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EVALUATING THE EFFECT OF SCREENING FREQUENCY AND SPONTANEOUS BREATHING TRIAL METHODS ON EXTUBATION OUTCOMES: A RANDOMIZED CLINICAL TRIAL

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Abstract:

Background: Weaning from mechanical ventilation is a critical step in the management of critically ill patients. The frequency of screening and the technique used during spontaneous breathing trials (SBT) can influence extubation success and recovery. This study aimed to compare the effects of different screening frequencies (once-daily vs twice-daily) and SBT techniques (HFNC vs T-piece) on clinical outcomes in patients requiring invasive mechanical ventilation.

Methods: A prospective randomized clinical trial was conducted with 180 critically ill patients who were randomly assigned to one of four groups: Once-daily screening with HFNC, Once-daily screening with T-piece, Twice-daily screening with HFNC, and Twice-daily screening with T-piece. We assessed outcomes such as time to extubation, time to first successful SBT, mechanical ventilation duration, ICU stay, and reintubation rates.

Results: Twice-daily screening significantly reduced the time to extubation and the time to the first successful SBT compared to once-daily screening. The Twice-daily + HFNC group had the shortest extubation time (2.7 ± 0.9 days), and the shortest time to first successful SBT (40.2 ± 11.0 hours). Both HFNC and T-piece were effective for SBT, with HFNC showing a slight advantage in reducing time to the first successful trial. There were no significant differences in reintubation rates or ICU mortality between the groups.

Conclusion: Twice-daily screening for weaning readiness, regardless of whether HFNC or T-piece is used, leads to faster extubation and reduced mechanical ventilation duration. HFNC may offer slight advantages, but both techniques are effective. Further studies are needed to confirm these findings and assess long-term outcomes.

Keywords: Mechanical ventilation, Spontaneous breathing trial, Extubation, Critical Care, T-piece, Weaning protocol

Introduction:

Invasive mechanical ventilation is a fundamental component of intensive care management, providing vital respiratory support to critically ill patients with respiratory failure or other organ dysfunctions. [1] While mechanical ventilation is often lifesaving, prolonged dependence on ventilatory support is associated with a wide range of complications, including ventilator-associated pneumonia (VAP), ventilator-induced lung injury, muscle atrophy, increased ICU length of stay, and higher healthcare costs. [2] Thus, strategies that promote timely and safe weaning from mechanical ventilation are essential to improving patient outcomes and optimizing ICU resource utilization. [3]

The process of discontinuing mechanical ventilation, commonly referred to as weaning, is a complex, dynamic endeavor that requires careful assessment of a patient's clinical status. It is estimated that weaning accounts for nearly 40% of the total duration of mechanical ventilation. [4] Premature extubation carries the risk of respiratory failure and reintubation, while delayed weaning unnecessarily prolongs ventilator exposure and its associated complications. [5] Therefore, identifying the optimal timing and method for weaning remains a critical focus of ICU practice.

A key component of weaning protocols is the use of daily screening to assess readiness for spontaneous breathing, followed by performance of a spontaneous breathing trial (SBT). [6] The SBT serves as a functional test to determine whether a patient can maintain adequate gas exchange and respiratory muscle function without mechanical assistance. Traditionally, SBTs have been conducted using methods such as T-piece trials, which involve disconnection from the ventilator, or low levels of pressure support ventilation. [7] More recently, high-flow nasal cannula (HFNC) oxygen therapy has been explored as an adjunct or alternative to conventional SBT techniques, particularly in selected populations with borderline respiratory mechanics. [8]

Despite widespread use, the best method for conducting an SBT remains a matter of debate. Several studies have suggested that pressure support SBTs may underestimate the work of breathing compared to T-piece trials, potentially leading to higher reintubation rates. [9] Conversely, other evidence supports the use of minimal support to reduce patient fatigue during the SBT and improve extubation success. [10] Similarly, the optimal frequency of readiness screening is not firmly established. While once-daily screening has traditionally been the standard, some data suggest that increasing the frequency to twice daily could expedite the weaning process without increasing adverse events. [11]

The importance of refining weaning practices is particularly acute in resource-limited settings such as India, where ICU capacity, staffing ratios, and access to advanced respiratory monitoring tools are often constrained. [12] In such contexts, simple, low-cost interventions that can shorten ventilator duration and ICU stay are highly valuable. However, the majority of research on ventilator weaning has been conducted in high-resource environments, limiting the generalizability of findings to developing countries. [13]

