Correspondence

Tracheal rupture in a 12 year-old-child: a possible complication of tracheal intubation?

SIR—Tracheal rupture is a rare event in children. We report a case of early diagnosis and successful management in a 12-year-old boy who was struck by a car and suffered severe head trauma. He presented with a Glasgow Coma Scale score of 3 to the rescue team. After administration of etomidate and succinylcholine, he was intubated on the scene using an 8.0 mm inner diameter tracheal tube and transferred by helicopter to the Children's Hospital.

On arrival in the hospital, he was ventilated and well-oxygenated on FiO_2 0.5; however, breath sounds were decreased over the left hemithorax. As the insertion depth of the tracheal tube was 24 cm, endobronchial intubation was assumed, and the tube was withdrawn by 3 cm. Over the next 10 min, marked subcutaneous emphysema down to the scrotum and abdominal distension developed. Radiological studies showed a correctly positioned tracheal tube, a left-sided pneumothorax, a pneumomediastinum and a large amount of air in the abdominal cavity. In addition, there was a left-lateral orbital fracture and a large skin laceration.

The patient was transferred to theatre. A chest tube was inserted and the wound was explored. Intracranial pressure monitoring (Camino device) showed an initial pressure of 15 mmHg.

Because of increasing peak airway pressures and a huge air leak through the chest tube, fibreoptic bronchoscopy was performed by the anaesthetist. It demonstrated a 3-cm longitudinal laceration, beginning at the tip of the tracheal tube and extending nearly to the carina. Immediate advice from an otolaryngologist and a thoracic surgeon was requested. A right-sided thoracotomy was performed and the tracheal tear was covered with a doubled free pericardial flap. Airway management was problematic: fibreoptic placement of a 7.0 mm inner diameter reinforced tracheal tube into the left mainstem bronchus did not result in successful ventilation; however, tracheal positioning of the cuff provided adequate gas exchange. During surgery, the cuff was seen bulging out of the laceration. It was deflated, and ventilation was provided over 90 min by manual jet ventilation through a Cook airway-exchange device placed down the tube into the right main bronchus. The patient was extubated after 72 h and further pulmonary course was uneventful.

Tracheobronchial rupture is a rare event that has been described after blunt thoracic trauma (1,2). Basically, the aetiology in this case remains unknown. However, because of the absence of signs of major thoracic trauma, it may have been associated with the tracheal intubation: overinflation of the cuff or a laceration caused by a stylette are possible explanations (3). In this case, details of the intubation procedure or the use of a stylette were not reported; however, the tracheal tear was at the site of the inflated cuff.

This case shows that, in the presence of a massive bronchial air leak, a high index of suspicion is needed and early bronchoscopy is mandatory (1,4,5). Respiratory problems arising after repositioning of a tracheal tube are a typical feature of tracheal rupture (5). For large tears, surgical repair is recommended (6), although successful conservative management has also been reported (7).

The trend to increasing use of cuffed tubes in paediatric anaesthesia (8) raises concerns, since the unskilled use of these tubes in infants and children might increase the incidence of this type of injury.

Acknowledgements

The authors wish to thank Susan Balogh, MD, for her help in editing this manuscript.

WILHELM RUPPEN*
CHRISTOPH SCHLEGEL†
WALTER KISTLER‡
REINHARD SCHLÄPFER§
MARTIN JÖHR*
*Departments of *Anaesthesia*
†Otolaryngology
‡Paediatric Surgery and
§Cardiothoracic Surgery
Kantonsspital, Luzern
Switzerland

References

1 Baumgartner F, Sheppard B, de Virgilio Ch *et al.* Tracheal and main bronchial disruptions after blunt chest trauma: presentation and management. *Ann Thorac Surg* 1990; **50:** 569–574.
2 Symbas PN, Justicz AG, Ricketts RR. Rupture of the airways from blunt trauma: treatment of complex injuries. *Ann Thorac Surg* 1992; **54:** 177–183.
3 Striebel HW, Pinkwart LU, Karavias T. Trachealruptur durch zu stark geblockte Tubusmanschette. *Anaesthesist* 1995; **44:** 186–188.
4 Rossbach MR, Johnson SB, Gomez MA *et al.* Management of major tracheobronchial injuries: a 28-year experience. *Ann Thorac Surg* 1998; **65:** 182–186.

