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RESEARCH ARTICLE

Analytical study for neonates with respiratory distress on mechanical ventilation admitted to NICU - Minia University Hospital

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Abstract

Introduction: Ventilatory assistance allows for the recovery and maintenance of the patient with cardiorespiratory failure. Thanks to this intervention, many neonatal patient`s lives are saved in the neonatal intensive care units (NICUs).

Objectives: This study is a prospective study to analyze the rate of failure and response of management of those patients on mechanical ventilation and relation between the response of cases on MV and different studied demographic, clinical and laboratory data.

Patients and methods: All neonates with respiratory distress admitted from February 2018 to February 2019.Clinical response of mechanical ventilation cases was observed. Demographic and clinical data of neonates included in the study were collected and analyzed.

Results: Among of 316 neonates, 162 cases (51.26%) treated with o2 only, 28 cases (8.86%) treated with bubble CPAP ,126 cases (39.87%) treated with mechanical ventilation. The cases on MV who survived were (23%) and cases who died were (77%). Low birth weight <2.5 kg: outcome is poor for VLBW and ELBW than NBW and LBW. Small gestational age < 34 weeks GA showed higher mortality .RDS were the most common cause for usage of MV. In MV settings with initial high Fio2 and PEEP were more in died group. Sepsis, shock and pulmonary hemorrhage were most common complications and both are associated with higher risk for mortality than other complications.

Conclusion: It was found that predictors of mortality in mechanically ventilated neonates concluded from this study were: low birth weight <2.5 kg with poorer outcome for VLBW and ELBW than NBW and LBW also small gestational age with poor outcome for neonates below 34 weeks GA especially with lack of use of lung surfactant in cases with RDS in VLBW and ELBW.

Key words: Respiratory distress, Mechanical ventilation; Neonates; NICU, Preterm

Background:

Respiratory disorders are the most frequent causes of admission to the NICU in both term and preterm infants **[1].** Every year, an estimated 2.9 million babies die in the neonatal period (the first 28 days of life), accounting for more than half of the under-five child deaths in most regions of the world, and 44% globally **[2].**

Respiratory distress (RD) is one of the most common neonatal problem encounter within the first few days of life **[3].** Other reports confirm that respiratory distress is common in neonates and occurs in approximately 7% of babies during the neonatal period **[1].** Respiratory disorders are the leading causes of early neonatal mortality (0–7 days of age) **[4].**

CPAP should be started from birth in all babies at risk of RDS, such as those <30 weeks' gestation who do not need intubation for stabilization. The interface should be short binasal prongs or a mask, and a starting pressure of about 6-8 cm H2O should be applied. CPAP with early rescue surfactant should be considered the optimal management for babies with RDS **[5].**

After stabilization, MV should be used in babies with RDS when other methods of respiratory support have failed. Duration of MV should be minimized. Targeted tidal volume ventilation should be employed as this shortens the duration of ventilation and reduces BPD and intraventricular hemorrhage. Caffeine should be used to facilitate weaning from MV. A short tapering course of low-dose dexamethasone should be considered to facilitate extubation in babies who remain on MV after 1–2 weeks **[5].**

There is no doubt that the introduction of ventilatory support over the past 40 years has been important in improving survival rates of infants suffering from respiratory compromise as neonates are vulnerable to respiratory. There are important differences in the approach and outcomes during mechanical ventilation of the term and preterm neonates. The mature term neonatal lung is less vulnerable to trauma and damage during mechanical ventilation and exposure to high concentrations of inspired oxygen **[6].**

Patients and Methods:

In February 2018 a strategy was established to understand factors associated with use of mechanical ventilation, outcome, complications and duration of ventilation among neonates admitted in Minia NICU. All neonates admitted with respiratory distress were treated with oxygen by nasal cannula initially. Observation of clinical response was done. Improved cases did not need more intervention. Resistant and irresponsive cases were conducted on bubble CPAP whenever available and in case of their failure then we start usage of mechanical ventilation but some cases were intubated and ventilated from the start before usage of nasal CPAP. Clinical response of mechanical ventilation cases was observed, cases either improved and successfully weaned or deteriorated and failed. Demographic and clinical data of neonates included in the study were collected and analyzed. They included weight, age, sex, mode of delivery, indication of ventilation, length of hospitalization, duration of ventilator assistance, complications of mechanical ventilation, settings of mechanical ventilation and mortality were collected. In addition, laboratory data including hemoglobin, white blood cells count platelet count, C-reactive protein, and arterial blood gases were recorded and analyzed for infants assisted during study period.

Babies were ventilated using the SLE 2000. The laboratory investigations were done under supervision of medical staff team of clinical pathology unit in Minia University Hospital as follows: CBC (Using SYMEX XP 300 machine). CRP (Biomed – CRP " Egy - Chem" - catalog No.301040). ABG (Using BG_800A machine).

Inclusion criteria for neonates treated with mechanical ventilation in this study:

1- Respiratory distressed neonates irresponsive to usual oxygen treatment through nasal cannula or with failure of CPAP were included.
2- Frequent intermittent apnea unresponsive to methylxanthine therapy or caffeine citrate.

3-Administration of surfactant therapy in infants with RDS.

4-PaO2 below 50 mm Hg, or FiO2 above 0.80.

5- PaCO2 above 60 to 65 mm Hg with persistent acidemia.

Exclusion criteria: We excluded the neonates with surgical congenital malformations, neonates ventilated for surgical causes and those who left the hospital against medical advice and neonates with congenital cyanotic heart disease.

