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Comparison of Pressure Support versus T-Piece Trial for Weaning from Mechanical Ventilation

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ABSTRACT

Post-operative patients are particularly vulnerable to hazardous effects of prolonged ventilation owing to their limited reserves, catabolic state and acute injury related to surgical incision and dissection. Thus, early weaning protocols are required for better outcome in this population. **Objective:** To compare PSV versus T-Piece trial for weaning from Mechanical Ventilation. **Methods:** The quasi experimental study was conducted at ICU of Mayo Hospital Lahore from 28-05-2021 to 28-11-2021. Total 60 patients undergoing elective post-operative mechanical ventilation were selected after taking written informed consent. Patients were divided in two groups, Group A: Pressure support ventilation and Group B: T piece ventilation. Frequency and percentage of successful extubation were recorded in both groups. Data were analysed with SPSS version 26.0. Frequency of successful extubation was compared using chi square test taking p-value ≤0.05 as significant. **Results:** In Group A, 93.33% (n=28) of patients had successful extubation, while only 66.66% (n=20) patients in Group B had successful extubation, p-value=0.009. **Conclusion:** This study indicated that PSV results in successful extubation and liberation from mechanical ventilation than T piece trial.

INTRODUCTION

In the ICU setting, making the decision to extubate a patient is a crucial moment, as failed extubation followed by reintubation is associated with a high risk of mortality [1]. On average, reintubation occurs in about 10% of planned extubations, but this rate can surpass among patients with increased risk factors [2]. Successfully weaning patients off mechanical ventilation is among the most complex challenges for ICU clinicians. Early recognition of patients who are ready to breathe independently can help reduce the duration of ventilator use and decrease the likelihood of associated complications [3]. Typically, when a patient is considered ready for spontaneous breathing, a screening tool known as the Spontaneous Breathing Trial (SBT) is performed; however, evidence on its effectiveness remains mixed [4]. Various strategies are employed for weaning [5]. Pressure Support Ventilation (PSV) is a spontaneous mode of ventilation in which a constant pressure level is maintained, and the ventilator delivers support whenever the patient initiates a breath [6]. In T-piece mode, the Endotracheal Tube (ETT) is disconnected from the ventilator and attached to a T-shaped tube which provides oxygen therapy to the patient; in this mode,

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patient satisfaction may be better than in pressure mode [7]. Studies comparing T-piece trials and PSV have shown mixed results. In some trials, PSV was associated with a higher rate of successful extubation than the T-piece [8]. PSV has also shown superiority in terms of respiratory parameters such as respiratory rate and tidal volume, and in some cases, shorter weaning durations [9]. Despite this, other studies found no significant difference between the T-piece and PSV in terms of extubation success. In certain patient populations, switching to spontaneous breathing can negatively impact left ventricular function and may increase the risk of SBT failure, particularly with the T-piece due to higher respiratory muscle workload and potential cardiogenic pulmonary edema [10].

This study aimed to add clinical evidence regarding use of T-piece versus pressure support to discontinue the mechanical ventilation in patients admitted in the local ICU setup. No conclusive evidence regarding use of either t-piece or pressure support for weaning from mechanical ventilation. So, this study would add clinical evidence and implementation of this study will help to reduce the duration of hospital stay of patient. In this way financial burden can be reduced in the health care system.

