SUBMITTED 8 SEP 20
REVISIONS REQ. 28 DEC 20, 24 FEB 21; REVISIONS RECD. 10 FEB 21 & 10 MAR 21
ACCEPTED 7 APR 21
ONLINE-FIRST: AUGUST 2021
DOI: https://doi.org/10.18295/squmj.8.2021.122

Risk Factors of Extubation Failure in Intubated Preterm Infants at a Tertiary Care Hospital in Oman

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Abstract

Objectives: To determine extubation failure (EF) rate among intubated preterm infants (<37 weeks gestational age [GA]) admitted to a tertiary care neonatal intensive care unit (NICU) in Oman and identify the risk factors associated with EF. **Methods:** Charts of all intubated preterm infants (<37 weeks GA) from January 2013 to December 2017 were retrospectively reviewed. EF was defined as reintubation within 7 days of planned extubation. Demographics, ventilation parameters, blood gas values and other possible risk factors of EF were collected. Statistical analysis included comparisons between EF and extubation success (ES) groups, and binary logistic regression analysis. **Results:** A total of 190 preterm infants were intubated during the study period, with 140 eligible for analysis. N=106 were successfully extubated; 34 (24.3%) failed extubation. GA <28 weeks (p=0.029), lower 1-minute APGAR score (p=0.023) and patent ductus arteriosus diagnosis (PDA) (p=0.018) were significantly associated with EF. After the multivariate analysis, only GA <28 weeks predicted EF with adjusted odds ratio (95% confidence interval) of 2.62 (1.17 – 6.15). **Conclusions:** EF rate in preterm infants admitted at our NICU in Oman, was within international rates. GA <28 weeks was the only predictor of extubation failure identified. Neonatal practitioners need to seriously consider extreme prematurity in extubation process and consider implementing strategies to decrease extubation failure in this group of fragile infants.

Keywords: Premature Infants; Neonate; Airway Extubation; Extubation Failure, Risk Factors.

Advances in Knowledge

- This study identified extubation failure rate as 24.3% and reaffirmed that extreme prematurity (gestational age <28 weeks) is an important predictor of extubation failure in intubated preterm infants admitted to a level III neonatal intensive care unit in Oman.

Application to Patient Care

- Health care professionals in neonatal intensive care units need to seriously consider extreme prematurity prior extubation of preterm infants and consider implementing strategies that may help decrease extubation failure such formal assessment of extubation readiness and use of positive pressure ventilation as post-extubation respiratory support.

Introduction

Invasive mechanical ventilation is a life-supporting intervention, used for patients with respiratory failure, including preterm infants in neonatal intensive care units (NICUs). Despite of this advantage, extubation failure (EF) is a recurrent issue. EF occurs in approximately 40% of intubated extremely low birth weight (ELBW) infants globally, [1] but is highly variable between 10 and 30%.[2] This is partly due to the absence of a consistent definition for EF, and standardized criteria to determine EF.[2] EF has been defined as reintubation within 24, 48, and 72 hours however, some patients have required reintubation up to 7 days post extubation. [2,3]

It is of utmost importance to extubate infants as soon as they are ready. Prolonged intubation and mechanical ventilation in preterm infants are associated with significant adverse effects including ventilator-associated pneumonia (VAP), [3] bronchopulmonary dysplasia, sepsis and subglottic stenosis. [4] However, this is a tenuous balancing act because premature extubation may lead to EF, which itself is associated with serious complications such as prolonged mechanical ventilation, prolonged hospital stay, higher mortality rate as well as complications related to the reintubation procedure itself. [5-7]

In order to find an optimal strategy for successful extubation in preterm infants, there must be an awareness of potential risk and success factors. Previous studies had identified predictors of EF such as lower 5-minute APGAR score, [8, 9] poor acid-base homeostasis, [10] lower gestational age (GA) ($\leq$ 28 weeks), [9] post-extubation lung collapse, [11] patent ductus arteriosus (PDA) [11] and acquired pneumonia. [11] Similarly, Chawla et al [12] identified markers of successful extubation in preterm infants, including higher 5-minute APGAR score and arterial pH prior to extubation, lower peak fractional concentration of inspired oxygen (FiO_2) on the first day of life and prior to extubation, lower arterial partial pressure of carbon dioxide ($PaCO_2$) prior to extubation, and "non-small" for GA.

