Comparison of Clinico-Demographic Characteristics and Rapid Shallow Breathing Index of Patients on Mechanical Ventilation at Intensive Care Unit

Md. Sirajul Islam[1], Uzzwal Kumar Mallick[2], AKM Ferdous Rahman[3],
Md. Gias Uddin[4], Kazi Eshika Raka[5]

[1]Assistant Professor, Department of Critical Care Medicine, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh; [2]Registrar, Department of Critical Care Medicine, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh; [3]Assistant Professor, Department of Anesthesia, Pain, Palliative and Intensive Care Unit, Dhaka Medical College and Hospital, Dhaka, Bangladesh; [4]Phase B residence, Anesthesiology, Department of Anesthesia, Pain, Palliative and Intensive Care Unit, Dhaka Medical College and Hospital, Dhaka, Bangladesh; [5]Lecturer, Department of Physiology, Care Medical College, Dhaka, Bangladesh

Abstract

Background: Mechanical ventilation (MV) is a life-saving intervention in the intensive care unit that should be considered for patients with respiratory failure. **Objective:** The purpose of the present study was to compare the clinico-demographic characteristics and rapid shallow breathing index of patients on mechanical ventilation at intensive care unit. **Methodology:** This prospective cohort study was conducted in the Department of Anesthesia, Pain Palliative & Intensive Care Unit of Dhaka Medical College Hospital, Dhaka, Bangladesh from January 2014 to December 2015 for a period of two (2) years. Patients on mechanical ventilation more than 48 hours with the age of 18 to 60 years after fulfilling the inclusion and exclusion criteria were included as study population. One type of ventilator (eVent Medical) was used in all patients. Primary and daily setting of ventilators and the decision to weaning of the patient was made by the ICU consultants. The rapid shallow breathing index (RSBI) was measured by the ratio of respiratory frequency (f) to average exhaled tidal volume (EVT). When rapid shallow breathing index was 105 breath/min/L or less and more than 105 breath/min/L were taken as low and high RSBI respectively. **Result:** A total number of 117 patients were recruited for this study after fulfilling the inclusion and exclusion criteria of which 92 patients were in low RSBI group and the rest 25 patients were in high RSBI group. The mean age was found 31.8±12.8 years in low RSBI group and 35.9±13.2 years in high RSBI group (p>0.05). It was observed that male was found 57(62.0%) in low RSBI group and 13(52.0%) in high RSBI group (p>0.05). It was observed that 14(15.2%) patients had laparotomy in low RSBI group and 4(16.0%) in high RSBI group (p>0.05). Surgical patients was found 27(29.3%) in low RSBI group and 11(44.0%) in high RSBI group (p>0.05). **Conclusion:** In conclusion there is no statistical significant relationship of age, gender and clinical diseases of the patients with low and high rapid shallow breathing index who are under mechanical ventilation at intensive care unit. *[Journal of National Institute of Neurosciences Bangladesh, July 2021;7(2):92-96]*

Keywords: Clinico-demographic characteristics; rapid shallow breathing index; mechanical ventilation; intensive care unit

Introduction

Mechanical ventilation in critically ill patients is the most important support in intensive care unit (ICU)[1]. After mechanical ventilatory support, weaning from

ventilator is the main challenge in ICU. Weaning of patients from MV involves two different processes like ventilator discontinuation and removal of the endotracheal tube (extubation)[2]. The decision regarding the removal of the endotracheal tube is crucial because both failed extubation and delay extubation associated with a lot of complications and adverse effects[3].

Prolonged mechanical ventilation support in ICU needs prolonged stay, increases the financial burden and is an important cause of mortality and morbidity[4]. On the other hand, premature extubation may lead to re-intubation, which also ultimately results in increased length of stay in ICU, mortality, morbidity and costs[5]. Therefore, accurate knowledge of the risk factors and predictors of extubation failure is needed.

