http://www.pjbs.org

PJBS

ISSN 1028-8880

# Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 12 (1): 83-86, 2009
ISSN 1028-8880


# Survey of Factors Effective on Outcome of Weaning from Mechanical Ventilation

N. Bilan, Sh. Shva and Sh. Ghaffari
Tuberculosis and Lung Diseases Research Center, Tabriz University of Medical Sciences, Iran

**Abstract:** This study was aimed to recognize factors effective on weaning from mechanical ventilation and determine the reasons of unsuccessful Spontaneous Breathing Trial (SBT) and reintubation. The study population consisted of 202 critically ill pediatric patients who received mechanical. When the patient was enrolled in the study, mechanical ventilation support was stopped and the patient underwent a 2 h trial of Spontaneous Breathing Trial (SBT), at the end of the trial if $PaCO_2$ was in normal range was extubated. Of the 202 patients who underwear SBT, 141 attempts had successful trial. The remaining 61 patients had sign of poor tolerance during the trial of spontaneous breathing and were reconnected to the ventilator. One hundred and forty one patients (69.8%) successfully passed the trial. 17 (12%) of above mentioned group required reintubation within 48-72 h. The overall success and failure rate was 61.3 and 38.7%, respectively. Mortality rate in patients who did not tolerate SBT or were extubated, or required reintubation were 13% (8 patients), 11.3% (14 patients) and 23.5% (4 patients), respectively. The most common reasons for reintubation were neuromuscular disease (58.8%) congenital cardiac disease (23.5%) and aspirative pneumonia (17.6%). The finding indicates that two third of intubated patients, respond successfully to SBT and could be extubated and the neuromuscular diseases is the main cause of reintubation.

**Key words:** Spontaneous breathing trial, reintubation, mortality

## INTRODUCTION

Although mechanical ventilation is a life-saving intervention for pediatric patients suffering from acute respiratory failure, it is associated with numerous grave complications and should be discontinued at the earliest possible time (Chavez *et al*., 2006).

The process commonly referred to as weaning from invasive mechanical ventilation involves first assessing the patient's ability to breathe without the ventilator and then the ability to continue breathing without an artificial airway (Khamiees *et al*., 2001). Weaning from mechanical ventilation usually implies two separate but closely related aspects of care, discontinuing mechanical ventilation and removal of any artificial airway. The first problem the clinician faces is how to determine when a patient is ready to resume ventilation on his or her own. Once a patient is able to sustain spontaneous breathing a second judgment must be made regarding whether the artificial airway can be removed (Alia and Esteban, 2000). This decision is made on the basis of the patient's mental status, airway protective mechanism, ability to cough and character o secretion (Alia and Esteban, 2000). In recent years, several studies have focused on how the weaning process is conducted and have concluded that a systematic approach is superior to the old physician judgment and experience model. It has been shown that using a systematic approach decreases the length of time on mechanical ventilation support and total hospital costs but not duration of hospitalization. The fact that 50% of self-extubated patients do not require reintubation suggests that our judgments and experience are far from complete (Kupfer and Tessler, 2001). More than 40% of the time that a patient receives mechanical ventilation is spent trying to wean the patient from ventilation (Esteban *et al*., 1995).

Extubation failure and reintubation are associated with significant risks, including an increased incidence of pneumonia, prolonged stay in PICU and increased mortality (Edmunds *et al*., 2001). Published rates of extubation failure varied from 4.9 to almost 29% (Chavez *et al*., 2006; Esteban *et al*., 1999). As Esteban *et al*. (1995) study, once daily trial of spontaneous breathing led to extubation about three times more than intermittent mandatory ventilation and about twice as quickly as pressure support ventilation. Extensive efforts have been made to identify predictors of successful weaning and extubation. We undertook a survey on pediatric patients receiving mechanical ventilation to recognize effective factors on outcome of weaning from mechanical ventilation and determine the reasons of unsuccessful SBT and reintubation.

**Corresponding Author:** N. Bilan, Tuberculosis and Lung Diseases Research Center, Tabriz University of Medical Sciences, Iran

## MATERIALS AND METHODS

**Patients:** The study was conducted between March 2006 and March 2008. The study population consisted of 202 critically ill pediatric patients who received mechanical ventilation until a first attempt was made to discontinue ventilator support.

Weaning procedures started only after the underlying disease process that necessitated the mechanical ventilation has significantly improved or resolved.

To be enrolled in the study, the patients had to have an adequate gas exchange as indicated by a ratio of the partial pressure of arterial oxygen ($PaO_2$) to the fraction of inspired oxygen ($FiO_2$) above 200 with positive end expiratory pressure (PEEP) of 5 cm $H_2O$ or less or $PaO_2$ above 60 mmHg while breathing with an $FiO_2$ of 0.40 or less, a core temperature below 38°C, a hemoglobin level above 10 g $dL^{-1}$ and no further need for vasoactive or sedative agents. In addition the attending physicians had to agree that the patient was in stable condition and ready to be weaned from the ventilator (MacIntyre *et al*., 2001).

