Clinical Reports

Intraoperative aspiration in a paediatric patient

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Aspiration around uncuffed endotracheal tubes in paediatric patients is an uncommon event. Uncuffed endotracheal tubes are commonly used in paediatrics even when the risk of gastric aspiration is significant. A case history is presented of an 8½-year-old who aspirated during a laparotomy for bowel obstruction. The patient was intubated with an uncuffed #6.0 Portex endotracheal tube. A small leak was noted during positive pressure ventilation. The aspiration was significant such that the patient required 24 hours of positive end-expiratory pressure (PEEP) in an intensive care unit.

Uncuffed endotracheal tubes are used because post-intubation stridor is minimized, the lungs are compliant and the funnel-shaped trachea is more likely to secure the airway from aspiration. An uncuffed tube however, does not completely seal the airway, particularly in the presence of an audible "leak." As a result of this case, we now consider the use of a cuffed endotracheal tube in children whenever a 5.5 internal diameter or larger is required. When the risk of pulmonary aspiration is present, the cuff is inflated to reduce the likelihood of contamination of the airway.

Key words

COMPLICATIONS: aspiration; ANAESTHESIA: paediatric.

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Uncuffed endotracheal tubes are used commonly in paediatric anaesthesia, even when the risk of gastric aspiration is significant. The following case report describes an 8½-year-old child who aspirated during surgery while the airway had been secured with an uncuffed endotracheal tube.

Case report

An 8½-year-old male was admitted with a five-day history of nausea, vomiting, and mild abdominal pain. He had not taken anything by mouth for 12 hours. He had ingested no solids for five days. His past history included a laparotomy for appendectomy and Meckel's diverticulectomy at six years of age. Review of systems was unremarkable. He weighed 27 kg, was 137 cm tall, had a blood pressure of 140/80 torr, heart rate 100 bpm, respirations 29 breaths per minute and temperature 36°C. The abdomen was distended and tympanitic with periumbilical tenderness. There were no signs of peritonitis. The bowel sounds were present and a nasogastric tube was in place. The remainder of the physical examination was normal. The preoperative diagnosis was obstruction of the lower bowel. The patient was scheduled for a laparotomy. The preoperative laboratory findings included haemoglobin 141 g·L⁻¹, serum sodium 133 mmol·L⁻¹, serum potassium 4.3 mmol·L⁻¹, serum chloride 96 mmol·L⁻¹, glucose 6.4 mmol·L⁻¹ and urea 4.7 mmol·L⁻¹. Urinalysis was normal.

On arrival in the operating room, the patient was monitored with an electrocardiogram, precordial stethoscope, axillary temperature probe, blood pressure cuff and doppler ultrasound on the radial artery. A #20 gauge intravenous catheter was *in situ*. A rapid sequence induction was used, consisting of thiopentone 5 mg·kg⁻¹, atropine 0.02 mg·kg⁻¹ and succinylcholine 1 mg·kg⁻¹. Cricoid

pressure was applied at the onset of loss of consciousness. The patient was intubated without difficulty with a 6.0 mm uncuffed endotracheal tube (Portex). Air entry was present and equal in both lung fields. A leak around the endotracheal tube was present at a peak inspiratory pressure of 15 cm H₂O. Anaesthesia was maintained with an inspired halothane concentration of 1.5 per cent, 6 L/N₂O, 4 L/O₂ and d-tubocurarine.

The patient was found to have an adhesion band with obstruction and ischaemia of the terminal ileum. The adhesions were lysed and the small bowel was decompressed proximally and cephalad, to the stomach. In an effort to aid in this decompression, the nasogastric tube was suctioned vigorously. Two hundred ml of thick bowel contents were aspirated through the nasogastric tube. Minutes after this decompression, the peak airway pressure suddenly increased. Auscultation of the chest revealed bilateral rhonchi. Laryngoscopy revealed a significant amount of bowel contents in the oropharynx. Suctioning of the endotracheal tube demonstrated similar material in the distal trachea. The patient's vital signs remained unchanged. The inspired O₂ concentration was increased to 60 per cent and an arterial blood gas sample was drawn from a radial artery five minutes later (pH 7.40, PCO₂ 39 mmHg, PO₂ 58 mmHg). The inspired O₂ concentration was increased to 100 per cent and 5 cm of PEEP was added. A second arterial sample was drawn 50 minutes later (pH 7.40, PCO₂ 53 mmHg, PO₂ 125 mmHg). At the completion of surgery, the oral endotracheal tube was changed to a #6.5 nasotracheal tube. This tube had a small leak at 20 cm H₂O positive pressure. A chest x-ray was taken prior to transfer to the ICU. This demonstrated the endotracheal tube to be in good position and indicated changes in the left upper lobe compatible with aspiration. In the Intensive Care Unit, the patient received IPPB with 10 cm H₂O PEEP and FiO₂ of 0.6. He was treated with intravenous antibiotics (clindamycin and gentamycin) and was sedated with a morphine infusion for 24 hours. The following day, the patient was extubated and transferred to the ward. There were no long-term sequelae as a result of the pulmonary aspiration.