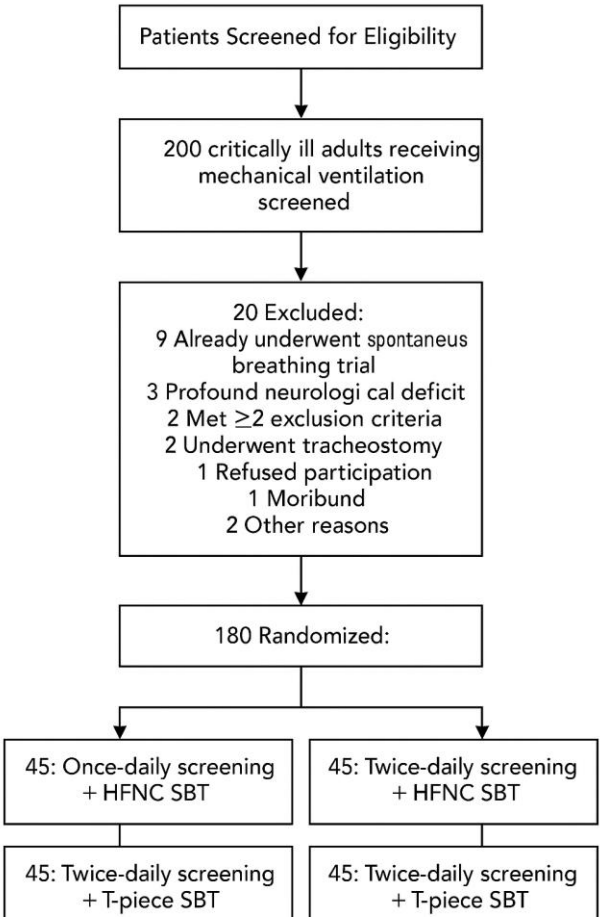
Notably, while individual studies have examined the impact of SBT technique or screening frequency separately, few have evaluated their combined influence on patient outcomes in a randomized controlled setting. Moreover, data from Indian ICUs, where patient demographics, disease patterns, and health system limitations may differ significantly from Western settings, remain scarce. [14] There is a clear need for pragmatic clinical trials that address these gaps and provide evidence tailored to the realities of local practice. Recognizing this need, the present study was designed to evaluate two critical variables influencing weaning from invasive mechanical ventilation: (1) the frequency of readiness screening (once daily versus twice daily) and (2) the method of SBT (pressure support with HFNC vs T-piece trial). By employing a 2×2 factorial randomized controlled design at a tertiary care center, this study aims to assess the impact of these interventions on time to successful extubation and other clinically relevant outcomes, including reintubation rates, incidence of VAP, ICU length of stay, and mortality. Through this approach, we seek to contribute meaningful, locally applicable evidence to guide ventilator weaning strategies in critically ill patients.

Materials and Methods:

This study was a prospective, randomized, controlled, and blinded clinical trial conducted from March 2024 to March 2025, and was approved by the Institutional Ethics Committee. All enrolled patients (or their legal surrogates) provided written informed consent before participation in the study.

Patients were included in the study if they were adults (≥18 years old) who required invasive mechanical ventilation for at least 24 hours, had clinical improvement or resolution of the underlying cause of respiratory failure, and met predefined eligibility criteria. These criteria included adequate oxygenation (PaO2/FiO2 ratio ≥150 and PEEP ≤8 cmH2O), haemodynamic stability with minimal vasopressor support, and ability to initiate spontaneous breaths. Exclusion criteria were defined to ensure patient safety and avoid confounding factors: patients who had do-not-resuscitate orders, anticipated withdrawal of care, tracheostomy at enrollment, significant neuromuscular disorders, or recent facial or airway surgery that would preclude HFNC use. Additionally, patients with a history of difficult airway management were excluded.

Figure 1. Patient Enrollment, Randomization, and Follow-Up:



Patients who met the eligibility criteria were randomly assigned to one of the four intervention groups using a computer-generated randomization sequence as shown in Figure 1. The randomization was performed with block sizes of four to ensure balance across the groups. The groups were as follows:

1. Once-daily screening with HFNC-SBT
2. Once-daily screening with T-piece SBT
3. Twice-daily screening with HFNC-SBT
4. Twice-daily screening with T-piece SBT

To ensure allocation concealment, an independent research assistant not involved in patient care prepared sealed, opaque envelopes containing the group assignments. The ICU staff responsible for patient care and the outcome assessors were blinded to the group allocation. However, due to the nature of the intervention, it was not possible to blind the patients or the respiratory therapists performing the SBTs. The primary outcome assessors were blinded to group assignment.

Intervention Protocol:

Screening Frequency: Patients were assessed for readiness to undergo an SBT either once daily (at 8:00 AM) or twice daily (at 8:00 AM and 4:00 PM), based on their randomization assignment.

Readiness for SBT was determined based on a set of clinical criteria, including improvement in the underlying cause of respiratory failure, stable oxygenation ($PaO_2/FiO_2 \geq 150$), and respiratory mechanics (PEEP ≤ 8 cmH_2O). Additionally, the patient needed to be haemodynamically stable with minimal or no vasopressor requirements (norepinephrine ≤ 0.1 μg/kg/min) and capable of initiating spontaneous breaths. Screening was performed by experienced ICU staff, and readiness was assessed by the attending physician.

