodol Meditec S.A., Vizcaya, Spain) with the aid of a bougie.

The patient was transferred into theaters and positioned prone. This resulted in rapid desaturation, a significant decrease in the end tidal carbon dioxide values and hypotension. There was a precipitous decrease in the expired tidal volume (Vte) from 400 to 100 mL. The patient was immediately placed in a supine position and reassessed. A total of 100% oxygen, small aliquots of phenylephrine, and intravenous fluids was administered. The attending respiratory physician was called in for advice and flexible bronchoscopy was performed, which revealed a slit-like left main bronchus.

Following a multidisciplinary discussion involving the spinal surgeon, the anesthetic team and the respiratory physician, the decision was made to apply halo traction through the spine in order to reduce the magnitude of the scoliosis and, therefore, the extrinsic compression on the bronchus. This was achieved using Gardner Wells tongs to the skull and bilateral lower limb skin traction with 4 kg weight to the tongs and each lower limb. Improved lung
compliance and tidal volumes were achieved following application of traction, and the patient was able to tolerate the prone position without further ventilatory complication. The surgery proceeded uneventfully.

**Discussion**

Neuromuscular scoliosis is caused by a heterogeneous group of conditions, in which the underlying pathology will have significant impact on the patient’s perioperative course [1]. Our patient developed scoliosis secondary to his underlying multi-minicore disease. He was noted to have restrictive lung disease on spirometry, which is well known to be the most common lung defect in young patients with progressive scoliosis [2].

Extensive pulmonary testing including measurement of flow-volume loops and lung volumes were not carried out preoperatively. These may have alerted us to the concurrent presence of airway obstruction. Boyer et al. [3] in their review of lung function tests of 44 children with idiopathic scoliosis found that while only 7% met the criteria for airflow obstruction using standard spirometric techniques, 46% were found to have moderate-to-severe gas trapping using by plethysmography and helium dilution methods.

McPhail et al. [2] demonstrated in a small case series of 18 pediatric patients with syndromic and congenital scoliosis that 33% of these patients had obstructive lung disease (OLD) as evidenced by pulmonary function tests. All patients with OLD demonstrated compression of the bronchial main stems as confirmed by preoperative flexible bronchoscopy and computed tomography (CT). The side of compression was dependent on the side of major thoracic curvature. Our patient had compression of his left main bronchus, which was associated with his primary left-sided thoracic curvature (Fig. 1). It is also worth noting that this patient’s main curve was relatively proximal compared to the majority of patients with a main thoracic curve; the apex was located at T6 compared to the usual T8–9. This creates a larger deforming force around the carina and main bronchi. This knowledge is invaluable in predicting and managing intraoperative ventilatory complications. Furthermore, as the spirometric evidence of OLD in the above case series was supported by radiological imaging which showed airway compression, it is likely that we will consider performing preoperative thoracic CT imaging with three-dimensional reconstruction on all our high-risk patients undergoing this type of surgery, particularly patients with significant or worsening respiratory symptoms.

We postulate that the degree of bronchial compression worsened significantly in prone position, resulting in gas trapping, high peak airway pressures, and the consequent circulatory disturbances. Lee et al. describe a similar case of a patient with thoracolumbar scoliosis whose ventilation deteriorated rapidly when moved into prone position. Urgent flexible bronchoscopy performed in prone position revealed complete collapse of the trachea proximal to the carina. The principle anesthetist addressed the problem by inserting the endotracheal tube further, beyond the collapsed trachea, thus stenting the trachea open. This would not have possible in the case of our patient as the obstruction was at the level of the left main bronchus [4].

The application of modified halo-femoral traction to this patient resulted in an immediate improvement in the ventilatory parameters, and the patient was moved to the prone position successfully. Although studies have shown an improvement in pulmonary function with perioperative application of halo-gravity traction [5], to the best of our knowledge, this is the first reported case of using halo-femoral traction to negate the pressure effects of prone position in the context of bronchial torsion.
Acknowledgments
No ethical approval was required for this case report. We obtained written and verbal informed consent from the patient and the patient’s parent.

Conflict of Interest
No conflicts of interest declared.

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