

Common Complications of Endotracheal Intubation in Newborns

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Abstract

Objective

The purpose of this study was to assess the frequency of complications of endotracheal intubation (ETI) in neonates.

Methods

The newborns that were admitted and needed urgent or semi-urgent intubation were enrolled in this study over a 1 year period. Route for intubation in all cases were orotracheal. Cases were not routinely sedated or paralyzed. The patients were clinically and radiographically assessed.

Results

Of 233 newborn infants who were admitted to the neonatal intensive care unit (NICU) at the Children's Medical Center, 60 infants were intubated. A total of 131 attempts were documented. Unsuccessful attempts with difficult intubation were 17(13%); successful intubation attempts were 114(87%). Complications were detected in 69 cases (61%). The most common complication was laryngeal injury (24%). Accidental extubation was the most frequent event (12%). Tube blockage 7% and endotracheal tube (ETT) malposition was 3%. The complications were less during placement of ETT (12%), but were high during maintenance (61%) and removal of the endotracheal tube (28%). 47% of patients required repeated intubation. There was a significant statistical difference between complications of medicated and unmedicated patients. There was no significant statistical difference relative to gestational age, route of delivery, sex, birth weight, and length of time the ETT remained in place.

Conclusion

Trauma to the larynx and vocal cords were the most common complications. Difficult and repeated intubation played a major role. Premedication for non-urgent or semi-urgent intubation was safer and more effective than awake intubation. We did not assess long-term outcomes associated with endotracheal tube intubation; this was a limitation of the present study. Operator skill and post-operative care are confounding variables that may influence the results.

Key words

Endotracheal tube, intubation, newborn, tube complications

Abbreviations:

ETT: Endotracheal tube

NICU: Neonatal intensive care unit

NRP: Neonatal resuscitation program

ETI: Endotracheal intubation

Bpm: Beats per minute

Introduction

Complications attributable to intubation increase morbidity and may increase the mortality rate. There have been few reports of

overall complications and no recent reports in newborns. A number of complications during and following ETI in infants are described in the literature including acute and chronic complications. James Blundell (1790-1878) was the first to use a mechanical device for tracheal intubation in newborns⁽¹⁾. Tracheal intubation is performed frequently in the neonatal intensive care units and delivery rooms. This procedure is extremely distressing, painful and has the potential for airway injury⁽²⁾. The potential short

term complications are described and include: Tracheal tube complications (malpositioning or displacement, occlusion of tube from thickened secretions, accidental tube extubation), respiratory complications (apnea, oropharyngeal aspiration, atelectasis, pneumothorax, pneumonia), systemic complications (hypoxia, bradycardia, hypertension, infection), acute trauma (contusions or lacerations of tongue, gums, pharynx, epiglottis, trachea, vocal cord, esophagus, perforation of esophagus or trachea) hemorrhage, effects on oral structures⁽³⁻⁵⁾. Some complications may be transient and clinically insignificant, but others may persist into later life causing various degrees of anatomic and functional disability including chronic trauma (glottis/sub glottis stenosis, granuloma or cyst)⁽⁴⁾. The objective of this study was to determine the frequency of short-term complications of urgent / semi-urgent endotracheal intubation.

Method

The Tehran University of Medical Sciences (TUMS), Children's Medical Center-NICU provides full neonatal care for high risk neonates. This was a prospective, case series, descriptive, analytical study in newborns admitted for urgent or semi urgent ET intubation during a one-year period. The length and size of uncuffed, soft polyvinyl chloride ET were selected according to NRP guidelines. The infants who died or were transported to another hospital, were excluded. A data sheet was used to record of information collected at the time of intubation and the neonates were followed up to 1 week after the tracheal tube was removed. Our institutional ethics committee approved the study. Age, weight, gestational age, sex, route of delivery, premedication drugs, and complications were recorded. All patients

were ventilated. The patients were clinically and radiological assessed.

A difficult intubation was defined as poor view of vocal cords, increased lifting force on the laryngoscope blade, malposition of ETT (identified on chest roentgenogram and/or by physical signs of unilateral ventilation that resolved when the tube was partially withdrawn). Tissue damage was defined as the presence of abrasion, laceration of lips, mouth or facial skin resulting from improper fixation or ETI. Pharyngeal bleeding or laceration visualized during intubation was included in the list of complications; postintubation stridor was defined as the occurrence of stridor within 1 to 2 hrs after extubation in the absence of prior airway disease. Intraluminal blockage was suspected when any difficulty was experienced passing an appropriate-sized suction catheter. Blockage was confirmed on visual inspection when the tube was removed. Nosocomial pneumonia was defined as the presence of new infiltrates on the chest radiograph after at least 24 hrs post-intubation in a patient not previously infected, and evidence of pus cells or bacteria on Gram stain of tracheal aspirate obtained with a suction catheter. Pneumothorax was defined as free air in the pleural cavity resulting from ETT suction, diagnosed radiographically. Atelectasis was identified as collapse of a segment, lobe or entire lung as determined by chest radiograph. The duration per attempt for intubation was at most 20 seconds. The intubation attempt was stopped if the infant developed bradycardia (heart rate <60 bpm or cyanotic (oxygen saturation <80%) provided the baby is stable (reventilated by mask delivering 100% oxygen) before the next attempt by another expert person of the resuscitation team. All cases were intubated orally. The patients

Table -1. Characteristics and outcomes of outborn and inborn groups.

