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Original Article

To Assess Rapid Shallow Breathing Index as a Predictor for Weaning in Intensive Care Unit Patients

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Abstract

Background: Weaning from mechanical ventilation (MV) is a major concern for the intensivist and has disastrous results when not accomplished as per the protocols. The preweaning assessment of the patient, address of the underlying condition for which the ventilation was initiated, for recognition of difficult to wean in advance is the best method of preventing damage caused by the inability to maintain the airway.

Aim: This study was carried out to evaluate the efficacy of clinical test rapid shallow breathing index (RSBI) which can predict the successful weaning in patients undergoing elective or mandatory MV.

Materials and Methods: A total of 120 adult patients of age group 18–70 years of either sex of ASA Class I and II, undergoing MV for various procedures, were included in this study. Preweaning evaluation is carried out by measuring demographic variables, hemodynamic variables, arterial blood gas (ABG), and calculation of RSBI. These variables were then correlated with the success of weaning, successful extubation, need for reintubation, requirement of non-invasive support, and validation of pre-existing RSBI values. Data are presented as the mean ± standard deviation. Results having $P < 0.05$ were considered statistically significant.

Results: Sensitivity, specificity, positive predictive value, and negative predictive value of RSBI <105 as an index for successful weaning were 86.4%, 69.85%, 56.1, and 92.1, respectively. No method either individually or in combination with other identifies all cases of successful weaning. Overall failure to wean rate was 30.43% which was comparable with most of the other studies. There was a weak positive correlation between age and weaning failure, but it was not statistically significant. Correlation between weight and weaning failure was not established. There was a weak negative correlation between the duration of intubation and weaning failure. Patients who were intubated for longer period of time were associated with more incidence of weaning failure, but it was not statistically significant. The higher PaO_2/FiO_2 ratio was associated with successful weaning, and there was a statistical significant difference among both groups. Bipap support was required in 15.8% patients in 48 h.

Key words: Mechanical ventilation, Reintubation, Rapid shallow breathing index, Weaning

INTRODUCTION

Mechanical ventilation (MV) is a common life support modality in intensive care unit (ICUs). The process of ventilatory support follows a continuum of care, beginning with the patient requiring initial support and hopefully ending with the ability to sustain spontaneous breathing. Some patients move through the process quickly, while others require a longer period, and some do not make it through at all. Throughout the process, many patient assessments are made and ventilator adjustments executed to accomplish the therapeutic goals of improving oxygenation and ventilation, increasing patient comfort, and minimizing the likelihood of causing secondary injuries such as ventilator-induced lung injury, ventilator-associated diaphragmatic dysfunction, or ventilator-associated pneumonia (VAP).

Airway management and respiratory support are of great importance in ICU.[1] Weaning is a transmission process

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through which patients resume spontaneous breathing after MV.[1,2] Accurate weaning time is critically important in ICU. Any delay in ventilation removal may lead to ventilator acquired pneumonia and other possible side effects.[3,4] It is also associated with an increase in the cost of the treatment. Premature removal may increase the length of ICU stay or result in patient's death.[5] On the other hand, increase in a number of patients who need ICU hospitalization, and high relevant expenses have resulted in using a variety of indices including maximal inspiration pressure (PImax), minute ventilation, and vital capacity for successful weaning. These indices have different specificity and sensitivities.[6] All these criteria have their shortcomings. The clinical challenge then is to balance aggressiveness with safety. A common quality indicator addressing this balance is the reintubation rate (i.e., patients needing reintubation out of a total number of patients extubated). A value too low suggests unnecessary delays in ventilator removal; a value too high suggests inappropriate aggressiveness in support removal. Reported reintubation rates range from 4% to 23% for different ICU populations and may be as high as 33% in patients with mental status changes and neurologic impairment.[7,8]

Rapid shallow breathing index (RSBI) is one of the most commonly used indices which was first introduced by Yang and Tobin.[8] RSBI is calculated by this formula:

$$\frac{\text{Respiratory rate}}{\text{Tidal volume (liters)}}$$

Several medical centers perform weaning if RSBI is <105.[9] A variety of studies have defined different specificities and sensitivities for RSBI.[10,11] Our main objective of this study was to predict the success and failure of extubation based on clinical assessment and RSBI criteria. We wish to find sensitivity, specificity, positive predictive, and negative predictive value of RSBI. We also want to find the newer threshold of RSBI in Indian population, if it exists. Secondary objectives of our study are to find a correlation between age, sex, weight, duration of intubation, and PaO_2/FiO_2 with success of weaning.

Aims and Objectives

Aims

This study is aimed to address the issue of assessing RSBI as an indicator for successful weaning from MV.

Objectives

The objectives are as follows:

1. To evaluate sensitivity, specificity, positive predictive value, and negative predictive value of RSBI <105 as an indicator of successful weaning.
2. To redefine different values of RSBI as a better predictor of extubation success.
3. To find a correlation between age, sex, weight, duration of intubation, and PaO_2/FiO_2 with success of extubation.
4. To find a correlation between RSBI and non-invasive ventilation in extubated patients.
5. To find out overall weaning failure rate in our institution using RSBI as an indicator.

