Clinical profile of mechanically ventilated newborns at tertiary care level hospital

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ABSTRACT

BACKGROUND: Neonatal deaths account for nearly 64% of all infant mortality. Birth asphyxia, congenital pneumonia, immaturity (birth weight less than 750 gms), hyaline membrane disease, intraventricular haemorrhage, and neonatal infections are leading causes of neonatal mortality in our country. Thus, mechanical ventilation has become important treatment modality in NICU to enhance newborns survival having respiratory failure. Objectives: To study the clinical profile of the neonates requiring mechanical ventilation and identify immediate complications associated with it. Study design and setting: Prospective cohort study carried out in tertiary care level neonatal intensive care units of SSG hospital, Vadodara from November 2009 to November 2010 for 1 year. MATERIALS AND METHODS: 170 newborns on mechanical ventilation admitted to NICU and post-operative patients required ventilatory support admitted to extra and intramural NICU were managed by NICU protocols. 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. Continuous clinical monitoring of heart rate, respiratory rate, retractions, chest expansion, air entry, capillary refilling time, peripheral pulses, status of hydration and oxygen saturation was done. All babies were monitored for any complications. RESULTS: 6.83% neonates required mechanical ventilation out of which 56.5% were preterm neonates. The most common indication for ventilation was Hyaline membrane disease (45.3%) followed by perinatal asphyxia and Meconium aspiration syndrome (11.1%), septicemia (10.5%) and congenital pneumonia (8.2%). Sepsis was the most common complication of mechanical ventilation (21.2%), followed by Air leak (5.9%) and Ventilation associated pneumonia (5.3%). CONCLUSIONS: As sepsis was the most common complication of mechanical ventilation steps to ensure asepsis like Strict aseptic measures followed as protocols in NICU, early oro-gastric feeding with expressed breast milk, judicious use of appropriate antibiotics, liberal use of disposable material and other strategies to prevent nosocomial infections should be followed to reduce incidence of sepsis.

Keywords: NICU, Neonate, Mechanical ventilation.

INTRODUCTION

Neonatal deaths account for nearly 64% of all infant deaths and 50% of under five mortality in India. Also, many avoidable handicaps during childhood have their origin in perinatal period. Birth asphyxia, congenital pneumonia, immaturity (birth weight less than 750 gms), hyaline membrane disease, intraventricular haemorrhage, and neonatal infections are leading causes of neonatal mortality in our country [¹]. It is possible to increase survival of neonates and improve the quality of life only through prompt and adequate management of neonates which is not possible without respiratory intensive care and assisted ventilation. Thus, it has become essential and mandatory to establish neonatal advanced life support facilities in neonatal intensive care units to enhance newborn survival. Many critically sick babies, who develop life-threatening apnoea or cardiovascular collapse from a variety of causes, need cardiopulmonary resuscitation. Infants with progressive respiratory distress with impending respiratory failure or tiring respiratory muscles, can be supported and saved by assisted ventilation facilities [²].

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According to the National neonatal perinatal database (NNPD) data 2002-2003 62% of all neonatal deaths were attributed to prematurity. Hyaline
membrane disease, perinatal asphyxia, sepsis and congenital malformations are the common causes of neonatal mortality in premature babies\textsuperscript{[3]}. In a study conducted on the epidemiology of respiratory distress of newborns by Alok Kumar at JIPMER Pondicherry, preterm babies had the highest incidence of respiratory distress syndrome followed by post term and term babies. Transient tachypnoea of newborn was found to be common among both the term and preterm babies\textsuperscript{[4]}. Meconium Aspiration syndrome is one of the most common causes of respiratory distress in term and post term infants\textsuperscript{[5]}. Approximately 50% of the newborns who are born with meconium stained amniotic fluid develop meconium aspiration syndrome and a large percentage of babies with meconium aspiration syndrome require mechanical ventilation\textsuperscript{[6]}. In a study conducted by Sushma Nangia in New Delhi, Hyaline membrane disease was the most common indication for mechanical ventilation followed by birth asphyxia. Apnoea of prematurity and persistent pulmonary hypertension of the newborn were the other list of important causes \textsuperscript{[7]}. 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)\textsuperscript{[8]}. 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\textsuperscript{[11]}. The objective of the study was to study the clinical profile of the neonates requiring mechanical ventilation and identify immediate complications associated with it.