	Inborn	Outborn	P
Total	96	65	
Mean gestational age (w)	30.59±2.4	30.68±2.8	0.827
Mean birth weight (g)	1396±427	1445±486	0.507
5-min APGAR	8.3±1.7	8.6±1.5	0.346
Incidence of RDS	65(67.7%)	44(67.7%)	0.998
Incidence of pneumothorax	11 (11.5%)	11(16.9%)	0.322
Intraventricular hemorrhage	24 (25%)	36(55.4%)	<0.001
Mortality rate	22 (22.9%)	17(27.4%)	0.522

were preoxygenated to ensure normal oxygen saturation before laryngoscopy. All infants had monitoring (heart rate, oxygen saturation) continuously. Cases were not routinely sedated or paralyzed, the patients in the semi-urgent cases were premedicated with either intravenous midazolam 0.1 mg/kg or fentanyl 4 µg/kg. The trachea was intubated again (reintubation) when ETT complications (tube blockage, displacement, accidental extubation) were observed. Glucocorticoids were not routinely used for extubation.

The statistical analyses of data were performed using SPSS statistical software. Data were compared by using student T-test, Anova and Chi-square test (considered significant if the probability value was < 0.05).

Results

From October 2006 through October 2007, a total of 233 newborn infants were admitted to the NICU of the children's medical center; 60 required endotracheal intubation. A total of 131 attempts were documented. Unsuccessful attempts with difficult intubations were 17(13%) and successful intubation attempts were 114. Complications were detected in 69 cases (61%). Characteristic findings for gestational age, sex, delivery route and premedication drugs between both groups (with or without complication) were recorded (Table 1). Premedication drugs had a significant effect on complications ($p=0.038$). The frequency of complications of endotracheal tube intubation during intubation was 21 cases (12%), throughout intubation 103 cases (60%) and after extubation in 48 cases (28%). Duration of intubation was less than 7 days in 104 cases and was more than 7 days in 10 cases; duration of intubation had no significant association with complications ($p=0.97$).

The most common complication was laryngeal damage (Table 2). Common clinical findings were stridor, edema, congestion, and hemorrhage. Accidental extubation was the most frequent event throughout the intubation period.

Discussion

Endotracheal intubation is performed for potentially life-threatening situations.

Complications attributable to intubation increase morbidity and mortality rate in all patients. Every patient had at least two complications in our study that is more than other studies ⁽⁶⁾. Difficult intubation was a factor in only 39% of airway injuries, 87% of the airway injuries were temporary, and 8% resulted in death ⁽⁷⁾. Trauma to the larynx and vocal cord is common following endotracheal intubation. Contributing factors are tubes that are oversized, prolonged intubation, and repeated reintubation ⁽⁶⁾. Although in this study the duration of intubation had no significant association with complications, recovery was generally prompt without mortality but the overall rate of short-term complications of endotracheal intubation was 61%, the larynx was involved in 24% and repeated intubation and difficult intubation were contributing factors to laryngeal damage.

Tissue damage particularly trauma to pharynx was the second common complication of ETI in our series (16 cases). Mucosal laceration, bleeding, swelling, abrasion of the tissues were caused by the tube or by materials securing the tube to the face.

In our study 47% of patients required repeated intubation, accidental extubation was the cause of complications in 12%. In our experience accidental extubation occurred when tube fixation was loose or patients were moved temporarily. Black and colleagues reported 3.5% accidental extubation and 2.6% tube blockage ⁽⁸⁾. Approximately 30% of infants require repeated intubation (Dankle 1987; Noblett 1995) for accidental extubation, failure of intubation, tube blockage, inappropriate tube size and upper airway obstruction ^(9,10). Ramon et al reported accidental extubation in 3.2% of all patients. Little et al reported 9.2% in another series ⁽⁶⁾. Laryngoscopy and intubation of an active, unmedicated patient is more difficult for operator, more uncomfortable for the patient, and the risk of complications may be increased ⁽¹¹⁾. There was a significant statistical difference between unmedicated and medicated neonates and complications in our study.

Unplanned self-extubation, ETT displacement and tube blockage exposed half of these patients to the additional hazards of reintubation, it

is not our practice to change the ETT on a regular basis, but suddenly deterioration of patient condition and the possibility of tube complications were reasons for changing the ETT.

Blockage of the endotracheal tube due to secretion occurred frequently (in 7% of our patients without death) in contrast to the findings of others who reported rates of 1%-6% with death; but others reported 16-22.6% with four deaths⁽⁶⁾. Inadequate humidification, infrequent suction and inadequate chest physiotherapy attributed to our study results.

