CASE REPORTS

Implications of a tracheal bronchus for adult anaesthetic practice

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The problems posed by tracheal intubation in the presence of a tracheal bronchus in adults are exemplified with three case histories. The anomaly has been categorized into three types on the basis of its potential to cause problems when attempting intubation. Suggestions are given for ways of securing the airway that are safe and less likely to result in obstruction and hypoxia.

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The presence of a congenital anomaly of the central airway can be of significance to anaesthetists. The commonest anomaly is a tracheal bronchus that supplies the right upper lobe and which is reported to be present in 0.1–3% of the population.1 2 In its most severe manifestation, a carina arises at mid-tracheal level. These usually present in childhood, sometimes surprisingly late, having been misdiagnosed as asthma, as the presenting symptoms may be wheeze or stridor. In adults, a variant is more common and is experienced as a spectrum of abnormalities ranging from a small but distinct bronchus connected to the lower third of the trachea to a bronchus that arises from the trachea at the level of the carina (carinal trifurcation) and just proximal to the normal origin of the right main bronchus. Arbitrarily, these have been classified as Types I, II and III (Fig. 1), for ease of description and significance to anaesthetists, and are illustrated here with individual case reports. Type I is largely of importance to those who may have to anaesthetize children; Type II abnormalities can potentially be obstructed by a normal tracheal tube; and Type III, similar to Type II, presents problems when one-lung ventilation (OLV), particularly of the right lung, is contemplated.

Case 1 (Type I)

In 1985, a 21-yr-old male presented for construction of an aorto-pulmonary window and re-anastomosis of collaterals to help relieve some of the hypoxia stemming from pulmonary atresia, an absent main pulmonary artery and a ventriculoseptal defect. A patent ductus arteriosus had mistakenly been tied off in infancy. He was cyanosed, with a dusky and plethoric complexion, had drumstick clubbing of the fingers, a haemoglobin concentration of 24 g dl⁻¹, and pulmonary function tests 50% of predicted. A history of wheeze with upper respiratory chest infections was not seen as particularly significant against the background of his general condition. Surgical access was planned through a right lateral thoracotomy: a medium-sized, left Robertshaw double-lumen tube (DLT) was inserted, and lung separation appeared to have been achieved. Thiopental, phenoperidine and pancuronium were used at induction and isoflurane and nitrous oxide for maintenance of anaesthesia. After the chest had been opened and OLV instituted, oxygen saturation, measured from interval blood gases, had decreased from 88 to 55% and was unchanged despite the use of 100% inspired oxygen. The DLT was removed and a tracheal tube inserted, with some improvement in oxygen saturation. At the end of the procedure, a rigid bronchoscope was inserted to remove secretions, at which point the abnormal anatomy of the airway was found. It appeared to be similar to that of a teenager who had been investigated for a respiratory wheeze and whose bronchogram is shown in Fig. 2.

Case 2 (Type II)

A 53-yr-old male ex-smoker presented with a shadow in the left lower lobe of the lung after a routine chest x-ray. It was proposed to insert a right-sided DLT prior to left thoracotomy but at pre-intubation rigid bronchoscopy a tracheal bronchus was noted 1 cm above the carina. It was felt that the tracheal limb of a DLT would block the tracheal bronchus and reduce the zones for ventilation significantly. A bronchial blocker (Rusch) was inserted through the rigid bronchoscope and sited in the left main bronchus. A 9.0 mm cuffed oral tracheal tube was placed beside the blocker so all zones of the right lung could be ventilated (Fig. 3).
Fig 1 Schematic representation of the types of tracheal bronchus likely to be of significance to anaesthetists.

Fig 2 Bronchogram of a teenager who presented with a wheeze. The upper lobe (tracheal) bronchus can be seen arising just below the tip of a rigid bronchoscope close to the mid-tracheal point. The bifurcation at the level of a normal carina is between left main bronchus and bronchus intermedius to right middle and lower lobes.

Case 3 (Type III)
A 54-yr-old male with a secondary lesion from bowel malignancy in the left thorax was prepared for thoracotomy. At rigid bronchoscopy, a tracheal bronchus was noted at the level of the carina (Fig. 4). The chance that the bronchus would be blocked by the bronchial limb of a right-sided DLT was considered high so a blocker (Rusch) was inserted into the left main bronchus using a rigid bronchoscope. A 9.0 mm cuffed tracheal tube was used to ventilate the right lung.

Fig 3 Schematic representation of the siting of a bronchus blocker and tracheal tube that prevents obstruction of a tracheal bronchus for OLV of the right lung.

