

Predictors of Extubation Failure Among Type II Respiratory Failure Patients

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Abstract

Aim: The aim of the study is to assess the predictors of extubation failure with type II respiratory failure for ICU patients.

Method: Cross-sectional retrospective study was conducted in the critical care area of King Abdulaziz Medical City (KAMC) ICU for all patients from 18-80 years old with type II respiratory failure who undergo extubation failure and followed three days post the extubation during 2016-2017.

Result: 50 patients were enrolled in this study, 18 of them were male (36%) and the rest 32 were female (64%). 37 of them were successfully extubated (74%) and 13 were failed extubation (26%).RSBI was higher among the successful extubated patients than those who had failed extubation. GCS was variable between 9-10 which is considered moderate in the failed extubated patient. The mean age of patient who failed extubation is 55 years old, while those who successfully extubated is 63 years old. Patients who failed were mostly with normal BMI.

Conclusion: Among patients with type II respiratory failure it can be listed that RSBI, GCS, age and BMI considered as the main causes of extubation failure. Low RSBI with mean of 55.15 is highlighted as one of the predictors of reintubation. Patients with moderate GCS

maybe reintubated. Age of the patient might be highlighted as one of the predictors if it also accompanied with other disease regarding to type II respiratory failure which could not be the primary disease. Normal BMI cannot prevent extubation failure, so patients might be reintubated with mostly normal BMI

Introduction

Extubation failure can be defined as the disability to breath normally after removal of endotracheal tube in order to facilitate breathing mechanism (1). 2 to 25% of ventilated patients developed extubation failure in a period of 24 to 72 hours after decision of planned extubation (2). Respiratory failure is one of the reasons for extubation failure. Respiratory failure is a lung disease characterized in a form of disability to regulate a normal range of oxygen on body tissues leading to high level of carbon dioxide on body tissues due to impaired mechanism of removing CO₂ (3). Respiratory failure can be divided into two groups depending on the physiological dysfunction (4). Type I which is called as hypoxemia due to lack of oxygen delivery, and Type II that's called as ventilation failure which occurs because of high levels of CO₂ (hypercapnia) (5). Type II respiratory failure involves obstructive lung diseases characterized by narrowing of

the airway resulting in difficulty of breathing, and it involves Chronic Obstructive Pulmonary Disease(COPD), asthma, bronchiectasis, and cystic fibrosis (6,7). Respiratory failure can also be classified as acute or chronic, and patients with chronic respiratory failure type II are at risk of developing any risk factors (8) and fatal COPD kind of type II respiratory failure is one of leading causes of death in United States (9). In addition, there are many methods used to achieve successful extubation, failing in one of them can increase the frequency of extubation failure.

Literature Review

Airway Patency with the effort of cough and mental status are considered as extubation failure causes (10). Many investigations had shown that low cough effort plays an important role in extubation outcomes (11). The cough strength can be determined by Cough Peak Flow (CPF), and the value of CPF can be differ depending on the place of measurement (12). A value of > 160 L/min measured through the mouth shows a good result therefore a successful extubation, same as a value of > 60 L/ min measured through endotracheal tube (12). Any of CPF values under normal limits might lead to impaired mucociliary functioning which result in secretion accumulations (13). In 2004 a study was conducted on eighty-eight patients to estimate the role of CPF on Extubation failure; fourteen of them were gone under unsuccessful extubation due to low values of CPF (11).

Spontaneous breathing trials (SBT) are used to determine whether a patient is ready to be extubated from mechanical ventilation by using a minimum ventilation support, or sometimes with no ventilator support (14). SBT was done on group of 202 patients for 2 hours in order to examine who will extubated successfully and 17 of those patients were reintubated on a period of 24 to 72

hours (15). However, it is normal to fail in extubation after successful SBT (16).

A study conducted on 2007 on 673 patients whom on mechanical ventilation for long time and 122 of them reintubated within 48 hours due to decreased Level of Consciousness (LOC) which can be measured by Glasgow Coma Scale (GCS) (17).

