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Neonatology

EXPERIENCE WITH NEONATAL MECHANICAL VENTILATION AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: To increase the survival of newborns with respiratory failure mechanical ventilation is an important treatment modality but the investment in terms of money, time, skill and infrastructure has its limited use in developing countries.

Objective: To study the clinical profile and immediate outcome of neonates receiving mechanical ventilation at the Level III neonatal intensive care unit of Niloufer Hospital, a tertiary care hospital.

Methods: Hundred and thirty neonates were admitted at Level III NICU and received mechanical ventilation during the study period was included in the study. The baseline characteristics of the neonates, indications for mechanical ventilation and immediate outcome of the neonates with respect to birth weight, gestational age and their underlying etiology were studied.

Result: Hyaline Membrane disease (n=65, 50.0 %) and community acquired sepsis (n=30, 23.0 %) were the major indications for mechanical ventilation followed by HIE and meconium aspiration syndrome. Mortality rate in the present study is 70.7%. The mortality rates showed a decrease with increasing gestational age and birth weight.

Conclusion: Mechanical ventilation in resource limited and high flow units must be focused on neonates > 1000gms and/or > 28 wks. Although Neonatal Ventilation is well established entity in the western world still in developing countries a lot is desirable in terms of availability of good quality equipment and trained medical and paramedical personnel.

KEYWORDS :

1. INTRODUCTION

Neonatal deaths account for nearly 64% of all infant deaths and 50% of under five mortality in India. Birth asphyxia, congenital pneumonia, immaturity (birth weight less than 750gms), hyaline membrane disease, intra ventricular haemorrhage, and neonatal infections are leading causes of neonatal mortality in our country [1]. Prompt and adequate management of these neonates with respiratory intensive care and assisted ventilation is required to increase the survival of neonates and improve the quality of life. Infants with progressive respiratory distress with impending respiratory failure or tiring respiratory muscles, can be supported and saved by assisted ventilation facilities [2]. Thus, it has become essential and mandatory to establish neonatal advanced life support facilities in neonatal intensive care units to enhance newborn survival.

Mechanical ventilation and advanced life support facilities demand optimal infrastructure, essential monitoring and therapeutic equipments and specially trained pediatricians and nurses to provide state-of-the-art facilities and expertise to look after babies admitted in the Neonatal Intensive Care Unit (NICU) [3]. The expansion of newborn care facilities and good quality indigenously fabricated basic newborn care including better ventilation modalities has led to better outcome of high risk and critically sick newborns [1].The objective of this study was to assess the clinical profile of the neonates requiring mechanical ventilation and mortality of ventilated neonates based on weight, gestational age and indication for ventilation.

2. MATERIALS AND METHODS

This study was conducted in the Level III NICU, Department of Neonatology, Niloufer Hospital, over a period of 9 months from January to September 2016. Niloufer Hospital is a tertiary care referral teaching hospital in Hyderabad. This Medical College Hospital is the largest tertiary neonatal unit in the Government Sector in the state and is a referral centre for patients from the surrounding states also. The unit being in the government sector, is often constrained to work as a low resource setting in order to deliver heath care services to the vast numbers of patients who access its services. It is a 10 bedded unit equipped with 3 ventilators (bella vista - 1 and pricol - 2)

This is a retrospective study on mechanical ventilation for various reasons i.e. babies with hyaline membrane disease, perinatal asphyxia, meconium aspiration syndrome, septicemia, pneumonia, apnoea of prematurity, transient tachypnoea of newborn etc. including both Inborns and Outborns. Neonates with birth weight < 500 grams, gestational age< 26 weeks, presence of lethal congenital malformation, abrupt termination of ventilator support for any reason and unwilling to give informed consent were excluded.

