Optimally fitted endotracheal tubes decrease the probability of postextubation adverse events in children undergoing general anesthesia

P Suominen, T Taivainen, N Tuominen, V Voipio, K Wirtavuori, A Hiller, R Korpela, T Karjalainen, O Meretoja
Department of Anesthesia and Intensive Care, Hospital for Children and Adolescents, Helsinki, Finland

Background: The air leak test is recommended for assessing the appropriate size of an uncuffed endotracheal tube (ETT) in children (1,2). A properly fitting ETT should allow for an air leak of around 20 to 25 cmH\textsubscript{2}O ventilating pressure, in order to minimize the risk of mucosal ischaemia at the cricoid ring and adverse events after removal of ETT (1,3). Our objectives were to determine whether when using modern siliconised ETTs there is a certain threshold air leak value beyond which there is a higher risk for adverse events after the removal of the ETT and to define other risk factors related to extubation.

Methods: We enrolled 234 cases ranging from newborn to nine years of age requiring tracheal intubation for elective or emergency surgery. General anesthesia was induced by a mask or intravenously. The endotracheal tube size was calculated using the formula: (age (yr)/ 4) +4.5. After the induction of anesthesia, the patient’s trachea was intubated and the correct position was confirmed. The attending anesthetist assessed the leak pressure. Incidences of adverse events (prolonged or barking cough, obstructed or prolonged inspiration or expiration, subcostal and sternal retractions, arterial desaturation, or laryngospasm) were recorded after removal of ETT. A statistical comparison was made between a group of patients with an audible air leak at threshold pressures 20, 25, 30 and 35 cmH\textsubscript{2}O and a group of patients with an absent air leak over the same pressure range. The 2x2 cross tabulations with Fisher’s exact test were used for the statistical comparison of data. In addition, relative risks with 95 % confidence intervals were computed. Logistic regression was used to compare the impact of explanatory covariates on each binary response variable. A P-value less than 0.05 was considered statistically significant.

Results: Ten patients were excluded from the study. A total of 218 children underwent 224 operations under general anesthesia. Twenty-five cmH\textsubscript{2}O pressure was a threshold value and an audible air leak at 25 cmH\textsubscript{2}O or below was associated with a significantly (p=0.04) lower incidence of postextubation adverse events compared with an absent air leak at this pressure (9 vs. 19 per cent). The other significant risk factor for postextubation adverse events was anesthesia experience 6 months or less (p=0.02) while age, ASA status, operation type, premedication, duration of intubation and extubation awake or asleep were not significantly associated with adverse events after extubation. Children who had an absent air leak at 25 cmH\textsubscript{2}O pressure had 2.8 times more adverse events during emergence from anesthesia than those with an audible air leak. Adverse events after the removal of ETT were 3.7 times more likely to occur in children whose anesthesia was provided by a less experienced anesthesia trainee. Continuous positive pressure on the airway, 100% oxygen and intravenous lidocaine (1mg/kg) were used for treatment of the adverse events. None of the patients received muscle relaxants or required reintubation.

Discussion: Adverse events after removal of ETT were more likely to occur in children with an absent air leak at 25 cmH\textsubscript{2}O pressure and in children whose anesthesia was provided by less experienced anesthetist. Anesthesiologists must keep in mind that the pressure at which an air leak is detected is equal to the pressure exerted on the mucosa at the cricoid ring, the narrowest part of the trachea, and the air leak pressure should not exceed the perfusion pressure of the mucosa. Seegobin et al. (3) showed that continuous elevated pressure above 30 cmH\textsubscript{2}O compromises mucosal capillary blood flow in the tracheas of adults. The tracheal mucosal perfusion pressure is unknown in children but it is most likely lower than in adults.

Refs:
2. Finholt D.A. et al., Anesthesiology, 1984