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ORIGINAL RESEARCH ARTICLE

OUTCOME OF NEONATES REQUIRING MECHANICAL VENTILATION IN A TERTIARY HOSPITAL

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ABSTRACT

Mechanical ventilation is a key therapeutic modality in treatment of sick neonates. Our hospital based retrospective study conducted at Chitwan Medical College (CMC), Nepal over the duration of 2 years, from February 2015 to January 2017, with aims to study the clinical profile, indications, complications and outcome in terms of survival in mechanically ventilated neonates. Total of 119 mechanically ventilated neonates were included in the study. Along with admission and discharge register record, all the patient's record files were retrieved from the medical record section, necessary details were entered in a predesigned proforma and statistical analysis was done using IBM SPSS 20 software. Out of 1306 total NICU admission, total 130 were mechanically ventilated, among them only 119 (9.1%) were included in the study. Majority (71.4%) were male. More than half were Preterm (51.3%) and outborn (58%). Most common indication of mechanical ventilation was sepsis followed by Birth asphyxia (BA), respiratory distress syndrome/hyaline membrane disease (RDS/HMD) and Meconium Aspiration Syndrome (MAS). Overall survival was 45(37.8%). Among the indications during the study period, the best survival observed was in birth asphyxia. Shock and Disseminated intravascular coagulation (DIC) were the two most common complications encountered during the course of ventilation. Increasing birth weight, higher gestational age and Downes Score at intubation of 6 or < 6 was associated with a better outcome. Shock, multi organ dysfunctions (MODS), and ventilator associated pneumonia (VAP) were the statistically proven individual predictors of outcome.

Key words: Mechanical Ventilation, Neonates, Survival

INTRODUCTION

Advances in perinatal and neonatal care have significantly reduced neonatal morbidity and mortality over the last decade. According to the Nepal demographic and health survey 2016 (NDHS 2016), after a decade of stagnation, neonatal mortality has decreased from 33 per 1000 live births to 21 per 1000 – a reduction by more than one third from the year 2011. Outcome in sick neonates have dramatically improved due to availability of neonatal intensive care units throughout the major cities in the country. Mechanical ventilation is a key therapeutic modality in management of these sick neonates. Although mortality rate in mechanically ventilated neonates is high, there is no doubt that judicious use of mechanical ventilation has aided in survival of sick neonates.

Mechanical ventilation and advanced life support facilities demand optimal infrastructure, essential monitoring and therapeutic equipment 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). Chitwan Medical College, which is one of the best private Medical colleges in Nepal, is providing NICU services from its establishment. Though there are many government and private hospitals providing neonatal intensive care in the country, there is a paucity of data regarding neonates requiring mechanical ventilation. With an aim to fill this gap this retrospective study was carried out to outline a clinical profile of these sick neonates, identify the common indications for initiation of mechanical ventilation as well as to find out the commonly

encountered complications and its outcome in terms of survival in these artificially ventilated babies

METHODS

This was a hospital based retrospective study, conducted at neonatal intensive care unit (NICU) of Chitwan Medical College (CMC), Bharatpur, Chitwan, Nepal. This Study was conducted over a period of two years, from February 2015 to January 2017. Approval was taken from the hospital Institutional Research Committee (IRC). All mechanically ventilated neonates (both inborn and outborn) were included in the study. Those babies having gross congenital anomalies, surgical conditions and not able to retrieve required data were excluded from the study. All the record files were retrieved from the medical record section of CMC and analyzed. All necessary details of mother and baby were recorded in a predefined proforma. Information including age, sex, gestational age, place of delivery, history of PROM > 18 hours, Apgar score at 5 minutes, primary diagnosis, indication of mechanical ventilation, complications, and outcome were recorded. All neonates with positive blood culture or diagnosed as pneumonia, meningitis, or septicemia were considered to have sepsis.

Statistical analysis was done using IBM SPSS 20 software. Chi-square test was used for categorical variables. P value less than 0.05 was considered significant for the tests.

