
An Unusual Airway Obstruction Secondary to Congenital Malformation of the Thoracic Inlet

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A number of reports describe airway obstruction due to tracheal compression by mediastinal tumors, cysts, or vascular anomalies. This is a report of an unusual type of airway obstruction secondary to congenital abnormalities of the thoracic spine and the manubrium.

REPORT OF A CASE

A 14-year-old girl with congenital thoracolumbar scoliosis was scheduled for spinal fusion. The patient weighed 40 kg, was 159 cm tall and had thoracic dextro-scoliosis (58 degrees) and lumbar levo-scoliosis (29 degrees). There was no sign or symptom of upper airway obstruction, and there was no history of congenital stridor. The remainder of the medical history, physical examination and laboratory data was essentially normal.

Precordication consisted of secobarbital and morphine sulfate, given intramuscularly one hour before, and atropine, iv, immediately before induction of anesthesia. Following thiopental and succinylcholine, tracheal intubation was easily accomplished with a 7-mm cuffed endotracheal tube.

Arterial blood pressure, esophageal heart sounds, electrocardiogram, central venous pressure, rectal temperature, and urinary output were monitored. After tracheal intubation, 60 per cent nitrous oxide and 40 per cent oxygen were administered via a semi-closed absorber with controlled manual ventilation. It soon became very difficult to expand the lungs. Ventilation was satisfactory after repositioning of the endotracheal tube. Following intravenous injection of d-tubocurarine and placing the patient in the prone position, ventilation again became exceedingly difficult. Returning the patient to the supine position, deflating the endotracheal tube cuff, passing a catheter through the endotracheal tube, and extubation and reintubation twice with new endotracheal tubes 7 and 7.5 mm in size did not correct the problem. Despite administration of 100 per cent oxygen, cyanosis and hypotension ensued. The trachea was then extubated, and the patient’s condition improved promptly after ventilation with oxygen by mask. Bronchoscopy with Sanders ventilating systems revealed findings suggestive of tracheomalacia just above the carina. With the bronchoscope distal to this area, ventilation of the lungs was quite easy. Residual d-tubocurarine was reversed with atropine and neostigmine and the patient was taken to the recovery room.

Subsequent fiberoptic bronchoscopy under topical anesthesia revealed that a 2-cm-long segment of trachea near the carina was flattened anteroposteriorly. This was confirmed by a tracheogram, but the etiology remained uncertain. Barium esophagram and aortogram were normal. Twenty-three days following the originally scheduled operation, the patient underwent a right thoracotomy for tracheal exploration under general anesthesia. After preoxygenation for 5 minutes, induction was achieved with thiopental, enflurane, and oxygen with spontaneous respiration. Using deep en-
flurane anesthesia, left endobronchial intubation was easily accomplished with a 7.5-mm cuffed endotracheal tube and one-lung anesthesia was continued with enflurane, oxygen, and assisted ventilation.

Tracheal compression was found to be the result of an abnormal thoracic inlet (fig. 1). The trachea was mobilized to the left, anchored, and the chest closed. To test the effectiveness of this operative procedure, with the patient still deeply anesthetized with enflurane, the endotracheal tube was withdrawn and repositioned so that the distal end of the tube was proximal to the original site of tracheal lesion. Following this, ventilation became exceedingly difficult (table 1). However, manual elevation of both the sternoclavicular joints corrected this problem, suggesting the necessity for resection of the manubrium. The endotracheal tube was repositioned and general anesthesia continued for partial resection of manubrium (fig. 1). Following this, ventilation was easily maintained with the endotracheal tube proximal to the prior site of obstruction. The following day, endotracheal extubation was uneventful, and the patient was discharged a week postoperatively with no sign of upper airway obstruction.

Four months later the patient was readmitted for spinal fusion. Bronchoscopy and endotracheal intubation were performed using enflurane, nitrous oxide, and oxygen anesthesia. Bronchoscopy demonstrated the original site of tracheal compression to be considerably more patent. The rest of the anesthetic course and the operative procedure (spinal fusion) were uneventful.

