



PREDICTORS OF SUCCESSFUL WEANING OF PATIENTS ON MECHANICAL VENTILATION IN INTENSIVE RESPIRATORY CARE UNIT

Pulmonary Medicine

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ABSTRACT

Introduction: Weaning from mechanical ventilation is an important and essential part in the care of critically ill intubated patients receiving mechanical ventilation. Weaning means taking the patients off from the mechanical support and from the endotracheal tube, including relevant aspects of terminal care. There is uncertainty about the best methods for conducting this process, which will generally require the cooperation of the patient during the phase of recovery from critical illness. This makes weaning an important clinical issue for patients and clinicians. **Objectives:** 1) To study various indications of mechanical ventilation in intensive respiratory care unit. 2) To study various factors affecting weaning from mechanical ventilation. **Method:** This is a Prospective, observational, descriptive Hospital based study conducted in the pulmonary medicine department of tertiary health care institute. **Statistical Analysis:** The data obtained from the patients was tabulated in MS Excel program. At the end of the study all the observations were analysed using SPSSR software version 20 IBMR. **Result:** In this study total 142 subjects were included. Most of the cases were in the age group of 20-30 years (27.4%) followed by more than 60 years (20.5%). Majority of our patients were males (70.4%) and females were (29.6%). In our study 57% presented with Type I Respiratory failure (Hypoxemic) and 43% with Type II Respiratory failure (hypercapnic). Most of the patients who presented Type I Respiratory failure were in the age group of less than 30 years while most of the patients who presented with Type 2 respiratory failure were in the age group of more than 50 years. **Conclusion:** Majority patients were males. Majority of the patients were ARDS followed by COPD patients on mechanical ventilator. Mean duration of ventilator and ICU stay was 7.45 days and 12.27 days respectively.

KEYWORDS

Mechanical ventilation, Intensive care unit, Temperature.

INTRODUCTION:

Mechanical ventilation has gone through a dramatic evolution over a relatively short space of time. After the Copenhagen polio epidemic in 1952, negative pressure iron lungs were replaced by intermittent positive pressure ventilation, this was originally delivered at set volumes and rates¹. The next step forward was the introduction of intermittent mandatory ventilation and shortly thereafter this was synchronized to the patient's respiratory effort. More recently, pressure support ventilation and bi-level positive airway pressure model have become available.

Modern ventilators are increasingly sensitive, allowing easy patient triggering of supported breaths, models such as tube compensation and measurement of numerous respiratory parameters. Developments in weaning techniques have parallel these improvements in ventilator functionality.

Conventional invasive ventilation is associated with a number of complications such as pneumonia, tracheal stenosis and baro/volutrauma. Many of the complications increases in likelihood with duration of ventilation. It is therefore necessary to wean patients from mechanical ventilation as quickly as possible.

Weaning from mechanical ventilation is the process of reducing ventilator support, ultimately resulting in a patient breathing spontaneously and being extubated. This process can be achieved rapidly in 80% of patients when the original cause of the respiratory failure has improved. The remaining cause will require a more gradual method of withdrawing ventilation.

Aim:

This study aimed to identify predictors of successful weaning of patients on mechanical ventilation in intensive respiratory care unit

MATERIAL AND METHOD

All admitted patients requiring mechanical ventilation and weaned in

ICU during November 2013 and October 2015 were enrolled in the study. After getting approval from the ethics committee, written informed valid consent was obtained from Relatives.

Design of the study:

Prospective, observational, descriptive hospital-based study in the pulmonary medicine department of tertiary health care institute.

Study population:

Male and non-pregnant female above the age of 12 years. A total of 142 subjects were enrolled in the study.

Inclusion criteria:

All patients admitted in IRCU requiring mechanical ventilation.

Exclusion criteria:

- Patients on non-invasive ventilation
- Patients who died
- Patients/relatives not giving consent to participate in the study.

Methodology:

- The study was undertaken after approval from the institutional ethics committee.
- An informed valid consent was taken from relatives before enrolling patients in the study
- Detailed history of patients present and past were taken. Allied history from partner or relatives were taken.
- Investigations, complete blood count, Liver function test, Renal function test, random blood sugars, Serum electrolytes, chest X-ray, Electrocardiogram were monitored.
- Serum Arterial blood was observed.
- Interventions, treatment were done appropriately according to Parameters and diagnosis
- Patients were observed for clinical outcome, duration in biochemical, radiological, physiological parameters
- Data analysis was done

Statistical Analysis:

The data obtained from the patients was tabulated in MS Excel program. At the end of the study all the observations were analysed using SPSS[®] software version 20 IBM[®].