Methodology: Details of antenatal, natal and postnatal history, birth weight, gestational age, type of delivery, Apgar score and other details were recorded from the case records. All mechanically ventilated neonates were managed by NICU UNIT protocols. Diagnosis of underlying condition was made by using standard clinical, laboratory and/or radiological criteria. All the babies were nursed under servo control open care system. Continuous clinical monitoring every 6 hours of heart rate, respiratory rate, retractions, chest expansion, air entry, capillary refilling time, peripheral pulses, status of hydration and oxygen saturation was done. Continuous monitoring of oxygen saturation was done using pulse oxymeter (Radical 7). Arterial Blood Gas analysis by radial artery puncture was done 12 hourly in stable babies and 6 hourly or even more frequently in unstable babies and with changes of ventilator settings. Blood glucose was monitored twice daily using dextrostix. Sepsis work-up was done whenever clinically indicated. Chest radiographs were taken as and when necessary by clinical condition. Renal profile and serum electrolytes were done in all neonates on mechanical ventilation at 6 hours of life (or on admission in extramural NICU) and later as and when necessary. Daily 24 hour urine output measurement was done. Time cycled, pressure limited, continuous flow infant ventilators with varying peak inspiratory pressure (PIP), positive end expiratory pressure (PEEP), flow rates, inspiratory time and FiO2 were used. Initial ventilator settings and change in settings varied with underlying disease and

arterial blood gas analysis. All babies were monitored for any complications.

Statistical analysis: Data was analyzed with the help of SPSS version 20. P value < 0.05 was considered significant.

3. RESULTS

During the study period, total of 854 newborns were admitted (inborn - 278, outborn - 576), out of which 130 (15.22%) mechanically ventilated neonates satisfying the criteria were included in the study. Basic characteristics of neonates are shown in Table 1. Male to female ratio in our study was 1.5:1.Term neonates were 40 (30.7%) and preterm neonates were 90 (69.2%).

Table 1: Baseline characteristics of Ventilated Neonates: (n=130)

Parameter		Extramural No.(%)	Intramural No. (%)	Total No.(%)
Sex	Male	64 (59.2%)	14 (63.6%)	78 (60%)
	Female	44 (40.7%)	8 (36.3%)	52 (40%)
Maturity	Full term	34 (31.4%)	6 (27.2%)	40 (30.7%)
	Preterm	74 (68.5%)	16 (72.7%)	90 (69.2%)

The overall mortality rate was 70.7% (92 out of 130). Difference in mortality rate among term (n=30; 80%) and preterm (n=60; 66.6%) neonates was not statistically significant (X2=2.37, p=1.22).

Weight and gestational age wise distribution of the neonates and their outcome is depicted in tables 2 and 3.

Table 2: Weight Distribution of Ventilated Neonates: (n=130)

Weight (gm)	Intramural No.(%)	Extramural No.(%)	Ventilated No.(%)
<1000	1 (4.5 %)	12 (11.1%)	13 (10.0 %)
1000- 1499	9 (40.9 %)	26 (24.0 %)	35 (26.9 %)
1500- 1999	5 (22.7 %)	23 (21.2 %)	28 (21.5 %)
2000 – 2499	2 (9.0 %)	15 (13.8 %)	17 (13.0 %)
≥ 2500	5 (22.7%)	32 (29.6 %)	37 (28.4 %)
Total	22 (100%)	108 (100%)	130 (100%)

Table 3: Outcome based on gestational age and birth weight

Birth wt	No.(130)	Percentage	Deaths (92)	Percentage
< 1000 gms	13	10.0	13	100
1000 – 1499 gms	35	26.9	28	80.0%
1500 – 1999 gms	28	21.5	20	71.4 %
2000 – 2499 gms	17	13.0	10	58.8%
> 2500 gms	37	28.4	21	56.75
Gestational age				
< 28 wks	10	7.6%	10	100
28- 32 wks	33	25.3 %	29	87.8
32- 37 wks	47	36.1%	30	63.8
> 37 wks	40	30.7 %	23	57.5

The two major weight categories included > 2500 gms and 1000- 1499 gms. Mortality was noted to be inversely proportional to the weight. Majority of the ventilated neonates were more than 32 wks. As the gestational age of the neonate increased, mortality rate has decreased.