Glasgow Coma Scale (GCS) was used to determine patients who have unsuccessful extubation. Furthermore, GCS from 15 -13 is mild range ,9-12 moderate and less than 8 is severe (18). The extubation process might be delayed if GCS is < 8 , or if there is secretion accumulation which requires a suctioning frequently or poor cough strength (19). Another extubation trials on 21 patients had shown that the patients whom extubated successfully had have GCS values from 13.6 to 11.2 in comparison with the others with low GCS which resulted in extubation failure (20). Neurocritical care unit (NCU) patients are commonly appeared to have extubation failure (21).

Incidence of unsuccessful extubation is related with postoperative patient and the duration on mechanical ventilation which may result in death. Reintubation After Planned extubation (RAP) is commonly seen after anesthesia which may cause another complication related to these anesthetic agents (22). Rocouronium which is an endotracheal facilitator that works as muscle relaxant during intubation (23) was used on patients who had different surgeries, and they showed an obvious role of Rocouronium on increasing the ratio of extubation failure within 2 hours after the decision of extubation (24).

A study on 74 MICU patients showed that 21 patients had an extubation failure because of long duration on mechanical ventilation, and this may lead to increase the mortality among those patients (25). However, patients who failed to extubate are more likely to transfer for long-term care units and spend long duration on mechanical

ventilation (26). Extubation failure has a significant role on increasing the mortality (27). Patients who cannot tolerate extubation and require reintubation are at high risk of hospital mortality (28). In addition, there is a relationship between extubation failure and cardiac surgeries. Earlier studies demonstrated that it is common to reintubate patients after cardiac surgeries (29), and most of patients who required reintubation are the ones with cardiorespiratory issues (30).

Many researches had discussed the causes of extubation failure, and others had examined the predictors of it without specifying the diseases itself which should be taken in consideration. If extubation failure can be predicted based on the causes among type II respiratory failure patients prevent unsuccessful procedure? and will these predictors help to prevent undesirable effects related to extubation failure. Hence the current study was planned to clarify the relation between the extubation failure and type II respiratory failure among ICU patients and use this relation for patient safety and provide successful extubation without harmful effects.

Materials and Methods

The outline of the study is given in figure 1

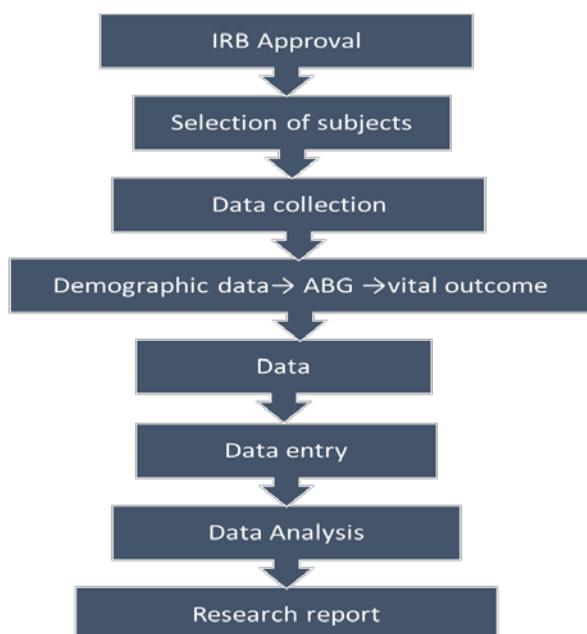


Figure 1 outline of the study

Study Area/Setting

The proposed study was conducted in the critical care area of KAMC ICU for all patients with type II respiratory failure who undergo extubation failure

Study Subjects

All patients admitted, transferred or died of type II respiratory failure in KAMC-ICU during 2016-2017 was selected for the study based on the following inclusion and exclusion criteria

Inclusion Criteria

1-Males and females of 18- 80 years old admitted to ICU and require intubation and were extubated but reintubated afterwards

