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OUTCOME OF NEONATES ON MECHANICAL VENTILATION GRADUATING FROM NICU

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ABSTRACT

To analyse the indications, complications and outcome of babies requiring mechanical ventilation. Prospective study done at Basaveshwar and sangameshwar hospital attached to M.R medical college,gulbarga. A total of 132 Neonates ventilated in NICU from dec 2009-may 2011 are included in this study. Birth asphyxia, hyaline membrane disease, septicaemia, meconium aspiration syndrome and neonatal pneumonia. In the 132 ventilated neonates best outcome was seen in babies with gestational age of >37 weeks, with birth weight of >2.5kgs, and with mean duration of ventilation more than 99 hours. Outcome was good in Birth asphyxia (56.36%), followed by meconium aspiration syndrome (55.5%), and very poor outcome in babies with hyaline membrane disease and septicaemia (36.84%). Shock was the commonest complication followed by pulmonary haemorrhage, sepsis, tube block and air leaks.

KEY WORDS

Ventilation; Neonates; Hyaline membrane disease; Birth asphyxia; Meconium aspiration syndrome;

INTRODUCTION

Mechanical ventilation was started in the west in early mid of 20th centuary and became widely accepted in 70's and 80's. In India, mechanical ventilation was started in around 1980. Attachment to the patient can be by way of a facemask, a head box, an endotracheal tube, nasal prongs, a tracheostomy or a negative pressure apparatus surrounding the thorax. It is still in its infancy but is a fast developing area, especially in the last few years as represented by increasing number of literature. The results reported by the few in and around the country are promising. Mechanical ventilation is the corner stone of present generation pediatric intensive care. In the recent years this modality has evolved into a most highly specialized discipline. From the iron lungs used in the past primarily to treat respiratory paralysis in poliomyelitis, modern day ventilator have evolved into microprocessor based sophisticated devices capable of a large number of functions with many modes and alarms to make them as physiological and safe as possible for the patients. Assisted ventilation may be defined as the movement of gas into and out of the lung by an external source connected directly to the patient.

AIMS AND OBJECTIVES OF THE STUDY

Ventilatory therapy in the neonatal period is in its infancy in India but a fast developing one. In

our study we would like to prospectively evaluate neonatal ventilation its indications, short term survival and complications in various disease states. We also like to look at the influence of gestational age and weight on immediate outcome of neonatal ventilation.

1. To study the influence of gestational age and weight on the immediate outcome in ventilatory therapy
2. To study the mean duration of ventilation.
3. To study the complications associated with mechanical ventilation.

MATERIALS AND METHODS

This was a prospective observational study durong December 2009 to May 2011 was conducted on 132 consecutive neonates admitted in neonatal intensive care units of Basaveshwar and Sangameshwar Teaching & General Hospitals, attached to M.R. Medical College, Gulbarga, who required ventilatory therapy. At admission, details of antenatal, natal and postnatal history, the birth weight, gestational age, type of delivery, APGAR score, onset of respiratory distress, distress scoring and other details were recorded in a predefined proforma. Diagnosis was made using standard clinical, laboratory and/ or radiological criteria. Intermittent positive pressure ventilation was initiated on babies who satisfy the inclusion and exclusion criterias. Time cycle, pressure limited, continous flow ventilator was used and the initial settings varied with the underlying disease and arterial blood gas analysis. The aim was to use minimum possible pressure and FiO_2 to maintain normal blood gases.

Babies were nursed under servo control open care system. Arterial blood gas (ABG) was done whenever indicated. Continuous non-invasive oxygen saturation monitoring was done. Babies were managed according to the unit protocol. All babies were monitored for any complications like air leak, congestive cardiac failure; patent ductus arterioses etc. chest physiotherapy was given during and after ventilation. Babies were weaned of the ventilator if they showed clinical, radiological and blood gas improvement with bare minimum ventilatory support. Steroid was started 24 hours before expected extubation time. After extubation the child was placed under oxygen hood until indicated.

The endpoint of the study was

1) Hemodynamically stable neonate accepting feeds.

2) Fit to be shifted out of NICU.

3) When the baby succumbs during ventilatory care.

Inclusion Criteria: This study was done on sick neonates, admitted in NICU of Basaveshwar and Sangameshwar Teaching & General Hospitals, attached to M.R.Medical College, Gulbarga from December 2009 to May 2011 whether inborn or outborn, having signs and symptoms of: Hyaline membrane disease (HMD):Meconium aspiration syndrome (MAS): Birth asphyxia (BA): Septicemia: Neonatal pneumonia (NP)

Exclusion criteria: Surgical cases like tracheo oesophageal fistula, congenital diaphragmatic hernia, Necrotizing enterocolitis, Kernicterus, Persisting pulmonary hypertension of newborn, patients unwilling to give informed consent.