**Protocol:** When a patient was enrolled in the study, mechanical ventilation support was stopped and the patient breathed spontaneously through Continues Positive Airway Pressure (CPAP) of 5 cm $H_2O$ for 2 h.

The development of tachypnea, paradoxical motions of the abdomen or rib cage, hypoxemia, tachycardia, blood pressure liability, diaphoresis or sever anxiety indicated that the patient is not ready to discontinue from mechanical ventilatory support.

If a patient had sign of poor tolerance at any time during the trial, mechanical ventilation was reinstituted and the reasons of failure were recorded.

At the end of the trial if $PaCO_2$ was in normal ranges patients were extubated. In the cases of patients who underwent a successful trial and were extubated but required reintubation within 48-72 h, the reason for reintubation was prospectively recorded as: background disease, complication of intubation or extubation, upper airway obstruction, hypoxemia, respiratory acidosis, clinical sign of increased respiratory work, impaired clearance of secretion, cardiac failure and atelectasis.

**Statistical analysis:** All statistical analysis were performed using $SPSS_{15}$ software. All categorical variables were analyzed with Chi-square tests, except where small size required the use of Fisher's exact test. Comparison of continues variables among the two group was done with Student's t-test for variables with normal distribution. Data were presented as mean±SD or proportions as appropriated. The significant level was identified as p-value<0.05.

## RESULTS

During the period of study there were 253 patients requiring mechanical ventilation. Of these, 51 died without ever having been extubated, leaving 202 patients. The mean age of the group was 36.3±44.3 months with a range of 1 to 168 months. There were 58.3% male and 41.7% female in study group. 78.9% of patients were intubated secondary to acute respiratory failure and 21.1% required intubation due to neurologic dysfunction.

Mean number of ventilator days before extubation was 5 days with a median of 2 days. Mean duration of endotracheal intubation and mechanical ventilation in the patients with successful extubation was 73.8±60 h whereas the same period for extubation failure group was 123.5±115 h (p = 0.01).

Of the 202 patients who underwear SBT, 141 attempts were successful. The remaining 61 patients had sign of poor tolerance during the trial of spontaneous breathing and were reconnected to the ventilator and 20 of these patients had successful trial next times. 17(12%) of successful patients required reintubation within 48-72 h (Fig. 1).

The overall successful extubation rate was 61.3% and an overall failure rate for planned first extubation was 38.7%.

Among unsuccessful SBT and reintubated patients 10(16.3%) and 5(29.4%) required tracheostomia, respectively.

Mortality rate in patients who did not tolerate SBT or extubated or required reintubation were 13% (8 patients), 11.3% (14 patients) and 23.5% (4 patients), respectively (Fig. 1). Mortality is higher in patients who require reintubation within 48 h after extubation than in patients who tolerate extubation (p = 0.037).

The most common reasons for reintubation were neuromuscular disease (58.8%) congenital cardiac disease (23.5%) and aspirative pneumonia (17.6%). Hypercapnia at the time of first intubation and reintubation was the dominant type of respiratory failure in the patients with failed extubation.

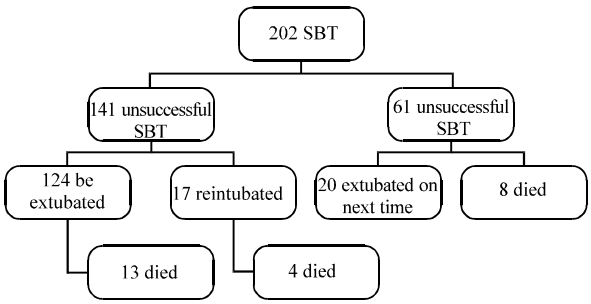


Fig. 1: Outcome of patients underwent spontaneous breathing trial

## DISCUSSION

As with earlier study by Edmunds *et al.* (2001), we found that mortality is higher in patients who require reintubation within 48 h after extubation than in patients who tolerate extubation. We found that more than two thirds of the patients were extubated after their first trial of spontaneous breathing.

Patients who require reintubation have a poor prognosis, with hospital mortality exceeding 30 to 40%. The need for reintubation is an independent predictor of mortality even after controlling for the presence of co-morbid conditions and generalized severity of illness (Epstein *et al.*, 1997; Epstein and Cibotaru, 1998). Many factors influence a patient's ability to tolerate extubation. The ability to maintain adequate gas exchange is affected by central inspiratory drive, respiratory muscle strength, and the work load placed on the muscles of respiration (Edmunds *et al.*, 2001). Published rates of extubation failure varied from 4.9% to almost 29% (Chavez *et al.*, 2006; Esteban *et al.*, 1999) probably reflecting difference in patient population and criteria used to determine the appropriateness of both extubation and reintubation. A lower rate of reintubation is often assumed to reflect superior care and monitoring quality assurance. A lower extubation rate, however, could equally signal on overly cautious style of practice, placing a patient at risk of ventilator associated complication by postponing extubation (Esteban *et al.*, 1999).