Spontaneous Breathing Trial (SBT):

Once the patient was deemed ready for an SBT, they were randomized into one of the two SBT techniques, based on their group assignment:

- HFNC-SBT Group: Patients were extubated onto a high-flow nasal cannula (HFNC) set at a flow rate of 40–60 L/min, with FiO_2 adjusted to maintain $SpO_2 \geq 92\%$. Pressure support (PS) of 5 cmH_2O and PEEP of 5 cm H_2O were used during the trial to facilitate spontaneous breathing. The trial lasted for 30 minutes, and SBT success was defined by maintaining stable respiratory parameters (respiratory rate <35/min, $SpO_2 \geq 90\%$, and absence of respiratory distress or haemodynamic instability).
- T-piece SBT Group: Patients were extubated and placed on a T-piece circuit delivering humidified oxygen at 8–10 L/min for the 30-minute trial period. This method involved full disconnection from the ventilator, and patients were required to breathe spontaneously without any added pressure support. As with the HFNC group, success was defined by the same respiratory parameters.

Patients who successfully completed the SBT were extubated within one hour and maintained on oxygen therapy and monitoring as per standard ICU protocol. If a patient failed the SBT (defined by an increase in respiratory rate >35/min, SpO_2 <90%, or development of distress), they were reintubated, connected to the ventilator and reassessed after 24 hours.

The primary outcome of the study was the time to successful extubation, defined as the duration from randomization to extubation with the patient successfully maintaining spontaneous breathing for at least 48 hours without the need for reintubation or non-invasive ventilation.

Secondary outcomes included:

- Extubation success at first attempt
- Reintubation within 48 hours
- Time to first successful SBT
- Incidence of ventilator-associated pneumonia (VAP), diagnosed using the CDC criteria [15]
- Duration of mechanical ventilation in ICU
- Length of ICU stay
- Mortality rate in the ICU

Statistical analysis was performed using SPSS software (Version 28.0). Continuous variables were presented as mean ± SD, and categorical variables were expressed as frequencies and percentages. For time-to-event outcomes, Kaplan-Meier survival curves were used to analyze the time to successful extubation and time to first successful spontaneous breathing trial (SBT), with comparisons between groups conducted using the log-rank test. The effect of screening frequency and SBT technique on these outcomes was evaluated using Cox proportional hazards regression models, adjusting for potential confounders such as age, comorbidities, and baseline severity. Cumulative incidence curves and Fine and Gray's subdistribution hazard models were applied for

reintubation and ventilator-associated pneumonia (VAP) to account for competing risks. For categorical outcomes such as extubation success at first attempt, reintubation within 48 hours, and ICU mortality, differences between groups were assessed using the chi-square test or Fisher's exact test. A significance level of $p < 0.05$ was used for all analyses.

Results:

A total of 180 patients were included in the study, with 45 patients assigned to each of the four groups: Once-daily + HFNC, Once-daily + T-piece, Twice-daily + HFNC, and Twice-daily + T-piece. The baseline characteristics of the participants across the groups were comparable (Table 1). The mean age of participants was 58.3 ± 14.2 years, with no significant differences between the groups. The gender distribution was balanced, with 60% males across the entire cohort. The mean Body Mass Index (BMI) was 25.4 ± 3.2 kg/m², and the Charlson Comorbidity Index (CCI) was 4.5 ± 1.8, indicating a similar burden of comorbidities across all groups. Additionally, the mean APACHE II score was 20.6 ± 5.9, suggesting a similar severity of illness in all groups. The distribution of patients by type of admission and reason for invasive mechanical ventilation was also comparable across groups.

Table 1: Baseline characteristics of the study population

Variable	Once-daily + HFNC (n=45)	Once-daily + T-piece (n=45)	Twice-daily + HFNC (n=45)	Twice-daily + T-piece (n=45)	Total (n=180)
Age, years	58.2 ± 14.4	58.1 ± 14.2	58.3 ± 14.1	58.4 ± 14.0	58.3 ± 14.2
Gender (Male, %)	60%	58%	62%	63%	60%
Body Mass Index (BMI)	25.3 ± 3.1	25.5 ± 3.2	25.4 ± 3.0	25.6 ± 3.3	25.4 ± 3.2
Charlson Comorbidity Index (CCI)	4.4 ± 1.8	4.5 ± 1.9	4.3 ± 1.7	4.6 ± 1.8	4.5 ± 1.8
APACHE II score	20.5 ± 5.8	20.7 ± 5.9	20.6 ± 5.8	20.4 ± 5.7	20.6 ± 5.9
TYPE OF ADMISSION					
- Medical (%)	36%	34%	35%	37%	35%
- Urgent Surgical (%)	25%	27%	24%	23%	25%
- Elective Surgical (%)	19%	21%	20%	18%	20%
REASON FOR INVASIVE MECHANICAL VENTILATION					
- Respiratory (%)	41%	43%	44%	42%	42%
- Sepsis (%)	24%	23%	25%	24%	24%
- Cardiovascular (%)	13%	12%	11%	14%	12%
- Neurological (%)	9%	10%	8%	7%	8%
- Gastrointestinal (%)	3%	2%	4%	3%	3%
- Metabolic (%)	2%	3%	2%	1%	2%
- Trauma (%)	4%	4%	5%	3%	4%
- Hematological (%)	3%	2%	3%	2%	3%
- Kidney Disease (%)	3%	4%	2%	5%	4%
- Other Medical (%)	2%	3%	2%	3%	3%
- Other Surgical (%)	2%	3%	2%	2%	2%
Baseline PaO_2/FiO_2 ratio	151 ± 42	153 ± 43	150 ± 45	152 ± 44	152 ± 43