MATERIALS AND METHODS

This study was conducted after getting due approval from Institutional Ethics Committee and Scientific Committee. Written informed consent was taken from the attendants of the patients after providing them with the patient information sheet.

Study Design

This was a prospective, observational, hospital-based clinical study.

Study Site

This study was conducted at the Department of Anaesthesiology, St.Stephen's Hospital.

Study Duration

This study was from June 2015 to May 2017.

Study Population

Study was conducted on 120 patients admitted in Surgical ICU coming to St Stephen's Hospital who were intubated for at least 48 h.

Sample Size

Sample size came out to be 112; we included a total of 120 patients in our study.

Eligibility Criteria of Patient

Inclusion criteria

The following criteria were included in the study:

- Patients who are clinically stable and have the criteria for weaning from the ventilator.
- Patients who are intubated for at least 48 h.
- Age >18 years of either gender.

Exclusion criteria

The following criteria were excluded from the study:

- Patients who are clinically unstable.
- Evidence of myocardial ischemia, heart rate (HR) >140 beats/min.
- Patient with fever and significant electrolyte abnormalities.
- High vasopressor requirement (i.e., >5 mcg/min of noradrenaline) for maintaining blood pressure (BP).
- PaO_2/FiO_2<150–200 mm Hg with FiO_2≥=50% and PEEP ≥=8 cm of H_2O.

- Unplanned extubation.
- Patient is unable to initiate an inspiratory effort.

Study Intervention

All those patients who were intubated because of respiratory failure due to miscellaneous diagnosis for at least 48 h were included in the study.

Readiness for weaning was assessed patients who were hemodynamically stable, conscious, and oriented and having a minimum sign for respiratory distress were subjected to spontaneous breathing trial (SBT). Baseline hemodynamic variables such as HR, BP, and SPO_2 were recorded. Baseline ABG were done to assess PaO_2/FiO_2 ratio. Baseline respiratory rate and tidal volume were calculated with Wright's Spirometer to calculate RBSI. Patients with RSBI <105 were subjected to 30 min SBT with T-Piece.

After 30 min, hemodynamic variables such as HR, BP, and SPO_2 were recorded. ABG were done to assess PaO_2/FiO_2 ratio.

Respiratory rate and tidal volume were calculated with Wright's Spirometer to calculate RBSI. Patients with RSBI <105 were considered as a candidate for extubation. Patients were extubated after following standard protocol. After extubation patient was observed for 48 h. Hemodynamic parameters such as HR, BP, and SPO_2 were recorded. RR was also recorded and ABG were obtained for monitoring the period of extubation.

Patients showing signs of clinical deterioration were provided with non-invasive ventilation with Bipap support and then observed for clinical stability. Patients who were not able to maintain the clinical stability were reintubated, and they were considered to be a failure to wean on the basis of RSBI.

Study Tools

Wright's Spirometer and RSBI.

Statistical Analysis

The data obtained were subjected to statistical analysis with the consult of a statistician. The data so obtained were compiled systematically. A master table was prepared, and the total data were subdivided and distributed meaningfully and presented as individual tables along with graphs.

Statistical procedures were carried out in two steps:
1. Data compilation and presentation.
2. Statistical analysis.

Statistical analysis was done using (Statistical Package of the Social Sciences Version 20; Chicago Inc., USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Quantitative variables were compared using mean values and qualitative variables using proportions.

Significance level was fixed at $P \leq 0.05$.

RESULTS AND OBSERVATIONS

Table 1 reveals the demographic distribution of study subjects according to age and gender. Most of the patients were >50 years old. There was the statistically significant difference in the distribution of study subjects according to age and gender ($P = 0.015$).

Tables 2 and 3 reveal the demographic distribution of study subjects according to weight and gender. There was statistically no significant difference in the distribution

Table 1: Demographic distribution of study subjects according to age and gender

Age groups (year)	Male *n* (%)	Female *n* (%)	Total *n* (%)
<25	4 (3.3)	8 (6.7)	12 (10.0)
26-50	28 (23.3)	15 (12.5)	43 (35.8)
>50	49 (40.8)	16 (13.3)	65 (54.2)
Total	81 (67.5)	39 (32.5)	120 (100.0)
Mean age (year)	54.38	43.64	50.89
Chi-square value	8.339		
Significance *P* value	0.015 (S)		

Table 2: Demographic distribution of study subjects according to weight and gender

Weight (Kg)	Male *n* (%)	Female *n* (%)	Total *n* (%)
<50	13 (10.8)	6 (5.0)	19 (15.8)
50–70	49 (40.8)	23 (19.2)	72 (60.0)
>70	19 (15.8)	10 (8.3)	29 (24.2)
Total	81 (67.5)	39 (32.5)	120 (100.0)
Mean weight (kg)	61.51	61.59	61.53
Chi-square value	0.069		
Significance "*P*" value	0.966 (NS)		

of study subjects according to weight and gender ($P = 0.966$).