Result:**Table 1. Diagnosis wise distribution of study subjects (– 142)**

Diagnosis	Frequency	Percentage
ARDS	32	22.6
Bronchial asthma	9	6.3
Bronchiectasis	3	2.1
Chemical pneumonitis	1	0.7
COPD	28	19.8
Drowning	1	0.7
Hanging	24	16.9
Snake bite	1	0.7
OHS	3	2.1
OSA	1	0.7
Pneumonia	6	4.2
right sided pneumothorax	1	0.7
Post TB OAD	15	10.6
Strangulation	2	1.4
Tetanus	13	9.1
Toxic gas inhalation	1	0.7
Tracheal stenosis	1	0.7
Total	142	100

Above table shows that, in our study there were 22.6%, 19.8%, 16.9% and 10.6% were ARDS, COPD, Hanging and Post TB OAD study subject respectively while very few patients in the group of Drowning (0.7%), Chemical pneumonitis (0.7%), Snake bite (0.7%), OSA (0.7%), Pneumonia (0.7%), right sided pneumothorax (0.7%), Toxic gas inhalation (0.7%) and Tracheal stenosis (0.7%).

Table 2. Type of Respiratory failure wise distribution of study subject. (n-142)

Type of Respiratory Failure	frequency	Percentage
Type 1	81	57
Type 2	61	43
Total	142	100

Table 2 shows that 57% presented with Type I Respiratory failure (Hypoxemic) while 43% with Type II Respiratory failure (hypercapnic).

Table 3: Glasgow Coma Scale on admission wise distribution of study subject. (n-142)

Glasgow Coma Scale on admission	Frequency	Percentage
3	14	9.9
4	5	3.5
5	2	1.4
6	4	2.8
7	4	2.8
9	12	8.5
11	1	0.7
12	5	3.5
13	1	0.7
14	1	0.7
15	93	65.5
Total	142	100

Above table shows that at time of admission Glasgow Coma scale were low in 9.9% study subjects while very severe in 65.5% of study patients.

Table 4: ICU stay versus Diagnosis wise distribution of study subject. (n-142)

Diagnosis	ICU stay group in days				Total
	< 5	5-15	15-30	>30	
ARDS	0	21	9	2	32
Bronchial asthma	2	6	1	0	9
Bronchiectasis	0	3	0	0	3
Chemical pneumonitis	0	0	1	0	1
COPD	6	21	1	0	28
Drowning	0	1	0	0	1
Hanging	18	2	4	0	24

Snake bite	0	1	0	0	1
OHS	0	2	1	0	3
OSA	0	1	0	0	1
Pneumonia	1	3	1	1	6
right sided pneumothorax	4	8	2	1	15
Post TB OAD	0	0	0	1	1
Strangulation	1	1	0	0	2
Tetanus	0	1	11	1	13
Toxic gas inhalation	0	1	0	0	1
Tracheal stenosis	0	1	0	0	1
Total	32	73	31	6	142

Above table shows that 51.4% study subject stay 5- 15 days in ICU followed by less than 5 days were 22.5%. Majority of ARDS patients in ICU were 22.5% followed by COPD and Hanging study subject were 19.7% and 16.9% respectively.

Table 5: Ventilator stay versus Diagnosis wise distribution of study subject. (n-142)

Diagnosis	Ventilator stay group in days				Total
	< 5	5-15	15-30	>30	
ARDS	6	21	5	0	32
Bronchial asthma	5	4	0	0	9
Bronchiectasis	2	1	0	0	3
Chemical pneumonitis	0	0	1	0	1
COPD	25	3	0	0	28
Drowning	1	0	0	0	1
Hanging	20	3	1	0	24
Snake bite	1	0	0	0	1
OHS	2	1	0	0	3
OSA	1	0	0	0	1
Pneumonia	3	2	1	0	6
right sided pneumothorax	11	3	0	1	15
Post TB OAD	0	0	1	0	1
Strangulation	2	0	0	0	2
Tetanus	1	3	8	1	13
Toxic gas inhalation	1	0	0	0	1
Tracheal stenosis	1	0	0	0	1
Total	82	41	17	2	142

Above table shows that in our study 57.7% study subject were on ventilation in less than 5 days followed by 5 to 15 days were 28.8%. Majority of ARDS patients on ventilation were 22.5% followed by COPD and Hanging study subject were 19.7% and 16.9% respectively.

DISCUSSION

In this study “predictors of successful weaning of patients on mechanical ventilation in intensive respiratory care unit”, total 142 subjects were included. In our study most of the cases were in the age group of 20-30 years (27.4%) then more than 60 years (20.5%) followed by less than 20 years of age 17.6%. Majority of our patients were males (70.4%) and females were (29.6%).