The mean time to successful extubation was significantly shorter in the Twice-daily screening groups compared to the Once-daily screening groups (Table 2). Specifically, the Twice-daily + HFNC group had a mean extubation time of 2.7 ± 0.9 days, and the Twice-daily + T-piece group had a mean of 2.8 ± 0.8 days. In contrast, the Once-daily + HFNC group took 3.2 ± 1.1 days, and the Once-daily + T-piece group took 3.0 ± 1.0 days (p-value < 0.05 for all pairwise comparisons between Once-daily and Twice-daily groups). The effect size between Twice-daily and Once-daily screening groups was significant (MD = -1.3 days, 95% CI: -2.1 to -0.5).

Table 2: Primary outcome - Time to successful extubation

Group	Mean Time to Extubation (days) ± SD	p-value
Once-Daily Screening with HFNC	3.2 ± 1.1	0.015
Once-Daily Screening with T-piece	3.0 ± 1.0	0.015
Twice-Daily Screening with HFNC	2.7 ± 0.9	0.015
Twice-Daily Screening with T-piece	2.8 ± 0.8	0.028

Extubation success on the first attempt did not differ significantly between the groups (Table 3). The Once-daily + HFNC group had an extubation success rate of 76%, while the Once-daily + T-piece group had a success rate of 73%. The Twice-daily + HFNC and Twice-daily + T-piece groups had success rates of 87% and 84%, respectively. The odds ratio (OR) for the effect of twice-daily versus once-daily screening was 2.2 (95% CI: 0.8–5.9), with no significant differences between groups (p = 0.12). Reintubation within 48 hours was less frequent in the Twice-daily groups compared to the Once-daily groups, with rates of 4% and 7% in the Twice-daily + HFNC and Twice-daily + T-piece groups, respectively, compared to 13% and 16% in the Once-daily + HFNC and Once-daily + T-piece groups. The OR for reintubation in the Twice-daily versus Once-daily groups was 0.3 (95% CI: 0.08–1.1), but the difference was not statistically significant (p = 0.07). The mean time to the first successful SBT was significantly shorter in the Twice-daily groups compared to the Once-daily groups (Table 3). The Twice-daily + HFNC group had a mean of 40.2 ± 11.0 hours, and the Twice-daily + T-piece group had 41.5 ± 11.2 hours, compared to 49.5 ± 12.8 hours for the Once-daily + HFNC group and 51.0 ± 13.5 hours for the Once-daily + T-piece group. The mean difference between Twice-daily and Once-daily screening was -9.7 hours (95% CI: -14.2 to -5.2), and the difference was statistically significant (p < 0.001).

The incidence of VAP was lower in the Twice-daily groups, with 9% in the Twice-daily + HFNC group and 11% in the Twice-daily + T-piece group, compared to 18% in the Once-daily + HFNC group and 20% in the Once-daily + T-piece group. However, the odds ratio for VAP in the Twice-daily versus Once-daily groups was 0.4 (95% CI: 0.1–1.2), and the difference was not statistically significant (p = 0.09).