Table 4 reveals the association of RSBI and Bipap requirement among study subjects. It's shows that mean RSBI of study subjects with the requirement of Bipap was 87.76. It was almost the same among both the groups ($P = 0.990$).

Table 5 reveals the frequency of extubation success among study subjects. Out of 120 subjects, 83 (69.17%) were successfully extubated while 37 (30.83%) failed to extubate successfully.

Table 6 reveals the association of age and extubation success among study subjects. It's shows that the mean age of study subjects with successful extubation was less when compared to study subjects who require reintubation, but the difference was statistically not significant ($P = 0.064$).

Table 7 reveals an association between weight and extubation success among study subjects. It was almost the same among both the groups ($P = 0.971$).

Table 8 reveals extubation success among study subjects. It was less among subjects with successful intubation as compared to subjects who required reintubation but statistically, it was insignificant ($P = 0.160$).

Table 9 reveals the association of RSBI and extubation success among study subjects at baseline. Its shows that mean RSBI was less among subjects with success intubation as compared to subjects who required reintubation and the difference was statistically significant ($P = 0.019$).

Mean PaO_2/FiO_2 ratio was more among subjects with successful intubation but the difference was statistically not significant ($P = 0.774$).

Tables 10 and 11 reveal the association of RSBI and extubation success among study subjects at 30 min. Mean RSBI was less among subjects with successful intubation, and the difference was statistically significant ($P = 0.001$).

Table 12 reveals the association of PaO_2/FiO_2 ratio and extubation success among study subjects at 30 min. It was more among subjects with successful intubation as compared to subjects who required reintubation. There was a statistically significant association ($P = 0.188$).

Table 3: Sensitivity, specificity, positive predictive value, and negative predicive value of RSBI

Parameter	Values
Area under the ROC curve (AUC)	0.757
Sensitivity	86.4%
Specificity	69.85
Positive predictive value	56.1
Negative predictive value	92.1
Cutoff point using Youden Index	88

RSBI: Rapid shallow breathing index

Table 4: Correlation of RSBI and requirement of Bipap among study subjects at 30 min

Bipap required	RSBI		
	Mean±SD	Minimum	Maximum
Yes (*n*=25)	85.76±13.59	40	105
No (*n*=95)	85.80±13.88	41	104
Pearson's correlation coefficient	0.001 (no linear relation)		
Student *t*-test	0.013		
Significance *P* value	0.990 (NS)		

RSBI: Rapid shallow breathing index, SD: Standard deviation

Table 5: Frequency of extubation success among study subjects

Extubation success	*n* (%)
No	37 (30.83)
Yes	83 (69.17)

Table 6: Association of age and extubation success among study subjects

Extubation	Age (year)		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	48.90±16.990	17	87
Failure (*n*=37)	55.35±18.379	17	90
Student *t*-test	1.872		
Significance *P* value	0.064 (NS)		

SD: Stanadard deviation

Table 7: Association of weight and extubation success among study subjects

Extubation	Weight (Kg)		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	61.55±10.004	39	84
Failure (*n*=37)	61.49±8.252	48	79
Student *t*-test	0.036		
Significance *P* value	0.971 (NS)		

SD: Standard deviation

Table 8: Intubation and extubation success among study subjects

Extubation	Duration of intubation (days)		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	2.99±0.956	2	7
Failure (*n*=37)	3.27±1.122	2	6
Student *t*-test	1.415		
Significance *P* value	0.160 (NS)		

Table 9: Association of RSBI and extubation success among study subjects at baseline

Extubation	RSBI		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	83.88±13.236	44	105
Failure (*n*=37)	89.76±10.797	61	105
Student *t*-test	2.371		
Significance *P* value	0.019(S)		

RSBI: Rapid shallow breathing index, SD: Standard deviation

Table 10: Association of PaO_2/FiO_2 ratio and extubation success among study subjects at baseline

Extubation	PaO_2/FiO_2 ratio		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	391.88±119.187	166	696
Failure (*n*=37)	384.95±128.466	216	633
Student *t*-test	0.287		
Significance *P* value	0.774 (NS)		

SD: Standard deviation

Table 11: Association of RSBI and extubation success among study subjects at 30 min

Extubation	RSBI		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	82.52±14.033	40	105
Failure (*n*=37)	93.14±9.074	55	105
Student *t*-test	4.220		
Significance *P* Value	0.001 (HS)		

RSBI: Rapid shallow breathing index, SD: Standard deviation

Table 12: Association of PaO_2/FiO_2 ratio and extubation success among study subjects at 30 min

Extubation	PaO_2/FiO_2 ratio		
	Mean±SD	Minimum	Maximum
Success (*n*=83)	415.88±126.433	142	760
Failure (*n*=37)	384.22±107.736	220	630
Student *t*-test	1.323		
Significance *P* value	0.188 (NS)		

SD: Standard deviation

Table 13 reveals Bi-level positive airway pressure support needed at 24 h and 48 h. Out of 120 study subjects, 13 (10.8%) needed Bi-level positive airway pressure support at 24 h, and 6 (5%) needed Bi-level positive airway pressure support at 48 h.

