



A STUDY ON CLINICAL OUTCOME AND COMPLICATIONS OF MECHANICALLY VENTILATED NEONATES IN A TERTIARY CARE CENTRE

Dr. Sagi Sai Kiran Siddhartha

Final Year Post-graduate, Department Of Pediatrics, RMC, Kakinada

Dr. M. S. Raju

Professor And Hod Of Pediatrics, RMC Kakinada.

Dr. Shaik K John Mohammad Alisha

Assistant Professor Of Pediatrics

Dr. V. Vijaya Bhaskara Rao*

Associate Professor Of Pediatrics.*Corresponding Author

ABSTRACT

Background: Decreasing mortality in sick and ventilated neonates is an endeavor of all neonatologists. Assisted ventilation has become an indispensable part of the neonatal intensive care. This study was undertaken to find out complications in ventilated neonates and also study possible predictors of outcome. **Objective:** To know the immediate outcome and complications in neonates on mechanical ventilation. **Results:** In the current study, Neonates survived on ventilator were 52.1% and mortality was 47.9%. Incidence of air leak in the survived group was 2.4% and in non survivor group was 6.4%. Incidence of Tube block in Survived group was 1.2% and in non survivor group was 5.1%. Incidence of shock was 14.1% in the survived group and 29.5% in non survivor group. Incidence of pulmonary haemorrhage was 7.1% in the survived group and 23.1% in non survivor group. Incidence of septicemia was 9.4% in the survived group and 21.8% in non survivor group. Incidence of ventilator associated pneumonia in survived group was 10.6% and in non survivor group 19.2%. **Conclusion:** In our study, the survival rate of ventilated babies was 52% and about half of them developed complications. Among the factors analyzed Presence of sepsis and pulmonary hemorrhage were predictive of poor outcome.

KEYWORDS : Mechanical ventilation, outcome, complications

INTRODUCTION

Neonatal deaths account for around 65% of all infant deaths and half of all under five mortality in India. Hyaline membrane disease, birth asphyxia, congenital pneumonia and sepsis are leading causes of neonatal mortality in our country.

Quality of life and survival of neonates can be improved through intensive care and assisted ventilation. It is mandatory to enhance newborn survival by establishing advanced life support facilities in neonatal intensive care unit.

Mechanical ventilation (MV) and advanced life support facilities demand optimal infrastructure, essential monitoring, therapeutic equipment and specially trained paediatricians and nurses to provide state-of-art facilities and expertise to look after the high risk and critically sick newborn babies admitted for better outcome in the Neonatal Intensive Care Unit (NICU).²

PATIENTS AND METHODS :

STUDY DESIGN: Hospital based prospective observational study.

STUDY SETTING: Government General Hospital Kakinada.

INCLUSION CRITERIA:

1. All neonates of more than 28 weeks and birth weight of more than 1000 grams, admitted during the study period who require mechanical ventilation with informed consent from parents /caregivers.

EXCLUSION CRITERIA:

1. Neonates who require ventilation but not given consent from parents/caregivers.
2. Cases with lethal congenital anomalies or post-surgical babies
3. Gestational weeks less than 28 weeks.
4. Birth weight less than 1000 grams
5. Deaths within 24 hours of the admission
6. Deaths within 12 hours of ventilation.

METHODOLOGY:

Informed consent was obtained from the parents /caregivers of every included neonate. For each ventilated neonate information, including age, sex, admission, weight (recorded by electronic weighing machine), gestational age (by modified Ballard's scoring), any maternal illness, mode of delivery, any resuscitation at the time of birth, neonatal problems, primary diagnosis, hospital stay and complications will be recorded.

The indications for initiation of mechanical ventilation are:

- PaO₂ < 50 mmHg
- PaCO₂ > 60 mmHg
- Intractable or recurrent apnea
- Gasping or poor respiratory efforts
- O₂ saturation < 85% on supplemental oxygen
- Continuous positive airway pressure (CPAP) failure, defined as worsening respiratory distress, and/or hypoxemia (PaO₂ < 50 mmHg) / hypercarbia (PaCO₂ > 60 mmHg) despite CPAP pressure of 7-8 cm H₂O and FiO₂ of 0.8 or recurrent episodes of apnea.