In a developing country like Bangladesh, most of the critically ill patients are not able to bear the expenses of ICU[6]. Other hand there is no cost to measure the RSBI; it can measure just with the help of mechanical ventilator. Therefore, this present study was undertaken to compare the clinico-demographic characteristics and rapid shallow breathing index of patients on mechanical ventilation at intensive care unit.

Methodology

This study was conducted in the Department of Anesthesia, Pain Palliative & Intensive Care Unit of Dhaka Medical College Hospital, Dhaka, Bangladesh. This study was a prospective cohort study. This study was conducted from January 2014 to December 2015. Non-purposive sampling was applied for this study. Patients on mechanical ventilation more than 48 hours with the age of 18 to 60 years after fulfilling the inclusion and exclusion criteria were included as study population. Patients with tracheotomy, patients with spinal cord injury, self extubation or unplanned extubation, patients who expired before spontaneous breathing trial, patients shifted to another hospital before weaning and within 48 hours of weaning were excluded from this study. Ethical clearance was taken from Ethical Review Committee of Dhaka Medical College before starting this study. One type of ventilator (eVent Medical) was used in all patients. Primary and daily setting of ventilators and the decision to weaning of the patient was made by the ICU consultants. During the weaning process, the arterial blood gases (ABG) values was checked and the patients was separated from mechanical ventilation by gradually decreasing the respiratory rate and pressure support (PS) in SIMV (synchronized intermittent mandatory ventilation) and PSV (pressure support ventilation) modes. The rapid

shallow breathing index (RSBI) was defined as the ratio of respiratory frequency (f) to average exhaled tidal volume (EV_T). When rapid shallow breathing index was 105 breath/min/L or less and more than 105 breath/min/L were taken as low and high RSBI respectively. The RSBI was measured with the headboard raised to 30º to 45º and with the patient in the dorsal decubitus position while monitoring the patients' vital signs. Tracheal suction was performed as per need. After measuring RSBI, patients was separated from mechanical ventilator and given T-piece trial (1 to 4 hours) and finally extubated as per advice of ICU consultant and observed for 48 hours. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean values were calculated for continuous variables. The qualitative observations were expressed by frequencies and percentages. Chi-Square test was used to analyze the categorical variables. Student Unpaired t-test was used for continuous variables such as age, RSBI etc. P value <0.05 was considered as statistically significant.

Results

A total number of 117 patients were recruited for this study after fulfilling the inclusion and exclusion criteria of which 92 patients were in low RSBI group and the rest 25 patients were in high RSBI group. In this study it was observed that 36(39.1%) in low RSBI group and 7(28.0%) in high RSBI group patients belonged to age 21-30 years. The mean age was found 31.8±12.8 years in low RSBI group and 35.9±13.2 years in high RSBI group. The mean difference was not statistically significant (p>0.05) between two groups (Table 1).

Table 1: Comparison of Age and Rapid Shallow Breathing Index (n=117)

Age Group	Low RSBI	High RSBI	P value
18 to 20 Years	11(12.0%)	4(16.0%)	
21 to 30 Years	36(39.1%)	7(28.0%)	
31 to 40 Years	18(19.6%)	6(24.0%)	
41 to 50 Years	16(17.4%)	8(32.0%)	
51 to 60 Years	8(8.7%)	5(20.0%)	
Total	**92**	**25**	
Mean±SD	31.8±12.8	35.9±13.2	0.161
Range (min, max)	18 to 60	18 to 60	

Student t test was performed to see the level of significance.

It was observed that male was found 57(62.0%) in low RSBI group and 13(52.0%) in high RSBI group. Female was 35(38.0%) in low RSBI group and 12(48.0%) in

high RSBI group. The difference was not statistically significant (p>0.05) between two groups (Table 2).