Currently, there are no studies regarding EF in preterm infants in Middle Eastern Countries. This study aims to describe EF rate among intubated preterm infants in a tertiary care NICU in Oman, and to determine the risk factors associated with EF. It is anticipated this study will provide specific criteria that neonatal practitioners can use to assess extubation readiness in preterm infants and optimize success.

Methods

This was a retrospective case-control study in a level III NICU of a tertiary and academic perinatal hospital (Sultan Qaboos University Hospital [SQUH]) in Oman. SQUH has approximately 5000 deliveries per year, and its NICU has a 24-bed capacity. Eligible infants were intubated preterm infants (<37 weeks) admitted over a period of 5 years (January 2013 to December 2017). Infants who died prior to extubation, extubated for palliative care/comfort care, transferred to another hospital with an endotracheal tube (ETT), had an unplanned/accidental extubation, or tracheostomized were excluded. Only the first planned extubation attempt for each patient was assessed for this study. For this study, EF was defined as the need for re-intubation within 7 days of a planned extubation. [2,3] Ethical approval was obtained through the institution's

Medical Research Ethics Committee (MREC). The patients' electronic charts were reviewed, and specific predefined clinical variables including patient's demographic data, pre-extubation ventilation parameters (mode, respiratory rate [RR], peak inspiratory pressure [PIP], peak end expiratory pressure [PEEP], tidal volume [Vt in ml/kg], FiO_2), blood gas values (pH, partial pressure of carbon dioxide [pCO_2], bicarbonate [HCO_3^-] and base excess [BE]) and other risk factors of EF were collected. Blood gas values included a mix of arterial, venous, and capillary samples.

Ventilation and Extubation Practices

All infants were ventilated using Dräger babylog® VN500 or SLE5000 ventilators. The primary ventilation mode was pressure control conventional ventilation from 2013 until 2016, and volume-targeted conventional ventilation in 2017. High frequency oscillatory ventilation (HFOV) was used as a rescue mode. Infants were extubated once they were on minimal ventilatory parameters (PIP/PEEP 16/5, RR 30/min, FiO_2 <0.35), had normal blood gases, and deemed ready by the medical team (established spontaneous breathing, hemodynamically stable). Post-extubation interventions included bubble nasal CPAP, nasal noninvasive positive pressure ventilation (NIPPV) for infants <1000g, and high flow nasal cannula for late preterm. Pre-and post-extubation extubation blood gas tests were performed one to two hours prior and after extubation respectively.

Statistical Analysis

The study population was classified into two groups: EF and extubation success (ES). Descriptive statistics includes mean and standard deviation (SD) or median and interquartile range (IQR) for continuous variables; and counts and percentages for categorical variables. Normality of continuous variables was tested using One Sample Kolmogorov-Smirnov test. The differences in patient characteristics and possible risk factors between the ES and EF groups were tested using chi-square test for categorical variables, independent sample t-test for normally distributed continuous variables, and Mann-Whitney U test for non-normally distributed continuous variables. Adjusted binary logistic regression analysis was performed to determine predictors of EF, using clinical variables that were significantly different between the two groups (EF versus ES). After obtaining the results of these statistical analyses (post-hoc), we repeated the analyses in the sub-group of infants <28 weeks GA (multivariate regression analysis was not completed as the sample size was small, and only one variable was significant in the univariate analysis [see Results section]). Missing data was excluded from the data analyses. SPSS version 23 (Armonk, NY: IBM Corp) was used for data analysis. A p-value ≤ 0.05 was considered statistically significant.

Results

Patient Characteristics

Figure 1 shows the study population flow chart. A total 140 were included, out of which 34 failed extubation (EF rate 24.3%). The mean (±SD) GA was 31.6 (± 3.0) weeks in the ES group, and 26.1 (± 1.2) in the EF group. The most common reasons for reintubation are shown in (Figure 2). The majority of extubation failures (79.4%) occurred within the first three days of extubation (Figure 3). Table 1 and 2 show the clinical characteristics, ventilatory and blood gas parameters of the EF and ES groups.