STUDY PERIOD: The study period was one and half year i.e., from 1st January 2020 to 30th June 2021

STUDY TOOLS : Mechanical ventilator, Pulse oximeter, Arterial blood gas analyser and other tools as required.

RESULTS

Table 1: Outcome of mechanical ventilation

	Frequency	Percentage
Survived	85	52.1%
Expired	78	47.9%
Total	163	100%

In the current study, survived on ventilator were 52.1% and mortality was 47.9% (78/163)

Table 2: Incidence of Air leak and outcome

Air leak	Survived		Expired		Total	
	N	%	N	%	N	%
Yes	2	2.4%	5	6.4%	7	4.3%
No	83	97.6%	73	93.6%	156	95.7%
Total	85	100%	78	100%	163	100%

Chi square test = 1.61, p=0.20, Not statistically significant

In the current study, incidence of air leak in survived group was 2.4% and in non survivor group was 6.4%. There was no statistically significant association observed Survival rate of 28.5% (2/7) and mortality rate of 71.4% (5/7) among neonates ventilated with air leak was observed.

Table 3: Incidence of tube block and Outcome

Tube block	Survived		Expired		Total	
	N	%	N	%	N	%
Yes	1	1.2%	4	5.1%	5	3.1%
No	84	98.8%	74	94.9%	158	96.9%
Total	85	100%	78	100%	163	100%

Chi square test = 2.12, p=0.14, Not statistically significant

The incidence of Tube block in Survived group was 1.2% and in non survivor group was 5.1%. There was no statistically significant association observed.

Survival rate of 20% (1/5) and mortality rate of 80% (4/5) among neonates ventilated with tube block was observed.

TABLE 4: Incidence of shock and outcome

Shock	Survived		Expired		Total	
	N	%	N	%	N	%
Yes	12	14.1%	23	29.5%	35	21.5%
No	73	85.9%	55	70.5%	128	78.5%
Total	85	100%	78	100%	163	100%

Chi square test = 5.66, p=0.01*, statistically significant

In the current study, incidence of shock was 21.5%. In the survived group it was 14.1% and in non survivor group was 29.5%. This observation was statistically significant as p value calculated to be <0.05.

Survival rate of 34.2%(12/35) and mortality rate of 65.8%(23/35) among ventilated neonates with shock was observed.

Table 5: Incidence of Pulmonary haemorrhage

Pulmonary Haemorrhage	Survived		Expired		Total	
	N	%	N	%	N	%
Yes	6	7.1%	18	23.1%	24	14.7%
No	79	92.9%	60	76.9%	139	85.3%
Total	85	100%	78	100%	163	100%

Chi square test = 8.26, p=0.004*, statistically significant

In the present study, incidence of pulmonary haemorrhage was 14.7%. In the survived group it was 7.1% and in non survivor group it was 23.1%. This observation was statistically significant as p value calculated to be <0.05.

Survival rate of 25%(6/24) and Mortality rate of 75%(18/24) among ventilated neonates with pulmonary hemorrhage was observed.

Table 6: Incidence of septicemia

septicemia	Survived		Expired		Total	
	N	%	N	%	N	%
Yes	8	9.4%	17	21.8%	25	15.4%
No	77	90.6%	61	78.2%	138	84.6%
Total	85	100%	78	100%	163	100%

Chi square test = 4.77, p=0.02, statistically significant

In the current study, incidence of septicemia was 14.7%.

In the survived group it was 9.4% and in non survivor group it was 21.8%. This observation was statistically significant as p value calculated to be <0.05.

Survival rate of 32% (8/25) and Mortality rate of 68% (17/25) among ventilated neonates developed sepsis was observed.