Table 4: Distribution of neonates based on indication for mechanical ventilation and outcome

Indication for ventilation	No. of cases(%)	No. of deaths(%)
RDS	65 (50.0%)	49 (75.3%)
SEPSIS	30 (23.0%)	18 (60.0%)
HIE	17 (13.0%)	12 (70.5%)
MAS	12 (9.2%)	8 (66.6%)
CHD	4 (3.0%)	3 (75%)
IEM	1 (0.7%)	1 (100%)
KERNICTERUS	1 (0.7%)	1 (100%)
Total	130 (100%)	92 (70.7%)

RDS: Respiratory distress syndrome
MAS: Meconium aspiration syndrome
HIE: Hypoxic ischemic encephalopathy
CHD: Congenital heart disease
AOP: Apnea of prematurity

As shown in Table 4, the most common indication for ventilation in our study was Hyaline membrane disease (50 %) followed by sepsis (23.0%), HIE (13 %), MAS (9.2 %), congenital heart disease (3.0%). Other than this one neonate with acute bilirubin encephalopathy and inborn error of metabolism required mechanical ventilation.

TABLE 5: WEIGHT WISE AND ETIOLOGY WISE ANALYSIS OF VENTILATED NEONATES

Indication	< 1000 gms	1000-1499 gms	1500 – 1999 gms	2000 - 2499 gms	> 2500 gms	Total
RDS	13 (13)	25 (20)	19 (12)	8 (4)	-	65 (49)
SEPSIS	-	7 (5)	6 (5)	5 (3)	12(5)	30 (18)
HIE	-	3 (3)	2 (2)	3 (2)	9 (5)	17 (12)
MAS	-	-	1 (1)	1 (1)	10 (6)	12 (8)
CHD	-	-	-	-	4 (3)	4 (3)
IEM	-	-	-	-	1 (1)	1 (1)
Kernicterus	-	-	-	-	1 (1)	1 (1)
TOTAL	13 (13)	35 (28)	28 (20)	17 (10)	37 (21)	130 (92)

TABLE 6: GESTATIONAL AGE WISE ANALYSIS OF VENTILATED NEONATES

Indication	< 28 wks	28-32 wks	32-37 wks	> 37 wks	Total
RDS	10 (10)	26 (23)	29 (16)	-	65 (49)
SEPSIS	-	5 (4)	11 (9)	14 (5)	30 (18)
HIE	-	2 (2)	5 (3)	10 (7)	17 (12)
MAS	-	-	2 (2)	10 (6)	12 (8)
CHD	-	-	-	4(3)	4(3)
Kernicterus	-			1(1)	1(1)
Total	10 (10)	33 (29)	47 (30)	40 (23)	130 (92)

The outcome of the ventilated neonates in relation to birth weight and gestational age is shown in tables 3.The etiology and outcome were analyzed by stratifying these neonates into five weight groups and four gestation groups and the results presented in Table 5 and Table 6 respectively. It is obvious from the tables that with increasing birth weight and gestational age, the percentage mortality decreases significantly.

Among the 4 major indications for ventilation, the cause specific mortality was highest in RDS (75.3%), followed by HIE (70.5%), MAS (66.6%) and sepsis (60.0%). The duration of ventilation was highest in cases of sepsis (3.09 ± 2.11) followed by RDS (2.2± 1.44), MAS (1.63 ± 0.67), HIE (2.0 ± 1.49) and CHD (1.75 ± 0.95). Mortality in males (n= 58, 74.3%) is higher compared to females (n=34, 65.3%). Mortality in Inborn babies (n=14, 63.6%) was comparatively lower than in out born babies. (n=78, 72.2%).

