Original Research Article

Study of clinical profile and short-term outcome of neonates requiring assisted mechanical ventilation

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Abstract

Background: Assisted ventilation has become an indispensable part of the neonatal intensive care. Infants with progressive respiratory distress with impending respiratory failure can be supported and saved by assisted ventilation facilities. In present study we aimed to study clinical profile and short-term outcome of neonates requiring assisted mechanical ventilation at a tertiary hospital. **Material and Methods:** Present prospective observational study was conducted in a neonatal intensive care unit in neonates who received mechanical ventilation for minimum of 6 hours. Data was collected and entered in a Microsoft excel sheet. The results obtained were tabulated and analysed and using the chi square test and multiple logistic regression, p value was calculated. p value less than 0.05 was considered as statistically significant. **Results:** During study period total 156 neonates required minimum 6 hours of mechanical ventilation and were considered in present study. During study period we noted 22% mortality (n=34). We compared baseline parameters of survived and died neonates. A statistically significant difference was noted for gestational age (less in died neonates), birth weight (less in died neonates), cause of admission as asphyxia, neonatal surgeries, fulminant sepsis (more deaths were noted) , neonatal acidosis. In present study Acidosis(pH<7.2), use of inotropes, preterm gestation, use of blood products, birth weight <2.5kg , positive blood culture, presence of sepsis and IUGR were noted as factors significantly associated with mortality. **Conclusion:** Mechanical ventilation reduces the neonatal mortality, hence facilities for neonatal ventilation should be included in the regional and central hospitals providing intensive care for neonates.

Keywords: Mechanical Ventilation, neonate, respiratory distress, hyaline membrane disease

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INTRODUCTION

Assisted ventilation has become an indispensable part of the neonatal intensive care. Infants with progressive respiratory distress with impending respiratory failure can be supported and saved by assisted ventilation facilities.[1] A significant proportion of neonates admitted to NICU require mechanical ventilation; and mechanically ventilated neonates have a high fatality. Mechanical ventilation aims to achieve adequate gas exchange. There is a growing body of evidence to avoid invasive mechanical ventilation via the endotracheal tube whenever feasible.[2] The indications for intubation and invasive mechanical ventilation are severe respiratory failure, as evidenced by severely impaired oxygenation and alveolar ventilation, reduced respiratory effort, and circulatory failure in certain instances.[2] Though most babies can be successfully managed with non-invasive therapy like nasal cannula oxygen and CPAP, mechanical ventilation is required for severe RDS. The most important use of mechanical ventilation in neonates is respiratory failure

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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.[3,4] Current International Guidelines on New-born Resuscitation suggest about 30–60 s of time following delivery should be allocated to assess spontaneous respiratory and heart activity before initiating intermittent positive-pressure ventilation if indicated.[5,6] In present study we aimed to study clinical profile and short-term outcome of neonates requiring assisted mechanical ventilation at a tertiary hospital.

MATERIAL AND METHODS

Present prospective observational study was conducted in a neonatal intensive care unit working under Department of Paediatrics, Dr.Ulhas Patil Medical College, Jalgaon. Neonates requiring mechanical ventilation during the study period of 1 year (October 2019 to September 2020) were considered for this study. Study was approved by institutional ethical committee.

Inclusion criteria

- Neonates who received mechanical ventilation for minimum of 6 hours

Exclusion criteria

- Neonates who died within 6 hours of life,
- neonates with birth weight < 500 grams,
- abrupt termination of ventilator support for any reason and
- gestational age <26 weeks.
- Taken discharge against medical advice, not willing to participate

Study was explained to parents and a written informed consent was taken from parents. Clinical, demographic and birth details were noted. Hematological, radiological investigations were noted and follow up was kept till 14 days from discharge. All neonates were managed as per standard operating protocol of NICU.

Data was collected and entered in a Microsoft excel sheet. The results obtained were tabulated and analysed and using the chi square test and multiple logistic regression, p value was calculated. p value less than 0.05 was considered as statistically significant.