Differences between EF and ES

There were significant differences between the EF and ES groups for the following three clinical variables: GA<28 weeks, 1-minute APGAR score , and PDA (Table 1). After the multivariate analysis, only the variable GA<28 weeks remained as a significant predictor of EF; 1-mintue APGAR score and PDA were no longer associated with EF (Table 3). Infants with EF had significantly higher total mechanical ventilation (MV) days as well as longer length of hospital stay (Table1). There were no significant differences in other clinical variables (APGAR score at 5 minutes, birth weight (BW), weight at intubation and extubation, day of life at intubation and extubation, caffeine use, pre-extubation hemoglobin (Hb) level), IVH rate, pre-extubation ventilatory variables (mode, Vt, PIP, PEEP, rate, FiO_2) and pre-extubation blood gas results (Table 1 and 2). After extubation, pH, HCO_3^- and BE were significantly lower in the EF compared to the ES group (Table 2).

For the post-hoc subgroup analysis of infants <28 weeks (n=54), 35 (64.8%) had ES, and 19 (35.2) had EF. Given the results of the multivariate analyses on the whole cohort, it is not surprising the presence of PDA was significantly higher in the EF group (ES=14 [42.9%], EF=15

[73.7%], $p=0.03$) in this subgroup. Similar to the whole group, the median (IQR) of total MV days was higher in the EF group (ES=5.0 [10], EF=20 [23] days, $p<0.001$), but not significantly different for the length of hospital stay (ES=70 [15], EF=87 [53] days, $p=0.142$). All other variables were not significantly different between ES and EF groups.

Discussion

This study determined EF rate (and associated risk factors) among intubated preterm infants in a tertiary care NICU in Oman. EF rate was found to be on the upper boundary of the 10 to 30% EF rate range found by Al-Mandari et al 2015, [2] however the majority of respondents (93%) in that study defined EF as occurring within 72 hours. The longer the period of time after extubation, the higher the risk of reintubation. [1] Thus, our definition of reintubation within 7 days may be a more accurate reflection of EF rate. Compared with other EF studies using 5 to 7 days post-extubation as their benchmark, our EF rate was similar to Hermeto et al 2009 (23.1%) and Wang et al 2017 (23.5%), [9, 10] and lower than Chawla et al 2017 (42%) and Stefanescu et al 2003 (40%). [1, 12] However, it is important to consider differences in GA in these various studies as it may have contributed to difference in EF rate as well. The association of EF with extreme prematurity (exclusively <28weeks) has been inconsistent in the literature; some studies showed an association, [8, 9, 13] others did not. [10-12]

Costa et al 2014, [8] and other authors [9, 12] found 5-minute APGAR score was significantly lower for those with EF compared to ES. This association was absent in our study likely because most infants (81.4%) had a high 5-minute APGAR score > 6. In addition, the 5-minute APGAR score was missing for 5 infants (3.6%).

Loss of impact of PDA on extubation outcome on multivariate regression is likely due to the influence of GA, as our post-hoc subgroup analyses of infants <28weeks showed a significant difference in PDA presences between the EF and ES groups. The impact of PDA on extubation outcomes continues to be a controversial issue. Hermeto et al 2009 [9] and Chawla et al 2013, [6] found significant associations between EF and presence of PDA, while Wang et al 2017 and Szymankiewicz et al 2005 [10, 14] did not. Similarly, the association between BW and EF is aligned with previously published studies, [10, 11] but contrasts with findings of other studies that showed lower BW is associated with increased chance of EF.[9, 13, 18] In our study, medians BWs were not associated with EF, likely because they were consistently larger (>1000g).

Randomized trials of prophylactic use of caffeine showed increase chances of successful extubation in preterm infants within one week of age.[19] The lack of difference in caffeine use in this study is most likely because our NICU routinely uses caffeine in all preterm infants < 32 weeks GA. This was about 75% of our sample size, and equally distributed between the ES (74%) and EF (79%) groups, p=0.649.