5 Besmer I, Schüpfer G, Stulz P *et al.* Die Trachealruptur: verzögerte Diagnose durch primär zu tiefe endobronchiale Intubation. *Anaesthesist* 2001; **50:** 167–170.
6 Kaloud H, Smolle-Juettner FM, Prause G *et al.* Iatrogenic ruptures of tracheobronchial tree. *Chest* 1997; **112:** 774–778.
7 Ross HM, Grant FJ, Wilson RS *et al.* Nonoperative management of tracheal laceration during endotracheal intubation. *Ann Thorac Surg* 1997; **63:** 240–242.
8 James IG. Cuffed tubes in children. *Paed Anaesth* 2001; **11:** 259–263.

How to manage the unavailability of an appropriately sized uncuffed tracheal tube?

SIR—Frequently, we cannot find an uncuffed tracheal tube (TT) size that permits leakage at 20–30 (1,2) or 20–25 (3) cmH_2O of airway pressure. If there is no leak at airway pressures greater than 35–40 cmH_2O, the risks of airway injury must be weighed against the potential problems caused by a TT of smaller lumen (1). As postintubation croup is associated with tight TT fit (3), gauze may be packed into the oral cavity to cope with excessive leakage around a smaller TT. Unless removed before extubation, however, a throat pack or its debris may result in airway obstruction. In case we are using a cuffed TT instead of uncuffed TT, we have to use a 0.5 mm smaller (1) or 1 mm smaller (4) TT, and continue to devote careful attention to the intracuff pressure, especially during inhalational anaesthesia with N_2O.

The advantage of the outer diameter (OD) of uncuffed TT was emphasized for paediatric anaesthesia (5). Coincidentally, we were preparing a similar suggestion that, without an appropriately sized uncuffed TT, we may solve the problem by choosing a TT of a different kind or make with a different OD. However, it does not seem to be easy to find a TT larger or smaller than the preceding one by a constant difference in OD.

One range of uncuffed TTs with increasing OD can be given as an example: the OD [internal diameter (ID)] of uncuffed TT (Contour: Mallinckrodt Medical, Athlone, Ireland) are 4.9 (3.5), 5.6 (4.0), 6.2 (4.5) and 6.9 (5.0) mm. The OD of ID 3.5 uncuffed reinforced TT (Mallinckrodt Medical) is 5.2 mm. The OD (ID) of another kind of uncuffed TT (Satin Soft: Mallinckrodt Medical) are 6.0 (4.0) and 6.5 (4.5) mm. [All data about OD are from the manufacturer's catalogue.]

When the selected TT seems a little looser or tighter than appropriate, the advantages of switching to another type or make of TT of the same ID or one-size smaller ID as a next available choice are: (i) use of low fresh gas flow, (ii) reduction of air contamination, (iii) avoidance of repeated laryngoscopy, (iv) reduced risk of aspiration and postintubation croup and (v) avoidance of the increased airway resistance in the unlikely event of using a cuffed TT. Disadvantages of this practice are the price of special TT and the higher airway resistance compared with, if it were to exist, the use of a conventional TT with an ideal fit.

Acknowledgement

Support was provided solely from departmental sources.

J.-H. BAHK
W.-S. AHN
Department of Anesthesiology and Clinical Research Institute Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Korea

References

1 Motoyama EK. Endotracheal intubation. In: Motoyama EK, Davis PJ, eds. *Smith's Anesthesia for Infants and Children*, 5th edn. St Louis: CV Mosby, 1990: 269–290.
2 Cot CJ. Pediatric anesthesia. In: Miller RD, ed. *Anesthesia*, 5th edn. Philadelphia: Churchill Livingstone, 2000: 2088–2117.
3 Rice LJ, Cravero J. Pediatric anesthesia. In: Barash PG, Cullen BF, Stoelting RK, eds. *Clinical Anesthesia*, 3rd edn. Philadelphia: Lippincott-Raven Publishers, 1997: 1115–1124.
4 Khine HH, Corddry DH, Kettrick RG *et al.* Comparison of cuffed and uncuffed endotracheal tubes in young children during general anaesthesia. *Anesthesiology* 1997; **86**: 627–631.
5 Malhotra SK, Dutta A. Pediatric endotracheal tubes: the advantage of outer diameter. *Anesth Analg* 2001; **93**: 801–802.

The sitting or prone position for posterior fossa surgery?

