Clinical Reports

The ultra-thin bronchoscope in management of the difficult paediatric airway

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The use of an ultra-thin flexible fiberoptic bronchoscope with a single lumen diameter of 2.7 mm at the distal tip to assist intubation of paediatric patients with a difficult airway is reported. Two patients (ages 30 months and 18 months) with mandibular hypoplasia and one patient (three months) with the Pierre-Robin syndrome are reported. In each case two fiberoptic bronchoscopes were used. The first allowed introduction of topical local anaesthetic while the second and smaller one was used for tube placement.

The use of the fiberoptic bronchoscope is widely accepted in the management of a "difficult airway" in adults.[1] However, application of this technique to infants and children has been limited by the size of available instruments. Until recently, the smallest bronchofiberscope allowed minimum tube sizes of 4.5 mm ID. Consequently, alternative techniques such as blind nasal intubation, or the "retrograde approach" are still advocated in the literature.[2,3] Another problem with the "difficult paediatric airway" is the choice of anaesthetic. Adequate immobilisation must be assured to allow atraumatic introduction of the instrument while allowing sufficient spontaneous respiration to avoid hypoxia. In 1979, Alfery *et al.*[4] reported a successful "contralateral fiberoptic nasal intubation" of a newborn with congenital ankylosis of the jaws under ketamine anaesthesia.

Key words
EQUIPMENT: bronchoscope, fiberoptic bronchoscope; INTUBATION, TRACHEAL: difficult.

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We have successfully intubated the trachea of two siblings with congenital ankylosis of the temperomandibular joints and one infant presenting with the Pierre-Robin syndrome. In all three cases direct nasotracheal intubation was performed, using an ultra-thin flexible bronchoscope with a single lumen diameter of 2.7 mm at the distal tip.

Case Reports

Case 1

The older sibling was a 30-month-old physically retarded girl (82 cm, 10 kg) with mandibular hypoplasia. Physical examination revealed a total ankylosis with complete immobility of the mandible. Between the front teeth, a residual gap of 0.4 × 3 cm allowed only minimum food ingestion. Premedication consisted of atropine 0.15 mg, IM 30 min prior to induction of anaesthesia. Monitoring included an ECG, blood pressure (oscillometry) and pulse oximetry. After preparation of the nasal airway with a vasoconstrictor (xylometazoline 0.1 per cent, 0.3 ml) and a 5 min period of preoxygenation anaesthesia was induced with intravenous ketamine (20 mg). For tracheal intubation two different bronchoscopes were used. The first allowed the introduction of the local anaesthetic while the second and smaller one was used for tube placement. First a 3.5 mm fiberscope (Olympus BF-3C4) was advanced through the right nostril. Following easy visualisation of the cords, topical anaesthesia of the larynx was achieved by injecting 0.5 ml lidocaine one per cent through the biopsy channel of the bronchoscope, which subsequently was removed. At this point a second injection of ketamine (20 mg) was given. A 3.0 mm ID armoured tube was detached from its connector, slipped over a second fiberscope ("ultra-thin" flexible bronchoscope, Olympus PF-27L, Figure 1) and attached to its proximal end with adhesive tape.

The fiberbronchoscope was then passed through the right nostril to visualise the cords and then introduced into the trachea as a guide for passage of the endotracheal tube.

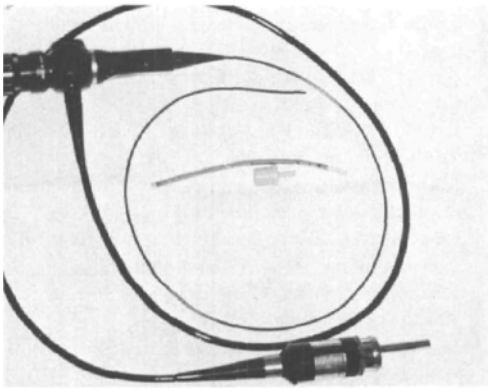

FIGURE 1 Ultra-thin flexible bronchoscope (Olympus PF-27L) with a diameter of 2.7 mm at the distal tip and a 3.0 mm ID armoured endotracheal tube.

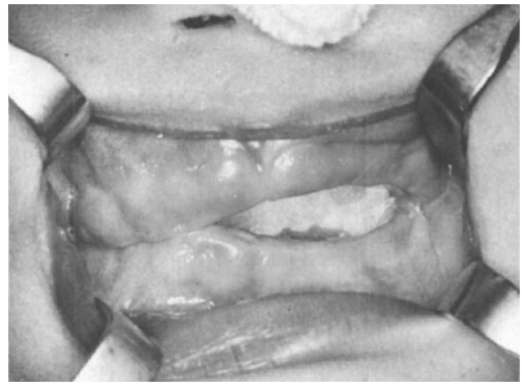

FIGURE 2 Mouth of 18-month-old boy (Case 2) with congenital ankylosis of the tempero-mandibular joints. (Mouth contains a surgical gauze pad.)

Case 2

This patient, the younger 18-month-old brother (Figure 2) was also physically retarded (71 cm, 8.6 kg). There was complete immobility of the mandible with contact of the upper and lower alveolar ridges, leaving only a frontal gap of 2.5 × 0.4 cm for nutrition. The patient breathed 100 per cent O_2 for five minutes after which anaesthesia was induced with intravenous ketamine (20 mg). The two-step fiberoptic approach described previously was carried out. For the second step a 3.0 mm ID armoured tube was slipped over the ultra-thin bronchoscope and tracheal intubation performed. The cumulative dose of 40 mg ketamine provided adequate sedation without undesirable side effects.