**DISCUSSION**

The serious airway obstruction described here was the result of compression of the trachea in a narrow thoracic inlet between the manubrium and the thoracic vertebral body (fig. 1). Skeletal muscle relaxation was the key factor that unmasked this silent

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**TABLE 1. Serial Blood-Gas Changes**

<table>
<thead>
<tr>
<th>Anesthetic Course</th>
<th>pH</th>
<th>P_{CO_2}</th>
<th>P_{O_2}</th>
<th>Standard HCO_3^-</th>
<th>F_{O_2} (Per Cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-lung anesthesia with chest wall intact; spontaneous respiration</td>
<td>7.28</td>
<td>50</td>
<td>250</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td>One-lung anesthesia with chest wall open; assisted respiration</td>
<td>7.36</td>
<td>38</td>
<td>275</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td><strong>(Mobilization of Trachea)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endotracheal tube distal to the lesion, both lungs ventilated</td>
<td>7.28</td>
<td>56</td>
<td>325</td>
<td>23</td>
<td>100</td>
</tr>
<tr>
<td>Endotracheal tube proximal to the lesion, obstructed airway</td>
<td>7.26</td>
<td>58</td>
<td>95</td>
<td>22</td>
<td>100</td>
</tr>
<tr>
<td>Repositioning of the endotracheal tube distal to the lesion, both lungs ventilated</td>
<td>7.32</td>
<td>42</td>
<td>375</td>
<td>21</td>
<td>100</td>
</tr>
<tr>
<td><strong>(Partial Resection of Manubrium)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endotracheal tube proximal to the lesion, in the recovery room</td>
<td>7.28</td>
<td>44</td>
<td>350</td>
<td>19</td>
<td>100</td>
</tr>
</tbody>
</table>
pathologic condition. During the first anesthesia, airway obstruction occurred following succinylcholine and endotracheal intubation. Improvement was probably coincident with return of skeletal muscle tone as the effect of succinylcholine diminished. In retrospect, the problem was then re-created as skeletal muscles were again relaxed by d-tubocurarine and compounded by placing the patient prone. The key points in dealing with this emergency were extubation and ventilation by mask. Bronchoscopy was useful although not critical to the resuscitation.

Knowledge of the initial anesthetic experience and the results of subsequent investigations led us to select the second anesthetic technique with the following features: 1) avoidance of muscle relaxants, 2) preservation of spontaneous respiratory activity during the entire procedure, 3) endotracheal intubation beyond the point of obstruction—endobronchial intubation if necessary, and 4) oxygenation by Sander's ventilating system or by mask as dictated by the situation. During the second procedure, manual elevation of the manubrium was found to be helpful. In accordance with Pracy, gradual withdrawal of the endotracheal tube helped diagnose the presence or absence of obstruction at the end of the operation.

In conclusion, this type of unexpected airway obstruction can occur during anesthesia, especially in patients with coexistent musculoskeletal anomalies. The etiologic factor described here should be considered after the more common causes have been eliminated. In such a case, the maneuvers we have outlined may be helpful or life-saving.

REFERENCES


Collapse of a Disposable Endotracheal Tube by Its High-pressure Cuff

ALAN K. KETOVER, M.D.,* AND ALFRED FEINGOLD, M.D.†

Many problems can arise with the use of endotracheal tubes. One such difficulty is lumen reduction caused by the cuff in a reusable heat-sterilized armored tube. This case describes collapse of the lumen of a disposable polyvinyl chloride endotracheal tube by the high-pressure cuff.

REPORT OF A CASE

A 69-year-old Caucasian man was scheduled for diagnostic right thoracotomy for a mass in the right upper lobe. The patient had undergone an uneventful bronchioscopy two weeks prior. An intravenous anesthetic was used for induction, and the trachea was intubated with a 9.0-mm Foregger disposable endotracheal tube. The cuff was inflated until no air leak was heard. Breath sounds were equal bilaterally. Halothane–nitrous oxide–oxygen anesthesia was administered, with manually controlled ventilation. Twenty minutes after the start of the operation, and an hour after intubation, an increase in airway resistance was noticed, and inspiratory and expiratory whistling sounds were heard through an esophageal stethoscope. A 16-French suction catheter would not pass through the endotracheal tube. The thorax was open and the lungs were observed to be ventilating adequately. At the completion of the operation the trachea was extubated. Abnormal pulmonary sounds were not heard thereafter.

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† Foregger Disposable Pre-cut Endotracheal Tube with Connector, Catalog #2-171-811, 9.0 Murphy, Lot #CD 051.