Exclusion Criteria

- 1- Patients with Ventilator Associated Pneumonia (VAP)
- 2- Patients in general wards
- 3- Patients <18 years and >80 years old

Study Design

Cross-sectional retrospective study

Sample Size

According to NGHHA data the number of intubated patients with type II respiratory failure is 60 per month. With the margin of error 6 percentage and 95 percentage confidence level they require sample size most calculated as 83, fixed as 85 using Raosoft online sample size calculator

Sampling Technique

Convenient sampling was to select the samples

Data Collection methods, instruments used, measurements

The data for the patient for the day of extubation and the 3 following days (to see if the extubation will failed or not) was collected from RT chart of Best Care system used in KAMC Demographic data , ABG(Arterial Blood Gases), Absence or presence of secretion , gag and cough reflex(To asses the response) ,RSBI(Rapid Shallow Breathing Index which is calculated by the formula

Respiratory Rate(RR)/Tidal Volume Vt) and oxygen requirements

Data Management and Analysis Plan:

The collected data was entered in Microsoft Excel and exported to SPSS version 22 for data analysis. Tables and figures were used to represent the results.

Frequency and percentage was used for categorical variable.

Mean and SD was used to represent continuous variable.

Results

Out of 50 patients, 18 of them were male (36%) and the rest 32 were female (64%) as shown in figure1. The maximum age of study population was 80 and minimum of 19 years old. The result for the extubated patients was 37 of them were successfully extubated with percentage of 74.0 while the remaining 13 were failed with percentage of 26.0. out of 18 male 6 of them were failed in extubation with percentage of 46.2% while a total of 32 female 7 failed with percentage 53.8% the used test was Chi square: 0.786, with p value= 0.375 so there is no significant. The mean age of patients who failed in extubation was 55.15 with no significant of p value, and 63.46 for patients who successfully extubated Statistical test used is Mann Whitney U test. The mean for RSBI for who had been successfully extubated was 64.73 with no significant statically while clinically this value has significant to extubation outcome. For failed extubation the mean of RSBI was 59.54 with no significant. Glow Coma Scale for patients who are having extubation failure in the day of extubation and three days later was moderate with uses of kruskal-walls test with p value of 0.971.

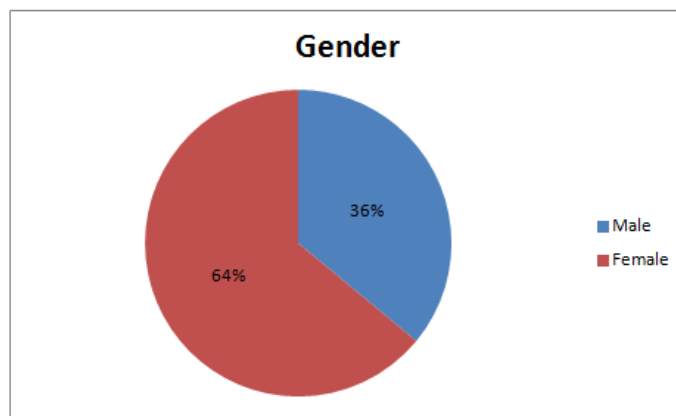


Figure 2Pie diagram showing Gender distribution of participants

Table 1 BMI for patient’s population.

BMI		N	Mean (SD)		
Underweight	Success	1	13.37		
	Failure	3	15.95 (1.61)	T= 1.391	0.299
Normal	Success	3	24.56 (0.31)	T= -3.123	0.011
	Failure	9	21.60(1.58)		
Overweight	Success	10	27.63 (1.60)	-	-
	Failure	-	-		
Class 1 obesity	Success	16	32.25(1.50)	-	-
	Failure	-	-		
Class 2 obesity	Success	6	37.32(1.65)	-	-
	Failure	-	-		
Class 3 obesity	Success	1	40.80	-	-
	Failure	1	44.95		

Table 2 The mean and SD for ABG results for patients who failed in extubation.