RESULTS

During study period total 156 neonates required minimum 6 hours of mechanical ventilation and were considered in present study. During study period we noted 22% mortality (n=34). We compared baseline parameters of survived and died neonates. A statistically significant difference was noted for gestational age (less in died neonates), birth weight (less in died neonates), cause of admission as asphyxia, neonatal surgeries, fulminant sepsis (more deaths were noted) , neonatal acidosis.

Table 1: Comparison of mechanically ventilated neonates in terms of the outcomes (n=156).

Characteristics	Outcomes		P-value
	Recovery (n=121)	Death (n=34)	
Gestational age (week)	35.83 ± 2.17	34.09 ± 3.15	0.046*
Birth weight (gr)	2718± 432	2201 ± 954	0.034*
Neonatal age (day)	5.29 ± 7.14	4.45 ± 6.25	0.24
Maternal age (year)	24.25 ± 5.13	24.32 ± 4.18	0.67
Indication for ventilation			
RDS and prematurity	41 (26%)	6 (4%)	0.78
Asphyxia	29 (19%)	9 (6%)	0.034*
Neonatal surgeries	17 (11%)	7 (4%)	0.023*
Congenital heart disease	11 (7%)	1 (1%)	0.67
Fulminant sepsis	11 (7%)	7 (4%)	0.012*
Multiple anomalies	7 (4%)	2 (1%)	0.66
Pneumonia	5 (3%)	2 (1%)	0.45
Initial blood gas abnormality			
Pao2 < 50 (mm Hg)	133 (85%)	23 (15%)	0.38
Pco2 > 60 (mm Hg)	135 (87%)	21 (13%)	0.35
PH <7.1 (mEq/L)	131 (84%)	25 (16%)	0.005*
Positive blood culture	4 (3%)	5 (3%)	0.57
Pneumothorax	3 (2%)	5 (3%)	0.56
Duration of mechanical ventilation (day)	5.89 ± 3.12	5.21 ± 4.01	0.45
Length of stay (day)	10.92 ± 11.21	6.1 ± 5.47	0.32

(* - statistically significant)

In present study Acidosis(pH<7.2), use of inotropes, preterm gestation, use of blood products, birth weight <2.5kg , positive blood culture, presence of sepsis and IUGR were noted as factors significantly associated with mortality.

Table 2: Prediction of mortality

Parameters	Mortality	Total no.	Percentages	p value
Acidosis(pH<7.2)	33	56	58.93	< 0.001*
Inotropes	31	59	52.54	< 0.001*
Gestation Preterm	34	69	49.28	< 0.001*
Blood Products	12	26	46.15	< 0.001*
Birth Weight <2.5kg	25	55	45.45	< 0.001*
Blood Culture Positive	3	7	42.86	0.023*
Sepsis	7	18	38.89	0.032*
IUGR	21	55	38.18	0.045*
Sex Male	19	89	21.35	0.39
Asphyxia	7	36	19.44	0.56
HMD/RDS	6	47	12.77	0.65

(* - statistically significant)