During of this study, pneumothorax occurred in 4 (2%) patients who suddenly deteriorated, just after deep endotracheal suctioning. The study reported 3 cases of pneumothorax because of deep endotracheal tube suction. Endotracheal suction plays a major role in providing airway care, but it is no without inherent hazard. In routine practice of neonatal intensive care the suction catheter is usually inserted until slight resistance is felt with the tip no more than 1 to 2 cm above the carina and then withdrawn. Secondary pneumothorax after endotracheal suction in an infant who suddenly deteriorates during or after suctioning is serious⁽¹²⁾. One study reported air leak in 6.8% and found pneumothorax, pneumomediastinum and pulmonary interstitial emphysema, and pneumothorax to be 10.7% and due to barotrauma. Although the use of sedatives and muscle relaxants may decrease the barotrauma in ill patients this concept was not demonstrated⁽⁶⁾.

Orotracheal, uncuffed ET intubation was preferred in our unit. Post extubation atelectasis may be more common in nasally intubated infants⁽⁹⁾. We had 16 (9%) cases of lung collapse; probable contributing factors were the presence of ETT and positive pressure ventilation which cause physiologic disruption to mucociliary function. Moreover, silent aspiration of oropharyngeal contents occurs in a significant proportion intubated with uncuffed ET as reported by Ramon⁽⁶⁾. Tube malposition overall in our study was 3%; the tube was in the right bronchus.

Patients in NICU are at higher risk for nosocomial infection. The frequency of pneumonia is particularly high in those patients

requiring prolonged intubation and mechanical ventilation (17%) who were intubated for a mean of 15 days. Overall occurrence rate of lung infection in our series was 10% which is more than other studies whose rates were 2.3% and 2.7% when ventilated for 1 to 6 days⁽⁶⁾. Our high occurrence rate of pneumonia may reflect the inaccurate direct tracheal suction and care in severe ill patients.

In one study 6.2% of patients sustained severe lesions⁽⁷⁾. Studies reported the overall complication rate of endotracheal intubation at 8% to 24%^(8,6). Our success rate (87%) appears higher. One study showed that intubation was successful only 60% of time even when practitioners with considerable experience attempt intubation⁽¹³⁾. The subglottic epithelium may be lost within a few hours of intubation, but that progression of injury is relatively short-lived. Ulcer healing starts in a few days, rapidly progresses from day 10 and in the majority of cases is complete after 30 days⁽¹⁴⁾. In our study we followed the patients for 7 days after extubation. We did not assess long-term outcomes associated with ETI.

Although the risks and benefits of using premedication for intubating unstable newborns are debated, recent evidence shows that premedication for non-urgent or semi-urgent intubation may be safer and more effective than awake intubation especially for inexperienced personnel, and minimize the potential for air way, oropharyngeal injury^(2,15).

Only 37% of United Kingdom (UK) neonatal units routinely sedate babies before intubating and 14% of units have formal guidelines for sedation before intubation.⁽¹⁶⁾ We have no formal guideline for sedation before intubation of babies. The study reported the complications were more common in smaller babies⁽⁸⁾; we did not detect significant statistical differences for gestational age and birth weight, duration of remaining ETT, or route of delivery. The higher proportion of injury reported in the female gender⁽⁷⁾, was not significant in our study.

Many of adverse effects associate with intubation (such as bradycardia, hypertension etc.) are related to the laryngoscope being in the mouth; digital intubation is a simple technique that may have advantages when compared

with intubation by direct visualization⁽¹⁷⁾. The insertion technique, the advantages and disadvantage of the laryngeal mask (LMA) compared with ETT were recently reviewed ⁽¹⁸⁾.

Conclusion

Trauma to the larynx and vocal cord were most common complications. Difficult and repeated intubation played major role. Premedication for non- urgent or semi-urgent intubation was safer and more effective than awake intubation. We did not assess long term outcomes associated with endotracheal tube intubation; this is the limitation of the present study.

Conflict of interest All authors of manuscript do

not have any conflict of interest.

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Table1- Characteristic findings of short-term complication of ETI in complicated and uncomplicated groups

	Gestational age		Sex		Delivery route		Premedication	
	preterm	Term	female	male	NVD*	C/S*	Medicated	Un medicated
Complicated patients	(n) 38 (%) 64%	31 56%	29 63%	40 59%	19 53%	50 64%	39 53%	30 73%
Uncomplicated patients	(n) 21 (%) 36%	24 44%	17 37%	28 41%	17 47%	28 36%	34 47%	11 27%
Total	(n) 41	73	78	36	68	46	55	59
P Value	0.038		0.25		0.65		0.38	

*Normal vaginal delivery
**Cesarean section

Table2- Frequency of events of short-term complications of ETI

Complications	Number of events	Percent (%)
Post intubation stridor	41	24
Tissue damage	32	19
Accidental extubation	20	12
pneumonia	17	10
Lung collapse	16	9
Tube malposition	13	8
Blockage of tube	12	7
Pneumothorax	4	2

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