Statistical analysis:

Data were statistically analyzed using the SPSS software package, version 16 (SPSS Inc., Chicago, IL, USA) on a personal computer. Numerical data were expressed as range, mean± SD, median, and percentiles. Non numerical data were expressed as frequencies. Comparative studies were done using Student t test and chi square test. (p value < 0.05 was considered significant). Pearson correlation test was used to detect correlation between different parameters. Receiver operating characteristic (ROC) curve analyses with measurement of area under the curve (AUC) were performed to identify the appropriate cut-off values. P<0.05 was considered statistically significant.

Results:

Discussion:

In this study, the total number of cases needed ventilation was (39.8%) and this result is in agreement with this study **[7]** who reported that ventilated cases were (32%). In this study, the survival rate of mechanical ventilated cases was (23%) while the mortality rate was (77%) and this result is in agreement with this study **[7]** who showed that survivors were (33.3%) and non survivors were (66.7%) but in contrary with these study **[8],[9] ,[10] ,[11]** who reported that the mortality rate was less than that reported in this study and reported to be between 43-67 %.This result may be explained by that the majority of the cases needed MV were preterm and they represented about two thirds of the cases died and in some of these studies MV used were more advanced with more modalities and more efficacy also in some studies reported using HFOV in cases as MAS or in air leak cases as pneumothorax. Sepsis also found to be one of the major complications in this study and one of the major indications for ventilation increasing risk for mortality unlike some of these studies who reported less incidence of sepsis than in this study.

In this study, the majority of the cases who survived were neonates ≥ 34 weeks gestation while nearly 10% survived of neonates <34 weeks gestation. This result is in agreement with this study **[12]** who found that neonates who are between (>34 - < 37) weeks gestational age had the highest survival rate followed by neonates who are between (30 - <34) weeks gestational age who had less survival rate than the previous group followed by neonates who are between (27- <30) weeks gestational age who had the least survival rate.

Regarding to the duration of ventilation assistance significant difference (p=0.024) was found between survived group and group who died and this result is in agreement with this study **[10]** who found

that (70.37%) of the cases survived needed **(**1-7) days of ventilation , also in agreement with this study **[8]** who found that (75.8%) of the cases survived required ventilation for (4-7) days .This result may be explained by the fact that short period of MV will cause an inflammation cascade in the lungs as showed in this study **[13]** and this suggests that weaning from MV should be done as soon as possible, in order to prevent pulmonary sequelae and adverse neurodevelopmental outcomes **[14].**

In this study, survival rate for RDS was (48.3%)and this is in agreement with both studies **[7]** and **[9]** While the mortality rate of RDS was the highest compared to other indications of MV and this result is contrary with this study **[10]** and with this study **[11]** who reported that the mortality rate for RDS was only 15-25%. The poor outcome of neonates on MV for RDS of prematurity may be due to limited use of surfactant, co-existence of co-Morbidities like shock and occurrence of sepsis, necrotizing enterocolitis, disseminated intravascular coagulation and pulmonary hemorrhage. Use of surfactant was limited due to its cost if available. The value of surfactant is improving outcome of neonates with RDS, decreasing the length of ventilation and decreasing the incidence of some complications had been observed as it was discussed in this study **[15].**

As regard to initial platelet count, there was statistically significant difference between survived and died groups showing that thrombocytopenia is very important prognostic factor for mortality and this result is in agreement with this study [**11].** The result can be explained in this study as thrombocytopenia was frequently associated with sepsis which leading to poor prognosis.

In our study pulmonary hemorrhage (27.8%) and shock (25.8%) had significant association with mortality and this result is in agreement with this study **[11]** and this study **[17]** who found a very poor outcome in neonates following pulmonary hemorrhage and shock.

In this study **[18]** who described pulmonary hemorrhage as predictive of mortality and a terminal event. Shock represents an advanced stage of a disease process of varied etiologies and its relationship with mortality is understandable.

Regarding to sepsis as the third most common complication in our study with high mortality rate, this result is in agreement with this study **[10]** that showed that sepsis was the third most common complication in their study (8.6%) with disease specific mortality rate (40%).

VAP and pneumothorax incidence in our study was (4.8%) and (3.2%) respectively and this result is in agreement with this study **[18]** and with this study **[19]** but in contrary with this study **[10]** who observed that pneumonia was more common complication (12.06%) with mortality rate (14.28%) and pneumothorax incidence was (10.34%) with disease specific mortality (50%).

No cases with IVH reported in our study and this result is contrary with this study **[20]** with incidence (2.35%) and in contrary with this study **[21]** who found that number of IVH cases were 3 with 100% mortality rate.

According to univariate and multiple logistic regressions of predictors of mortality in mechanically ventilated neonates it was found that pulmonary hemorrhage, shock , gestational age <34w , PH ≤7.1 , initial Fio2 , initial PEEP and birth weight <2.5 kg were the main prognostic factors indicating

mortality in our study while increased CRP level ,thrombocytopenia, anemia and long duration on mechanical ventilation were the main factors associated with complications and this result in agreement with both studies **[7 , 11].**

This explained by the fact that the mature term neonatal lung is less vulnerable to trauma and damage during MV and exposure to high concentrations of inspired oxygen **[6].**.

Conclusions:

Predictors of mortality in mechanically ventilated neonates concluded from this study were: low birth weight <2.5 kg with poor outcome for VLBW and ELBW also small gestational age with poor outcome for neonates below 34 weeks GA especially with lack of use of lung surfactant in cases with RDS in VLBW and ELBW.

Sepsis worsens MV outcome. Monitoring of TLC, platelet and CRP should be done and correlated with clinical condition of the case. Shock and pulmonary hemorrhage were the most common complications and were associated with sepsis and they were associated with higher risk for mortality than other complications considering them predictors for mortality.

Conflict of interest: The authors declared no conflict of interest.

Author's contributions: SS and EA conceived the study. ME revised the patients' medical reports and the final manuscript. All authors revised the final draft of the manuscript.

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