Table 2: Distribution of the Patients by Sex and Rapid Shallow Breathing Index (n=117)

Gender	Low RSBI	High RSBI	Total	P value
Male	57(62.0%)	13(52.0%)	70(59.8%)	
Female	35(38.0%)	12(48.0%)	47(40.2%)	0.367
Total	**92(100.0%)**	**25(100.0%)**	**117(100.0%)**	

Chi-square test was performed to see the level of significance.

The association between diagnosis and rapid shallow breathing index of the patients were recorded. It was observed that 14(15.2%) patients had laparotomy in low RSBI group and 4(16.0%) in high RSBI group. Others result are depicted in the table. The difference was not statistically significant (p>0.05) between two groups (Table 3).

Table 3: Distribution of the patients by diagnosis and rapid shallow breathing index (n=117)

Diagnosis	Low RSBI	High RSBI	Total	P value
Laparotomy	14(15.2%)	4(16.0%)	18(15.4%)	
Head injury operated	12(13.0%)	3(12.0%)	15(12.8%)	
GBS	13(14.1%)	0(0.0%)	13(11.1%)	
Head injury non operated	8(8.7%)	4(16.0%)	12(10.2%)	
Eclampsia with HELLP	8(8.7%)	3(12.0%)	11(9.4%)	0.679ns
Sepsis	7(7.6%)	3(12.0%)	10(8.0%)	
Encephalopathy	8(8.7%)	2(8.0%)	10(8.0%)	
COPD	5(5.4%)	2(8.0%)	7(6.0%)	
Other	17(18.5%)	4(16.0%)	21(17.9%)	
Total	**92(100.0%)**	**25(100.0%)**	**117(100.0%)**	

Chi-square test was performed to see the level of significance.

The association between surgical and non-surgical patients and rapid shallow breathing index was recorded. It was observed that surgical patients was found 27(29.3%) in low RSBI group and 11(44.0%) in high RSBI group. Non-surgical patients was found 65(70.7%) and 14(56.0%) in low RSBI and high RSBI groups respectively. The difference was not statistically significant (p>0.05) between two groups (Table 4).

Table 4: Comparison of Surgical and Non-Surgical Patients and Rapid Shallow Breathing Index (n=117)

Diagnosis	Low RSBI	High RSBI	Total	P value
Surgical	27(29.3%)	11(44.0%)	38(32.5%)	
Non-surgical	65(70.7%)	14(56.0%)	79(65.5%)	0.165
Total	**92(100.0%)**	**25(100.0%)**	**117(100.0%)**	

Chi-square test was performed to see the level of significance.

Discussion

Prolonged mechanical ventilation support in ICU needs prolonged stay, increases the financial burden and is an important cause of mortality and morbidity[7]. On the other hand, premature extubation may lead to re-intubation, which also ultimately results in increased length of stay in ICU, mortality, morbidity and costs[8]. Therefore, accurate knowledge of the risk factors and predictors of extubation failure is needed.

A total of 117 patients of ICU who fulfilled the criteria of extubation after 48 hours in mechanical ventilation under Anesthesia, Pain, Palliative and Intensive Care unit of Dhaka Medical College Hospital, Dhaka were included in this study. Patients with spinal cord injury, self extubation, unplanned extubation, or MV lasting <48 hours and patients or attendants not agreeing to participate in the study were excluded from the study. The present study findings were discussed and compared with previously published relevant studies.

In this present study it was observed that more than half (53.0%) patients had MV in duration of ≤7 days. The mean duration of MV was found 10.0±6.7 days with range from 3 to 21 days. Similarly, Bien et al[14] observed the mean duration of MV was 11.0±10.0 days, which is consistent with the current study. On the other hand, Fadaii et al[8] found that the mean duration of mechanical ventilation was 17 days varied from 2 to 45 days, which is higher with the current study.