4. DISCUSSION

It is indispensable to strive for increasing the survival chances of neonates receiving mechanical ventilation to improve the overall neonatal mortality rate as the ventilated group represents the most serious of all neonates admitted to a neonatal unit. Therefore an audit of the clinical profile and outcome of ventilated neonates like the present study is a very useful method of analyzing our deficits and for getting ideas to improving the standard of care.

In our study 15.22 % of neonates required mechanical ventilation. Nangia et al [4], Mathur et al [5] and P.K.Riyas et al [6] reported that 8.9%, 13% and 5.6% of the babies admitted in their nursery required mechanical ventilation. This probably depends upon several factors like draining area, level of services available and considering ours is a tertiary hospital which caters to a large catchment area. Male to female ratio in our study was 1.5:1, which is similar to the study conducted by Hossain et al and Bashir et al [7,8]. Majority (90%) of the mechanically ventilated newborns were above 32 weeks of gestation. According to the weight distribution data, 63% of the neonates were low birth weight, which is comparable to Malhotra et al [9] (80%) and Trivedi SS et al [10] (70%) studies.

The most common indication for ventilation in our study was Hyaline membrane disease, followed by sepsis, Meconium aspiration syndrome and perinatal asphyxia. Studies by Nangia et al[4], Mathur et al [5] and Singh et al[11]also reported Hyaline membrane disease as the most common indication while Riyas et al[6] reported birth asphyxia as the most common indication (37.3%) followed by Hyaline membrane disease (31.4%).

In the present study female babies had a lower mortality rate – 65.3% compared to 74.3% in males. Most other Indian studies also show a

similar trend. Further it was observed that inborn babies had a lower mortality rate of 63.6% when compared to 72.2% in outborn babies. It is possible that early intervention would have been responsible for better outcome in inborn babies.

The overall mortality rate was 70.7% (92 out of 130), with a significant decrease in mortality with increasing birth weight and with increasing gestational age. The overall mortality (50.3%) and (55.8%) rate differs with Sushma et al and Mathur et al but the trend with weight and gestation age is similar [4], [5].

RDS constituted 50.0 % of babies ventilated with mortality rate of 75.3%. The outcome of HMD in other studies ranged from 11.1% to 53.1% [6,12,9]. The reasons for the poor outcome of HMD and low LBW survival can be (i) deficit of surfactant therapy, (ii) high rate of nosocomial infection,(iv) organ immaturity of very low birth weight and extremely low birth weight babies and (v) lack of effective monitoring while on ventilator. Other studies have also shown the risk factors for poor outcome are birth weight <2000gm, prematurity and late referrals to NICU [13].

Babies with MAS and asphyxia also had high mortality rate (66.6 % & 70.5% respectively). The late referral of mothers and delayed diagnosis of fetal distress lead to severe asphyxia and meconium aspiration which further contribute to persistent pulmonary hypertension of newborn (PPHN) leading to high mortality. Use of high frequency ventilation, NO and ECMO could decrease the morbidity and mortality if available.Use of IPPV has certainly increased the survival rate in different clinical conditions wherever required. Ventilation has to be used in the early part of illness before the start of metabolic complications or organ damage. Also, asepsis is to be maintained strictly, otherwise it makes all our effort in vain. For the improved outcome i.e. to decrease the morbidity and mortality of newborns requiring ventilator care, we need to improve our resources and neonatal intensive care services with an appropriate ratio between sick neonate and medical staff.

The deaths in HMD group could be reduced by reducing the incidence of unanticipated preterm deliveries and antenatal corticosteroid therapy in unavoidable preterm deliveries coupled eary CPAP and surfactant therapy in the postnatal period. More efficient intrapartum monitoring techniques need to be employed to reduce the incidence of severe intrapartum asphyxia. There is an urgent need to improve the facilities available in this centre (personnel and equipment) and upgrade it to a level-HI neonatal intensive care unit in order to bring down the mortality rate further.

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