The absence of differences in pre-extubation ventilation parameters and blood gas results between EF and ES groups in this study is similar to Wang et al 2017,[10] but different from Chawla et al 2017[9] who found lower pH, higher CO_2 and higher FiO_2 prior to extubation were significantly associated with EF, and Shalish et al 2019[18] who found a significant correlation between lower pre-extubation PEEP and EF. As expected, our study found significantly worse post-extubation blood gas values in the EF compared to the ES group (Table 2), and is similar to Wang et al 2017.[10] However, these factors cannot be used to predict risk extubation failure. Brix et al 2014 found that Hb <8.5 mmol/l was associated with EF.[20] Our study showed no significant difference in pre-extubation Hb level between the EF and ES groups (Table 2), likely because the study population had normal mean Hb levels >8.5 mmol/l prior to extubation (related to the unit's transfusion policy).

The longer duration of MV and hospital length of stay in the EF group (Table1) are expected morbidities of EF. This is consistent with many previous studies.[6, 8, 11, 18] The duration of MV for the EF group was also significantly higher for the subgroup of infants <28 weeks GA, but not significantly different for hospital length of stay. We speculate in the <28weeks GA subgroup, other complications impacted and balanced out their hospital length of stay, because the median (IQR) for the whole <28week subgroup was high at 72.5 (33.75) days, e.g., bronchopulmonary dysplasia. These subgroup results also support that GA (especially <28weeks) impacted ES, and hospital length of stay for all the infants included in our study. Prospective, clinical trials with larger sample sizes is needed to confirm these results.

A number of limitations in this study need to be considered. This study was of a retrospective design which have more biases associated with confounding, and causality. [23] Moreover, some of the data were not documented in patients' electronic charts, resulting in missing data and a smaller sample size, which could have negatively biased the results. Missing data were excluded from the analyses. The subgroup analysis on infants <28 weeks GA was done post-hoc, and resulted in a decrease in the sample size. This was done for exploratory reasons; inferences on these results should be made with caution. Blood gas values were arterial, venous, or capillary; we could not distinguish them as they were not categorized separately in patients' charts. Finally, this study only reviewed the charts of preterm infants of a single tertiary center in Oman and may not be generalizable in other settings.

Conclusion

Extubation failure rate (within 7 days of extubation) in preterm infants admitted to a Middle Eastern tertiary care NICU (Oman), was found to be 24.3%, and is within reported international rates. GA <28 weeks was found to be the main predictor of extubation failure. Neonatal practitioners need to seriously consider extreme prematurity before extubation. It may be beneficial to implement strategies known to help decrease extubation failure such formal assessment of extubation readiness, and post-extubation non-invasive positive pressure ventilation in this group of infants.

References

1. Stefanescu BM, Murphy WP, Hansell BJ, Fuloria M, Morgan TM, Aschner JL. A randomized, controlled trial comparing two different continuous positive airway pressure systems for the successful extubation of extremely low birth weight infants. Pediatrics. 2003;112(5):1031-8.

2. Al-Mandari H, Shalish W, Dempsey E, Keszler M, Davis PG, Sant'Anna G. International survey on periextubation practices in extremely preterm infants. Archives of disease in childhood Fetal and neonatal edition. 2015;100(5):F428-31.

3. Miller JD, Carlo WA. Pulmonary complications of mechanical ventilation in neonates. Clinics in perinatology. 2008;35(1):273-81, x-xi.

4. Kamlin CO, Davis PG, Morley CJ. Predicting successful extubation of very low birthweight infants. Archives of disease in childhood Fetal and neonatal edition. 2006;91(3):F180-3.

5. Baisch SD, Wheeler WB, Kurachek SC, Cornfield DN. Extubation failure in pediatric intensive care incidence and outcomes. Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies. 2005;6(3):312-8.

6. Chawla S, Natarajan G, Gelmini M, Kazzi SN. Role of spontaneous breathing trial in predicting successful extubation in premature infants. Pediatric pulmonology. 2013;48(5):443-8.

7. Kurachek SC, Newth CJ, Quasney MW, Rice T, Sachdeva RC, Patel NR, et al. Extubation failure in pediatric intensive care: a multiple-center study of risk factors and outcomes. Critical care medicine. 2003;31(11):2657-64.

