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Rate of extubation success after applying spontaneous breathing trial (SBT) protocol in National Guard Health Affairs

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ABSTRACT

The objective of this study is to assess extubation success (no need for reintubation within 48 h) tendency after applying spontaneous breathing trial protocol in *National Guard Health Affairs (*NGHA). This is a prospective study done on extubated patients who undergo a spontaneous breathing trial (SBT) prior to extubation in King Abdulaziz Medical City (KAMC), Riyadh, NGHA. We used stratified sampling technique to include patients both males and females who were intubated, between 18 and 90 years old, and with FIO_2 requirement < 40%. Data was collected by data collection form and analyzed by SPSS. We collected information about 93 patients; their mean age was 58.19 years. SBT protocol was applied correctly (on KAMC hospital criteria) on 42 patients. 85.7% of patients who received correct SBT had successful extubation, while patients who received wrong SBT had a 75.5% extubation success. Moreover, vital signs for patients who had correct SBT was decreasing within the normal range after 48 h. However, it increased for patients who had wrong SBT. Their ABG after extubation was normal for 51.6% of all participants, although most of them had correct SBT. In conclusion, correct application of SBT protocol was followed by higher rate of extubation success and normal vital signs and ABG results.

Keywords: Extubation success, Spontaneous breathing trial, National Guard Health Affairs.

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INTRODUCTION

Different problems were reported to have occurred in the intensive care environment during care of patients. The major problems are prolonged mechanical ventilation and reintubation of the patients after unsuccessful extubation, which increase mortality rate. To control these problems, several protocols have been designed to enhance weaning process, which is the way to release the mechanical ventilator from the patient gradually to exchange the work of the breathing from the ventilator to the patient. Spontaneous breathing trial (SBT) is one of the effective weaning protocols.

The importance of the study is the research will enquire about whether SBT protocol will increase the extubation success or not. The evidence created based on the study will improve the patient care and safety in NGHA.

The aim of the study was to assess the effectiveness of

spontaneous breathing trial (SBT) protocol in NGHA. The specific objectives were to assess daily SBT protocol, to assess rate of extubation success, and to assess patient response to SBT protocol. The secondary objective was to assess extubation failure in NGHA.

This literature explains some of the prolonged mechanical ventilation complications, defines SBT protocol, and shows previous studies about success or fail extubation after SBT protocol. When the patients are on mechanical ventilation for a long time, the chance of getting worse complications will increase. The most important complications are ventilator-associated lung injury, pulmonary edema, and cell damage and necrosis (Funk et al., 2010; Chang, nd; Lone and Walsh, 2011; Ely et al., 1996; Kacmarek, 1999). Moreover, barotrauma that occur due to applying high pressure, and atrophy of respiratory muscles are complications of prolonged mechanical ventilation (Rouby et al., 1993; Levine et al., 2008; Hermans et al., 2010). Laboratory studies have shown that the diaphragmatic inactivity that cause due to prolonged mechanical ventilation is associated with atrophy of myofibers in the diaphragm (Hermans et al., 2010; Shanely et al., 2002; Gayan-Ramirez et al., 2005). Because of these complications, health care providers tried to decrease this period and increase the extubation success rate by designing weaning protocol.

Spontaneous breathing trails protocol is one of the effective weaning protocols. It is a test used to decide whether patients can be successfully weaned and extubated from mechanical ventilation or not (Gayan-Ramirez et al., 2005). Spontaneous breathing can be assessed when the respiratory therapist check 5 criteria during suctioning, which are PEEP ≤ 5, PaO_2/FiO_2 > 200, adequate cough during suctioning, f/VT ≤ 105, and no infusion of sedatives or vasopressors sedatives or vasopressors. Then patients undergo two-hour trial of T-piece. If they tolerated the trial, their breathing become spontaneous. Respiratory therapist should discontinue the trial if one of these occurred happened; RR > 35 / min for 5 minutes, SaO_2 < 90 %, HR > 140 / min, sustained changes in HR > 20%, sys BP > 180 or < 90, and increased anxiety and diaphoresis (Ely, 1996). Earlier studies reported that around 87% of patients, who applied SBT protocol, were successfully extubated from mechanical ventilation without reintubated (Thille et al., 2013).

