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Ventilation Difficulty Secondary to a Tracheal Diverticulum

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The inability to provide effective ventilation in a patient during anesthesia will have profound or fatal consequences if not detected and corrected expediently. Visual confirmation of the intratracheal passage of the endotracheal tube during direct laryngoscopy is a most reliable sign of correct placement,[1] but ventilatory insufficiency or absence can still result from underlying mechanical, anatomic, and functional abnormalities. We report a patient with a unique anatomic cause of ventilatory difficulty with endotracheal intubation.

CASE REPORT

A 17-month-old, 7-kg boy presented for direct laryngoscopy and bronchoscopy during general anesthesia. The patient was the product of a 33-week gestation with a complicated neonatal course including duodenal atresia and esophageal atresia with a C-type tracheoesophageal fistula. Corrective surgery at 2 days of age included resection of the tracheoesophageal fistula, end-to-end anastomosis of the esophagus, and repair of the duodenal atresia. A Nissen fundoplication was done at 3 months of age because of gastroesophageal reflux. Failure to thrive, multiple pneumonias, and progressive stridor prompted the diagnostic operative laryngoscopy and bronchoscopy.

No preanesthetic medication was given. Anesthesia was induced *via* mask with halothane and nitrous oxide. After administration of atracurium 4 mg, the trachea was intubated under laryngoscopic visualization with a 4.0-mm-ID cuffed endotracheal tube. The tip of the tube was positioned 11.5 cm from the lips. Manual ventilation through a pediatric circuit system failed to raise the chest wall; breath sounds were absent, as was air movement on auscultation of the epigastrium. There was no capnographic evidence of carbon dioxide during attempted ventilation. Manual assessment of the reservoir bag revealed extremely poor compliance, with inspiratory pressures as great as 60 cm failing to produce chest wall excursion. Repeat laryngoscopy confirmed placement of the endotracheal tube through the vocal cords. The endotracheal tube was withdrawn and examined and was found to be patent. Ventilation of the lungs *via* mask was performed easily and resulted in good bilateral breath sounds and normal capnography. The trachea was reintubated easily, but the same clinical findings indicating absent ventilation were again noted.

Once again the trachea was extubated and the lungs ventilated easily by mask. The tip of a rigid bronchoscope was inserted 1 cm beyond the vocal cords, and ventilation through the scope was accomplished easily. Bronchoscopic examination of the distal trachea revealed a large diverticulum on the posterior wall about 2.5 cm above the carina (fig. 1). The diverticulum expanded with positive pressure (fig. 2) and resulted in a lumen of nearly the same diameter as a mainstem bronchus with a depth of several centimeters. The remainder of the trachea was normal. After the procedure the anesthetic agents were discontinued, and the patient awoke without difficulty.

DISCUSSION

In treating ventilatory insufficiency in the presence of an appropriately placed endotracheal tube, consideration must be given to obstructive causes within the endotracheal tube, positioning difficulties, physiologic dysfunction, and anatomic abnormalities. Included in the first category are endotracheal tube lumenal occlusion with secretions or foreign body, tube kinking, cuff herniation over the distal opening, and errors in tube manufacture. An endotracheal tube tip positioned directly on the carina may lodge against the tracheal mucosa and make ventilation difficult. Bronchospasm can be severe enough to mask the confirmatory signs that verify intubation. Anatomic anomalies such as severe tracheal stenosis and intratracheal neoplasms may compromise ventilation with an otherwise correctly placed endotracheal tube. To date, there has been no published report of a tracheal diver-

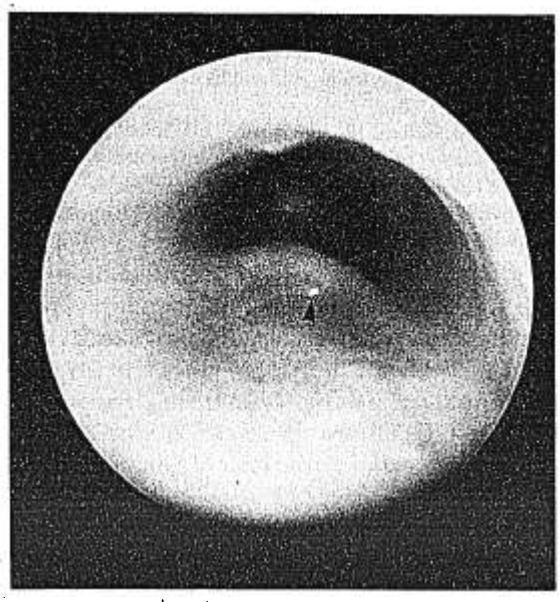

FIG. 1. Bronchoscopic view of the carina, showing a diverticulum (arrowhead) on the posterior wall of the trachea.

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FIG. 2. Same view as figure 1, showing the expansion of the tracheal diverticulum with positive pressure.

ticulum interfering with ventilation under general anesthesia.

Tracheal diverticula are rare and when present are usually found in the posterior or lateral wall of the trachea.[2] Usually they are asymptomatic. Although recurrent fistulae[3,4] have been documented in numerous postoperative tracheoesophageal fistula outcome series, tracheal diverticula have not yet been described as a sequelae to surgical repair.

We present a patient with surgically corrected tracheoesophageal fistula in whom we encountered severe and unexpected ventilatory difficulties secondary to a large tracheal diverticulum. The diverticulum was large enough to admit the endotracheal tube tip inadvertently as it was placed to an appropriate length. In so doing it prevented effective ventilation and presented a confusing clinical picture until bronchoscopy revealed its presence. Subjected to manual ventilation at high pressure, the blind pouch may have perforated with persistent effort.

This report highlights an unexpected cause of ventilatory difficulty. The clinical constellation of absent breath and gastric sounds, lack of chest excursion, and the absence of end-tidal carbon dioxide despite visualization of the intralaryngeal entry of an endotracheal tube suggested a mechanical tube obstruction. When this was not verified on inspection of the withdrawn tube and was reproducible with reintubation, only an intratracheal anatomic anomaly could explain this scenario. All anesthesiologists should be alert to this possibility when caring for children who have undergone tracheoesophageal fistula repair.

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Aortic Compression by Transesophageal Echocardiographic Probe in Infants and Children Undergoing Cardiac Surgery

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Transesophageal echocardiography (TEE) is being increasingly used to monitor cardiovascular function during surgery in both adults and children. There have been few adverse effects reported from the use of TEE in adults or children. We have encountered four cases of descending aortic compression due to a TEE probe, which, if not detected, could have caused significant complications. Although three cases involved infants less than 2 yr of age, the most recent case involved a 9-yr-old boy. In this report, we present the first two of these cases.