Table 14 reveals re-intubation needed at 24 h and 48 h. Out of 120 study subjects, 28 (23.3%) needed re-intubation at 24 h, and 37 (30.83%) needed re-intubation at 48 h.

Tables 15 and 16 reveal Pearson' Correlation of Extubation Success with age, weight, duration of intubation, RSBI, and PaO_2/FiO_2 ratio. All the parameters showed a negative correlation with extubation success except PaO_2/FiO_2 ratio which had weak positive correlation ($P = 0.001$) [Figures 1-16].

DISCUSSION

Assessment of spontaneous breathing is a routine procedure carried out in all mechanically ventilated patients. Many different techniques are used to decide if a patient is able to breathe independently.[12] Pre-extubation respiratory parameters (also known as weaning predictors) and weaning strategies have been studied previously, and their relevance has been found to vary according to the center where the studies were carried out.[13]

MV can cause complications in several systems that can subsequently extend the amount of time that MV is required. Consequently, MV can lengthen a patient's stay in the ICU and increase the risk of mortality. Both prolonged ventilation support and early withdrawal are associated with a number of complications.[14,15] Between 25% and 40% of extubated patients can develop respiratory failure,[16,17] even when extubation is performed appropriately. Moreover, there are no established objective parameters for identifying patients who are at risk of failure during the MV weaning procedure, and 5–20% of extubated patients require reintubation due to associated complications.[18,19] It has been shown that systematic identification protocols can significantly decrease the duration of MV by identifying patients with suitable conditions for the interruption of MV, which serves to reduce the likelihood of VAP, the MV times, the ICU and hospital stay and also the complications associated with prolonged ventilation and early withdrawal.[20,21]

Finding the cause of respiratory failure is the first step in the management of patients who are under MV. The second step is to select patients who can have spontaneous respiration and can breathe without the aid of ventilator.[22] A standard assessment method for weaning should be simple and safe.[23]

For the 1st time Yang and Tobin used RSBI for weaning in 1991. They reported RSBI as the most specific and most sensitive index for weaning. For tidal volume measurement, they used a special spirometer which was connected to the trachea.[8] Although some studies have considered RSBI as a useless method,[24,25] many ICUs use RSBI for weaning.[23] Such differences may be attributed to sample size or absence of a global definition for weaning.[25]

This study was done to evaluate sensitivity, specificity, positive predictive value, and negative predictive value of RSBI <105 as an indicator of successful weaning. We also aimed to find a lower threshold of RSBI as a better predictor of successful weaning. With this study, we wanted to find a correlation between age, sex, weight, duration of intubation, and PaO_2/FiO_2 with successful weaning.

In this prospective, observational and hospital-based clinical study, 120 patients who were admitted in SICU with at least 48 h of intubation were selected. SBT was given for 30 min to the patients who were hemodynamically stable and have RSBI <105. After 30 min, RSBI was recalculated and patients with value <105 were extubated. Extubated patients were observed for 48 h for any sign of hemodynamic compromise and requirement of NIV or reintubation. Patients who were reintubated in 48 h were considered to be a failure to wean.

Demographic parameters such as age distribution and sex distribution were recorded.

Table 13: Bi-level positive airway pressure support needed at 24 h and 48 h

Bi-level positive airway pressure	24 h *n* (%)	48 h *n* (%)
Yes	13 (10.8)	6 (5)
No	107 (89.2)	114 (95.0)

Table 14: Re-intubation needed at 24 h and 48 h

Re-intubation	24 h *n* (%)	48 h *n* (%)
Yes	28 (23.3)	37 (30.83)
No	92 (76.7)	83 (69.16)

Table 15: Success of intubation according to gender

Success	Male (%)	Female	Total
Success	57 (47.5)	26 (21.7)	83
Failure	24 (20.0)	13 (10.8)	37
Total	81	39	
Chi-square value	0.169		
P value	0.681 (NS)		

Mean duration of intubation with successful extubation and failure of extubation was 2.99 ± 0.956 and 3.27 ± 1.12, respectively [Table 8]. With RSBI <105, we extubated all the patients and observed them for 48 h. Failure rate was 30.43% in our clinical study [Table 5]. An investigation by Esteban *et al.*[26] is perhaps the best known of the randomized trials. This multicenter study evaluated four methods of weaning patients from MV: Intermittent mandatory ventilation, pressure support ventilation, intermittent SBTs throughout the day, and single SBTs. Failure of extubation occurred in 13.8%, 18.9%, 15.2%, and 22.6% of the patients, respectively.[26] More recently, Bien *et al.*[27] evaluated the predictive power of three contemporary methods of weaning: T-piece, automatic tube compensation, and pressure support ventilation in 68 consecutive medical ICU patients. The rate of failure of extubation for the cohort was 33.8%.

ROC curve was drawn to estimate the parameter, and we found sensitivity to be 86.4%, specificity was 69.85%, positive predictive value was 56.1, and negative predictive value was found to be 92.1 [Table 3]. Fadaii *et al.*[28] found that RSBI <105 breaths/min/L has specificity, sensitivity, negative predictor value, and positive predictor value of 77.8%, 71.4%, 96.1%, and 26.3%, respectively. Yang and Tobin[29] in their benchmark study found that RSBI <105 is associated with sensitivity, specificity, positive predictive value, and negative predictive value of 97%, 64%, 78%, and 95%, respectively. These values are comparable with our study.