The extubation is removal of the tube after intubation of the larynx or trachea. At the end of the weaning process, it may be apparent that a patient no longer needs mechanical ventilation to maintain sufficient ventilation and oxygenation. However, extubation should not be ordered until it has been determined that the patient is able to protect the airway and the airway is patent. Need for reintubation after 48 h of extubation is considered extubation failure (Thille et al., 2013). Extubation failure is highest when a combination of risk factors are present.

Many earlier studies came out with viewed and contradictory results with respect to the success / failure of extubation. One of these researches, a research done in 1996 used two methods: T-tube system which shows 78% of extubation success, the other method is Pressure Support Ventilation which displays 86% successful extubation (Esteban et al., 1997). Another study which was performed in 1998 suggested that successful SBT tends to be followed by successful extubation since the failure rate was only 13.4% (Esteban et al., 1998). On the other hand, there is another research study conducted in 2001 which found that extubation tends to fail after successful SBT. They assumed that the patient should be evaluated before extubation (Khamiees et al., 2001). Moreover, some researchers conducted study from 2005 to September 2006; their plan was to compare between the patient outcomes for the first and the last 8 weeks of the study time (Robertson et al., 2008). The results have been showing a failure of extubation in the first 8 weeks, but in the last 8 weeks the result improved to 42% of successful extubation (Robertson et al., 2008). Based on the evidences, it was suggested that clinicians should assess the patients with respect to their mental status, endotracheal secretions, and pre-extubation $PaCO_2$ before extubation rather than depending only on SBT result (Mokhlesi et al., 2007). It was also successful that SBT protocol is a critical objective in improving extubation successful rate in ventilated infants (Chawla et al., 2013). The results showed that 80% of infants were successfully extubated after applying SBT (Chawla et al., 2013).

Intensive care unit health care providers try very hard to wean patients on mechanical ventilation as early as they can, to avoid the complications of prolonged mechanical ventilator. These complications include ventilator associated lung injury and barotrauma. Furthermore, most of the past years researches showed increase in extubation success after applying SBT, though some of them suggest that the patient should be checked before extubation even when SBT succeed. Indeed, because of lack of researches regarding SBT protocol in NGHA, this research will enquire about whether SBT protocol will increase the extubation success or not. The evidence created based on the study will improve the patient care and safety in NGHA.

MATERIALS AND METHODS

This is a cross sectional prospective study medical record review for all extubated patient who were admitted to King Abdulaziz Medical City (KAMC) between September and November 2017. The study included both male and female who were intubated in Intensive Care Unit (ICU2, TICU and SICU). We excluded from this study patients who are (is) younger than 18 years old or older than 90 years old, patients who required FiO_2 more than 40%, and sedated patient. We used stratified random sampling technique to select the samples. The sample size is 93.

Data collection methods and analysis plan

Data was collected using data collection form, which includes

demographic data, ventilatory status, ABG values, and the need of reintubation without any intervention with measurement tools (Appendix I). The data collected was entered in MS excel and was transferred to SPSS version 22 for statistical analysis. Results were presented in tables and figures. Categorical variables were expressed as frequencies and percentages. Mean and Standard deviation (SD) were used for continuous variables.

RESULTS

We collected information on 93 patients. The mean age for those patients was 58.19 years with a SD of 19.54. Out of 93 patients, there were 57 males (61.3%) and 36 females (38.7%). The highest two reasons for admission to ICU were pneumonia and post operation (20, 21.5% each). The lowest three reasons for admission to ICU were bronchiectasis, pulmonary edema, and stridor (1, 1.1% each). Table 1 shows basic characteristics of the patients.

Figure 1 shows the major percentage of patients had hypertention (HTN) (51.61%) followed by diabetes mellitus (DM) which included 48.39%, and congestive heart failure (CHF) 17.2%. The patients who had chronic obstructive pulmonary disease (COPD) included 7.53%, while patients who had asthma and cancer included 5.38% each.