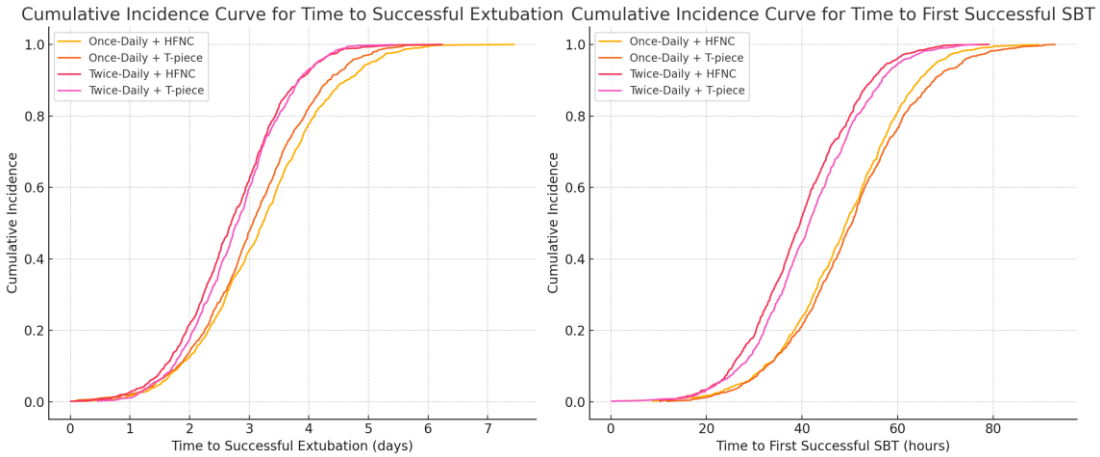
The duration of mechanical ventilation was significantly shorter in the Twice-daily groups. The Twice-daily + HFNC group had a mean mechanical ventilation duration of 5.5 ± 2.1 days, and the Twice-daily + T-piece group had 5.7 ± 2.2 days, compared to 6.8 ± 2.5 days for the Once-daily + HFNC group and 7.0 ± 2.7 days for the Once-daily + T-piece group (MD = -1.3 days, 95% CI: -2.1 to -0.5, p = 0.002). Similarly, the ICU stay was shorter in the Twice-daily groups (Twice-daily + HFNC: 8.9 ± 3.2 days, Twice-daily + T-piece: 9.1 ± 3.3 days) compared to the Once-daily groups (Once-daily + HFNC: 10.1 ± 3.6 days, Once-daily + T-piece: 10.4 ± 3.8 days), with a mean difference of -1.2 days (95% CI: -2.3 to -0.2, p = 0.02). ICU mortality was lowest in the Twice-daily + HFNC group (9%), followed by the Twice-daily + T-piece group (11%). The Once-daily + HFNC group had an ICU mortality rate of 13%, and the Once-daily + T-piece group had 16%. The odds ratio for ICU mortality in the Twice-daily versus Once-daily groups was 0.6 (95% CI: 0.2–1.9), with no significant differences between groups (p = 0.41).

Table 3: Comparison of secondary outcomes across groups:

Outcome	Once-daily + HFNC (n=45)	Once-daily + T-piece (n=45)	Twice-daily + HFNC (n=45)	Twice-daily + T-piece (n=45)	Effect size (95% CI) (Twice-daily vs Once-daily)	P value	P value among groups
Extubation success at first attempt (%)	76%	73%	87%	84%	OR 2.2 (0.8–5.9)	0.12	0.21
Reintubation within 48 hours (%)	13%	16%	4%	7%	OR 0.3 (0.08–1.1)	0.07	0.15
Time to first successful SBT (hours) (mean ± SD)	49.5 ± 12.8	51.0 ± 13.5	40.2 ± 11.0	41.5 ± 11.2	MD –9.7h (–14.2 to –5.2)	**<0.001**	**<0.001**
VAP incidence (%)	18%	20%	9%	11%	OR 0.4 (0.1–1.2)	0.09	0.12

Mechanical ventilation duration (days) (mean ± SD)	6.8 ± 2.5	7.0 ± 2.7	5.5 ± 2.1	5.7 ± 2.2	MD –1.3d (–2.1 to –0.5)	**0.002**	**0.01**
ICU stay duration (days) (mean ± SD)	10.1 ± 3.6	10.4 ± 3.8	8.9 ± 3.2	9.1 ± 3.3	MD –1.2d (–2.3 to –0.2)	**0.02**	**0.04**
ICU mortality (%)	13%	16%	9%	11%	OR 0.6 (0.2–1.9)	0.41	0.48

Figure 2: The cumulative incidence curves for both Time to Successful Extubation and Time to First Successful Spontaneous Breathing Trial (SBT)



The cumulative incidence curves for both Time to Successful Extubation and Time to First Successful Spontaneous Breathing Trial (SBT) were plotted based on the provided mean values and standard deviations for the four screening methods.

- Time to Successful Extubation: The curve for Twice-Daily Screening with HFNC showed the quickest median time to successful extubation (mean = 2.7 days, SD = 0.9), followed closely by Twice-Daily Screening with T-piece (mean = 2.8 days, SD = 0.8). Once-Daily Screening with HFNC and Once-Daily Screening with T-piece demonstrated slightly longer times to successful extubation, with means of 3.2 days (SD = 1.1) and 3.0 days (SD = 1.0), respectively. The curves indicate a general trend of faster extubation with more frequent screening, particularly with the use of HFNC.
- Time to First Successful SBT: The curve for Twice-Daily Screening with HFNC (mean = 40.2 hours, SD = 11.0) displayed the shortest time to the first successful SBT, with a clear advantage over the other groups. Twice-Daily Screening with T-piece followed closely (mean = 41.5 hours, SD = 11.2), while Once-Daily Screening with HFNC (mean = 49.5 hours, SD = 12.8) and Once-Daily Screening with T-piece (mean = 51.0 hours, SD = 13.5) demonstrated longer times to first successful SBT.