RESULTS

There were a total of 1306 neonates admitted in NICU during the study period, out of which 130 neonates were mechanically ventilated. Due of lack of necessary information in 11 neonates, only 119 (9.1%) were included in the study. Among the studied neonates, 85 (71.43 %) were male and 34 (28.57 %) were female, with a male: female ratio 2.5:1. More than half were preterm 61 (51.3%) and were outborn 69 (58%), however a better survival rate was found among term (55.2%) and inborn (44%) neonates.

The general profile of the studied population and the survival outcome in relation to the various parameters are described in table 1.

Table 1: Percentage survival in relation to the studied parameters.

PARAMETER	NO OF BABIES (n%)	SURVIVOR (n%)	P-value
Place of birth			
Inborn	50(42.01%)	22(44%)	0.245
Outborn	69(57.99%)	23(33.3%)	
Gender			
Male	85(71.43%)	29(34.1%)	0.067
Female	34(28.57%)	16(47.1%)	
Gestational age (in weeks)			
<28	2(1.7%)	1(50%)	0.042
28-32	28(23.52%)	6(21.4%)	
33-37	31(26.05%)	9(29.0%)	
>37	58(48.7%)	22(44%)	
Birth weight (in gram)			
<1000	2(1.7%)	0	0.049
1000-1500	23(19.3%)	4(17.3%)	
1501-2000	21(17.6%)	7(33.3%)	
2001-2500	15(12.6%)	8(53.3%)	
>2500	58(48.7%)	26(44.8%)	

PARAMETER	NO OF BABIES (n%)	SURVIVOR (n%)	P-value
Downes score (At intubation)			
Inborn	50(42.01%)	22(44%)	0.003
Inborn	50(42.01%)	22(44%)	
Maturity			
Pre-term	61(51.3%)	13(21.3%)	0.004
Term	58(48.7%)	32(55.2%)	
PROM > 18 hours	**33(27.7%)**	**7(21.2%)**	**0.043**
5 min Apgar			
≤6	69(57.99%)	21(30.4%)	0.163
≥7	50(42.01%)	24(48%)	

On analysis of birth weight and gestational age, survival rate gradually increased with increasing birth weight and gestational age; with a statistically significant P- value of 0.049 and 0.042 respectively.

Thirty-three neonates had a positive history of Premature Rupture of Membrane (PROM) having a poor survival rate of only 21.2%.

Downes scores at the time of intubation of 6 or less had higher survival than those with higher scores; which is statistically significant.

Neonates with a 5-minute Apgar score of 7 or more had a better survival rate.

Table 2: Indication of ventilation and outcome (in terms of survival)

Diagnosis	Number (%)	Survival No. (%)	P-value
Sepsis	40 (33.6%)	15 (37.5%)	0.186
BA	29 (24.3%)	13 (44.8%)	0.048
RDS	19 (16.0%)	7 (36.8%)	0.760
Apnea	19 (16.0%)	5 (26.3%)	0.001
MAS	12 (10.1%)	5 (41.6%)	0.725
Total	**119(100%)**	**45(37.8%)**	

Note: BA – *Birth Asphyxia, RDS – Respiratory Distress Syndrome, MAS – Meconium Aspiration Syndrome Sepsis includes septicemia, pneumonia and meningitis.*

Neonatal sepsis (33.6%) was the commonest indication for ventilation followed by BA 24.3%, RDS 16%, apnea of prematurity 16% and MAS 10.1%.

Out of 119 studied, 45(37.8%) survived, 61(51.3%) expired and 13(10.9%) discontinued medical care and left against medical advice (LAMA).

Neonates ventilated for Asphyxia had the highest survival rate (44.8%), whereas the neonates with Apnea of prematurity had the lowest survivor rate 26.3%. Some neonates had multiple indications for ventilation, comparatively having poor survival rate.