Figure 2 shows the percentage of patients with correct and incorrect application of SBT. Out of 93 patients, majority (54.8) received incorrect application of SBT.

When we apply SBT correctly, the patients who have respiratory diseases and reintubated were 4 (17.4%) of 23 patients. In addition, the patients who have non-respiratory diseases and reintubated were 2 (10.5%) of 19 patients as shown in Table 2.

When we apply incorrect SBT, the patients who have respiratory diseases and reintubated were 5 (20.8%) of 24 patients. In addition, the patients who have non-respiratory diseases and reintubated were 8 (29.6%) of 27 patients as shown in Table 3.

Regarding vital signs, in the normal cases vitals after the extubation normally increase and then start to decrease to the normal range. In Table 4 we found that patients who received correct SBT their respiratory rate was 21.19 in the first 15 min and then decreased to 21.00 after 48 h. However, in Table 5, for patients who received wrong SBT their respiratory rate was 20.8 in the first 15 min and then increased to 23.29 after 48 h.

In Table 6, it is shown that patients who have normal arterial blood gases (ABG) were 48 (51.6%). Out of them, 28 (66.7%) patients received correct SBT.

Table 1. Basic characteristics of the sample.

Basic characteristics	Mean ± SD
Age in years	58.19 ± 19.54
Gender	No. (%)
Male	57 (61.3)
Female	36 (38.7)
Total	93 (100.0)
Admission diagnosis	Frequency (%)
Pneumonia	20 (21.5)
Post operation	20 (21.5)
Septic shock	13 (14.0)
Pneumothorax	6 (6.5)
Pulmonary embolism	5 (5.4)
Cardiac arrest	5 (5.4)
Hemothorax	4 (4.3)
Decreased LOC	4 (4.3)
Acute respiratory failure	4 (4.3)
Stroke	4 (4.3)
Pleural effusion	3 (3.2)
TB	2 (2.2)
Bronchiectasis	1 (1.1)
Pulmonary edema	1 (1.1)
Stridor	1 (1.1)
Total	93 (100.0)

LOC: Level of consciousness; TB: tuberculosis.

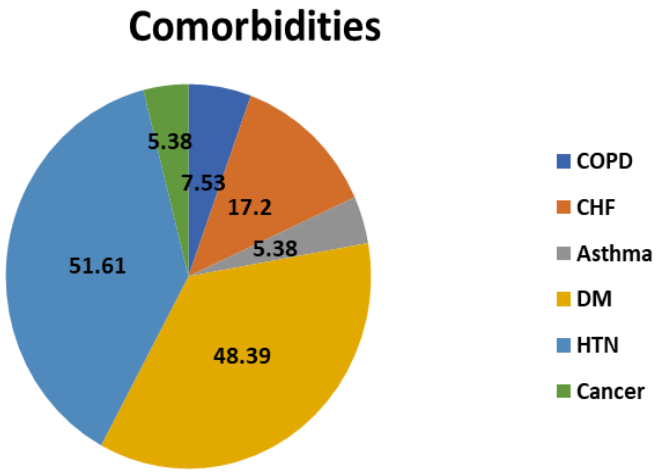

Figure 1. Comorbidities of study subjects.

DISCUSSION

Some studies showed failure of extubation even after applying SBT protocol correctly. One of them was conducted in 2001 which showed failure of extubation after applying successful SBT (Khamiees et al., 2001). Another study conducted from 2005 to September 2006 has shown failure of extubation after SBT in the first 8 weeks of the study (Robertson et al., 2008). While these two studies showed failure of extubation after successful SBT, our study provided a conflict in results. In our results we found that the reintubation rate in patients

