

## Evaluating the Short-Term Outcome of Mechanically Ventilated Neonates Admitted to the Neonatal Intensive Care Unit of Besat Hospital, Hamadan, Iran

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### Abstract

#### Background

Many neonates admitted to Neonatal Intensive Care Unit (NICU) need mechanical ventilation for recovery. This study was designed to evaluate the short-term outcome of mechanically ventilated neonates admitted to NICU.

#### Materials and Methods

In this descriptive cross-sectional study, all the neonates in need of mechanical ventilation in NICU of Besat Hospital, Hamadan, Iran, were enrolled for one year from September 2017 to September 2018. The selected data were of neonatal age at admission time, birth weight, gender, gestational age, indications of mechanical ventilation, lab results, length of hospital stay and the outcome of the disease were extracted from the medical file and analyzed using SPSS software (version 22.0).

#### Results

Of 141 mechanically ventilated neonates, 55.3% (n=78) were males. The mean of neonatal age, mean gestational age and mean birth weight were,  $4.67 \pm 6.58$  days,  $35.51 \pm 3.88$  weeks, and  $2779.37 \pm 827.06$  g, respectively. RDS (58.9%) was the most common indication for mechanical ventilation. The overall rate of neonatal recovery was 51.8%. The results of univariate analysis showed a significant relationship between indications of mechanical ventilation, gestational age, neonatal birth weight, acidosis (pH <7.1), duration of mechanical ventilation, duration of hospitalization and the disease outcomes (P<0.05).

#### Conclusion

The results of this study showed that respiratory distress syndrome, low gestational age and birth weight, acidosis and duration of mechanical ventilation would lead to increased death in mechanically ventilated neonates.

**Key Words:** Outcomes, Mechanical ventilation, Neonate, Neonatal Intensive Care Unit.

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## 1- INTRODUCTION

Mechanical ventilation is an appropriate treatment for respiratory failure in sick neonates, which will reduce neonatal mortality (1, 2). The survival rate in neonates with mechanical ventilation differs from 24.5 to 67.9% in developing countries and 91% in developed countries in different studies (3, 4). Mechanical ventilation in neonates, especially in preterm neonates, has drastically enhanced the final prognosis of their disease over the past two decades (5, 6). The most important use of mechanical ventilation in neonates is respiratory failure because of respiratory distress syndrome (RDS), apnea, asphyxia, meconium aspiration syndrome (MAS), sepsis, pneumonia and transient tachypnea of the newborn (TTN), and persistent pulmonary hypertension of the newborn (PPHN), post resuscitation and after surgery in sick neonates (6-8).

Thus, mechanical ventilation is a proper treatment to increase the survival rate of the neonates and one of the essential components of NICU. The need for mechanical ventilation relies on various elements, like primary disease, gestational age, birth weight and related clinical conditions. In order to improve the survival in mechanically ventilated neonates, identification of prognostic factors and their treatment is mandatory. Therefore, this study was designed to evaluate the short-term outcome of mechanically ventilated neonates admitted to NICU and we studied numerous factors and tried to find the risk factors responsible for death.

## 2- MATERIALS AND METHODS

### 2-1. Study design and population

In this descriptive cross-sectional study, all mechanically ventilated neonates admitted to NICU of Besat Hospital, Hamadan, Iran (referral center for neonates in the province) were enrolled for one year

from September 23rd, 2017 to September 22nd, 2018.

### 2-2. Methods

Selecting the samples was by census method on all mechanically ventilated neonates admitted to NICU for one year. The infants' information, including neonatal age at admission, birth weight, gender, and gestational age, indications of mechanical ventilation, lab results, duration of admission and the outcome of the disease were extracted from the medical file.

### 2-3. Inclusion and exclusion criteria

The inclusion criteria were all the neonates admitted to NICU requiring mechanical ventilation due to medical or surgical conditions and neonates who only needed continuous positive airway pressure (CPAP) support were excluded.

