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Survey of Factors Effective on Re-Intubation Among Children Admitted to Pediatric Intensive Care Unit

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Abstract: This study was aimed to recognize the risk factors of re intubation among children who were admitted to pediatric intensive care unit. In an analytical cross-sectional study, the risk factors of reintubation in two groups of patients compared, both groups consist of 55 children, one with successful extubation and another with extubation failure. The study showed that neuromuscular disorders are the main underlying disease in extubation-failure group ($p = 0.004$). Besides, in comparison between two group of patients who had successful versus failed extubation, hypercapnia ($\text{PaCO}_2 > 50_{\text{mmHg}}$) was shown to be the most common cause of both the first intubation ($p = 0.003$) and reintubation ($p = 0.002$) in patients who failed extubation. This study shows that neuromuscular disorders as a background, are the most common causes which defeat weaning from ventilator or result in reintubation by induction of hypercapnia.

Key words: Reintubation, neuromuscular disorders, respiratory failure

INTRODUCTION

Endotracheal intubation is done to maintain the patency of airways and make them accessible for Positive Pressure Ventilation (PPV). Although it is one of the most important parts of therapeutic measures in Pediatric Intensive Care Units (PICUs) and occasionally the sole way to save the patients in a critical life threatening situation, endotracheal intubation is always a temporary operation and must be reversed apropos.

The timing of extubation, to return the patient to physiologic respiration is a crucial decision and constantly accompanied by some risk of recurrent respiratory failure and need for reintubation.

Extubation failure is defined as a need for reintubation up to 72 h after planned extubation (Khamiees *et al.*, 2001). This may happen in 2-25% of all planned endotracheal extubations (Rathaar and Epstein, 2003; Daley *et al.*, 1996).

The more common underlying causes of weaning failure which will result in reintubation can be classified in following categories:

Imbalance between strength of respiratory muscles and work of breathing, upper airway obstruction, hypersecretion into airways, insufficient cough reflex and Central Nervous System (CNS) disorders and so on. The final effect of these factors may be either hypoxemia or hypercapnia (Beckmann and Gillies, 2001).

It is obvious that whenever PPV is needed, endotracheal intubation per se is not a therapeutic procedure but only an airway access to apply PPV. Reversely, when the patient does no longer need the PPV, weaning from mechanical ventilator should be tried and immediately followed by extubation to prevent the adverse effects of prolonged intubation; thus extubation often can be considered as the last step of weaning. On the other hand, if respiratory failure relapses (given the cause), PPV will be necessary again, making reintubation just a prerequisite.

Therefore, in suchlike literatures weaning failure, extubation failure and reintubation have been used interchangeably, although they are virtually different.

The adverse affects of reintubation are increased risk of nosocomial pneumonia, prolonged ICU stay and finally, increased morbidity and mortality rates.

This study planned to evaluate the above mentioned risk factors of reintubation.

MATERIALS AND METHODS

In a cross-sectional and analytical study on patients who had consecutively admitted to PICU of Tabriz Children's Hospital from January 2005 to October 2008, case and control patients were selected by using convenience sampling method and considering the inclusion criteria. They were categorized in two groups;

one with successful planned extubation (controls) and another with extubation failure (cases), variables such as age and sex were matched between these two groups, and their risk factors of reintubation compared. Followings are the inclusion criteria: age, more than 30 days and less than 14 years (infants and children); PICU admission; endotracheal intubation just for positive pressure ventilation and planned extubation for all patients and also a repeated need to endotracheal intubation and mechanical ventilation, for extubation-failure group. Sampling was stopped when each group reached to 55 patients who were matched by age and sex (completed sample size). The following data were collected from all patients: Age, sex, underlying disease which caused first intubation and necessitated mechanical ventilation, duration of mechanical ventilation before extubation and blood gas analysis results before first intubation and extubation.

Besides, causative factors of extubation failure and blood gas analysis results before reintubation was determined in patients of related group.

Finally, all collected data was statistically analyzed by t-test, which cleared the risk factors of reintubation in PICU patients.

RESULTS

In first group (successful extubation) there were 30 males and 25 females with the age average of 16.2±2 months and in second group (extubation failure) 30 males and 25 females with the age average of 15.7±4 months (p = Not significant).

Underlying disorders, in first group include: Aspiration pneumonia in 19 patients (34.5%); Congenital heart diseases with or without pneumonia in 17 patients (31%); Shock in 8 patients (15%); Neuromuscular disorders in 5 patients (9%); Apnea in 4 patients (7%) and drug poisoning in 2 patient (3.5%). In second group, Underlying disorders consisted of neuromuscular disorders in 28 patients (51%); congenital heart disorders with or without pneumonia in 16 patients (29%); aspiration pneumonia in 9 patients (16.5%) and renal failure in 2 patient (3.5%).

As showed in Table 1, neuromuscular disorders are the most important underlying cause for extubation failure.

Table 1 also shows that Hypercapnia (increased PaCO₂ to amounts more than 50 mmHg) at the time of first intubation and is the dominant type of respiratory failure in the patients who failed extubation. Beside this study indicates that in patients who need re intubation, hypercapnia was dominant as well (p = 0.002).

The average duration of mechanical Ventilation in the patients who had successful extubation was 58±67.8 h, whereas the same Period for extubation-failure group was 126.6±118 h, (p = 0.01).

DISCUSSION

The study shows that neuromuscular disorders as a background, are the most important cause of defeat in the process of weaning from Ventilator and the main underlying cause of reintubation. These findings are compatible with the studies of Epstein and Ciubotaru (1998) and Edmunds *et al.* (2001).

It was revealed that in any patient ,the longer the duration of mechanical ventilation, the more likely to fail extubation and need reintubation. The same matter has been reported by Edmunds *et al.* (2001).

This study shows that the patients who undergo mechanical ventilation for the first time, because of hypercapnic respiratory failure, are more susceptible to become dependent to mechanical ventilation, therefore the risk of extubation failure is much more in this group of patients, besides it is more likely for them to undergo further reintubation and mechanical ventilation because of relapsed hypercapnia (Table 1).

Weaning from ventilator and extubation of these patients must be planned very cautiously. Ventilatory support may be diminished gradually and tapered off by small decrements.

After completion of weaning and extubation, it is also necessary to continue or even increase the respiratory cares such as: upper airway toilet, suction of secretions, chest physiotherapy, non-invasive oxygen therapy and so on.

Table 1: Comparison of underlying disorders and blood gas imbalances in two groups of patients who had successful versus failed extubation

Disorders and imbalances extubation group	Neuro-muscular disorders (No.)	Other disorders (No.)	At the time of first intubation	
			Hypercapnia PaCO ₂ >50 _{mmHg}	Hypoxemia PaO ₂ <50 _{mmHg}
Successful (No.)	7	51	2	53
Failed (No.)	26	16	36	19
Total (No.)	33	67	38	72
p-value	0.004			0.003

Similar studies on patients, who had sustained reintubation, have been showed complications such as: nosocomial and ventilatory associated pneumonia, prolonged ICU stay and need for tracheostomy are more common. Besides, poor final outcome and increased morbidity and mortality rates are also reported (Torres *et al.*, 1995).

CONCLUSION

The highest risk of extubation failure and need for reintubation are seen in hypercapnic type of respiratory failure which predominantly complicates neuromuscular disorders. Therefore, the weaning process must be done gradually and prudently. Besides, supportive measures such as removal of secretions and oxygen therapy should be accurately applied.

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