SIR—We read with interest the paper by Orliaguet *et al.* (1) comparing the sitting or prone position for posterior fossa surgery in children. We were surprised that the authors did not mention the risk of paradoxcal embolism through a patent foramen ovale while discussing the drawbacks or risks of the sitting position. Furthermore, they did not include a preoperative cardiac investigation looking for a patent forearm ovale.

We wonder what the authors would do in the case of patent foramen ovale? We routinely use the sitting position for posterior fossa surgery but we think that the risk of paradoxical embolism must be weighed against the advantages of the sitting position in case of patent foramen ovale. This should be included in the preoperative

evaluation of the patient and in the informed consent obtained from parents.

DANIEL VISCHOFF*
PIERRE LIMOGES*
CLAUDE MERCIER†
*Departments of *Anesthesiology and †Neurosurgery*
Sainte-Justine Hospital
Montreal, Quebec
Canada

Reference

1 Orliaguet GA, Hanafi M, Meyer PG *et al.* Is the sitting or the prone position best for surgery for posterior fossa tumours in children? *Paed Anaesth* 2001; **11:** 541–547.

Authors' reply

SIR—We appreciate the letter from Dr Vischoff *et al.* We agree with the authors that the risk of paradoxical air embolism (PAE) through a patent foramen ovale (PFO) must be weighed against the advantages of the sitting position. We are aware that autopsy studies demonstrate that PFO occurs in 20 to 35 of the general population, and that the overall risk for PAE for adult patients in the sitting position has been estimated at 6–12 (1). However, the incidence of PAE in children in the sitting position is not known. Moreover, we would like to comment further on the interest of diagnosing a PFO in the preoperative period.

Although the sitting position has been implicated in the occurrence of venous air embolism (VAE), the alternative prone or lateral positions does not guarantee that this complication will not occur (2–4). In our experience, before using military antishock trousers (MAST) and positive endexpiratory pressure (PEEP), we observed a 26 incidence of clinically significant VAE in children undergoing neurosurgery in the sitting position. In contrast, following the use of a MAST suit and PEEP, this incidence decreased to less than 2 (5,6). In addition, in one patient who had an operation in the sitting position before the use of a MAST suit and PEEP, and who experienced a severe VAE with delayed recovery and severe residual disability, there was no echocardiographic evidence of a PFO (5). In fact, and as previously suggested, there may be other cause of PAE than PFO, including transpulmonary air passage (7). We think that neurosurgery in the sitting position in children is a safe procedure provided that a MAST suit and PEEP are used, and jugular venous compression is performed to detect a potential site of air entry before VAE occurs (8,9). In addition, since PAE is a rare complication which may occur in the absence of PFO (5,7) and alternative positions do not totally exclude the risk of VAE (2–4), and also that perioperative complications are primarily related to the surgical procedure or associated diseases rather than VAE or the sitting position (10), we do not systematically include a preoperative cardiac investigation looking for a PFO. Finally, weighing the potential risk of PAE (we have not seen one in the last 7 years) against the advantages of the sitting position (performed in the strict conditions described above), we have decided that the familiarity and confidence of our paediatric neurosurgeon with this position represents a more important determinant of the final outcome for children than the potential risk of PAE. Therefore, we do not perform a preoperative investigation that will not modify our intraoperative management of the patients and will not contraindicate the sitting position.

GILLES ORLIAGUET
PHILLIPE MEYER
Department of Anesthesiology and Critical Care
Groupe Hospitalier Necker Enfants Malades
Paris, France