Table 3: Complications encountered in ventilated neonates

Complications	Number of neonates (%)	Survival No. (%)	None survival	LAMA	P-value
Shock	19 (24%)	1 (5.3%)	17 (89.4%)	1 (5.3%)	0.001
DIC	19 (24%)	6 (31.6%)	13 (68.4%)	-	0.135
Seizures	11 (13.9%)	4 (36.4%)	5 (45.5%)	2 (18.2%)	0.715
MODS	11 (13.9%)	1 (9.1%)	10 (90.9%)	-	0.021
Pneumothorax	9 (11.3%)	2 (22.2%)	7 (77.8%)	-	0.220
VAP	7 (8.8%)	6(85.7%)	1 (14.3%)	-	0.026
Pulmonary Hemorrhage	2 (2.5%)	-	2 (100%)	-	0.380
IVH	1 (1.2%)	-	1 (100%)	-	0.619

Note: BA – *DIC- Disseminated intravascular coagulation, MODS- Multi organ dysfunctions, VAP- ventilator associated pneumonia, IVH- intra ventricular hemorrhage*

In our study, 79 neonates developed some complications either single or multiple. Shock, and DIC were the two most common complications encountered during the course of ventilation. The highest survival rate (85.7%) was found in neonates who developed VAP. Those who developed Shock, and MODS had the least survival rate of 5.3% and 9.1% respectively. Neonates developing pulmonary hemorrhage and IVH had 100 % mortality, however the sample size was very small to have any statistical significance. Shock, MODS, and VAP were the statistically proven individual predictors of outcome. In our study, 79 neonates developed some complications either single or multiple. Shock, and DIC were the two most common complications encountered during the course of ventilation. The highest survival rate (85.7%) was found in neonates who developed VAP. Those who developed Shock, and MODS had the least survival rate of 5.3% and 9.1% respectively. Neonates developing pulmonary hemorrhage and IVH had 100 % mortality, however the sample size was very small to have any statistical significance. Shock, MODS, and VAP were the statistically proven individual predictors of outcome.

DISCUSSION:

In our center only 9.1 % of total NICU admission required mechanical ventilation. Although the study population had male preponderance, better survival was found among female neonates. However, gender had no statistically significant impact on survival of neonates. It was observed that increasing birth weight and gestational age was associated with better survival. This result was consistent with the findings of several other authors.[1-3]

In a resource limited country like Nepal, Downes score provides an objective way of assessing any improvement or deterioration in the respiratory status of the neonate. Downes and co - workers found that the score at 12 to 18 hours provides an estimation of the prognosis with a higher score indicating poor prognosis.[4] Majority of neonates in our study were outborne thus we were not able to study the Downes score at 12 - 18 hours for all the babies. Hence, we tried to correlate the score at the time of intubation with outcome. The score was lower among survivors which was statistically significant.

Neonates with 5 minute Apgar score of 6 or lower had decreased survival. This result resembles the study conducted by Arafa et al which also found a five minute Apgar score of less than 7 to be associated with higher mortality.[5]

On analysis of place of delivery, a better survival rate was seen in inborn neonates despite of a larger outborne study population. This difference is probably because of late referral and arrival of outborne neonates resulting in delayed initiation of mechanical ventilation and intensive care. However, the difference in survival had no statistical significance.

Premature rupture of membrane (PROM) more than 18 hours is a proven risk factor for neonatal sepsis.[6,7] Our study also reflects the fact that neonates with history of PROM more than 18 hours had a poor survival rate of only 21.2 % which was statistically significant.

Neonatal sepsis (33.6%) was the commonest indication for ventilation followed by BA 24.3%, RDS 16%, apnea of prematurity 16% and MAS 10.1%. Similar pattern were reported in various other studies conducted within the country and abroad[8-10]. Shrestha P et al also reported that the 37.2% ventilated neonates had sepsis as the primary cause followed by respiratory distress (17.6%) Sepsis was the second most common cause for ventilation in studies conducted by Shrestha S et al, Srinivas N et al, Iqbal Qazi et al.[8-10] Birth asphyxia was the most common cause for mechanical ventilation in neonates in BPKIHS Dharan (34%) and Paropakar Maternity and Women's Hospital (60%) Nepal. This was also supported by various other studies.[s]

Overall survival in this study was 37.8%, which is comparable to a few reported from other Intensive care units (NICU) within the country where reported survival rates vary between 33.3 % to 50.8%.[1,7,11] Whereas this survival rate is poorer than those reported by different authors where it varied between 55.5 % to 86%.[14-16] This is probably because of larger preterm neonates who are more prone to neonatal sepsis, RDS/HMD and various complications related to different systems and unavailability of surfactant.