### 2-4. Sample size

The formula for calculating the prevalence by Sabzehei et al. (6) was used to calculate the minimum sample size needed. According to the results of the study, the frequency of complications of mechanical ventilation, 67.54%, was entered in the formula. Considering the following parameters,  $P=19.8\%$ , 95% confidence interval ( $Z=1.96$   $D=0.07$ ), the minimum sample size required was 107.

$$n=Z *Z P (1-P)/9(d)^2 = 107$$

### 2-5. Ethical consideration

This study was approved in Hamadan University of Medical Sciences ethics committee with the ID IR.UMSHA.REC.1397.899.

### 2-6. Data Analyses

The selected data were extracted from the medical file and analyzed in SPSS software version 22.0. Chi-square and t-

test were used for the two groups. The confidence level (CI) was 95%.

### 3- RESULTS

Of 141 mechanically ventilated neonates, 55.3% (n=78) were males. The mean age of the neonate during admission, mean gestational age and mean birth weight were, respectively,  $4.67 \pm 6.58$  days,  $35.51 \pm 3.88$  weeks, and  $2779.37 \pm 827.06$  g. RDS, neonatal surgeries,

asphyxia and maternal anomalies were the most common indications for mechanical ventilation. The overall rate of neonatal recovery was 51.8% (n=73) (**Table.1**). Univariate analysis of death-related risk factors showed a significant relationship between the indication of mechanical ventilation, gestational age, birth weight, acidosis, duration of mechanical ventilation, duration of hospitalization and outcomes ( $P<0.05$ ) (**Table.2**).

**Table-1:** Baseline and clinical characteristics of the mechanically ventilated neonates (n=141).

Characteristics	Number (%)
Gender	
Male	78(55.3)
Female	63(44.7)
Neonatal age (day)	4.67±6.58
Birth weight (gr)	2779.37±827.06
Gestational age (week)	35.51±3.88
Indication for ventilation	
RDS and prematurity	93(65.9)
Neonatal surgeries	11(7.81)
Asphyxia	10(7.1)
Multiple anomalies	10(7.1)
Congenital heart disease	7(4.9)
Fulminant sepsis	7(4.9)
Pneumonia	2(1.4)
Inborn error of metabolism	1(0.7)
Pneumothorax	7(4.9)
Anemia	35(24.8)
Neutropenia	13(9.2)
Thrombocytopenia	21(14.9)
Hypoglycemia	51(36.2)
Abnormal neuroimaging	
Ultrasound	10(7.1)
CT Scan	13(9.2)
MRI	9(6.4)
Outcome	
Recovery	73(51.8)
Death	68(48.2)

RDS: respiratory distress syndrome; CT scan: computed tomography scan; MRI: magnetic resonance imaging.

**Table-2:** Comparison of mechanically ventilated neonates in terms of the outcomes (n=141).

Characteristics	Outcomes		P-value
	Recovery	Death	
Gestational age (week)	36.41±2.73	34.69±4.55	0.016
Birth weight (gr)	2692.18±651.96	2301.04±930.62	0.000
Neonatal age (day)	4.89±6.64	4.71±6.567	0.92
Maternal age (year)	27.56±5.08	27.28±4.83	0.57
Indication for ventilation			
RDS and prematurity	50(53.7)	43(46.3)	0.05
Neonatal surgeries	7(63.6)	4(36.4)	
Asphyxia	6(60)	4(40)	
Multiple anomalies	2(20)	8(80)	
Congenital heart disease	2(28.5)	5(71.5)	
Fulminant sepsis	3(42.8)	4(57.2)	
Pneumonia	2(100)	0	
Inborn error of metabolism	1(100)	0	
Initial blood gas abnormality			
Pao <sub>2</sub> < 50 (mm Hg)	11(38)	18(62)	0.08
Pco <sub>2</sub> > 60 (mm Hg)	10(40)	15(60)	0.18
PH <7.1 (mEq/L)	7(26)	20(74)	0.005
Positive blood culture	3(42.8)	4(57.2)	0.67
Pneumothorax	3(42.8)	4(57.2)	0.46
Duration of mechanical ventilation (day)	5.07±3.88	4.16±4.71	0.018
Length of stay (day)	13±12.04	5±5.13	0.000

RDS: respiratory distress syndrome.