These results suggest that more frequent screening, particularly with HFNC, may facilitate earlier extubation and spontaneous breathing trials. The cumulative incidence curves provide a visual representation of the distribution of these times, highlighting the potential benefits of higher frequency monitoring in improving respiratory outcomes.

Discussion:

This prospective randomized clinical trial aimed to evaluate the effect of screening frequency and spontaneous breathing trial (SBT) technique on the time to successful extubation, as well as other important clinical outcomes in patients who required invasive mechanical ventilation. The key findings of this study suggest that a twice-daily screening regimen, regardless of whether high-flow nasal cannula (HFNC) or T-piece was used during the SBT, resulted in significantly reduced time to extubation and faster achievement of the first successful SBT compared to once-daily screening. These results add to the growing body of evidence supporting the importance of early and frequent assessment for weaning in critically ill patients.

Our study's finding that the twice-daily screening regimen significantly reduced the time to extubation is consistent with prior research on weaning protocols. Previous studies have shown that more frequent assessments of weaning readiness lead to quicker extubation and more efficient recovery from mechanical ventilation. [16] In our trial, the Twice-daily + HFNC group had a mean time to extubation of 2.7 ± 0.9 days, which was significantly shorter compared to 3.2 ± 1.1 days in the Once-daily + HFNC group. This reduction in extubation time supports the hypothesis that more frequent assessment increases the likelihood of identifying patients who are ready for extubation at an earlier stage. [17]

In addition to reduced time to extubation, the Twice-daily screening groups also showed a trend toward a lower incidence of reintubation within 48 hours, although this did not reach statistical significance. The Twice-daily + HFNC group had the lowest reintubation rate (4%) compared to 13% in the Once-daily + HFNC group. This is consistent with other studies that have found that the use of HFNC, in particular, may decrease reintubation rates by improving oxygenation and providing better respiratory support. [18] HFNC has been shown to reduce airway resistance and improve patient comfort, which may facilitate a more successful and less traumatic extubation process. [19] Thus, while we did not find a statistically significant reduction in reintubation, the trend is in line with previous findings that support HFNC as an effective adjunct during the weaning process.

An important secondary outcome of this study was the time to first successful SBT, which was significantly shorter in the twice-daily screening groups. The Twice-daily + HFNC group achieved the first successful SBT in a mean time of 40.2 ± 11.0 hours, which was about 9.7 hours earlier than the Once-daily + HFNC group. This finding corroborates the results of several studies that have demonstrated that more frequent SBTs are associated with faster extubation and reduced mechanical ventilation time. [20] Some studies also found that daily SBT assessments improved weaning outcomes, and our study extends these findings by showing that twice-daily assessments offer even more benefit, potentially due to increased opportunities to evaluate patient readiness for weaning. [21]

Furthermore, the incidence of ventilator-associated pneumonia (VAP) was lower in the Twice-daily screening groups, although the difference was not statistically significant. The Twice-daily + HFNC group had a VAP incidence of 9%, compared to 18% in the Once-daily + HFNC group. The reduction in VAP risk in the twice-daily groups may be attributed to the faster removal of the ventilator, thereby reducing the duration of invasive mechanical ventilation, which is a key risk factor for VAP. [22] Early extubation has been shown to significantly decrease the likelihood of developing VAP, as it minimizes the exposure to the mechanical ventilator and reduces the time spent in the ICU. [23]

Another noteworthy finding was the shorter duration of mechanical ventilation in the Twice-daily screening groups. The Twice-daily + HFNC group had the shortest mean mechanical ventilation duration (5.5 ± 2.1 days), which was significantly shorter than the Once-daily + HFNC group (6.8 ± 2.5 days). This reduction is in line with previous trials that have demonstrated that frequent screening and early extubation are associated with reduced mechanical ventilation duration. [24] By identifying patients who are ready for extubation more quickly, twice-daily screening facilitates earlier weaning, which is likely to shorten the overall duration of ventilation.

Similarly, ICU stay duration was significantly shorter in the Twice-daily groups, reinforcing the idea that optimizing the weaning process can lead to more efficient ICU care. Shorter ICU stays not only reduce the financial burden on healthcare systems but also improve overall patient outcomes. A number of studies have shown that early extubation and faster recovery from mechanical ventilation are associated with reduced ICU length of stay. [25] In this trial, the Twice-daily + HFNC group had a mean ICU stay of 8.9 ± 3.2 days, compared to 10.1 ± 3.6 days in the Once-daily + HFNC group.