METHODS

This Quasi experimental trial was conducted at ICU of Mayo Hospital, Lahore, from September 28, 2020, to March 28, 2021, following approval IRB [762/RC/KEMU]. Total 60 patients were enrolled using non-probability consecutive sampling. Sample size was calculated with 5% level of significance, 80% power of test, using expected percentage of successful extubation as 81.54% in T-piece group and 61.15% in pressure support group [11]. Sample size was calculated using WHO sample size calculator. Patients were divided into two groups using lottery method. Eligible participants included post-operative patients aged 18–50 years of either gender who were electively ventilated for more than 12 hours in surgical ICU. Patients were excluded if they had anemia (hemoglobin <8g/dl), intractable hypotension (BP <90/60 mmHg or MAP <60 mmHg despite adequate resuscitation), ventilator dependence due to chronic respiratory disease, heart failure with ejection fraction <30%, myocardial infarction (based on ECG changes and elevated troponin >100 mIU), or known neuromuscular or CNS disorder. After obtaining written informed consent, baseline demographic data including name, age, gender, history of diabetes (random blood sugar >200 mg/dl), smoking (>5 pack-years), hypertension (BP >140/90 mmHg). In pressure support group (Group A), patients were given inspiratory pressure of 5–7 cmH_2O, PEEP 5 cmH_2O, FiO_2 0.4, and expiration was triggered at 25% of peak inspiratory flow rate. In T-piece group (Group B), mechanical ventilation was stopped and ETT was connected to T-piece circuit transporting oxygen at 10–15 L/min. Twelve hours after surgery, patients were evaluated for readiness to wean using criteria: RR<30 breaths/min, SpO_2 >90%, HR <120 bpm, systolic BP 90–160 mmHg, alert, and rapid shallow breathing index <105. Patients who fulfilled these criteria were extubated and monitored [12]. Successful extubation was defined as no need for re-intubation, while re-intubation was performed if patients developed HR >120/min, RR >30/min, or SpO_2 <90%. The dataset was analyzed utilizing IBM SPSS version 26.0. For continuous variables, descriptive statistics such as means and standard deviations were calculated. Categorical variables were summarized using frequencies and percentages. To account for potential effect modifiers, data stratification was performed. Comparative analysis of successful extubation rates between different groups was conducted using chi-square test, p-value of 0.05 or less was considered indicative of statistical significance.

RESULTS

In Group A mean age of patients is 39.5 ± 1.50 years which is comparable to mean age of 39.0 ± 2.00 in Group B, p=0.2778. In Group A, 11 (36.66%) patients had diabetes, 16 (53.33%) patients were smokers, and 12 (40.0%) patients had hypertension. In Group B, 13 (43.37%) patients had diabetes, 17 (56.66%) patients were smokers, and 13 (36.66%) patients had hypertension.

Table 1: Comparison of Demographic Characteristics of Study Groups(n=30)

Variables		Group A Mean ± SD / Frequency (%)	Group B Mean ± SD / Frequency (%)	p-Value
Age (Years)		39.5 ± 1.50	39.0 ± 2.00	0.2778
Gender	Male	16 (40)	13 (36.6)	0.600
	Female	14 (60)	17 (63.3)	
Diabetics		11(36.66)	13 (43.37)	0.598
Active Smokers		16 (53.33)	17 (56.66)	0.795
Hypertensive		12 (40.0)	13 (36.66)	0.790

In Group A, 93.33% (n=28) of patients had successful extubation vs 66.66% (n=20) in Group B p-value=0.009, as shown in figure 1.

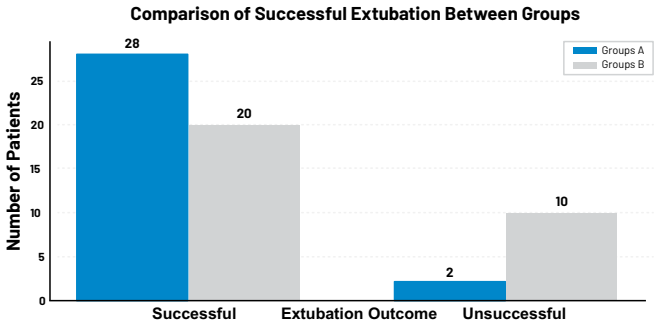

Figure 1: Comparison of Successful Extubation between Groups

As shown in table 2 successful extubation was higher in Group A across all age brackets, (p > 0.05 not statistically significant). Statistically significant difference was observed in males (p = 0.012), with Group A showing notably

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higher success rate. No significant difference was seen among females (p = 0.217). No significant difference in extubation success between groups for both diabetic (p = 0.977) and non-diabetic patients (p = 0.522), hypertensive and non-hypertensive patients, (p = 0.428 and 0.612, respectively). Among non-smokers, Group A had a significantly higher success rate (p = 0.020). Among smokers, this difference was not statistically significant (p = 0.166).