Mean RSBI for patients with successful extubation was 82.52 while it was 93.14 in patients who failed to wean [Table 11]. Our finding was in agreement with Youssef *et al.*[30] who found that RSBI value associated with success and failure was 72.9 and 96.0, respectively. Chao *et al.*[31] found in their study that lower threshold for RSBI can be as low as 97.

In our study, most of the patients were more than 50 years old, i.e., 65 (54.2%). Extubation was more successful in patients with lesser age. There was statistically no significant association between age and extubation success ($P = 0.064$) [Table 6]. This observation was in also done by Pilcher

Table 16: Pearson's correlation of extubation success with age, weight, duration of intubation, RSBI, and PaO_2/FiO_2 ratio

Parameters	Extubation success		
	Pearson's correlation coefficient (r)	*P* value	Inference
Age	−0.170	0.064	Weak Negative Correlation
Weight	−0.003	0.971	No Linear Relationship
Duration of intubation	−0.129	0.160	Weak Negative Correlation
RSBI	−0.362**	0.001	Moderate Negative Correlation
PaO_2/FiO_2 ratio	0.121	0.188	Weak Positive Correlation

RSBI: Rapid shallow breathing index

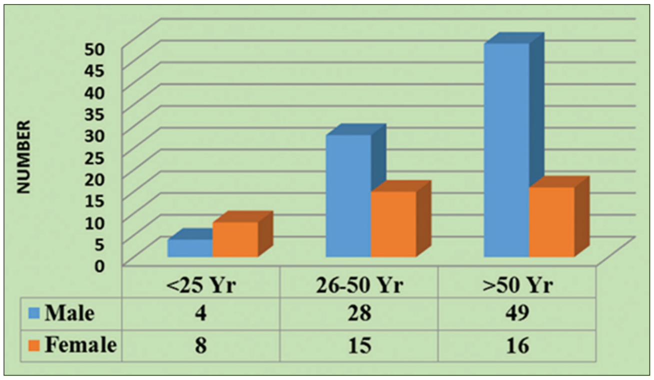

Figure 1: Demographic distribution of study subjects according to age and gender

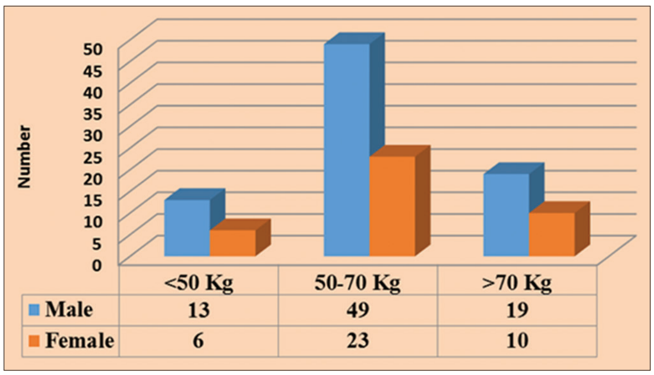

Figure 2: Demographic distribution of study subjects according to weight and gender

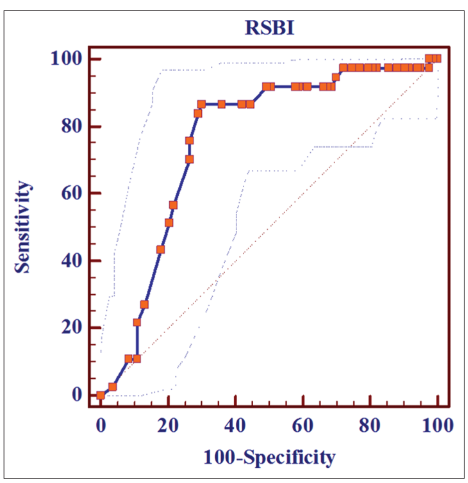

Figure 3: Showing sensitivity and specificity of RSBI

et al.[32] where they found that though old age patients are associated with more risk of weaning failure but the correlation between age and extubation success is not very strong. Pearson Correlation Coefficient is −0.170 which is weak negative correlation.