**MATERIALS AND METHODS**

This study was conducted in neonatology division of Department of Pediatrics of Medical College Baroda and Sir Sayajirao General Hospital.

**Study period:** November 2009 to November 2010.
changes of ventilator settings. Blood glucose was monitored twice daily using dextrostix. Sepsis work-up was done whenever clinically indicated. Endotracheal tube and blood culture sensitivity were ordered whenever septicemia or pneumonia was suspected. Chest radiographs were taken as and when necessary by clinical condition. Time cycled, pressure limited, continuous flow infant ventilators with varying peak inspiratory pressure (PIP), positive end expiratory pressure (PEEP), flow rates, inspiratory time and FiO\textsubscript{2} were used. Initial ventilator settings and change in settings varied with underlying disease and arterial blood gas analysis. The aim was to use minimal possible pressures and FiO\textsubscript{2} to maintain normal blood gases. All babies were monitored for any complications.

**Statistical analysis:** Data was analyzed in Microsoft Excel with the help of MedCalc statistical software (Trial Version). Median and Mean were used for calculation in data and distributed in the Gaussian manner.

**RESULTS**

**Table 1: Baseline characteristics of Ventilated Neonates: (n=170)**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Extramural No. (%)</th>
<th>Intramural No. (%)</th>
<th>Total No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>63 (64.9%)</td>
<td>34 (46.6%)</td>
<td>97 (57.65%)</td>
</tr>
<tr>
<td>Female</td>
<td>34 (35.1%)</td>
<td>39 (53.4%)</td>
<td>73 (42.35%)</td>
</tr>
<tr>
<td>Maturity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Term</td>
<td>36 (37.1%)</td>
<td>38 (52%)</td>
<td>74 (43.5%)</td>
</tr>
<tr>
<td>Pre Term</td>
<td>61 (62.9%)</td>
<td>35 (48%)</td>
<td>96 (56.5%)</td>
</tr>
<tr>
<td>Mode of delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginal</td>
<td>81 (83.5%)</td>
<td>49 (67%)</td>
<td>130 (76.5%)</td>
</tr>
<tr>
<td>Caesarian</td>
<td>16 (16.5%)</td>
<td>24 (33%)</td>
<td>40 (23.5%)</td>
</tr>
</tbody>
</table>

**Table 2: Weight Distribution of Ventilated Neonates: (n=170)**

<table>
<thead>
<tr>
<th>Weight (Gm)</th>
<th>Intramural No. (%)</th>
<th>Extramural No. (%)</th>
<th>Ventilated no. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1000</td>
<td>21 (2.7%)</td>
<td>5 (1.1%)</td>
<td>26 (1.5%)</td>
</tr>
<tr>
<td>1000-1499</td>
<td>18 (24.7%)</td>
<td>34 (35.1%)</td>
<td>52 (30.7%)</td>
</tr>
<tr>
<td>1500-1999</td>
<td>21 (28.7%)</td>
<td>28 (28.9%)</td>
<td>49 (28.8%)</td>
</tr>
<tr>
<td>2000-2499</td>
<td>17 (23.3%)</td>
<td>13 (13.4%)</td>
<td>30 (17.6%)</td>
</tr>
<tr>
<td>≥ 2500</td>
<td>15 (20.6%)</td>
<td>17 (17.5%)</td>
<td>32 (18.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>73 (100%)</td>
<td>97 (100%)</td>
<td>170 (100%)</td>
</tr>
</tbody>
</table>

**Table 3: Mode of Ventilation: (n=170)**

<table>
<thead>
<tr>
<th>Mode of Ventilation</th>
<th>Intramural</th>
<th>Extramural</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPAP only</td>
<td>19 (26%)</td>
<td>29 (29.9%)</td>
<td>48 (28.2%)</td>
</tr>
</tbody>
</table>
above 32 weeks of gestation and delivered vaginally (76.5%), which is similar to Trivedi SS et al.\textsuperscript{10} study in which 84% were delivered vaginally. According to the weight distribution data (Table 2), 91% of the neonates were low birth weight, which is comparable to Malhotra et al.\textsuperscript{11} (80%) and Trivedi SS et al.\textsuperscript{10} (70%). The most common indication for ventilation in our study was Hyaline membrane disease (45.3%) followed by perinatal asphyxia and Meconium aspiration syndrome (11.1%), septicemia (10.5%) and congenital pneumonia (8.2%)(Graph 1). Majority of patients (164) were given ventilatory support for a period of less than 7 days, Invasive mode being the predominant mode of ventilation (Table 3). Complications seen in mechanically ventilated neonates in our study are shown in Graph 2 with sepsis being the most common complication (21.2%).