Fig 4 Carinal trifurcation. Clinical photograph at bronchoscopy. From left to right: main bronchus, carina; main bronchus; upper lobe carina; and upper lobe bronchus.
However, immediately before thoracotomy, and in searching for CT evidence of the tracheal bronchus, it was noted on a more recent CT scan that a further lesion was present in the right lung. It was felt that a sternotomy would be appropriate but there was no consent. The following day, a sternotomy was conducted and a left-sided DLT was used successfully to produce lung separation. Particular care was taken to ensure that there was a sufficient margin of safety to ensure that the tracheal bronchus was not blocked by the tracheal lumen of the DLT or by herniation of the bronchial cuff.

**Discussion**

It is impossible, in Case 1, to know with any degree of certainty where the DLT lumen tube was placed. There are several possibilities, including correct siting and siting at the level of the tracheal bronchus with the true trachea cannulated with the endobronchial limb of the DLT. With hindsight, the hypoxia was most likely exacerbated by the fact that the patient did not have the pulmonary reserve nor the collateral oxygenating circulation to tolerate OLV. Nevertheless, the case illustrates the confusion caused by and the dangers of being unaware of the presence of a tracheal bronchus and the potential for a vital bronchus to be obstructed by a tracheal tube. An association of this type of anatomy with other congenital anomalies is known but the presence of cyanotic heart disease in this case distracted from the alerting symptom of a wheeze. Stridor is a typical presentation of severe manifestations of a tracheal bronchus. McLaughlin and colleagues discussed the presentation, diagnosis and management of such cases, which can include surgical resection. However, it is probable that the bulk of these abnormalities are of incidental interest and of no prognostic significance, unless tracheal intubation is required. The child illustrated in Figure 2 was asymptomatic otherwise and needed no further immediate management once it was recognized that the wheeze was not indicative of asthma.

Longer survival of many of these patients with severe malformations may mean that a tracheal bronchus of this type is potentially more likely to be found in the adult population requiring tracheal intubation. Figure 2 shows the nature of the problem. Essentially, the appearance on bronchoscopy was of the main carina arising at or near the mid-trachea. The rest of the trachea looked as though it arose from what in the normal subject is the origin of the left main bronchus. The lower carina is a bifurcation of left main bronchus and bronchus intermedius and is sited at the usual level. It is only with radiological techniques, such as bronchography, that the true anatomy can be defined. Under normal circumstances, without this knowledge, it is easy to envisage that tracheal intubation could have several consequences, some of which would result in hypoxia. Either the tracheal bronchus or the true trachea could be entered by an uncut tracheal tube or one cut by design not to be placed beyond the mid-tracheal point. Cannulation of the tracheal bronchus would obstruct most of the rest of the respiratory system; cannulation of the true trachea would bypass the right upper lobe. The suggested management of the airway for anaesthesia for non-thoracic procedures includes the use of short tubes sited in the upper trachea, careful attention to the position of the tip of the tube, and fibre-optic confirmation that the tracheal bronchus is not obstructed.

Case 2 proved to be a problem because of the nature of the surgery, and the solution to securing the airway was essentially related to the requirement for OLV. It has been used for the purpose of defining a Type II problem and is reported because it is illustrative of the potential dangers of tracheal tubes for the unwary in patients who have all the appearances of being normal. Such bronchial offsets have been reported as much as 6 cm from the carina, in which case it is possible to envisage an anaesthetist inadvertently obstructing a tracheal bronchus and creating a hypoxic shunt with a tracheal tube of standard length.

Occasionally, a tracheal bronchus can be seen by examination of the tracheal wall on a chest x-ray, but in practice these anomalies may come to light only accidentally. If an event occurs that makes the anaesthetist suspect that a tracheal bronchus is obstructed by a tracheal tube, it is likely that the only way of detecting it is by carefully withdrawing the tube to see if oxygen saturation is improved or by auscultation of the apical zone of the lung while such a manoeuvre is conducted. Although very rare, the condition should be added to main bronchial cannulation on a list of differential causes of desaturation associated with the action of tracheal intubation.

Type III anomalies (Case 3), sometimes described as carinal trifurcation, present particular problems for those using DLT. In 20 yr of thoracic practice, the proposed airway management has had to be altered to cater for the presence of a tracheal bronchus in three further cases. This experience alone may not justify routine bronchoscopy (rigid or fibre-optic) prior to the use of blockers, endobronchial tubes and DLT, but the potential to confuse intubators and harm patients if the presence of one of these anomalies is undetected is reason enough to reinforce it as sensible practice before insertion of any form of lung separator. In some cases a DLT will function adequately to secure lung separation, but the use of a bronchus blocker and a standard tracheal tube has proved the most suitable way of delivering operating conditions that do not inconvenience the surgical operator and of securing safe and optimal OLV.