Ethics: Ethical clearance is obtained from the ethical committee of the institution.

Statistical Analysis: Statistical analysis was done by SPSS 11.5 version Software and non-test of χ^2 (chi-square) has been applied for significance test.

RESULTS

Table-1: Outcome of ventilation in relation to gestational age and indication

Indications	<28 weeks		29-32 weeks		33-36 weeks		>37 weeks	
	I	E	I	E	I	E	I	E
Birth asphyxia	0	0	2	1	7	2	22	4
Hyaline membrane disease	6	6	5	8	3	8	0	2
Meconium aspiration syndrome	0	0	0	0	1	1	9	7
Septicemia	1	0	1	2	1	4	4	6
Neonatal pneumonia	0	0	0	0	0	0	1	1

Table: showing outcome of ventilation in relation to gestational age and indication. It is seen that irrespective of the indication, the survival rate increases with increasing gestational age.

Table-2: Outcome of ventilation in relation to birth weight and indication

Indications	<1 Kg		1-1.5 Kg		1.5-2 Kg		2-2.5 Kg		>2.5 Kg	
	I	E	I	E	I	E	I	E	I	E
Birth asphyxia	0	0	0	0	2	2	8	8	21	14
Hyaline membrane disease	2	1	7	15	5	5	0	3	0	0
Meconium aspiration syndrome	0	0	0	0	0	0	3	1	7	7
Septicemia	0	0	0	2	2	5	2	3	3	2
Neonatal pneumonia	0	0	0	0	0	0	0	0	1	1

Table : showing outcome of ventilation in relation to birth weight and disease status. It shows that irrespective of the indication, survival increased with increasing birth weight.

Table-3: Survival rate in relation to duration of ventilation

Duration (hrs)	Total	Improved		Expired	
		No.	Percent	No.	Percent
20 – 29	11	00	0.00	11	100.00
30 – 49	21	6	28.60	15	71.40
50 – 69	24	16	66.70	8	33.3
70 – 89	39	22	56.40	17	43.60
90 – 109	23	13	56.50	10	43.50
110 – 129	8	6	75.00	2	25.00
≥130	6	3	50.00	3	50.00
Total	132	63	47.70	69	52.30
Mean±SD	99.23±54.6	101.62±53.6		89.42±56.2	
Range	21-210	36-210		21-180	

All the categories of support, CPAP, SIMV, CMV/ IMV and in combination of modes were included in the study. All the cases of IMV/CMV and SIMV upon extubation routinely receive CPAP for 6-12 hours. Any baby receiving CPAP for more than 12 hours after IMV/ CMV and SIMV was categorized as CMV+CPAP or SIMV + CPAP. In the CPAP group, survival rate was 79% (11/14). 29 babies were given only SIMV mode of ventilation, survival rate was 51.7% (15/29). 17 babies were given only CMV mode, out of which one baby survived. (5.8%). 47 babies were put on CPAP at some time or the other. Another 25 babies were given a mix of mechanical ventilation.

Table-4: Survival rate in relation to complications

Complications	Total	Improved		Expired	
		No.	Percent	No.	Percent
Air leak	9	5	55.6	4	44.4
Septicemia	21	11	52.4	10	47.6
Tube block	12	6	50.00	6	50.00
Shock	32	16	50.00	16	50.00
Pulmonary hemorrhage	24	8	33.3	16	66.7
Total	98	46		52	

Survival rate in relation to complication

More than one complication was encountered in many cases. Shock was the commonest complication (32) and had a survival rate of 50%. Septicemia was experienced in 21 cases, pulmonary hemorrhage in 24 cases. Survival rates were
52.4% and 33.3% respectively. Three babies had weaning failure out of which one survived.

Table-5: Incidence of complications encountered in various disease states ring ventilation

Indications	Air leak	Septicaemia	Tube block	Shock	PH	Total
Birth asphyxia	2	12	4	10	6	34
Meconium aspiration syndrome	1	4	2	9	4	20
Hyaline membrane disease	2	4	2	8	4	20
Neonatal Pneumonia	2	1	3	2	3	11
Septicemia	2	1	1	3	7	14

Cases with birth asphyxia encountered maximum number of complications (34) followed by HMD and MAS with 20 each.

Out of 132 cases who received mechanical ventilation, 9 babies developed pneumothorax, 4 cases (44.4%), out of the 9 expired. It was noted that 4 cases, which expired due to complication of airleak were receiving with a mean PIP of more than 19.