Discussion

The accepted practice for patients with full

stomachs at The Hospital for Sick Children in Toronto is to intubate those less than 11 years old with uncuffed endotracheal tubes. The upper limit of 11 years for uncuffed tubes is used because oversized tubes cause pressure necrosis at the level of the cricoid.¹ The diameter of the cricoid ring does not approach that of the rima glottidis until 14 years of age,² and these young patients can be readily ventilated without the aid of a cuffed endotracheal tube. In addition, the consequences of a minimal aspiration which might occur in the presence of an uncuffed tube are minor^{3,4} compared to the long-term consequences of pressure necrosis of the tracheal epithelium.

There is some disagreement about the lower age limit one should begin to use a cuffed endotracheal tube. Smith³ uses cuffed tubes in six-year-olds. Gregory⁵ recommends the use of a cuff in pre-pubescent children and Graves⁶ suggests their use starting at age eight.

Whether or not cuffed endotracheal tubes reduce the incidence of aspiration in children is controversial.^{4,7} Browning *et al.*⁷ studied the incidence of silent aspiration in intubated children. The incidence of aspiration in the presence of uncuffed tubes was 77 per cent whereas the incidence of aspiration in patients with cuffed endotracheal tubes was only 11 per cent. Goitein *et al.*⁴ concluded that uncuffed endotracheal tubes which adequately seal the trachea will prevent clinically significant aspiration in infants and children. However, the authors used endotracheal tubes which fit very snugly. They noted that if an obvious air leak was present the endotracheal tube was changed to a larger size. The risk of snug-fitting endotracheal tubes is noted by Way *et al.*¹ who studied lesions produced by endotracheal tubes placed in the trachea of monkeys. He stated that "the use of an oversized endotracheal catheter appears to be a satisfactory means of consistently producing ulceration of the tracheal mucosa." He suggested that the cricoid cartilage prevented the mucosa and submucosa from yielding to the pressure of the endotracheal tube. Eckenhoff⁸ also observed that the cricoid ring was a problem area in children.

The above observations are a result of our experience with this one patient. Further studies where large numbers of children could be followed are needed to support our conclusions. However, as a result of the above case discussion, cuffed

endotracheal tubes from size 5.5 are now available for patients with a risk of a full stomach. The cuff is inflated carefully to a point where the leak is minimal. Such a practice eliminates the necessity of endotracheal tube changes because of inappropriate size selection. In this case had we inserted a #5.5 or #6.0 cuffed endotracheal tube, we could have readily inflated the cuff and possibly avoided the pulmonary aspiration. Other measures which might have affected the outcome of this case, include less vigorous decompression of the bowel and the presence of a large-bore nasogastric tube which could have drained all of the gastric contents.

In the past, we have always observed for a "good leak" prior to securing the endotracheal tube. In this particular case a "good leak" was actually a "bad leak" as this may have led to clinically significant pulmonary aspiration.

References

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Résumé

L'aspiration autour des tubes endotrachéaux pédiatriques sans ballonnet est peu fréquente. Les tubes endotrachéaux sans ballonnet sont souvent utilisés en anesthésie pédiatrique même si le risque d'aspiration bronchique est chez un patient âgé de huit ans et demi lors d'une laparotomie pour obstruction intestinale est présenté. Le patient a été intubé avec un tube endotrachéal sans ballonnet Portex #6.0. Une légère fuite a été noté lors de la ventilation à pression positive. L'aspiration bronchique a été significative à tel point que le patient a requis un traitement de 24 heures à l'unité des soins intensifs avec de la PEEP.

Les tubes endotrachéaux sans ballonnet sont utilisés afin de minimiser le stridor post-intubation; les poumons étant compliants et la trachée ayant la forme d'un entonnoir protégeant probablement ainsi les voies aériennes contre le risque d'aspiration bronchique. Cependant un tube sans ballonnet ne ferme pas complètement les voies aériennes particulièrement en présence d'une fuite perceptible. A la suite de ce cas on considère actuellement l'utilisation de tubes endotrachéaux avec ballonnet chez les enfants lorsque le tube de diamètre interne de 5.5 ou plus est requis. Quand le risque d'aspiration bronchique est présent le ballonnet est gonflé afin de diminuer la possibilité de contaminer les voies aériennes.