Finally, while ICU mortality was lower in the Twice-daily screening groups, the difference did not reach statistical significance. This finding suggests that while earlier extubation and a more efficient weaning process may improve certain clinical outcomes, the effect on mortality may be less

pronounced. Other studies have found similar results, showing that early extubation and successful weaning can improve survival in patients with respiratory failure, particularly in those with conditions such as acute respiratory distress syndrome (ARDS) or pneumonia. [26] However, it is important to note that mortality in critically ill patients is influenced by a range of factors, and extubation success is just one component of the overall clinical picture. [27]

This study has a few limitations that need to be considered. First, it was conducted at a single center, which may affect how applicable the results are to different hospitals or patient populations. We also focused primarily on the impact of screening frequency and SBT technique, but other factors, like the severity of the patients' underlying conditions, comorbidities, and sedation levels, might have influenced the outcomes. Additionally, we didn't assess long-term recovery outcomes, such as post-ICU functional status or quality of life, which would provide more comprehensive insights into the effectiveness of the weaning strategies. Lastly, while the sample size was sufficient for the main outcomes, a larger cohort might have been able to detect more subtle differences, particularly in secondary outcomes like reintubation rates and ICU mortality.

Conclusion:

In conclusion, this study suggests that twice-daily screening for weaning readiness can lead to quicker extubation, shorter ventilation times, and a reduced ICU stay. Although we didn’t see significant differences in reintubation rates or ICU mortality, the trends indicate that more frequent screening might help patients recover more quickly. When it comes to the spontaneous breathing trial techniques, both HFNC and T-piece were effective, with HFNC showing a slight advantage in terms of reducing the time to the first successful trial. However, the differences between the two methods were not large enough to be statistically significant. This points to HFNC potentially being a better option for certain patients, especially those who need additional support. Overall, these findings suggest that twice-daily screening, whether paired with HFNC or T-piece, could improve outcomes in mechanically ventilated patients. Further research with larger, multi-center trials is needed to confirm these results and explore their long-term effects.

References:

1. Esteban A, Alía I, Tobin MJ, Gil A, Gordo F, Vallverdú I, Blanch L, Bonet A, Vázquez A, de Pablo R, Torres A, de La Cal MA, Macías S. Effect of spontaneous breathing trial duration on outcome of attempts to discontinue mechanical ventilation. Spanish Lung Failure Collaborative Group. Am J Respir Crit Care Med. 1999 Feb;159(2):512-8.
2. Vincent JL, Moreno R. Clinical review: scoring systems in the critically ill. Crit Care. 2010;14(2):207.
3. Tobin MJ. Culmination of an era in research on the acute respiratory distress syndrome. N Engl J Med. 2000 May 4;342(18):1360-1.
4. Boles JM, Bion J, Connors A, Herridge M, Marsh B, Melot C, Pearl R, Silverman H, Stanchina M, Vieillard-Baron A, Welte T. Weaning from mechanical ventilation. Eur Respir J. 2007 May;29(5):1033-56.
5. Epstein SK. Decision to extubate. Intensive Care Med. 2002 May;28(5):535-46.
6. MacIntyre NR, Cook DJ, Ely EW Jr, Epstein SK, Fink JB, Heffner JE, Hess D, Hubmayer RD, Scheinhorn DJ; American College of Chest Physicians; American Association for Respiratory Care; American College of Critical Care Medicine. Evidence-based guidelines for weaning and discontinuing ventilatory support: a collective task force facilitated by the American College of Chest Physicians; the American Association for Respiratory Care; and the American College of Critical Care Medicine. Chest. 2001 Dec;120(6 Suppl):375S-95S.
7. Brochard L, Rauss A, Benito S, Conti G, Mancebo J, Rekik N, Gasparetto A, Lemaire F. Comparison of three methods of gradual withdrawal from ventilatory support during weaning from mechanical ventilation. Am J Respir Crit Care Med. 1994 Oct;150(4):896-903.