In our study, it was observed that the mean weight of study subjects with successful extubation and failure was 61.55 ± 10.00 and 61.49 ± 8.25, respectively. It was almost the same

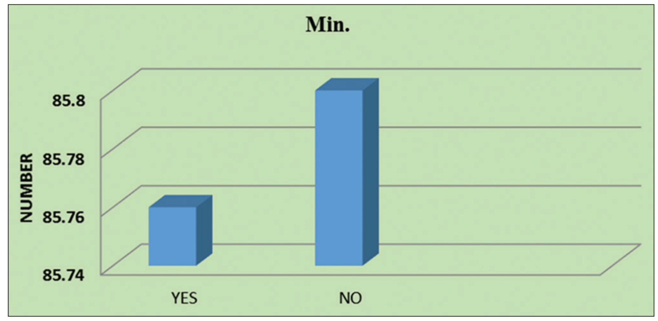

Figure 4: Correlation of rapid shallow breathing index and requirement of Bipap among study subjects at 30 min

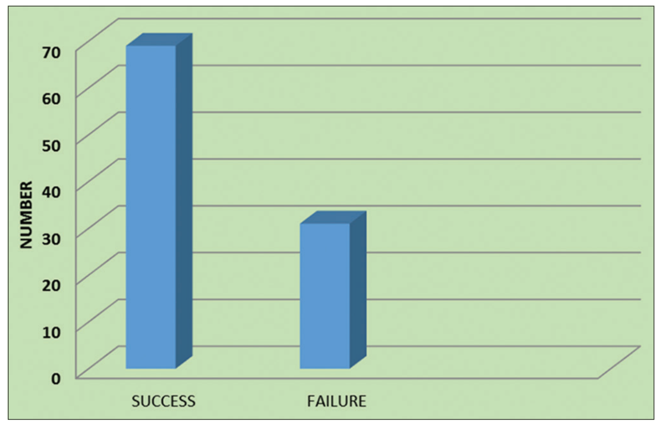

Figure 5: Frequency of extubation success among study subjects

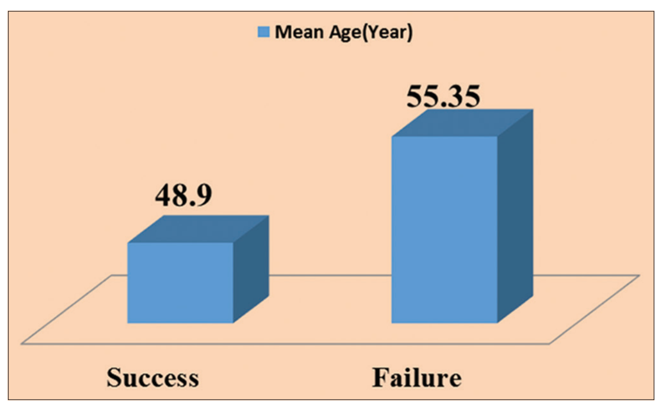

Figure 6: Association of age and extubation success among study subjects

among both the groups (P = 0.971) [Table 7]. Association between the weight of patient and extubation success has not been studied in the past. Pearson's Correlation Coefficient is −0.003 with P value of 0.9, and hence no correlation has been established in our study. Sex also does not affect the weaning success. Utensute *et al.* found that female sex is associated with a higher failure rate than the male (97% vs. 90%).[33]

In our study, the mean duration of intubation with successful extubation and failure was 2.99 ± 0.956 and 3.27 ± 1.12 days, respectively. It was less among subjects with

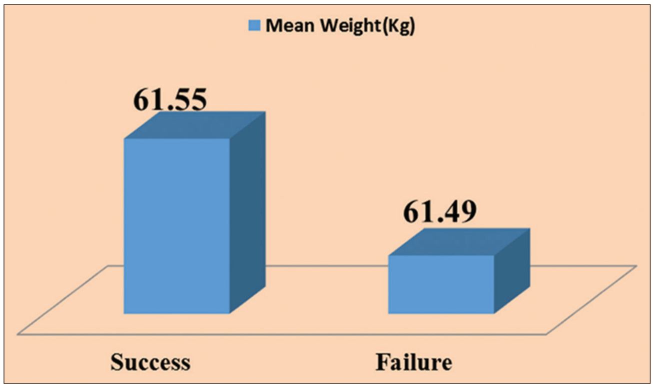

Figure 7: Association of weight and extubation success among study subjects

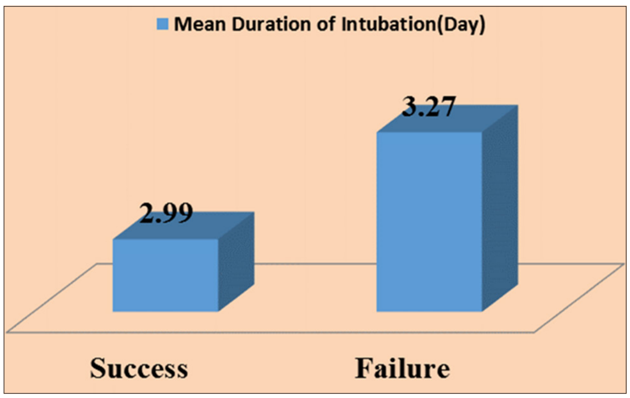

Figure 8: Association of intubation and extubation success among study subjects

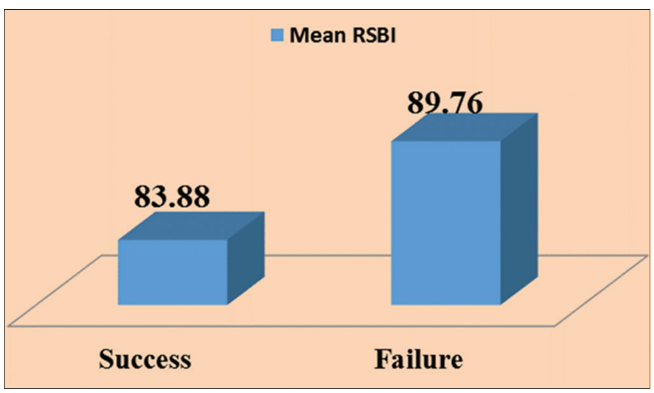

Figure 9: Association of rapid shallow breathing index and extubation success among study subjects at baseline