Table-6: Mean Range of weight and gestational age in total improved and expired cases

	Total		Improved		Expired	
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
Birth weight (kgs)	0.8-3.72	2.23±0.71	1.1-3.72	2.41±0.69	0.8-3.10	2.06±0.73
Gestational age (weeks)	26-42	35.65±4.02	30-42	36.12±4.12	26-40	35.02±3.91

Table-7: Overall survival rate

	Improved		Expired	
Total	No.	Percent	No.	Percent
132	63	47.8	69	52.2

Out of 132 babies ventilated for various conditions, 63 babies survived. The overall survival rate is 47.8%.

DISCUSSION

Gestational age

In our study group babies below, 28 weeks of gestational age were 9.8% 29-32 weeks were 14.39%, 33-35 weeks were 20.45% and more than 37 weeks were 55.3%. This is comparable with studies of S.Nangia1, L.Krishnan2, etc. in contrast, the number of babies below 32 weeks is 43.06% in a study done by N.C.Mathur.3 The smallest survivor who was on CPAP mode was

750 grams at birth and 26 weeks of gestational age.

Weight

In this study, the weight distribution was 2.2% in less than 1000 grams, 18.18% in 1-1.5 kg, 15.9% in 1.5-2 kg, 21.2% in 2-2.5 kg and 42% in >2.5 kg. In contrast to our observations, the babies between 1.5-2.5 Kg were more in S.Nangia[1] (61.22%) and N.C.Mathur[3] series had 38.79% of babies between 1-1.5 kg.

Ventilator settings

Mean PIP used in the present study in relation to various indications was birth asphyxia 17.4±1.05, HMD 18.3±1.3, MAS 16±1.3, septicaemia 17.85±1.5 and pneumonia 17.5±1.6.ventilator settings varied in all the studies (L.Krishnan[2], M Singh[4]).This may be because the ventilator settings used is individualized to the need of the baby considering various factors. Therefore every baby requires different settings and should be taken as an individual case. But it is noted that PIP needed in hyaline membrane disease is higher in all studies (L.krishnan[2], M Singh[4], and E.O.Reynolds[5]) which is comparable to our study. PEEP, rate and FiO_2 were needed more in expired cases comparable with the study done by E.O.Reynolds.

The mean duration of ventilation in relation to different disease states is given in **Table 9**.Hyaline membrane disease needed a mean duration of 102.1±58.2 in our study, which is just comparable with the study done by N.C.Mathur[3] (96.4%). Similarly the mean duration of ventilation given in cases of septicemia in his study is 94.3% as compared to 92.6±57.42 in our study. The mean duration of ventilation needed for birth asphyxia was 89.2±44.8, in contrast to that duration was 54.8 in a study conducted by N.C.Mathur[3] In the survived cases, maximum PIP was given to hyaline membrane disease, followed by pneumonia and birth asphyxia. MAS needed the least PIP. The mean PEEP and FiO_2 did not differ much. The mean PEEP and FiO_2 did not differ much.

In the CPAP group, survival rate was 79%. The IMV/ CMV group had the lowest survival rate of 5.8%. In L.Krishnan[2] series CPAP survival was 90% and IMV group had a survival rate of 18%.

Duration of ventilation needed was maximum in hyaline membrane disease (10.21±58.2) comparable to that of study done by N.C.Mathur[3] (96.4 hours). Birth asphyxia needed the least of only 89.2±44.8 hours. Duration of ventilation needed in survived cases was maximum in hyaline membrane disease (106.42±61.2), neonatal pneumonia 102.4±56.4, followed by septicemia (98.96±61.5), meconium aspiration syndrome (98.36±48.6) and birth asphyxia (96.21±46.2).

Complications

During the present study one or the other complication occurred in 74.24% of cases. Major complications were shock (32.6%), pulmonary hemorrhage (24.49%). septicemia (21.4%), tube block (12.24%) followed by air leak (9.1%), More than one complication occurred in many cases. shock was the commonest complication in contrast to all other studies. The incidence of septicemia in our series is comparable to series of L.Krishnan et al[2] (26.81%). In contrast to our study N.C.Mathur[3] series reported septicemia (36.7%), as commonest complication followed by pneumonia (28.8%) and air leaks (6.71%). M.Singh[6] in his subsequent study shows an incidence of septicemia of 50.6%. L.Krishnan[2] reports only 4.4% of septicemia and she attributes it to the use of minimum pressure, shortest possible duration of ventilation,

endotracheal toilet and vigorous postextubation chest physiotherapy.