Table 7: Incidence of Ventilator Associated pneumonia

VAP	Survived		Expired		Total	
	N	%	N	%	N	%
Yes	9	10.6%	15	19.2%	24	14.7%
No	76	89.4%	63	80.8%	139	85.3%
Total	85	100%	78	100%	163	100%

Chi square test = 2.40, p=0.12, Not statistically significant

In the current study, incidence of ventilator associated pneumonia was 10.6% in survived group and 19.2% in non survivor group.

There was no statistically significant association observed.

Survival rate of 37.5% and mortality rate of 62.5% and among ventilated neonates with VAP was observed.

DISCUSSION

Neonatal respiratory failure is a common and serious clinical problem associated with high morbidity and mortality.

The primary goal of invasive mechanical ventilation is to correct the compromised lung function, to restore adequate gas exchange, and reduce the work of breathing.

Mechanical ventilation of newborn has been practiced for several years with several advances made in the way. It was introduced in 1960s to support the infants with respiratory failure. Mechanical ventilation may be immediately required in multiple conditions of a sick newborn. This has contributed to the rapid decline in neonatal mortality in various parts of the world. As compared to the Western world and our neighbouring countries, neonatal ventilation in our country is still in its infancy. The basic infrastructure and expertise to ventilate newborn is lacking in majority of the hospitals.

The paucity of the data still exists and this study was carried forward with an aim to know the indications, clinical course and outcome of mechanical ventilation in neonates less than 28 days of age.

This study was carried forward to know the complications in neonates who require mechanical ventilation.

The study was conducted in NICU, government general hospital, Kakinada during the period of January 2020 to June 2021.

Around 163 newborns who were meeting inclusion criteria ventilated during the study period of January 2020 to June 2021 was studied. Details of babies on invasive mechanical ventilator has been recorded in a predefined proforma. Studies were conducted and analysed about the correlation between gestational age, birth weight weight on immediate outcome of mechanical ventilator. Outcome of the neonates have been assessed as survival or death. Also studied about the complications associated.

Outcome of mechanical ventilation:

In this present study, ventilator survival was 52.1%(85/163) and mortality was 47.9%(78/163). Malhotra et al³ reported a survival of 62% with 38% mortality, Mathur et al¹ with 74% mortality and Anantharaj et al⁵ and Karthikeyan et al⁶ with 54.7%, 42% and 32% respectively.

MORTALITY ON VENTILATOR-

Present study	47.9%
Malhotra et al	38%
Mathur et al	74%
Anantharaj et al	42%
Karthikeyan et al	32%

INCIDENCE OF VENTILATOR ASSOCIATED COMPLICATIONS IN NEONATES STUDIED:

INCIDENCE AND OUTCOME OF AIR LEAKS:

In this study, among 163 babies studied only 4.35% (7/163) had air leaks and 95.7%(156/163) had no air leaks. Among babies survived, 2.4%(2/85) had air leaks and in expiry group 6.4%(5/78) had air leaks.

This shows higher incidence of expiry than survival in babies with air leaks on ventilator. There was no statistically significant association observed.

Higher mortality rate of 71.4%(5/7) and lower survival rate of 28.5%(2/7) among neonates ventilated with air leak was observed.

Higher levels of PEEP and mean airway pressure³⁴ are usually attributed to their higher incidence of air leaks. In MAS, the air leaks could be due to the disease or due to the assisted ventilation. Other

studies like Shanti et al⁷(11.3%) and Monsef et al⁸ (4.9%) revealed higher incidence of air leaks in their study and Haneef et al⁹ revealed lower incidence of air leaks in their study. Studies like Riyas et al¹⁰ showed overall incidence of 13.7% with similar high incidence of mortality 64.3% and survival of 35.7% among neonates ventilated with air leak. Other studies like nasreen et al¹¹ showed incidence of 5.7% and karthikeyan et al⁶ with incidence of 5.1%. Anantharaj et al⁵ showed no survival among babies with airleaks with statistically significant p value. This shows a higher incidence of children expired than survived on mechanical ventilator with air leaks as a complication similar to other studies.