pH	Day of extubation	Mean	SD	F	p
pH	Day of extubation	7.36	0.07	F=1.023	0.392
	Day 1 post extubation	7.35	0.05		
	Day 2 post extubation	7.37	0.08		
	Day 3 post extubation	7.40	0.09		
PaO2	Day of extubation	74.99	17.60	F=0.466	0.707
	Day 1 post extubation	71.98	19.66		
	Day 2 post extubation	77.48	24.11		
	Day 3 post extubation	82.54	27.87		
PaCO2	Day of extubation	50.42	14.62	F= 0286	0.835
	Day 1 post extubation	48.44	11.80		
	Day 2 post extubation	47.64	6.02		
	Day 3 post extubation	46.53	7.81		

Discussion

In cross-sectional retrospective study conducted on patients who were mechanical ventilated in 2016 and 2017 with type II respiratory failure and were admitted to KAMC, we found that reintubation incidences within 48 to 72 hours mainly are associated with age, RSBI, GCS. In El Solh study and his colleague (19) they found that elderly patients who (≥ 70 years old) were reintubated more when comparing to younger patients while our result patients with mean of age at 55.15 had been reintubated comparing with patients who were successfully extubated their mean age was (63.46). Lee et.al (31) reported that RSBI with values more than 105 breath/min/L or less does not prevent successful extubation and the significant for their study was a value of $p = 0.004$, while in another study (32) they reported RSBI is an independent factor predicting for extubation failure, and when the breaths are >57 breaths/min/L the patient might be subjectable to reintubated. In our study, mean RSBI equal > 64.73 predict to successful extubation. RSBI value does not need to be more than 105 to have failed extubation because our result shows that RSBI with mean of 59.54 might have failed in extubation. Mokhlesi and his colleague (17) reported that moderate GCS (which is a range between 9-12) can clinically predict to reintubation as what we found on the patients who failed on extubation on our study. Patients whom been reintubated were with normal BMI with significant P value and the mean for their ABG result for the days were in normal ranges despite they were type II respiratory failure patients.

Over all, extubation failure cannot be precluded by certain variables and there are numerous variables can be added to predict extubation outcome the same as in our findings which had showed that it even with abnormal or extreme values the extubation result cannot be predicted exactly.

Limitation

For this research, there were little limitations that affect the research paper. The time for collecting data wasn't enough to cover all of the patients and their records which lead to decrease the number of sample size which later affect the over all result. Also, the number of extubated patients were not recorded on the medical records, and there is no code for the extubation procedure which make it difficult and time consuming to find extubated data. The other issue was that some of data were missing and not all of required data were found. Most of the patients who underwent extubation were not fitting our inclusion criteria. Another limitation was the study is not evaluating the patient for long term after 4 days of doing the procedure. On the other hand, the strength of this study that it is for specific disease population and covering all of ICUs areas in KAMC at 2016/2017.

Conclusion

In summary, in a retrospective cross-sectional study of respiratory failure type II and mechanically ventilated had been extubated and followed three days later post extubation, we found that RSBI, age, GCS and BMI may consider as predictors of extubation outcome. However, strong factors might be added as exact predictors of extubation failure such as APACHE score and administration of sedation, so there is a need for further studies to cover these aspects.

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Appendices

King Saud bin Abdulaziz University for Health Sciences
College of Applied Medical Sciences

Research Unit

CAMS 411&412 Research Methodology I &II

Research Title: Predictors of Extubation Failure Among Patients with Type II Respiratory Failure

1- Demographic data

SR.No-

Gender-

Age-

Height-

Weight-

2-Extubation date:

3- RSBI:RR/Vt

Day of Extubation	Secretion	GCS	Cough Reflex	Gag reflex	O2 requirements
Day 0					
Day 1					
Day 2					
Day 3					

4- ABG

	PH	Pao2	Paco2	Hco3
Day 0				
Day 1				
Day 2				
Day 3				