**DISCUSSION**

In our study 6.83% of neonates required mechanical ventilation. Nangia et al.\textsuperscript{12}, Mathur et al.\textsuperscript{13} and P.K.Riyas et al.\textsuperscript{14} 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 the infrastructure of the NICU. In a study done on risk factors and outcome of neonates on ventilatory support in Misurta central hospital, Libya by Dr. Bashir M. Ashour in 2008, males (52.5%) were more affected than females (47.5%) which are comparable to our study.\textsuperscript{15} Out of 170 neonates, 97 were admitted in Extramural NICU (M=63, F=34), with male to female ratio of 1.85:1 and 73 were in Intramural NICU (M=34, F=39), with male to female ratio of 0.87:1. Higher male to female ratio in intramural NICU was because females were not brought for admission to the hospital which proves gender bias against female babies. While male to female ratio in the intramural NICU represents true ratio of mechanically ventilated neonates, the more number of preterm babies in our study was probably because preterm infants having greater chance of development of respiratory distress syndrome at birth and require mechanical ventilator support. With the availability of bubble CPAP at our center, more numbers of preterm babies are being ventilated early in management of Hyaline membrane disease. In extramural NICU, the ratio of preterm to full term baby was 1.5:1, while it was 1:1 in intramural NICU. The preterm load of the extramural NICU appears to be due to early referral of preterm babies to a tertiary level NICU because of recent enhanced training of medical officers and nurses of the peripheries in emergency newborn care(EmNC), recent availability of transport facilities in the form of 108 andenhanced IMNCI training of the peripheral health workers. Out of 40 babies delivered by caesarian section, 24 were intramural babies and 16 were extramural babies. The increased rate of babies born by caesarian section in intramural NICU was due to the increased number of high risk pregnancies being referred to the hospital.

In our study the most common indication for ventilation was Hyaline membrane disease, followed by perinatal asphyxia, Meconium aspiration syndrome and septicemia, all of which can be accounted for by prematurity. Studies by Nangia et al.\textsuperscript{12}, Mathur et al.\textsuperscript{13} and Singh et al.\textsuperscript{16} also reported Hyaline membrane disease as the most common indication while Riyas et al.\textsuperscript{14} reported birth asphyxia as the most common indication (37.3%) followed by Hyaline membrane disease (31.4%). The predominant mode of ventilation the babies received was Invasive mode (almost 50%). CPAP formed the majority of the non-invasive group of ventilation (28%). A minor group received Neopuff (5%), this being mainly the babies admitted on the Extramural side. In our study, Sepsis was the most common complication of mechanical ventilation (21.2%), followed by Air leak (5.9%) and Ventilation associated pneumonia (5.3%). Mechanically ventilated babies face a particular risk because artificial airways bypass the body’s defenses against inhaled pathogens. Intubation associated lesions of pharynx and trachea lead to bacterial colonization by deterioration of swallowing reflex and...
ciliary functions. Subsequently these babies may develop pneumonia and sepsis. Studies by Singh et al\textsuperscript{16} and Mathur et al \textsuperscript{13} also reported sepsis as the most common complication with the rate of 37.7\% and 26.6\% respectively, while Krishnan et al \textsuperscript{17} reported Air leak (8.8\%) as the most common complication in their study. Thus, the overall rate of complications was less in our study as compare to the other studies.

**CONCLUSION**

As sepsis was the most common complication of mechanical ventilation steps to ensure asepsis are of paramount importance otherwise all efforts are doomed to failure. Strict aseptic measures followed as protocols in NICU, early orogastric feeding with expressed breast milk, judicious use of appropriate antibiotics, liberal use of disposable material and other strategies to prevent nosocomial infections may help to reduce sepsis. Air leak syndromes including pneumothorax, pneumomediastinum and pulmonary interstitial emphysema are frequent in neonatal period. Mechanical ventilation with positive pressure is one of the most common causes of these syndromes\textsuperscript{18} which can be prevented by careful monitoring and early intervention to achieve ultimate goal of decreasing neonatal mortality and morbidity.

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