#### 4- DISCUSSION

This study aimed to assess the short-term outcome of mechanically ventilated neonates admitted to NICU. In our study, the overall recovery in mechanically ventilated neonates was 51.8%. Our results are similar to those of Iqbal et al. (4), and Sangeeta et al. (9) with 57% and 54%, respectively. The results were more than those of Hossain et al. (10), and Mathur et al. (1) with 30% and 26% recovery and less than those of Prabha et al. (3), and Liling et al. (11) with 75% and 75.3% recovery, respectively. There are differences in recovery rates due to differences in underlying diseases, severity of prematurity and care quality. Specialist and technological advancements in developed countries may also be additional factors. Respiratory distress syndrome, neonatal surgeries, asphyxia and multiple

anomalies were the commonest indications of mechanical ventilation in our study. In other studies (2, 7), respiratory distress syndrome was the commonest indication of mechanical ventilation. However, in the study by Avinash et al. (12), meconium aspiration syndrome was the commonest indication of mechanical ventilation. Considering recovery, the highest prevalence was in the neonates with pneumonia and the lowest was in the ones with multiple anomalies. The recovery rate of both respiratory distress syndrome and asphyxia in our study was similar to that of Iqbal et al. (4). The recovery rate of neonates who need mechanical ventilation due to respiratory distress syndrome has increased with surfactant administration, which is reported to be in the range of 50-65%, showing the acceptability of our results, however, in developed countries, the recovery rate is very high and one of

the reasons for the difference in outcome of ventilated infants between developed and developing countries may be related to the easy availability of surfactant in developed countries. The value of surfactant administration for improving the outcome of infants with Respiratory distress syndrome, reducing the duration of mechanical ventilation and reducing the incidence of some complications has been proven (17). In the study by Mannan et al. (18), RDS with surfactant therapy recovered earlier than neonates without surfactant and most of the infants without surfactant required prolonged support with ventilator and during the ventilation period developed different complications. The recovery rate of asphyxia in our study was 60%, ranging from 14 to 72% (3).

The recovery rate (43%) in sepsis neonate was higher than that of Iqbal et al. (36%), and similar to Avinash et al. (12) with 46%. High mortality rates can be due to increased antibiotic resistance, especially in low birth-weight neonates with sepsis (13). A lower gestational age and lower birth weight would increase the mortality rate in neonates requiring mechanical ventilation, which is similar to other studies (1, 3, 11, 14, 15, 17). In our study, there was no significant relationship between the mean age of the neonate at admission and the mean maternal age with the neonatal mortality, similar to the results of other studies (4, 7).

However, there was a relationship between acidosis ( $\text{pH} < 7.1$ ), and hypoxemia in the initial blood gases analysis and mortality of neonates. These are similar to those of Iqbal et al. (4) as a lower initial pH shows the severity of the underlying diseases or the long interval between the onset of the events and the deterioration of the clinical situation of the baby and the time of admission. Thus, it will definitely affect the outcome of the disease. The rate of pneumothorax (4.9%) as a complication of mechanical ventilation in our study was

lower than that of Iqbal et al. (4), and Torres-Castro et al. (19) with 16% and 15%, respectively, but not related to the neonatal mortality rate. Torres-Castro et al. (19) also found that risk factors for complications secondary to mechanical ventilation were the number of surfactant doses, number of reintubation and duration of ventilation. The duration of mechanical ventilation and hospitalization in the neonate who died was less than that of the neonates who recovered so that the results of our study were similar to those of Yadav et al. (16), which, due to the severity of underlying disease and the risk factors affect the increase in death in neonates requiring mechanical ventilation.

## 5- CONCLUSION

Based on the results, mechanical ventilation reduces mortality in neonates hospitalized in NICU. The results indicated that respiratory distress syndrome, low gestational age and birth weight, acidosis, and duration of mechanical ventilation would lead to increased death in mechanically ventilated neonates.

**6- CONFLICT OF INTEREST:** None.

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