8. Costa AC, Schettino Rde C, Ferreira SC. [Predictors of extubation failure and reintubation in newborn infants subjected to mechanical ventilation]. Revista Brasileira de terapia intensiva. 2014;26(1):51-6.

9. Hermeto F, Martins BM, Ramos JR, Bhering CA, Sant'Anna GM. Incidence and main risk factors associated with extubation failure in newborns with birth weight < 1,250 grams. Jornal de pediatria. 2009;85(5):397-402.

10. Wang SH, Liou JY, Chen CY, Chou HC, Hsieh WS, Tsao PN. Risk Factors for Extubation Failure in Extremely Low Birth Weight Infants. Pediatrics and neonatology. 2017;58(2):145-50.

11. Hiremath GM, Mukhopadhyay K, Narang A. Clinical risk factors associated with extubation failure in ventilated neonates. Indian pediatrics. 2009;46(10):887-90.

12. Chawla S, Natarajan G, Shankaran S, Carper B, Brion LP, Keszler M, et al. Markers of Successful Extubation in Extremely Preterm Infants, and Morbidity After Failed Extubation. The Journal of pediatrics. 2017;189:113-9.e2.

13. Dimitriou G, Greenough A, Endo A, Cherian S, Rafferty GF. Prediction of extubation failure in preterm infants. Archives of disease in childhood Fetal and neonatal edition. 2002;86(1):F32-5.

14. Szymankiewicz M, Vidyasagar D, Gadzinowski J. Predictors of successful extubation of preterm low-birth-weight infants with respiratory distress syndrome. Pediatric critical care

medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies. 2005;6(1):44-9.

15. Gupta P, McDonald R, Goyal S, Gossett JM, Imamura M, Agarwal A, et al. Extubation failure in infants with shunt-dependent pulmonary blood flow and univentricular physiology. Cardiology in the young. 2014;24(1):64-72.

16. Chico MS, Nesargi S, Rao PN S, Chandrasekaran A, Bhat S. Predictors of Extubation Failure in Mechanically Ventilated Neonates in the NICU. Perinatology. 2018;19(1):1-6.

17. Guardia CG, Moya FR, Sinha S, Gadzinowski J, Donn SM, Simmons P, et al. Reintubation and risk of morbidity and mortality in preterm infants after surfactant replacement therapy. Journal of Neonatal-Perinatal Medicine. 2011;4:101-9.

18. Shalish W, Latremouille S, Papenburg J, Sant'Anna GM. Predictors of extubation readiness in preterm infants: a systematic review and meta-analysis. Archives of disease in childhood Fetal and neonatal edition. 2019;104(1):F89-f97.

19. Henderson-Smart DJ, Davis PG. Prophylactic methylxanthines for endotracheal extubation in preterm infants. The Cochrane database of systematic reviews. 2010(12):Cd000139.

20. Brix N, Sellmer A, Jensen MS, Pedersen LV, Henriksen TB. Predictors for an unsuccessful INtubation-SURfactant-Extubation procedure: a cohort study. BMC pediatrics. 2014;14:155.

21. Andrade LB, Melo TM, Morais DF, Lima MR, Albuquerque EC, Martimiano PH. Spontaneous breathing trial evaluation in preterm newborns extubation. Revista Brasileira de terapia intensiva. 2010;22(2):159-65.

22. Johnson RW, Ng KWP, Dietz AR, Hartman ME, Baty JD, Hasan N, et al. Muscle atrophy in mechanically-ventilated critically ill children. PLoS One. 2018;13(12):e0207720-e.

23. Cummings S, Kohn M, S H. Designing Cross-Sectional and Cohort Studies. Designing Clinical Research. 4th ed: Lippincott Williams & Wilkins; 2013. p. 85-96.