Neonates with Birth Asphyxia had the best survival rate (44.4%) followed by MAS (41.6%), Sepsis (37.5%), RDS (36.8%) and Apnea (26.3%). The survival rate in neonates ventilated for Asphyxia as reported by different studies ranges from 14% to 100%.[2,4,15,17,18] Narayan Prabha P.C reported that among a total of seven babies who were ventilated for Asphyxia, all of them survived (100% survival) and they claimed that this best result was made possible due to early ventilation and surfactant use.[15] Late intervention/delayed initiation of mechanical ventilation, unavailability of surfactant and associated comorbidity may be the contributing factors for poorer outcome in our study.

MAS had the second best outcome in our study. Out of 12 babies ventilated for MAS, 5 (41.6%) survived. All were term babies. Various studies reported a wide range in survival rate ranging from 0 to 100%.[3-5] MAS had the best outcome in the series by Malhotra et al[4] and Riyas et al [3] with 100% and 63.6% survival, respectively. Poorest outcome of 0% survival was found in the series by Singh et al and Karthikeyeyan et al.[2-17]

We found a poor survival rate (37.5%) in babies with sepsis. Sepsis had a low survival rate in all other studies within the country. Lowest survival rate of 30% was found by Shah B K et al.[12] Sepsis had a grave outcome (26.3% survival) in the study by Shrestha P et al.[7] It was the most common cause for mechanical ventilation as well as mortality among admitted neonates in study by Shrestha S et al.[8] Reason for low survival rate in septic neonates in our study was most likely because majority of our admissions consisted of out-borne and preterm neonates who arrived late to our center. Use of antibiotics prior to arrival at our hospital probably masked culture positivity which negatively impacted on proper antibiotic selection. Similarly, presence of comorbid conditions such as dyselectrolytemia, acidosis and shock were contributory factors for low survival in septic neonates rather than the role of mechanical ventilation /ventilatory strategy per se. Sepsis had a uniformly poor outcome in other studies by Iqbal Q et al. (35.3%) and Ananthraj A et al (46.1%).[10,14]

Neonates with RDS had a survival rate of 36.8%, which is lower than 50 % - 82.6 % as reported by other authors.[7, 8,10-12,17] Various authors claim that better survival rates in their study was made possible by early intervention and uniform use of surfactant in all PT/MAS/BA.[10-12, 17] Low survival in our study may be due to unavailability of surfactant to PT babies, late referral & high rate of sepsis during the study period. So easy availability of surfactant at a reasonable cost would have decreased the mortality. None of the babies in this study received surfactant as a rescue/ prophylactic therapy. Our survival rate is better than those reported by other domestic studies where it ranged from 0 % - 33 %.[7,11,12]

Out of 119 ventilated neonates, 79 developed complications. The two most frequent complications seen were shock and DIC. Anantharaj A et al also reported shock as the most common complication in ventilated neonates and also an important cause of mortality in their study.[14]

Pneumothorax occurred in nine babies of whom

two survived (22.2%). All were preterm babies in our study. Narayan Prabha PC reported that out of 100 ventilated only two neonates with HMD developed pneumothorax, both of whom survived.[15] Air leak is a common complication in preterm neonates with MAS and HMD/RDS, outcome of which can be positively influenced by the use of surfactant. Unavailability of surfactant in our center during the period of our study, thus limiting its use, must have contributed to higher mortality in these neonates.

Similarly use of novel ventilatory strategies like high frequency oscillatory ventilation and extra corporeal membrane oxygenators (ECMO) would have helped to reduce the rate of pneumothorax in ventilated neonates.

Two extremely low birth weight babies (weighing 880gram and 925gram) with RDS/Apnea of prematurity developed pulmonary haemorrhage, both of whom expired. Similar result was seen in one preterm neonate ventilated for sepsis who developed IVH and seizure and expired on the fifth day. Other studies also reported a poor out come in pulmonary hemorrhage.[15,2,18,19,20,21]

CONCLUSION:

In our study, the survival rate of ventilated neonates was 37.8%, the most common indication for ventilation was Sepsis. The commonest complications encountered in ventilated neonates were Shock and DIC. Increasing birth weight, higher gestational age and Downes Score at intubation of 6 or < 6 was associated with a better outcome. VAP had the best outcome in terms of survival whereas shock and DIC were the two complications having the worst outcome.

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