DISCUSSION

Many of admitted newborns are critically sick and require mechanical ventilation. The survival of sick neonates have improved significantly with the widespread use of mechanical ventilation in NICUs.[7] Several studies show that weight and gestational age are major determinants of neonatal mortality.[8,9] It is also related with severity of illness at admission, complications related to ventilator techniques and strategies and occurrence of co-morbid conditions like sepsis, coagulopathy, multi organ dysfunction, congenital malformations etc.[10] Monsef AR *et al.*,[11] studied 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 ± 6.58 days, 35.51 ± 3.88 weeks, and 2779.37 ± 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 unilabiate 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). They noted 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. Yadav M *et al.*,[12] studied of 50 ventilated newborns, m:f ratio was 2.1:1. The most common gestational age 28–36 weeks (60%) and mostly were appropriate for gestational age (66%). Survival rate 40% (20/50) being directly proportional to the gestational age and intrauterine growth pattern (P < 0.01). Babies by LSCS Lower Segment Cesarean Section survived more than born by normal vaginal delivery (46.7% vs. 37.1%). The initial assessment of APGAR score of >7 had a better outcome (56.3%; P < 0.03). The most common indication of ventilation was hyaline membrane disease (19/50) but the survival rate best in babies with meconium aspiration syndrome (54.5%). The most prevalent complication was sepsis (survival rate 60%) while conditions such as shock, intraventricular hemorrhage, disseminated intravascular coagulation, air leak syndrome, and pulmonary hemorrhage had 100% mortality. Thus, the outcome as survival is constrained by many factors; newborn's profile, conditions at birth, and postnatal resuscitation. Shrestha P *et al.*,[13] noted that one-third of admitted neonates in NICU required mechanical ventilation (MV). Commonest indication was severe respiratory distress (70%) followed by perinatal asphyxia (12%) and recurrent apnea (8%). Disease pattern were sepsis (37.2%), RDS of prematurity (17.6%), perinatal asphyxia (11.7%), meconium aspiration syndrome (9.8%), apnea of prematurity (7.8%) and congenital pneumonia (4%). Hospital acquired sepsis was a major complication occurring in 47% patients on mechanical ventilation. Survival rate among neonates on MV was 33%. Survival was better with increasing birth weight and gestational age. Survival was 100% in congenital pneumonia, 50% in perinatal asphyxia, 50% in recurrent apnea, 26% in sepsis, 20% in MAS and 0% in RDS of prematurity. Survival rate of neonates on mechanical ventilation in NICU was 33%. Sepsis was a major problem in NICU, which must be addressed to improve outcome. Similar findings were noted in present study. Prajakta D[14] studied 206 neonates, males comprised of 56.8% of ventilated neonates. The most common indication of ventilation was birth asphyxia, in 29.1% neonates, followed by neonatal sepsis (22.3%), respiratory distress syndrome (18.4%), and meconium aspiration syndrome (13.1%). Complications were seen in 35.9% neonates, the most common complication was ventilator associated pneumonia (50%), sepsis (40.5%), pneumothorax (16.2%). Survival rate among the ventilated neonates was 45.6%. Neonates with birth asphyxia and sepsis were the major problems in NICU, which must be addressed to improve outcome. Iqbal Q *et al.*,[15] studied 300 ventilated neonates, 52% were male. Mean age, weight, and gestational age were 21 ± 62 h, 2320 ± 846.2 g, and 35.2 ± 4.9 weeks, respectively. 130 (43%) neonates died.

Respiratory distress syndrome (RDS) (31.1%), sepsis (22.7%), and birth asphyxia (18%) were the most common indications for ventilation. Mortality in ventilated patients with sepsis, pneumonia, RDS or birth asphyxia was 64.7%, 60%, 44.6%, and 33.3%, respectively. Weight <2500 g, gestation <34 weeks, initial pH <7.1, presence of sepsis, apnea, shock, pulmonary hemorrhage, hypoglycemia, neutropenia, and thrombocytopenia were significantly associated with mortality ($P < 0.05$). Resuscitation at birth, seizures, intra ventricular hemorrhage, pneumothorax, ventilator-associated pneumonia, PO2, or PCO2 did not have a significant association with mortality. On logistic regression, gestation <34 weeks, initial pH <7.1, pulmonary hemorrhage, or shock were independently significant predictors of mortality. Conclusions: Weight <2500 g, gestation <34 weeks, initial arterial pH <7.1, shock, pulmonary hemorrhage, apnea, hypoglycemia, neutropenia, and thrombocytopenia were significant predictors of mortality in ventilated neonates. Meconium-stained babies should be aggressively managed to prevent complications like perinatal asphyxia and respiratory failure which may lead to the mortality. Those neonates with risk for adverse outcome should be managed with special focus on respiratory care with use of assisted ventilation and inhaled nitric oxide and extracorporeal membrane oxygenation, where available. Increasing gestational age, appropriate intrauterine growth pattern and increasing hospital stay were associated with better outcome whereas low-APGAR score was associated with higher mortality.

CONCLUSION

Mechanical ventilation reduces the neonatal mortality, hence facilities for neonatal ventilation should be included in the regional and central hospitals providing intensive care for neonates. A good understanding of different types of assisted mechanical ventilation modes with underlying pathophysiology of lung condition will provide optimal respiratory support in critically ill newborn infants.

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