SELECTED ARTICLES

Pediatric prehospital endotracheal intubation

Reviewers: Warren Thirsk, MD; Michael J. Bullard, MD
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Clinical question
Is endotracheal intubation (ETI) superior to bag valve mask (BVM) alone for prehospital pediatric airway management?

Article chosen
Gausche M, Lewis RJ, Stratton SJ, Haynes BF, Gunter CS, Goodrich, SM, et al. Effect of out-of-hospital pediatric endotracheal intubation on survival and neurological outcome: a controlled clinical trial. JAMA 2000;283:783-90.

Objective
To determine whether BVM ventilation followed by endotracheal intubation (ETI) improves survival to hospital discharge or neurological outcomes in pediatric patients requiring prehospital airway management, when compared to BVM alone.

Background
Most emergency medicine services (EMS) systems train for pediatric intubation, but retrospective reviews reveal that success rates are lower and complication rates higher for children than adults. Complications include incorrect tube size, mainstem bronchus insertion, esophageal placement and suboptimal drug utilization. Pediatric intubation is difficult, and there are limited opportunities for prehospital care providers to maintain their skill level. The question of whether prehospital intubation improves patient outcomes remains to be answered.

Population studied
Children were eligible if they were under 12 years of age or less than 40 kilograms in estimated weight, and if they had one of the following indications for airway management: apnea or cardiopulmonary arrest of any cause, respiratory failure (respiratory rate <12 or >60 breaths/min combined with decreased level of consciousness), severe partial or complete airway obstruction, head trauma with decreased pain response, and paramedic discretion. Ten important subgroups were identified a priori, including sudden infant death, submersion, head injury, poly-trauma, foreign body aspiration, status epilepticus, child maltreatment, cardiopulmonary arrest, respiratory arrest and reactive airway disease.

Setting
The study was performed in 2 large, 2-tiered (basic and advanced life support [ALS]) urban California EMS systems. All paramedics received standardized mannequin training in pediatric BVM and ETI prior to enrolling patients.

Study design
This controlled clinical trial took place over a 3-year period. On odd calendar days, patients received only BVM ventilation; on even calendar days, BVM was followed by ETI. An "intubation attempt" was defined as placement of a laryngoscope blade in the patient's mouth, and an "intubation success" was defined as an endotracheal tube in the trachea or main stem bronchus. Prehospital data were prospectively gathered on arrival to an emergency department, and survival and neurological outcome data were subsequently collected from hospital, coroner and EMS records. An elaborate, 3-level independent monitoring system was used to ensure patient safety.

Outcomes
The primary outcome was survival to hospital discharge. The secondary outcome was neurological function at hospital discharge, based on a modified Pediatric Cerebral Performance Category Scale with the following categories: normal or baseline, mild disability, moderate disability, severe disability, coma, or death.

Results
A total of 830 patients were enrolled, with 410 assigned to BVM and 420 to ETI. Baseline characteristics were similar

between groups, suggesting balanced allocation. Ten patients were lost to follow-up. There was significant crossover — 10 BVM patients were intubated and 115 intubation patients received only BVM — but data were analyzed on an intention-to-treat basis. Survival to discharge was 30.4% in the BVM group and 26.4% in the ETI group (odds ratio [OR], 0.82; 95% confidence interval [CI], 0.61–1.11). Neurological outcomes were also similar: 92 (22.8%) of 404 BVM patients and 85 (20.4%) of 416 ETI patients were normal or had mild disability at discharge. Three clinical subgroups (respiratory arrest, foreign body aspiration, child maltreatment) had significantly lower survival rates in the intubation group.

Intubation was attempted in 305 (73.3%) of 416 ETI patients and was successful in 177. Median scene time was 2 minutes longer for ETI patients, but total out-of-hospital time was under 25 minutes in both groups. General airway complications (gastric distension, vomiting, aspiration or airway trauma) occurred equally in 47% of BVM and 49% of ETI patients. Of concern, complications specific to intubation occurred in 107 (58%) of the intubated patients, including 3 (1.6%) esophageal intubations, 12 (6.5%) unrecognized dislodgements, 15 (8.1%) recognized dislodgements, 33 (17.8%) main stem intubations and 44 (23.6%) incorrect tube size. Only 1 of 15 patients with esophageal intubation or unrecognized ET displacement survived.

Study conclusions

The addition of ETI to BVM for the management of the prehospital pediatric airway in a rapid-transport EMS system does not improve survival or neurological outcomes. Pediatric intubation has a high complication rate, adds to scene time in the critically ill, and should be forsaken in favour of BVM in urban EMS systems.