8. Hernández G, Vaquero C, González P, Subira C, Frutos-Vivar F, Rialp G, Laborda C, Colinas L, Cuena R, Fernández R. Effect of Postextubation High-Flow Nasal Cannula vs Conventional Oxygen Therapy on Reintubation in Low-Risk Patients: A Randomized Clinical Trial. JAMA. 2016 Apr 5;315(13):1354-61.
9. Subirà C, Fernández R. The importance of the spontaneous breathing trial to keep extubated. Ann Transl Med 2019;7(22):705.
10. Thille AW, Boissier F, Ben Ghezala H, Razazi K, Mekontso-Dessap A, Brun-Buisson C. Risk factors for and prediction by caregivers of extubation failure in ICU patients: a prospective study. Crit Care Med. 2015 Mar;43(3):613-20.
11. Krishnan JA, Riekert KA, McCoy JV, Stewart DY, Schmidt S, Chanmugam A, Hill P, Rand CS. Corticosteroid use after hospital discharge among high-risk adults with asthma. Am J Respir Crit Care Med. 2004 Dec 15;170(12):1281-5.
12. Inglis R, Ayebale E, Schultz MJ. Optimizing respiratory management in resource-limited settings. Curr Opin Crit Care. 2019 Feb;25(1):45-53.
13. Schultz MJ, Dunser MW, Dondorp AM, Adhikari NK, Iyer S, Kwizera A, Lubell Y, Papali A, Pisani L, Riviello BD, Angus DC, Azevedo LC, Baker T, Diaz JV, Festic E, Haniffa R, Jawa R, Jacob ST, Kissoon N, Lodha R, Martin-Loeches I, Lundeg G, Misango D, Mer M, Mohanty S, Murthy S, Musa N, Nakibuuka J, Serpa Neto A, Nguyen Thi Hoang M, Nguyen Thien B, Pattnaik R, Phua J, Preller J, Povoa P, Ranjit S, Talmor D, Thevanayagam J, Thwaites CL; Global Intensive Care Working Group of the European Society of Intensive Care Medicine. Current challenges in the management of sepsis in ICUs in resource-poor settings and suggestions for the future. Intensive Care Med. 2017 May;43(5):612-624.
14. Javeri Y, Jagathkar G, Dixit S, Chaudhary D, Zirpe KG, Mehta Y, Govil D, Mishra RC, Samavedam S, Pandit RA, Savio RD, Clerk AM, Srinivasan S, Juneja D, Ray S, Sahoo TK, Jakkinaboina S, Jampala N, Jain R. Indian Society of Critical Care Medicine Position Statement for Central Venous Catheterization and Management 2020. Indian J Crit Care Med. 2020 Jan;24(Suppl 1):S6-S30.
15. Centers for Disease Control and Prevention. Ventilator-associated pneumonia (VAP) surveillance protocol. 2025. Available from: https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf
16. Wang Y, Lei L, Yang H, et al. Weaning critically ill patients from mechanical ventilation: a protocol from a multicenter retrospective cohort study. J Thorac Dis. 2022 Jan;14(1):199-206.
17. Ely EW, Baker AM, Evans GW, Haponik EF. The prognostic significance of passing a daily screen of weaning parameters. Intensive Care Med. 1999 Jun;25(6):581-7.
18. Burns KEA, Wong J, Rizvi L,et al; Canadian Critical Care Trials Group. Frequency of Screening and Spontaneous Breathing Trial Techniques: A Randomized Clinical Trial. JAMA. 2024 Dec 3;332(21):1808-1821.
19. Fernandez R, Subira C, Frutos-Vivar F, Rialp G, Laborda C, Masclans JR, Lesmes A, Panadero L, Hernandez G. High-flow nasal cannula to prevent postextubation respiratory failure in high-risk non-hypercapnic patients: a randomized multicenter trial. Ann Intensive Care. 2017 Dec;7(1):47.
20. Zein H, Baratloo A, Negida A, Safari S. Ventilator Weaning and Spontaneous Breathing Trials; an Educational Review. Emerg (Tehran). 2016 Spring;4(2):65-71.
21. Roca O, Riera J, Torres F, Masclans JR. High-flow oxygen therapy in acute respiratory failure. Respir Care. 2010 Apr;55(4):408-13.
22. Papazian L, Klompas M, Luyt CE. Ventilator-associated pneumonia in adults: a narrative review. Intensive Care Med. 2020 May;46(5):888-906.
23. Koenig SM, Truwit JD. Ventilator-associated pneumonia: diagnosis, treatment, and prevention. Clin Microbiol Rev. 2006 Oct;19(4):637-57.

24. Blackwood B, Burns KE, Cardwell CR, O'Halloran P. Protocolized versus non-protocolized weaning for reducing the duration of mechanical ventilation in critically ill adult patients. Cochrane Database Syst Rev. 2014 Nov 6;2014(11):CD006904.
25. Taylor M, Apparau D, Mosca R, Nwaejike N. Does early extubation after cardiac surgery lead to a reduction in intensive care unit length of stay? Interact Cardiovasc Thorac Surg. 2022 May 2;34(5):731-734.
26. Vaschetto R, Pecere A, Perkins GD, et al. Effects of early extubation followed by noninvasive ventilation versus standard extubation on the duration of invasive mechanical ventilation in hypoxemic non-hypercapnic patients: a systematic review and individual patient data meta-analysis of randomized controlled trials. Crit Care. 2021 Jun 1;25(1):189.
27. Zhu Y, Yin H, Zhang R, Ye X, Wei J. High-flow nasal cannula oxygen therapy versus conventional oxygen therapy in patients after planned extubation: a systematic review and meta-analysis. Crit Care. 2019 May 17;23(1):180.