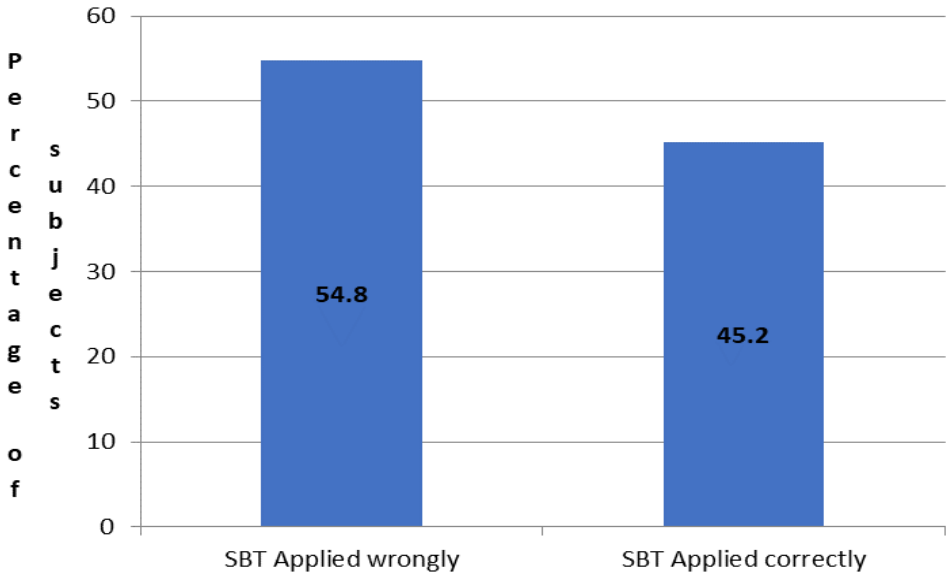

Figure 2. SBT in study subjects.

Table 1. Extubation outcome and correct application of SBT.

Type of disease	Reintubation		Total (%)
	Yes (%)	No (%)	
Respiratory	4 (17.4)	19 (82.6)	23 (100)
Non respiratory	2 (10.5)	17 (89.5)	19 (100)
Total	6 (14.3)	36 (85.7)	42 (100)

Test used is Pearson Chi-Square. P value is 0.527.

Table 3. Extubation outcome and incorrect application of SBT.

Type of disease	Reintubation		Total
	Yes (%)	No (%)	
Respiratory	5 (20.8)	19 (79.2)	24 (100)
Non respiratory	8 (29.6)	19 (70.4)	27 (100)
Total	13 (25.5)	38 (74.5)	51 (100)

Test used is Pearson Chi-Square. P value is 0.472.

received correct SBT (31.6%) which is lower than the reintubation rate in patients received wrong SBT 68.4%. In the correct SBT, we noticed that the majority of reintubation happen in a respiratory disease condition. However, reintubation also happens on non-respiratory conditions in the wronly applied SBT. Vital signs were in the normall range for both the groups, though there was a slight increase in respiratory rate for the wrongly applied SBT after 48 h of extubation. SPO_2 for both groups did not go below 97% and the heart rate was in the range of 60 to 80 BPM. Furthermore, most of the patients who reflict normal ABG after the extubation had a proper applied SPT protocol (66.7%). All things considered, this indicating that applying successful SBT will help by improving extubation and decreasing the reintubation rate. As well as educating even more about the SBT protocol will help to decrease the reintubation rate. Furthermore, Longer studies could evaluate if applying improper SBT will result in extubation failure and deterioration for patient vitals.

Strength and limitation of the study

The main strength for our study was the place that our data were collected from, which was *National Guard*

Table 4. Vital signs and correct application of SBT.

Variable	Time of extubation	Mean ± SD	F value	P value
SPO_2	During extubation	98.29 ± 2.20	1.903	0.131
	15 min after extubation	97.83 ± 2.66		
	24 hours	97.24 ± 2.13		
	48 hours	97.33 ± 2.08		
RR	During extubation	20.02 ±6.08	0.350	0.789
	15 min after extubation	21.19 ± 6.42		
	24 hours	21.02 ± 5.60		
	48 hours	21.00 ± 5.07		
HR	During extubation	60.45 ± 33.73	0.375	0.771
	15 min after extubation	64.60 ± 33.65		
	24 hours	67.24 ± 31.023		
	48 hours	66.52 ± 30.08		
BP	During extubation	72.52 ± 25.74	0.436	0.727
	15 min after extubation	76.07 ± 22.17		
	24 hours	78.12 ± 21.71		
	48 hours	76.60 ± 23.07		

Table 5. Vital signs and incorrect application of SBT.