Worldwide medical literature documents neurological disorders, congenital heart disease and inborn errors of metabolism to be the most common underlying disorders of ventilator dependency and extubation failure (Khamiees *et al.*, 2001; Rathaar and Epstein, 2003). Failure to wean has been attributed to an imbalance between the load faced by the respiratory muscle and their neuromuscular competence (Alia and Esteban, 2000).

The main mechanism that result in extubation failure include imbalance between strength of respiratory muscles and labor of breathing, hypersecretion into airways, upper airway obstruction, insufficient cough reflex and deficient respiratory center drive. The final manifestation of these mechanisms may be either hypoxemia or hypercapnia (Epstein and Cibotaru, 1998; Beckmann and Gillies, 2001).

Esteban *et al.* (1999) confirm that the most common reasons for reintubation were clinical signs of increased respiratory work, hypoxemia and impaired clearance of secretions. Epstein *et al.* (1998) found that the most common reasons for reintubation were respiratory failure (28%), congestive heart failure (23%), aspiration or excess pulmonary secretion (16%), and upper airway obstruction (15%).

Present study shows that neuromuscular disorders as underlying disease are the most important cause of defeat in the process of weaning from the ventilator and the main cause of reintubation, findings that are compatible with those studies. Neurologic factors caused a delay in discontinuing mechanical ventilation in 73% of the evaluations. Altered mental status was the neurologic condition that most frequently prevented weaning (Kelly and Matthay, 1993). In a similar study Fraser *et al.* (1998) claimed that 27% of children requiring mechanical ventilation for more than a month had a neuromuscular disorder. With complete absence of central derive, patients do not exhibit any ventilatory activity upon discontinuation from the ventilator, and this persists despite hypercapnia and hypoxemia (Boles *et al.*, 2007).

## CONCLUSION

Based on findings the patients with neuromuscular disorders and hypercapnic respiratory failure are commonly at risk of extubation failure.

## ACKNOWLEDGMENT

This study was supported by grant of Tuberculosis and Lung Disease Research Center, Tabriz University of Medical Sciences (grant No. 85/12).

## REFERENCES

Alia, I. and A. Esteban, 2000. Weaning from mechanical ventilation. Crit. Care, 4: 72-80.

Beckmann, U. and D.M. Gillies, 2001. Factors associated with reintubation in intensive care. Chest, 120: 538-542.

Boles, J.M., J. Bion, A. Connors, M. Herridge and B. Marsh *et al.*, 2007. Weaning from mechanical ventilation. Eur. Respir. J., 29: 1033-1056.

Chavez, A., R.D. Cruz and A. Zaritsky, 2006. Spontaneous breathing trial predicts successful extubation in infant and children. Pediatr. Crit. Care Med., 7: 324-328.

Edmunds, S., I. Weiss and R. Harrison, 2001. Extubation failure in a large pediatric ICU population. Chest, 119: 897-900.

Epstein, S.K., R.L. Ciubotara and J.B. Wong, 1997. Effect of failed extubation on the outcome of mechanical ventilation. Chest, 112: 186-192.

Epstein, S.K. and R.L. Ciubotaru, 1998. Independent effects of etiology of failure and time to reintubation on outcome for patients failing extubation. Am. J. Crit. Care Med., 158: 489-493.

Esteban, A., F. Frutos, M.J. Tobin, I. Alia and J.F. Solsona *et al*., 1995. A comparison of four methods of weaning patients from mechanical ventilation. New Eng. J. Med., 332: 345-350.

Esteban, A., I. Alia, M.J. Tobin, A. Gil and F. Gordo *et al*., 1999. Effect of spontaneous breathing trial duration on outcome of attempts to discontinue mechanical ventilation. Am. J. Res. Crit. Med., 159: 512-518.

Fraser, J., T. Henrichsen, Q. Mok and R.C. Tasker, 1998. Prolonged ventilation as a consequence of acute illness. Arch. Dis. Child, 78: 253-256.

Kelly, B.J. and M.A. Matthay, 1993. Prevalence and severity of neurologic dysfunction in critically ill patients. Influence on need for continued mechanical ventilation. Chest, 104: 1818-1824.

Khamiees, M., P. Raju, A. De Girolamo, A.Y. Amoateng and C.A. Manthous, 2001. Predictors of extubation outcome in patients who have successfully completed a spontaneous breathing trial. Chest, 120: 1262-1270.

Kupfer, Y. and S. Tessler, 2001. Weaning the difficult patient: The evaluation from art to science. Chest, 119: 7-9.

MacIntyre, N.R., D.J. Cook, J.R. Ely EW and S.K. Epstein *et al*., 2001. Evidence based guidelines for weaning and discontinuing ventilatory support: A collective task force facilitated by the American College of Chest Physicians: The American Association for Respiratory Care and the American College of Critical Care Medicine. Chest, 120: 375S-395S.

Rathaar, R.C. and S.K. Epstein, 2003. Extubation failure: magnitude of the problem, impact on outcomes and prevention. Curr. Opin. Crit. Care, 9: 59-66.