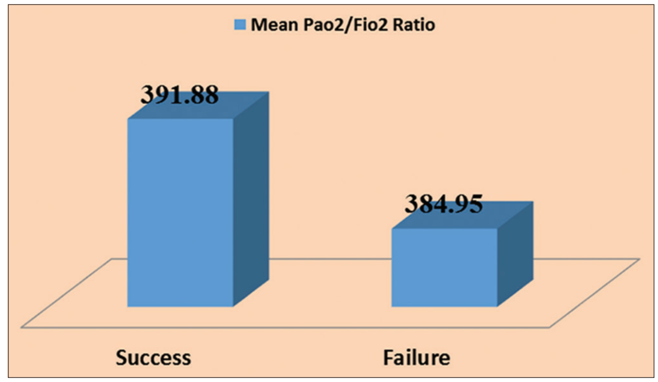

Figure 10: Association of PaO_2/FiO_2 ratio and extubation success among study subjects at baseline

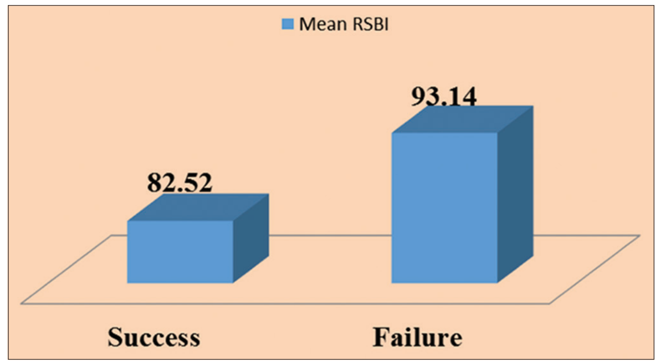

Figure 11: Association of rapid shallow breathing index and extubation success among study subjects at 30 min

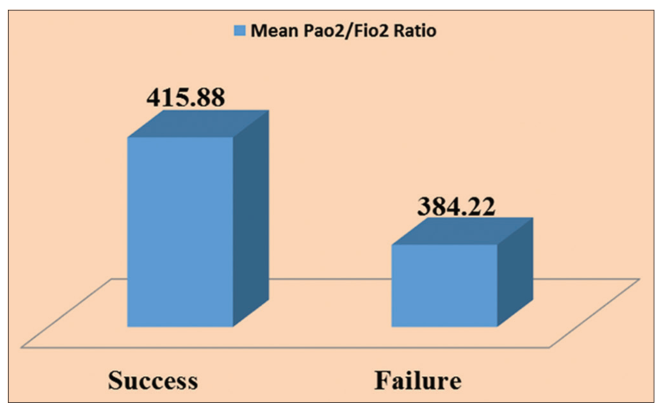

Figure 12: Association of PaO_2/FiO_2 ratio and extubation success among study subjects at 30 min

successful intubation as compared to subjects who required reintubation (P = 0.160) [Table 8]. Pearson's Correlation Coefficient for this association is −0.129 that shows a weak negative correlation. Esteban *et al.* had a similar observation in their systemic review of 2000 mechanically ventilated subjects. They found that there is no correlation between the duration of intubation and success of weaning.[34]

PaO_2/FiO_2 ratio is an index of ventilation and oxygenation adequacy. In our study, mean PaO_2/FiO_2 ratio with successful extubation and failure was 415.88 ± 126.43 and 384.22 ± 107.73, respectively. It was more among subjects with success intubation as compared to subjects who required reintubation (P = 0.188) [Table 12]. Pearson Correlation Coefficient is 0.121 which signifies a weak positive correlation. This parameter has not been assessed by previous investigators. Salam *et al.* studied ABG analysis in the decision making of extubation. In 83 patients they studied the correlation between PaO_2/FiO_2 ratio and found a statistically insignificant correlation. In our study, the