In our study pulmonary hemorrhage occurred in 24.49%.In contrast to that a series report by S.Nangia1 has an incidence of 9.5%. Pneumothorax occurred in 9.1% of cases in our study, which is comparable with series of L.Krishnan[2] (8.8%). The incidence of pneumothorax reported by M. Singh[4] is 15% and N.C.Mathur3 is 6.71%. Tube block encountered was 12.24% of cases in our study. In contrast to only 5.8% reported by L.Krishnan.2 High index of suspicion and early intervention would have contributed to the higher incidence in our study. 3 cases had weaning failure. In my study the leading cause of death was pulmonary hemorrage(66.7%).M.Singh reports IVH as a leading cause of death in his study(52%).

Survival:

The overall survival rate in our study was 47.8% (63/132). It is comparable with studies reported from other parts of the country by Ruchi Rai (48.5%), S.Nangia[1] (46.54%), M. Singh[4] (55.5%), N.C. Mathur[3] (55.8%), Maiyya P.P.7 (48.76%), Riyas et al8 (50.98%) and also with the reports from abroad by Richard L.9 (63.7%) and Lindroth et al[10] (53%). Male babies had a better survival rate with 51.08% compared to 40% in females. Survival rate improved proportionally with birth weight and gestational age. Babies weighing less than 1.5 Kg had a survival rate of only 29.16% as compared to 57.14% in babies weighing more than 2.5 Kg. Patients between 1-1.5kg 1.5 to 2 Kg and 2 to 2.5 Kg had survival rate of 66.7%,29.16%,42.85% and 46.42% respectively. These results were comparable with studies done by S. Nangia[1] (1 to 1.5 – 31%, 1.5 to 2 – 40.8%, 2 to 2.5 – 51.2% and more than 2.5 – 53%). N.C. Mathur[3] reports a better survival in 1 to 1.5 categories (59%) but the other groups are comparable (59.7% and 52.2%). Gestational age also had a similar trend with increasing gestational age survival rate improved. Babies who were less than 32 weeks had a survival rate of only 42.1% as compared to 49.3% in those with gestational age above 37 weeks. This is comparable with studies of S. Nangia[1] and N.C. Mathur[3]

Irrespective of the indications survival rate was better with increasing birth weight and gestational age. This trend is consistent in all studies. Inborn patients had a better survival rate with 51% compared to 45.78% in outborn babies. Survival rate was 56.36% in case of birth asphyxia, followed by MAS (55.55%) and neonatal pneumonia (50%). HMD and septicemia have comparatively poor outcome with both accounting for 36.84%. This is comparable with reports of N.C. Mathur[3] except for HMD 56.3% and pneumonia 77.1% .survival rates in all other indications are nearly comparable(Birth asphyxia 48.1%, MAS 61.2%, and septicaemia 44.1%).The survival rate of HMD was higher in all other studies except for the study done by S.Nangia which was 40.6% ,compared to our stud 0f 36.84%.Babies whom developed pulmonary hemorrage had a survival rate of only 33% as compared to more than 50% survival in babies with other complications.

CONCLUSION

Survival rate improved with increasing weight and gestational age. Babies below 1.5 Kg had a survival rate of only 29.16% whereas it was 57.14% in those who weighed more than 2.5 Kg. Babies who were less than 32 weeks of gestational age had a survival rate of only 42% as compared to 49.31% in those with gestational age above 37 weeks. Irrespective of the indication, the survival rate improved with increasing birth weight and gestational age. Commonest indications were, birth asphyxia

(41.6%), hyaline membrane disease (28.78%), septicemia (14.39%), meconium aspiration syndrome (13.6%), neonatal pneumonia (1.5%). Meconium aspiration syndrome had the best survival rate of 56.36%, followed by pneumonia (55.5%) and hyaline membrane disease (50%). Maximum pressure needed, among the various conditions that required ventilation was hyaline membrane disease requiring a maximum PIP of 17.2±1.21. Maximum duration of ventilation was needed in hyaline membrane with a mean of 106.42±61.2 followed by pneumonia (70.2±24.8). The overall range was 21 to 210 and a mean of 99.23±54.6. Shock was the commonest complication encountered (32.6%) followed by pulmonary hemorrhage (24.49%) and sepsis (21.4%). Outcome in babies who had pulmonary hemorrhage was poor with only 33.3% survival. Cases with birth asphyxia had the maximum incidence of complication (34) followed by hyaline membrane disease and meconium aspiration syndrome of 20 each. The incidence was high when pressure was more than 19 cm of H_2O. The overall survival rate in the present study was 47.80% (63/132). Majority of our admissions were outborns who hardly received any medical treatment before referral and during transport. Inspite of all these factors we were able to achieve a survival rate among ventilated neonates which is comparable to other studies conducted in past.

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