The rapid shallow breathing index (RSBI) is one of the most widely investigated predictors of extubation failure. Values ≤105 cycles/min/L are considered predictive of extubation success reported by Boles et al[9], Mokhlesi et al[10] and Vidotto et al[11]. In this current study it was observed that low RSBI (≤105 breath/min/L) was found 92(78.6%) patients and high RSBI (>105 breath/min/L) was 25(21.4%) patients. The mean RSBI was found 86.74±16.16 breath/min/L with range from 60.97 to 119 breath/min/L.

In this present study it was observed that 36(39.1%) in low RSBI group and 7(28.0%) in high RSBI group patients belonged to age 21-30 years. The mean age was found 31.8±12.8 years in low RSBI group and 35.9±13.2 years in high RSBI group. The mean age difference was almost alike between two groups, which indicates that the difference was not statistically significant (p>0.05) between two groups. In another study Mahoori et al[12] obtained that the mean age was 69.0±2.0 years in RSBI >105 breath/min/L and 67.0±3.0 years in RSBI <105 breath/min/L. The difference was not statistically significant (p>0.05) between two groups. Berg et al[13] (2012) found median age was 71

years in RSBI <105 group and 75 years in RSBI >105 group.

In this current study it was observed that male was found 57(62.0%) in low RSBI group and 13(52.0%) in high RSBI group. Female was 35(38.0%) in low RSBI group and 12(48.0%) in high RSBI group. The difference was not statistically significant (p>0.05) between two groups. Similarly, Berg et al[13] found female 45 in RSBI <105 group and 10 in RSBI > 105 group. Fadaii et al[8] found male 58.6% and female 41.4%, which is consistent with the current study. Similarly, Bien et al[14] and Chao and Scheinhorn[15] observed male 69.4% and 51.5% respectively, which are similar to the present study. On the other hand, Patel et al[16] found female predominance, where they found female 57.0% in their study patients.

In this series it was observed that 14(15.2%) patients had laparotomy in low RSBI group and 4(16.0%) in high RSBI group. GBS was found 13(14.1%) in low RSBI group. Head injury operated was found 12(13.0) in low RSBI group and 3(12.0%) in high RSBI group. Head injury non operated was found 8(8.7%) in low RSBI group and 4(16.0%) in high RSBI group. The difference was not statistically significant (p>0.05) between two groups. Similarly, Berg et al[13] found sepsis 9(11.0%) in RSBI <105 group and 6(33.0%) in RSBI >105 group. Regarding the diagnosis, it was observed in this series that laparotomy was more common (15.4%) followed by, 12.8% head injury operated, 11.1% GBS, 10.3% head injury non operated, 9.4% eclampsia with HELLP syndrome, 8.5% sepsis and 8.5% encephalopathy, 6.0% COPD and 17.9% had other diagnosis. Fadaii et al[8] observed that sepsis in 7.1%, COPD exacerbation 22.9% and pneumonia 27.1%. In another study Bien et al[14] obtained that acute exacerbation of COPD was found 44.0%, pneumonia was 21.0%, heart failure 10.0%, neurological diseases 10.0%, sepsis 3.0%, others 12.0%. Similarly, Patel et al[16] reported that obstructive lung disease was found 6.0%, pneumonia 6.0%, Congestive heart failure was 15.0%, and neuromuscular disease was 13.0%. All the above mentioned study's findings comparable with the current study.

In this present study it was observed that surgical patients were found 27(29.3%) in low RSBI group and 11(44.0%) in high RSBI group. Non-surgical patients were found 65(70.7%) and 14(56.0%) in low RSBI and high RSBI groups respectively. The difference was not statistically significant (p>0.05) between two groups. Similarly, Kuo et al[17] showed the medical and surgical patients did not significantly differ in any of the

parameters and weaning outcome measured in this study, which is closely resembled with the present study.

Conclusion

In conclusion there is no statistical significant relationship of age of the patients under mechanical ventilation at intensive care unit with low and high rapid shallow breathing index. Male is predominant than female considering low and high rapid shallow breathing index. Laparotomy is more found in low rapid shallow breathing index patients. Further large scale study should be carried out to see the level of significance.

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