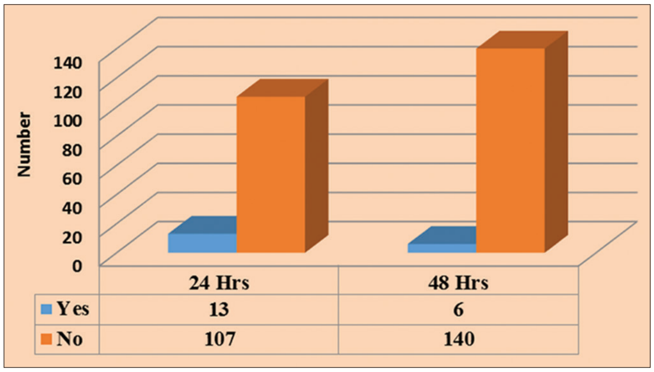

Figure 13: Bi-level positive airway pressure support needed at 24 h and 48 h

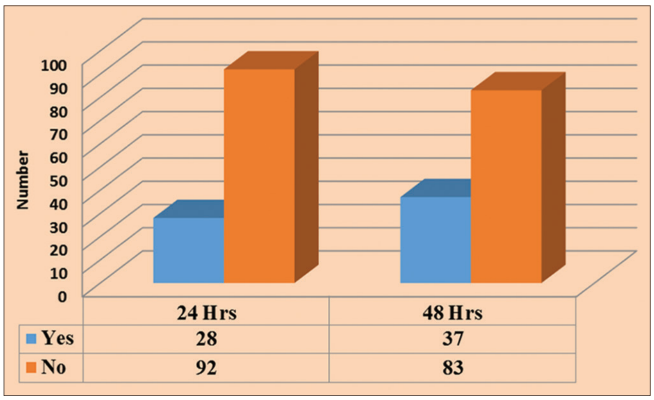

Figure 14: Re-intubation needed at 24 h and 48 h

association between PaO_2/FiO_2 and extubation success is statistically significant.[35]

Limitations of the Study

1. This study did not include other clinical parameters such as APACHE Score or systemic involvement. These factors may influence the success of weaning.
2. RSBI calculation was done after 30 min of SBT, but longer duration of SBT is associated with better outcomes.
3. RSBI calculation was done after T piece Trial, many studies have pointed out that SBT with pressure support has been associated with more successful outcomes.[36]

Recommendations

1. We recommend that RSBI <105 is an acceptable clinical index for weaning from mechanical ventilation, but a lower threshold value should always be considered to increase the sensitivity and specificity of this index.
2. We recommend that age, weight, and duration of intubation do not seem to be correlated with successful weaning. Further studies should be done to establish an evidence-based recommendation.
3. We recommend that PaO_2/FiO_2 ratio should be included in protocols designed to predict weaning success.

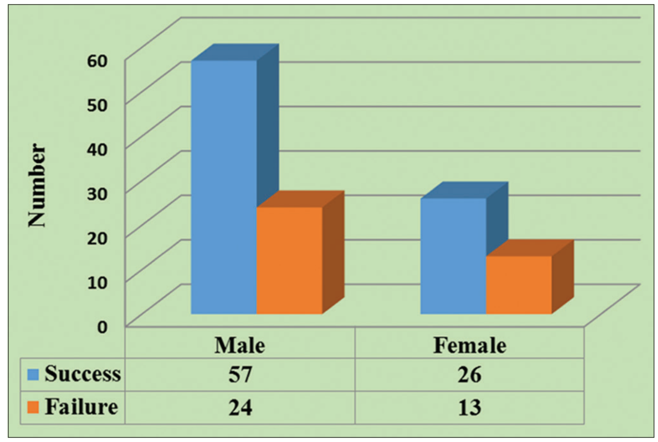

Figure 15: Success of intubation according to gender

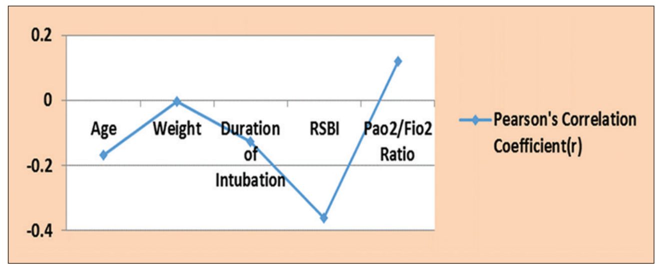

Figure 16: Pearson's correlation of extubation success with age, weight, duration of intubation, rapid shallow breathing index, and PaO_2/FiO_2 ratio

4. We recommend that protocol-based extubation should be followed in hospitals to improve the success rate of weaning.

CONCLUSION

The prospective, observational, hospital-based clinical study was done on 120 patients of age group 18–65 of either gender admitted in SICU and intubated for mechanical ventilation for at least 48 h.

The following conclusions were drawn:

1. Baseline characteristics were comparable in both successful and fail to wean patients.
2. Sensitivity, specificity, positive predictive value, and negative predictive value of RSBI <105 as an index for successful weaning were 86.4%, 69.85%, 56.1, and 92.1, respectively, which was comparable with most of the studies.
3. Lower value of RSBI (i.e., 82) was found to be better threshold for successful weaning.
4. Overall failure to wean rate was 30.43% which was comparable with most of other studies.
5. There was a weak positive correlation between age and weaning failure, but it was not statistically significant.
6. Correlation between weight and weaning failure was not established.

7. There was a weak negative correlation between the duration of intubation and weaning failure. Patients who were intubated for longer period of time were associated with more incidence of weaning failure, but it was not statistically significant.
8. The higher PaO_2/FiO_2 ratio was associated with successful weaning, and there was a statistical significant difference among both groups.
9. Bipap support was required in 15.8% patients in 48 h.

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