Table 2: Stratification of Successful Extubation between Groups by Various Factors

Variables	Subgroup	Group	Successful Extubation Yes (n)	Successful Extubation No (n)	p-Value
Age (Years)	18–30	A	05	00	0.104
		B	04	03	
	31–40	A	11	01	0.104
		B	07	04	
	41–50	A	12	01	0.238
		B	09	03	
Gender	Male	A	15	01	0.012
		B	07	06	
	Female	A	13	01	0.217
		B	13	04	
Diabetes	Yes	A	10	01	0.977
		B	08	05	
	No	A	18	01	0.522
		B	12	05	
Hyper-tension	Yes	A	11	01	0.428
		B	06	05	
	No	A	17	01	0.612
		B	12	05	
Smoking	Yes	A	15	01	0.166
		B	13	04	
	No	A	13	01	0.020
		B	07	06	

DISCUSSION

Extubation is critical step in the management of mechanically ventilated patients, marking the transition from artificial to spontaneous breathing [13]. Its success is vital to patient recovery, as failed extubation is associated with increased morbidity, prolonged ICU stay, and higher healthcare costs [14]. In this trial, the Pressure Support Ventilation (PSV) group had a significantly higher percentage of successful extubation compared to the group using the T-piece method (93.33% vs. 66.66%, p = 0.009). Similarly, Chittawatanarat *et al.*, suggested that PSV may lead to lower reintubation rates 10% in PSV versus 14.6% in T-piece [11]. Another meta-analysis also found a significant advantage for PSV over T-piece in terms of successful extubation (p < 0.001) [15]. PSV appears to facilitate shorter weaning processes, with a higher proportion of patients achieving successful weaning more quickly [16]. In contrast, Li *et al.*, reported no significant difference in successful extubation rates between T-piece and PSV (p = 0.27) [17].Yekefallah *et al.*, supported a superior role of the T-piece in successful extubation as compared to PSV [18]. Thille *et al.*, also found the reintubation rate to be lower in the T-piece group compared to PSV (13.6% vs. 14.9%, p = 0.024) [18, 19]. However, Azouz *et al.*, concluded that the T-piece, instead of aiding in weaning, may lead to prolonged weaning intervals and associated complications [20].It is also supported that while both T-piece and PSV are effective for extubation, PSV may be preferable in patients with difficult weaning due to its potential to reduce reintubation rates and shorten the weaning duration.However, the choice of method should be tailored to individual patient needs and clinical scenarios, as some studies indicate no significant differences in mortality or length of stay between the two methods [21].This study has certain limitations that should be considered. Foremost, sample size was comparatively small.Although calculation was performed to ensure adequate power larger sample size would have increased the generalizability of the results.Secondly, study was conducted on a homogeneous group of elective post-operative patients in surgical ICU, which limits the generalizability of findings to other patient populations such as those with medical conditions, emergency surgeries, or complex weaning scenarios (esepsis, trauma, or neuromuscular diseases).Inclusion of broader range of patients and comparison across different clinical settings may yield more comprehensive and generalizable results. This study did not evaluate long-term outcomes such as morbidity, mortality, or the reintubation requirement beyond the immediate post-extubation period.

CONCLUSIONS

In conclusion, this study demonstrated that pressure support ventilation had high incidence of effective extubation verses T-piece ventilation in patients requiring mechanical ventilation. These findings suggest that PSV is preferable strategy for facilitating successful extubation in this patient population.

Authors Contribution

Conceptualization: SB
Methodology: SB, MR, AQ, FM, MSA, MUS
Formal analysis: SB
Writing, review and editing: AQ, AB

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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