Variable	Time of extubation	Mean ± SD	F value	P value
SPO_2	During extubation	98.12± 4.46	1.979	0.118
	15 min after extubation	98.55 ± 1.60		
	24 hours	97.31± 3.33		
	48 hours	97.27 ± 2.62		
RR	During extubation	20.57 ± 6.33	3.063	0.029*
	15 min after extubation	20.80 ± 6.12		
	24 hours	23.31 ± 60.8		
	48 hours	23.29 ± 6.20		
HR	During extubation	65.47 ± 27.51	1.519	0.211
	15 min after extubation	74.37 ± 23.86		
	24 hours	67.31 ± 29.41		
	48 hours	63.18 ± 30.75		
BP	During extubation	71.75 ± 22.75	1.544	0.204
	15 min after extubation	74.76 ± 20.04		
	24 hours	72.41 ± 27.55		
	48 hours	64.25 ± 32.46		

Health Affairs (NGHA). NGHA consider one of the largest tertiary care center hospitals in Saudi Arabia. On the other hand, our study included some limitations such as missing ABGs which lead to exclusion of many patients due to missing information. Also, limited time which result in low sample size.

Conclusion

Patients who received correct SBT their vital signs and ABGs were normal. As a result, the reintubation rate was low for these patients which reflect success extubation. Longer studies could evaluate if applying incorrect SBT

Table 6. ABG analysis and application of SBT.

ABG analysis	Application of SBT		Total
	Correct	Wrong	
Normal	20 (39.2)	28 (66.7)	48 (51.6)
Fully compensated respiratory acidosis	2 (3.9)	2 (4.8)	4 (4.3)
Fully compensated metabolic acidosis	2 (3.9)	3 (7.1)	5 (5.4)
Fully compensated respiratory alkalosis	2 (3.9)	2 (4.8)	4 (4.3)
Fully compensated metabolic alkalosis	5 (9.8)	-	5 (5.4)
Uncomponsated metabolic alkalosis	2 (3.9)	1 (2.4)	3 (3.2)
Respiratory acidosis	4 (7.8)		4 (4.3)
Respiratory alkalosis	4 (7.8)	1 (2.4)	5 (5.4)
Metabolic alkalosis	3 (5.9)	2 (4.8)	5 (5.4)
Partialy compensated respiratory acidosis	1 (2)	-	1 (1.1)
Partialy compensated metabolic acidosis	1 (2)		1 (1.1)
Partialy compensated respiratory alkalosis	3 (5.9)		3 (3.2)
Partialy compensated metabolic alkalosis	2 (3.9)	3 (7.1)	5 (5.4)
Total	51 (100)	42 (100)	93 (100)

will result in extubation failure and deterioration for patient vitals.

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APPENDICES I

King Saud Bin Abdulaziz University for Health Sciences
College of Applied Medical Science
Research Unit
COAMS 411 & 412 Research Methodology I & II
Respiratory Thyrapy Program

Title: **Rate of extubation success after applying Spontaneous Breathing Trial (SBT) protocol in NGHA**

Data Collection Form

Patient demographic data :

Age		Serial number:
Gender		

Date of intubation:_____
Date of extubation:_____

SBT Trail :

Ventilatory status			Readings		
	Yes	No	SpO_2		
PEEP 5-8			RR		
PSV 5-8			HR		
FIO2 ≤0.40			PB		

Observing:

	SBT	15 minutes after extubation	After 24 hr	After 48 hr
HR				
RR				
BP				
SpO_2				

ABG:

PH	
$PaCO_2$	
PaO_2	

Reintubation in 48 hours: Yes ☐ no ☐