Commentary

Many physicians and EMS experts have concerns about expanding the scope of prehospital practise without evidence of benefit. This study suggests that, in an urban setting, BVM is as effective as nonpharmacologically supported ETI for a wide variety of prehospital pediatric patients requiring airway support. Further, it shows that prehospital research is viable and demonstrates one way to overcome the safety and randomization hurdles that have made prospective prehospital trials rare.[1]

Study strengths

A strong point of this study is its intention-to-treat analysis, which minimizes the inherent bias that sicker patients are more likely to be intubated. To illustrate, analysis on-treatment showed markedly different survival rates: 33% in the BVM group vs. 14% in ETI patients. Another strength of this study was the prospective collection of complication data, which would limit recall bias and underestimation that likely occurred in previous retrospective reviews.[2,3] Some criticize the even-day/odd-day patient allocation mechanism, which is not truly random, but prehospital randomization is difficult, and the alternate day methodology has been employed in previous prehospital studies.

Shortfalls

This study lacks the power to detect small yet potentially important outcome differences, especially among the various subgroups. In addition, while the low ETI attempt and success rates are comparable to other retrospective reviews,[2,4] it is unclear whether these low rates are due to anatomical challenges posed by the pediatric airway, inadequate pediatric intubation skills, or the lack of sedation and neuromuscular blockade options.

The training methods used may reduce external validity of the study data. Losek and colleagues[5] showed that, in children <18 months of age, Pediatric ALS training with supervised pediatric intubations in the operating room improved prehospital ETI success rates from 48% to 89%. But in this study, paramedics received only mannikin training. Retrospective data suggest that sedatives and neuromuscular blockers increase intubation success rates and reduce complication rates for aeromedical and ground-based paramedics,[3,6,7] but paramedics in this study lacked access to such agents.

This study was performed in a short-transport urban system, but BVM complications like gastric distension may be more significant with prolonged transport times; therefore these results may not apply to EMS systems with longer out-of-hospital times, nor to air transport systems where the potential benefits of airway protection with ETI may more clearly outweigh the risks.

The main benefit of this study is not that it proved ETI unnecessary, but rather that it challenged prehospital EMS providers to use stronger prospective methodology to evaluate new and already existing ALS interventions.

Competing interests: None declared.

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Which emergency department patients with minor head injuries require computed tomography?

Clinical question

Can a highly sensitive clinical decision rule be developed to determine which patients presenting to the emergency department (ED) with minor head injuries require computed tomography (CT)?

Article chosen

Stiell IG, Wells GA, Vandemheen K, Clement C, Lesiuk H, Laupacis A, et al. The Canadian CT Head Rule for patients with minor head injury. Lancet 2001;357:1391-6.

Objective

To determine if a highly sensitive and clinically sensible decision rule can be developed to guide the use of CT scanning in adults with minor head injuries.

Background

Despite an estimated one million annual ED visits in North America for minor head injuries, there is currently no methodologically sound and valid clinical decision rule to safely identify those patients not requiring a CT scan of their head. Previous studies have demonstrated up to a 4-fold variation in the ordering of CT among similar teaching facilities in Canada. In addition, the prevalence of significant intracranial lesions identified on a CT scan following minor head injury has been estimated to be between 0.7% and 3.7%. A highly sensitive clinical decision rule could improve the emergency management of patients and standardize the approach to patients with minor head injuries, therefore leading to significant cost savings.

Population studied

Inclusion criteria required all 3 of the following: 1) blunt trauma to the head resulting in definite amnesia, witnessed loss of consciousness or disorientation; 2) initial ED Glasgow Coma Scale (GCS) score of >13; and 3) injury within the past 24 hours. Exclusion criteria included age <16 years, no history of trauma as the primary event (e.g., primary seizure or syncope), obvious penetrating skull injury or depressed fracture, acute focal neurological deficit, major trauma with unstable vital signs, seizure prior to ED assessment, bleeding disorder or anticoagulant use, a return to the ED for reassessment of the same head injury, or pregnancy.

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Study design

Ten large Canadian hospitals participated in this prospective cohort study. The physician assessors were trained to assess patients for 22 standardized findings from the history, physical examination and neurological assessment. After clinical examination, patients underwent CT based on the judgement of the treating physician. CT scans were interpreted by neuroradiologists who were unaware of the defined clinical predictors. Reliability of radiographic interpretations was assessed by having all abnormal scans and 5% of randomly selected normal scans reviewed by a second radiologist who was unaware of the initial interpretation. There was 100% intrarater agreement for all scans.

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