Figure 1: Study population chart summary

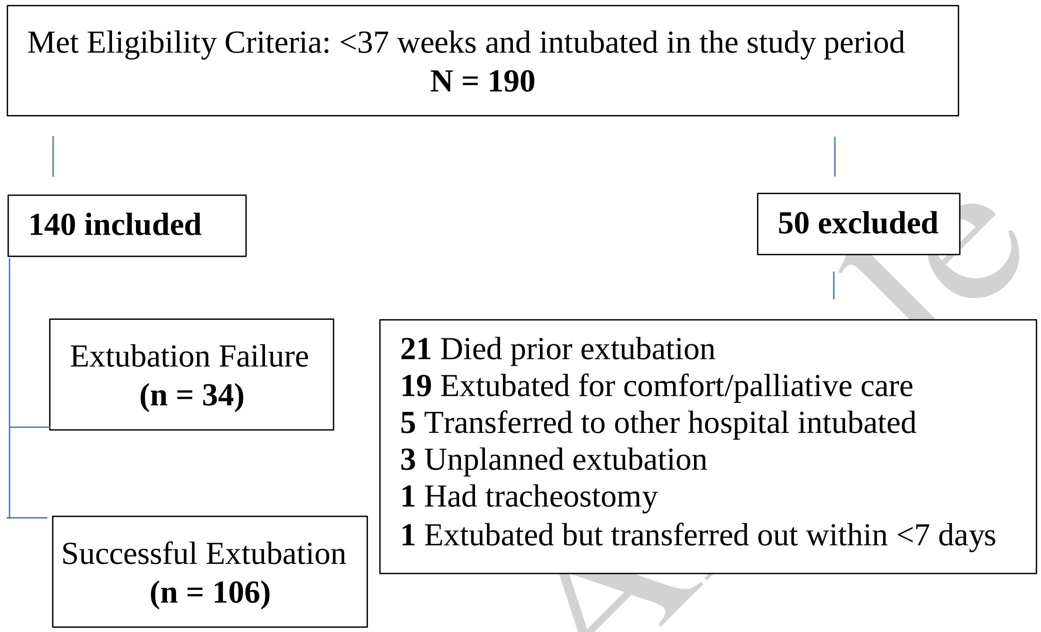

Figure 2: Reported Reason for Re-intubation (n=34)