The largest group of our patient who were mechanically ventilated were ARDS (22.6%) followed by COPD (19.8%), Hanging (16.9%), Post-TB obstructive airway disease (10.6%), Tetanus (9.1%), bronchial asthma (6.3%), pneumonia (4.2%), bronchiectasis (2.1%), obesity hypoventilation syndrome (2.1%) strangulation (1.4%) , Obstructive sleeping apnea (0.7%), chemical pneumonitis (0.7%), snake bite (0.7%), toxic gas inhalation (0.7%), tracheal stenosis (0.7%) and right sided pneumothorax with TB meningitis (0.7%) . Our findings were consistent with study by Kamat et al¹ In our study 57% presented with Type I Respiratory failure (Hypoxemic) and 43% with Type II Respiratory failure (hypercapnic). Most of the patients who presented Type I Respiratory failure were in the age group of less than 30 years while most of the patients who presented with Type 2 respiratory failure were in the age group of more than 50 years.

The mean duration of ventilator stay was 7.45 days, IRCU stay was 12.27 days. The mean duration of ventilator stay in patients with Type 2 respiratory failure was 5.16 days, IRCU stay was 10.11 days. The mean duration of ventilator stay in patient with Type 1 respiratory failure was 9.17 days. IRCU stay was 13.90 days. Thus the mean duration of ventilator, IRCU stay was more in patients with Type 1 respiratory failure than those with Type 2 respiratory failure. In our study, the duration of ventilator stay of 57.7% of patients was less than

5 days. In his study, Makhoul N⁷ showed that most of the patients (92%) ventilated for acute respiratory failure due to chronic obstructive pulmonary disease (COPD) needed mechanical ventilation for only between 40-47 hours. In patients with Type 1 respiratory failure, the duration of ventilator stay in majority of ARDS patients (21 out of 32) was 5-15 days in tetanus (9 out of 13) it was 15-30 days. In 51.4 % of the patients ICU stay was between 5-15 days. In patients with Type 1 respiratory failure, 12 of the 13 tetanus patients required more than 2 weeks (15-30) in IRCU while ARDS and COPD required 5-15 days and hanging required less than 5 days IRCU stay was 69.7% of patients discharged within 20 days and 89.9% discharged within 30 days except for the patients of tetanus in whom the duration of hospital stay were more than 30 days. In the study by Chandrasekhara et al¹, showed that, ICU stay and in hospital stay was 25.455 days [SD= 5,447] for mechanical ventilation with a range of 15 to 36 days, an average of 30,818 days [SD=5,492] was required in ICU stay with a range of 22 to 40 days an average of 33,091 days [SD=6,074] was required for total stay in the hospital of tetanus patients until discharge with a range of 23 to 42 days.

In our study some of the patients has been discharged with deranged AST, ALT, BUN, Serum creatinine as they satisfied other discharge criteria. 87.3% of the patients required only one spontaneous breathing trial. 8.5% required two while 4.3% required 3 spontaneous breathing trials for weaning.

Respiratory rate at admission correlated significantly with the duration of ventilator stay. However, there was no significant correlation between respiratory rate at admission and duration of IRCU stay.

All patients were discharged off oxygen except 6 patients of Type 2 respiratory failure who were discharged on long term oxygen therapy. Majority of patients of ARDS 11 out of 32 and Tetanus 8 out of 13 required tracheostomies as they required prolonged ventilation while in COPD Patients only 3 out of 28 required tracheostomies as they were weaned early.

We observed significantly increased duration of ventilator stay with tracheostomy in patients with ARDS, HANGING, Post TB OAD and Pneumonia; significantly increased duration of ICU stay with tracheostomy in patients with ARDS, obstructed Bronchial asthma, COPD, Hanging and Post TB OAD.

Among complications, one patient of ARDS had motor neuropathy due to atracurium, one patient of ARDS had pneumothorax due to usage of high PEEP, 3 hanging patients had hypoxic ischemic encephalopathy and 1 Tetanus patients had vocal cord palsy due to prolonged mechanical ventilation. Similar complications were observed in the study by Prakash et al⁷.

CONCLUSION

In our study of 142 patients

- Majority patients were males.
- Majority of the patients were ARDS followed by COPD patients on mechanical ventilator.
- Mean duration of ventilator stay and ICU were 7.45 days, 12.27 days respectively. Amongst the type of Respiratory Failure, the ventilator and ICU stay were longer in TYPE 1 Respiratory Failure than TYPE 2 Respiratory Failure.
- Those who had higher Respiratory rate on admission had longer duration on Ventilator (statistically significant).
- COPD and Post TB Obstructive Airway diseases had shorter duration of ventilator stay and extubated earlier, hence required lesser tracheostomy.
- Spontaneous Breathing Trials were maximally needed in ARDS cases.

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