References

1 Fuchs G, Schwarz G, Stein J *et al.* Doppler color-flow imaging: screening of a patent foramen ovale in children scheduled for neurosurgery in the sitting position. *J Neurosurg Anesthesiol* 1998; **10:** 5–9.
2 Cucchiara RF. Safety of the sitting position. *Anesthesiology* 1984; **61:** 790.
3 Harris MM, Strafford MA, Rowe RW *et al.* Venous air embolism and cardiac arrest during craniectomy in a supine infant. *Anesthesiology* 1986; **65:** 547–550.
4 Harris MH, Yemen TA, Davidson A *et al.* Venous embolism during craniectomy in supine infants. *Anesthesiology* 1987; **67:** 816–819.
5 Meyer PG, Cuttaree H, Charron B *et al.* Prevention of venous air embolism in paediatric neurosurgical procedures performed in the sitting position by combined use of MAST suit and PEEP. *Br J Anaesth* 1994; **73:** 795–800.
6 Orliaguet GA, Hanafi M, Meyer PG *et al.* Is the sitting or the prone position best for surgery for posterior fossa tumours in children? *Paed Anaesth* 2001; **11:** 541–547.
7 Bedell EA, Berge KH, Losasso TJ. Paradoxic air embolism during venous air embolism: transesophageal echocardiographic evidence of transpulmonary air passage. *Anesthesiology* 1994; **80:** 947–950.
8 Losasso TJ, Muzzi DA, Cucchiara RF. Jugular venous compression helps to identify the source of venous air embolism during craniectomy in patients in the sitting position. *Anesthesiology* 1992; **76:** 156–157.
9 Takahashi T, Yano K, Kimura T *et al.* Prevention of venous air embolism by jugular venous compression under superior sagittal sinus pressure monitoring in a brachycephalic patient during craniofacial reconstruction. *Paed Anaesth* 1997; **7:** 259–260.
10 Young ML, Smith DS, Murtagh F *et al.* Comparison of surgical and anesthetic complications in neurosurgical patients experiencing venous air embolism in the sitting position. *Neurosurgery* 1986; **18:** 157–161.

Use of the Laryngeal Mask Airway™ in mucopolysaccharidoses

SIR—The mucopolysaccharidoses are a group of inherited metabolic disorders in which an enzymatic abnormality leads to abnormal accumulation of mucopolysaccharides in different body tissues. One of the major anaesthetic problems in these patients is difficulty in airway management and tracheal intubation. They have a short neck, high larynx, a small hypopharynx, limited atlantoaxial mobility, macroglossia, thickened oral soft tissues, long immobile epiglottis and a narrow larynx and trachea (1,2). The Laryngeal mask airway (LMA™) has been used in difficult intubations and has earned a place in the difficult airway algorithm (3). Its role in the above group of patients has not yet been defined (2).

Our experience relates to a 9-year-old, partially deaf and blind female child with Hurler's syndrome, weighing 16 kg, who presented with hoarseness and obstructive sleep apnoea and was scheduled for bilateral nasal polypectomy. Awake fibreoptic intubation was ruled out because of mental retardation. The child was not given any premedication and was induced with 100 oxygen and sevoflurane. Deepening of anaesthesia resulted in complete loss of airway. Attempts to lift the jaw were unsuccessful. Insertion of a size 2 LMA resulted in an adequate airway and a good P_ECO_2 tracing, but positive pressure ventilation was unsuccessful through this. Exchange of the LMA to a larger size (2.5) again led to the loss of airway. After deepening the anaesthesia, a direct laryngoscopy was attempted but structures could not be identified due to folds of mucosa. A thin gum elastic bougie when inserted through the LMA resulted in oesophageal intubation. On insertion of the fibreoptic laryngoscope through the LMA, the laryngeal inlet could not be identified and there was suspicion of the presence of a mucosal polyp above the opening. A decision was taken to perform tracheostomy and a size 4.5 tube was inserted in a relatively narrow trachea. After tracheostomy, the surgeon attempted direct laryngoscopy using a straight blade, at which a very anterior epiglottis and large arytenoids covered with folds of mucosa were seen but the vocal cords or larynx could not be visualized.

It appears that although the anterior part of the LMA was sitting on the laryngeal inlet, the posterior part was not fitting snugly because of the narrowness of the inlet. This resulted in the bougie slipping into the oesophagus. Positive pressure ventilation was probably not possible because of the folds of mucosa covering the larynx and large floppy arytenoids acting as ball valves during positive pressure ventilation.

It appears that LMA has a limited but crucial place in the airway management of Hurler's syndrome cases. Although intubation was not possible through an LMA, it allowed time for other alternate measures to be instituted in a controlled manner.

FAUZIA ANIS KHAN
FAZAL HAMEED KHAN
Department of Anaesthesiology
The Aga Khan University Hospital
Stadium Road
PO Box 3500
Karachi 74800
Pakistan

References

1 Sjogren P, Pederson T, Steinmetz H. Mucopolysaccharidoses and anaesthetic risks. *Acta Anaesthesiol Scand* 1987; **31**: 214–218.
2 Moores C, Rogers JG, McKenzie IM *et al.* Anaesthesia for children with mucopollysacchroidosis. *Anaesth Intens Care* 1996; **24**: 459–463.
3 Benumof JL. Laryngeal mask airway and the ASA difficult airway algorithm. *Anesthesiology* 1996; **84**: 686–699.