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Sevoflurane and mivacurium in a patient with Huntington’s chorea

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There is little experience of anaesthesia for patients with Huntington’s chorea. These patients have an increased risk of intraoperative complications such as pulmonary aspiration. We present the successful anaesthetic management of a 17-yr-old patient suffering from Huntington’s chorea requiring urgent appendectomy. After rapid-sequence induction with thiopental 400 mg and succinylcholine 100 mg, anaesthesia was maintained with sevoflurane. For maintenance of neuromuscular blockade mivacurium 10 mg was administered and repeated 15 min later. Except for a short episode of postoperative shivering, the perioperative course was uneventful. Sevoflurane and mivacurium were used safely and effectively in this patient.

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Only a few case reports exist concerning the anaesthetic management of patients suffering from Huntington’s chorea.1–9 Huntington’s chorea is a rare hereditary disorder of the nervous system. Symptoms usually appear between the ages of 30 and 45 yr and include choreatic movements, progressive mental deterioration and ataxia. Early onset of symptoms is associated with more rapid and severe progression of the disease. Patients suffering from Huntington’s chorea are at higher risk of intraoperative complications, including pulmonary aspiration,1 a prolonged response to succinylcholine3 and thiopental,5 and increased sensitivity to midazolam.6 The primary goal in general anaesthesia for these patients is to provide airway protection and a rapid and safe recovery. The development of new short-acting drugs, such as propofol, has led to recommendation of a total intravenous anaesthesia (TIVA) technique,6–8 in patients with Huntington’s chorea, thus avoiding compromised postoperative recovery and the increased risk of postoperative shivering from potent inhalational agents. However, the recently introduced inhalational agent sevoflurane could eliminate the problem of prolonged recovery because of its favourable pharmacokinetic profile. Secondly, the use of the short-acting, non-depolarizing neuromuscular blocking drug mivacurium could provide adequate relaxation without

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the danger of prolonged paralysis at the end of the operation.

Case report
A 17-yr-old, 85 kg girl with a 4-yr history of Huntington’s chorea was admitted for urgent appendectomy. Her sister had died from Huntington’s chorea at the age of 25 yr. She suffered from progressive dementia and swallowing dysfunction with regurgitation, but was not taking any medication. She appeared anxious and uncooperative and did not respond appropriately to verbal commands. Laboratory investigations were normal.

To minimize the risk of aspiration, we performed rapid-sequence induction consisting of thiopental 400 mg and succinylcholine 100 mg with cricoid pressure applied. To determine the degree of muscle relaxation we used train-of-four (TOF) monitoring (Innervator; Fisher & Paykel Health Care, Auckland, New Zealand). After induction the TOF was no longer detectable and the trachea was intubated. Within 10 min, all four twitches of the TOF returned to control levels and mivacurium 10 mg was administered. Anaesthesia was maintained with fentanyl 0.25 mg and sevoflurane 1.5–2% inspired. After 15 min, a second increment of mivacurium 10 mg was given, as four twitches were detectable and the TOF ratio was >0.75. At the end of surgery, which lasted 70 min, the TOF had recovered to control values and sevoflurane was discontinued. After 5 min the patient regained consciousness and was extubated uneventfully without any reversal of residual neuromuscular block. To prevent postoperative nausea and vomiting, and thus reduce the risk of aspiration, we administered ondansetron 8 mg and ranitidine 50 mg i.v. The postoperative course was uneventful except for a short episode of shivering, which was successfully treated with pethidine 50 mg. The patient was discharged from hospital on the third postoperative day.

Discussion
Different anaesthetic techniques have been recommended for use in patients suffering from Huntington’s chorea. Spinal anaesthesia has successfully been performed in one patient. Some authors recommend using a TIVA technique and avoiding potent inhalational agents to reduce the risk of postoperative shivering and the precipitation of generalized tonic spasms. Others have used inhalational agents, such as halothane and isoflurane, without problems. In spite of recommendations to avoid potent inhalational agents, we decided to use sevoflurane to maintain anaesthesia because of its favourable pharmacological properties. It is easy to titrate and provides rapid recovery. It proved to be effective and safe in our patient; the short episode of postoperative shivering did not evoke generalized spasms and was easily treated by the administration of pethidine.

We did not find any prolonged effects from thiopental or succinylcholine, which have been found previously. The cause of the prolonged response to succinylcholine, as found in one patient in a previous report, may have been abnormal plasma cholinesterase and completely unrelated to Huntington’s chorea. The use of rocuronium for rapid-sequence induction in this patient might have been a feasible alternative, but the authors’ experience concerning rocuronium was too limited at that time. The recovery time for mivacurium was within the range reported in normal patients who have received similar doses. We could not find any evidence of altered mivacurium pharmacodynamics in our patient despite prior administration of succinylcholine.

The use of sevoflurane and mivacurium for general anaesthesia in patients suffering from Huntington’s chorea seems to be effective and safe.

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