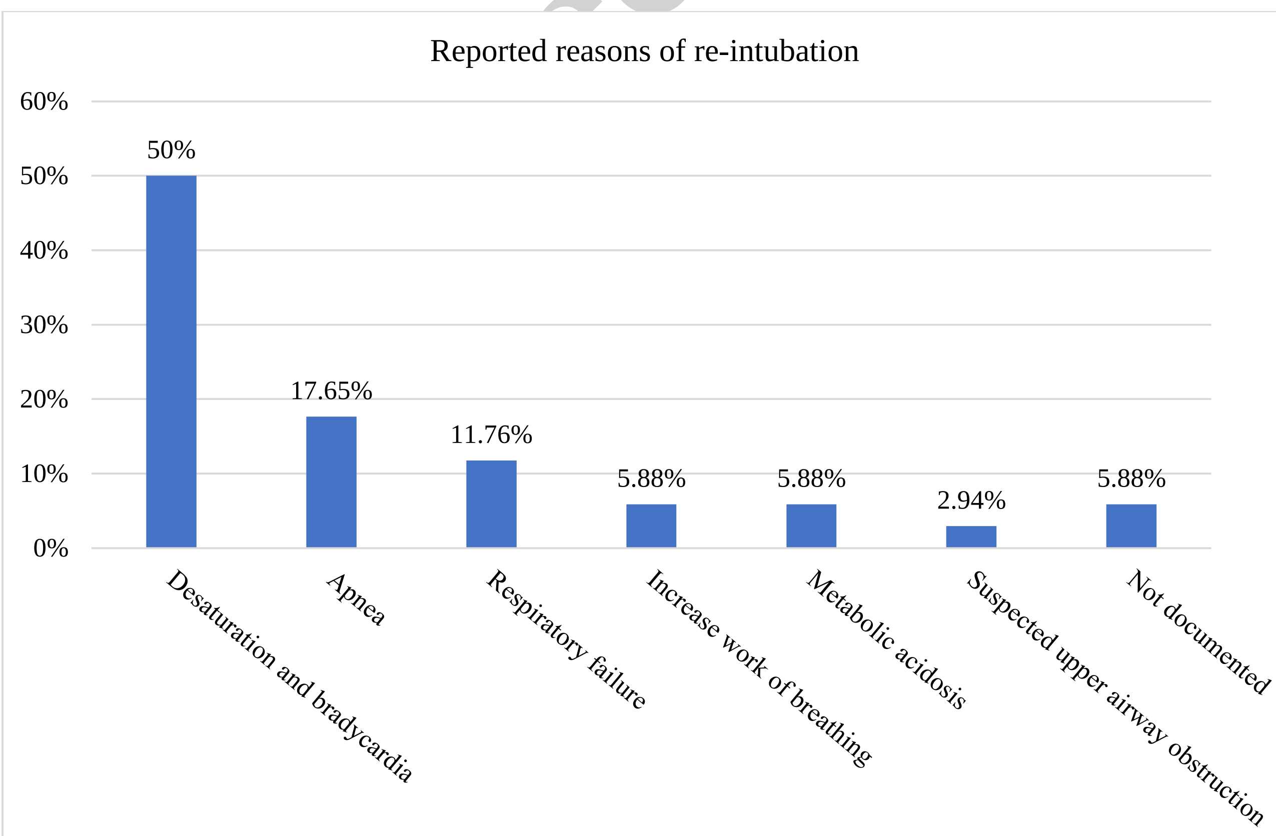

Figure 3: Cumulative Extubation Failure per day (n=34)

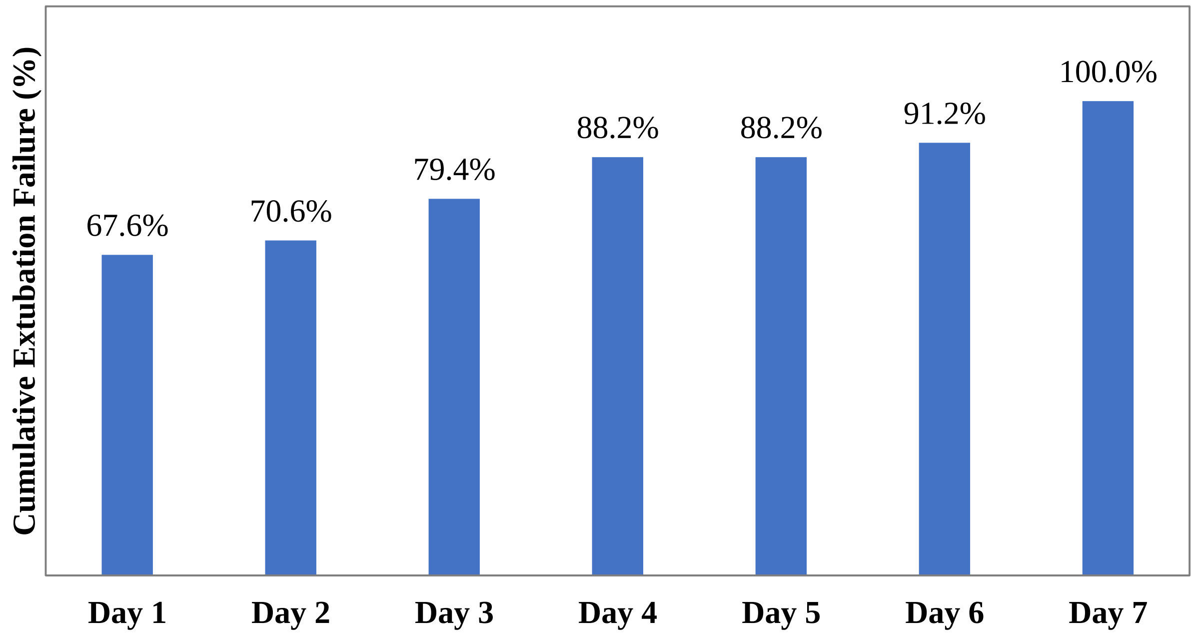

Table 1: Characteristics of extubation failure (EF) / extubation success (ES) groups