Case 3

A three-month-old girl with the Pierre-Robin syndrome presented for modeling of a silicone palate plate. Physical findings included a pronounced micrognathia with a maximum maxillomandibular opening of 2.0 cm, a cleft palate and glossoptosis.

Following atropine premedication and an initial dose of ketamine (1.5 $mg \cdot kg^{-1}$), given while the child was in the lateral position, the tongue was grasped with a tongue forceps to prevent obstruction. For topical analgesia of the larynx 1 ml lidocaine 0.5 per cent was injected through the biopsy channel of a 3.5 mm bronchoscope (Olympus BF-3C4). Fiberoptic pharyngoscopy revealed pronounced retropositioning of the tongue, completely obstructing the view of the larynx and requiring the use of a tongue forceps. Direct fiberoptic intubation was performed with a 3.0 mm ID armoured tube, slipped over the 2.7 mm bronchoscope.

Discussion

Congenital ankylosis of the tempero-mandibular joints with the base of the skull is extremely rare and seldom reported in the literature. Surgical intervention becomes necessary when nutrition is compromised.[5] Suggested management includes tracheostomy, blind nasal intubation or the retrograde technique. Tracheostomy in infants and young children is associated with a high incidence of complications and cannot be advocated as a standard approach.[6,7] A guided retrograde intubation requires an opening of the mouth sufficient to allow access to the posterior pharynx to grasp the catheter inserted through the crico-thyroid membrane. The extremely narrow oral gap in our patients made this manoeuvre impossible. Without an ultrathin bronchoscope, blind nasal intubation would have been the only possible management. However, numerous complications with this technique are reported in adults and children. Especially in neonates and infants application is limited by the anatomy, irritability and vulnerability of the paediatric larynx.

The major obstacle to blind nasal intubation in infants is the "boat-shaped" epiglottis, which forms an acute angle with the glottis, thus thwarting any attempt to pass the tip of the tracheal tube into the larynx. Direct vision made possible by the flexible fiberoptic instrument is invaluable in circumventing obstacles and preventing trauma to delicate structures. The lack of suitable fiberoptic instruments has led to the development of alternative techniques in the past. Stiles[8] suggested the passage of a cardiac catheter through the biopsy channel of a flexible bronchoscope into the trachea for use as a guidewire for a tracheal tube. We fear that the rigidity of such a catheter is likely to traumatize the tracheo-bronchial mucosa. Alfery *et al.*

described "contralateral nasal intubation" in which the tracheal tube is led through one nostril and the fiberscope through the other.[4] However, this would have been impossible in two of our cases as there was only one patent nostril.

Although "awake intubation" is occasionally recommended, we believe that adequate sedation is crucial for a successful outcome of fiberoptic intubation in infants.

Ketamine is sometimes quoted as unsuitable for procedures which include laryngeal manipulations.[9,10] We used it in all three cases without complications, which probably was due to atropine premedication and a careful topical anaesthesia of the larynx via the biopsy channel of the larger fiberscope. A number of publications support the use of ketamine for procedures such as we described.[4,11,12]

Our observations document that the new generation of ultrathin flexible bronchoscopes allows direct fiberoptic intubation even in infants and neonates. The diameter of the distal tip ranges from 1.8 to 2.7 mm, thus fitting into endotracheal tube sizes of 3.0 mm ID, provided the connector is detached. We recommend the use of soft, flexible armoured tubes which should be advanced with a carefully twisting motion. This precludes damage to the ultra-thin fiber bundles, a hazard only recently emphasized.[13] The development of these ultra-thin bronchoscopes makes a technique applicable to neonates and infants which was hitherto restricted to older children and adults. Further indications include the control of correct positioning of endotracheal tubes during prolonged intubation, correct placement of double-lumen tubes or endoscopic diagnosis of paediatric respiratory distress syndrome.

However, fiberoptic intubation of infants and neonates with ultrathin bronchoscopes should only be performed by anaesthetists with a broad endoscopic experience.

It should be noted that both fiberscopes described here have been replaced by the manufacturer. The BF-3C4 was succeeded by the BF-3C10 which is now fully submersible, facilitating sterilization. The Olympus PF-27L with a length of 90 cm was replaced by the PF-27M which is 55 cm long and can be disinfected easily. The diameter at the distal tip is still 2.7 mm to fit a 3.0 mm endotracheal tube without a connector.

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Résumé

On rapporte l'utilisation d'un bronchoscope flexible ultra-fin ayant à son bout distal une seule lumière d'un diamètre de 2.7 mm afin de faciliter l'intubation de patients pédiatriques présentant des difficultés des voies respiratoires. On rapporte le cas de deux patients (âges de 30 et de 18 mois) souffrant d'hypoplasie mandibulaire et d'un patient (âge de trois mois) souffrant du syndrome de Pierre-Robin. Dans chacun des cas on a utilisé deux bronchoscopes. Le premier permettait de pratiquer une anesthésie topique tandis que le second plus petit était utilisé pour installer le tube.