Outcome of Prophylactic Noninvasive Ventilation following planned Extubation in High-risk patients: A two-year prospective observational study

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Introduction

- Extubation Failure(EF) results in increased length of stay , morbidity , mortality , burden on healthcare system. Reintubation rate estimated around 20-25% [1]in high risk adult ICU patient's [2],.
- It is more relevant in times of global health pandemic , that we look out for the strategies which can potentially reduce the burden on our healthcare system .
- Prophylactic/Preventive use of non-invasive ventilation (NIV) is recommended following extubation in patients at high risk of EF.[2]
- Most studies [2,4] so far have addressed the issue of prophylactic NIV use in the setting of randomized control trials (RCTs). We planned a longitudinal study in a real-world scenario ,looking for the overall impact of prophylactic NIV in patients at high risk of EF.
- In a prospective cohort study, we examined the impact of prophylactic NIV in this subset of patients.

Methods and Materials

- 2-Year (01 January 2018 to 31 December 2019), single center, prospective observational study.
- High risk of EF patients are . 1) Age > 65, 2) NYHA 2-4 , 3) COPD , 4) Patient with prior failed SBT, 5) patient with 2 or more organ failures.
- Extubation failure (EF) was defined as developing respiratory failure within 72 hours post-extubation requiring reintubation or still requiring NIV support at 72 hours post extubation.
- Inclusion Criteria:
  - 18 Years of age requiring invasive mechanical ventilation for >24 Hours at high risk of extubation failure.
  - Underwent planned extubation after a successful SBT.
- Exclusion Criteria:
  - Unplanned extubation, craniofacial trauma or surgery, ongoing upper gastrointestinal bleeding, excessive respiratory secretions or inability to handle secretion, recurrent vomiting, recent gastric or oesophageal surgery, tracheostomized, perceived lack of cooperation, already on home NIV, the decision to limit therapeutic intervention, and refusal of consent.
- Clinical data of patients who required re-intubation were compared with those who were successfully extubated.
- All included patients were followed till discharge from hospital or death.

Procedures

- All ventilated patients were screened daily for weaning criteria and patients fulfilling these criteria were put on a trial of SBT, extubated directly if passed SBT.
- The technique of SBT (T-piece or low-level pressure support of)were at the discretion of the attending consultant intensivist.
- All consenting patients, considered at high-risk for extubation failure, were put on prophylactic NIV support started immediately after extubation.
- The goal was to apply NIV support continually for 6–12 hours post-extubation except for 15–20-minute periods to allow the patient to drink fluids or receive nursing care.
- NIV was set and maintained as per attending intensivist discretion in aim to achieve adequate oxygenation and ventilation , patient comfort and synchrony with ventilator.
- After that period unassisted breathing was allowed for a gradually increasing period provided the patient is comfortable and was able to maintain adequate oxygenation and pH remained above 7.35.
- Final decision regarding the discontinuation of NIV and the need for reintubation as per discretion of the attending intensivist.

Results and Discussion

- 85-patients fulfilled the inclusion criteria.
- 11.8%(10) of patients had EF within 72 hours of extubation, with an overall reintubation rate of 10.5%.
- Higher age ($p < 0.05$), longer duration of invasive ventilation ($p < 0.05$), and higher sequential organ failure assessment (SOFA) score at extubation ($p < 0.05$) were identified as risk factors for EF in univariate analysis. However, in the multivariate analysis, only a higher SOFA score remained statistically significant in forward logistic regression analysis ($p < 0.05$).
- We found a clear trend toward worsening organ function score in the EF group in the first 72 hours post-extubation, suggesting EF as a risk factor for organ dysfunction.
- Median duration of invasive ventilation (2.87 vs 1.75 days, $p < 0.05$) and SOFA score (4 ± 2.4 vs 2.7 ± 1.6, $p < 0.05$) were significantly higher at index extubation in the failure group.
- Mean duration of NIV support was 29.49 (±14.82) hours and was not significantly different between the success and failure groups
- Overall, ICU mortality in the study population was 9.49% and was significantly higher in failure group (50% vs 4%, $p < 0.001$).
- There was no statistically significant difference in ICU or hospital length of stay between successful and failed extubation groups.
- Fluid Balance(FB) was higher in EF group but statistically insignificant.
- Rate of adverse events(Agitation, mask intolerance, nasal bridge induration, conjunctival irritation, abdominal distension etc) was significantly higher in failure group compared to successful extubation group (80% vs 12%; $p < 0.001$).

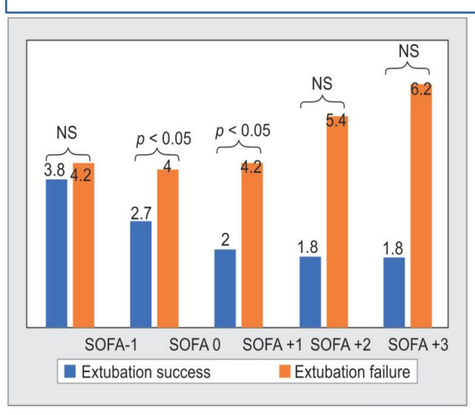

Figure - Changes in SOFA scores Before and after extubation

Table 4

Comparison of fluid balance between extubation success and failure groups from day before extubation (day −1) till day 3 (day +3) after extubation

Parameter	*Fluid balance 24 hours pre-extubation*	*Fluid balance On the day of extubation*	*Fluid balance 24 to 48 hours postextubation*	*Fluid balance 48 to 72 hours postextubation*
Extubation success (in mL), mean ± SD	626.99 ± 1021.04	−107.67 ± 712.06	−70.15 ± 847.62	65 ± 584.49
Extubation failure (in mL), mean ± SD	90.5 ± 1505.13	81.2 ± 1208.10	−19.8 ± 916.89	605.29 ± 901.97
p value	0.585	0.619	0.753	0.18

Day −1, day before extubation; Day 0, day of extubation; Day +3, day 3 after extubation; SD, standard deviation

Table 5

Outcome of prophylactic NIV

Parameter	*Total (N = 85)*	*Success (N = 75)*	*Failure (N = 10)*	*p value*
Duration of NIV support in hours (mean ± SD)	29.49 ± 14.82	29.6 ± 14.70	28.70 ± 16.54	0.97
Adverse effects, no. (%)	17 (20%)	9 (12%)	8 (80%)	<0.001
Death in ICU, no. (%)	8 (9.4%)	3 (4%)	5 (50%)	<0.001
Intensive care unit length of stay (in days)	9.49 ± 1.28	6.89 ± 7.68	13.3 ± 8.65	0.20
Hospital length of stay (in days)	11.37 ± 8.24	10.69 ± 8	16.4 ± 8.68	0.20

ICU, intensive care unit; NIV, noninvasive ventilation; SD, standard deviation

Limitations

- Single-centre study. However, the reintubation rate and time to reintubation in our study were similar to the NIV arms of earlier studies.
- Second, in our study, the final decision to reintubation was not protocolized and was at the discretion of the attending intensivist. However, the purpose of our study was to address the issue of prophylactic NIV in a real-world scenario.
- Third, our study is limited by the small sample size with only 10 patients failing extubation at 72hrs.
- Finally, we did not explore the role of high flow nasal cannula (HFNC).

Conclusions

- Prophylactic NIV use can potentially reduce Extubation Failure in high-risk patients.
- Higher age, longer duration of invasive ventilation, and higher baseline SOFA score at extubation remain risk factors for extubation failure even in this high-risk subset of patients on prophylactic NIV.
- Extubation failure is associated with the worsening of organ function.

References

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