Variable	ES (n=106) n (%) or Mean ± SD or Median [IQR]	EF (n=34) n (%) or Mean ± SD or Median [IQR]	P-value
Gestational age (GA, <28 weeks)	35 (33.0)	19 (55.9)	0.029[$] *
Gender (male)	58 (54.7)	20 (58.8)	0.825[$]
APGAR 1	5.98 ± 2.22	4.88 ± 2.38	0.023[#] *
APGAR 5	8.10 ± 1.62	7.72 ± 1.63	0.117[#]
Birth weight (kg)	1.44 ± 0.82	1.34 ± 0 .73	0.448[#]
Weight at intubation (kg)	1.46 ± 0.85	1.32 ± 0.70	0.481[#]
Weight at extubation (kg)	1.45 ± 0.82	1.33 ± 0.76	0.370[#]
Patent ductus arteriosus (PDA)**	39 (36.8)	21 (61.8)	0.018[$] *
Intraventricular hemorrhage (IVH) **	14 (13.2)	5 (14.7)	1.000[$]
Caffeine	78 (73.6)	27 (79.4)	0.649[$]
Day of life at intubation	1 [0]	1 [0]	0.798[@]
Day of life at extubation	3 [5]	2.5 [6]	0.965[@]
Total mechanical ventilation days	3 [4]	16 [26.5]	<0.001[@] *
Length of hospital stay (days)	54.5 [38.8]	67 [54.3]	0.01[@] *

APGAR 1=APGAR score at 1-minute; APGAR 5=APGAR score at 5-minutes;

IQR=interquartile range. *$p \leq 0.05$. **Grade and diagnosis date were not collected.

[$]: Chi square test, [#]: Independent sample t-test, [@]: Mann-Whitney test

Table 2: Ventilator and blood gas parameters prior to and after extubation

Variable	ES (n=106)	EF (n=34)	P-value
	n (%) or Median [IQR]	n (%) or Median [IQR]	
Prior to extubation			
Mode of ventilation (SIMV)	68 (64.2)	20 (58.8)	0.722[$]
RR (breaths/min)	30 [10]	25 [5]	0.093[@]
PIP (cmH_2O)	15 [1]	15 [2]	0.461[@]
PEEP (cmH_2O)	6.0 [0]	6.0 [0.05]	0.021[@]
Vt (ml/kg)	4.9 [3.6]	4.9 [2.5]	0.640[@]
FiO_2(%)	23 [4]	25 [7.5]	0.228[@]
pH	7.39 [0.08]	7.38 [0.1]	0.644[@]
pCO_2	37.5 [13.4]	35.5 [13.9]	0.513[@]
HCO_3^-	22.4 [3.7]	21.4 [2.6]	0.057[@]
BE	-2.5 [4.8]	-3.3 [4.05]	0.126[@]
Hb (g/dL)	13.5 [3.1]	13.9 [3.6]	0.363[@]
After extubation			
Respiratory support (CPAP)	77 (72.6)	28 (82.4)	0.720[$]
pH	7.36 [0.08]	7.32 [0.13]	<0.001[@]*
pCO_2	41.2 [13.97]	41.7 [18]	0.298[@]
HCO_3^-	21.7 [3.4]	19.6 [2.9]	< 0.001[@]*
BE	-3.0 [4.2]	-5.9 [4.4]	< 0.001[@]*

ES=extubation success; FiO_2= fraction of inspired oxygen; Hb=hemoglobin; HCO_3^- =bicarbonate; PCO_2=partial pressure of carbon dioxide; PEEP=positive end expiratory pressure; PIP=peak inspiratory pressure; RR=respiratory rate; SIMV=synchronized intermittent mandatory ventilation; Vt=tidal volume. Blood gas values were taken 1 to 2 hours prior and after extubation. *$p < 0.05$ (between ES and EF groups)

[$]: Chi square test, [@]: Mann-Whitney test

Table 3. Predictors of Extubation Failure

	Univariate		Multivariate*	
	Odds ratio	95% CI	Odds ratio	95% CI
PDA	2.775	1.251 – 6.154	2.326	0.967 – 5.592
GA	2.570	1.168 – 5.655	2.621	1.118 – 6.146
APGAR 1	2.997	1.190 – 7.548	2.533	0.958 – 6.695

* Adjusted Binary logistic regression analysis performed. CI=confidence interval; GA=gestational age; PDA= patent ductus arteriosus (PDA); APGAR 1= APGAR score at 1-minute.