STUDY	INCIDENCE	SURVIVAL AMONG VENTILATED NEONATES WITH AIR LEAKS
Current study	4.35%	28.5%
Riyas et al	13.7%	35.7%
Monsef et al	4.9%	42.8%
Shanti et al	11.3%	22.2%
Anantharaj et al	5%	0%

INCIDENCE AND OUTCOME OF TUBE BLOCK:

In this study, out of 163 children studied, 3.1% (5/163) had tube blocks and 96.9%(158/163) had no incidence of tube blocks. Among babies survived, 1.2%(1/85) had tube block and in expiry group 5.1%.(4/78) had tube block.

This study found a higher incidence of expiry than survival among babies with tube block. There was no statistically significant association observed.

Higher mortality rate of 80% (4/5) and lower survival rate of 20%(1/5) among neonates ventilated with tube block was observed.

In contrast, Studies like Riyas et al¹⁰ showed incidence of tube blocks in 32.3% with mortality in 35.8% and survival of 60.6% among neonates ventilated. Studies like nasreen et al¹¹ showed incidence of tube block in 52.8% neonates.

STUDY	INCIDENCE	SURVIVAL RATE AMONG VENTILATED NEONATES WITH TUBE BLOCK
Current study	3.1%	20%
Riyas et al	32.3%	60.6%

INCIDENCE AND OUTCOME OF SHOCK:

In this study, incidence of shock was 21.5%(35/163). Among total babies survived, 14.1%(12/85) had shock and 29.5%(23/78) among non-survival group had shock.

This shows a higher incidence of expiry among ventilated babies with shock. This observation was statistically significant as p value calculated to be <0.05 giving an inference that there is a positive correlation between mortality on ventilator and incidence of shock.

Higher mortality rate of 65.8% (23/35) and lower survival rate of 34.2% (12/35) among ventilated neonates with shock was observed.

Present study revealed more number of ventilated neonates with shock expired similar to other studies like Nasreen et al¹¹ and Shanti et al⁷.

In contrary, Anantharaj et al⁵ revealed higher survival rates than expiry in ventilated neonates with shock.

STUDY	INCIDENCE	SURVIVAL RATE AMONG VENTILATED NEONATES WITH SHOCK
Present study	21.5%	34.2%
Anantharaj et al	49%	57.1%
Nasreen sultana et al	64.1%	17.6%
Shanti et al	24%	5.3%

P value < 0.05 , statistically significant emphasizing importance of shock in outcome of ventilated neonates.

INCIDENCE AND OUTCOME OF PULMONARY HEMORRHAGE:

In this study, out of 163 children 14.7%(24/163) had pulmonary haemorrhage and rest 85.3%(139/163) had no pulmonary haemorrhage.

Among babies survived, 7.1%(6/85) had pulmonary haemorrhage and in expiry group 23.15(18/78) had pulmonary haemorrhage. This shows higher incidence of mortality among neonates with pulmonary haemorrhage. This observation was statistically significant as p value calculated to be <0.05 showing pulmonary haemorrhage as an important variable for mortality of ventilated newborns.

Higher mortality rate of 75% (18/24) and lower survival rate of 25% (6/24) among ventilated neonates with pulmonary hemorrhage was observed.

In the study done by Karthikeyan et al⁶ ,7.7% infants developed pulmonary hemorrhage. Studies done by Riyas et al¹⁰ showed 0.9% incidence of pulmonary haemorrhage with 0% survival, Shanthi et al⁷ with 2.5% incidence and 0% survival rate.

Other studies by Anantharaj et al¹⁷ showed 7%(7/100) incidence with survival in 14.3% (1/7).

STUDY	INCIDENCE	SURVIVAL RATE AMONG VENTILATED NEONATES WITH PULMONARY HEMORRHAGE
Present study	14.7%	25%
Anantharaj et al	7%	14.3%
Shanti et al	2.5%	0%
Riyas et al	0.9%	0%

INCIDENCE AND OUTCOME OF SEPSIS:

In this study among 163 children studied, 15.4%(25/163) had sepsis and 84.6%(138/163) had no incidence of sepsis. Among the babies survived, 9.4% (8/85) had sepsis and among expiry group 21.8%(17/78) had sepsis. This shows a higher incidence of mortality in babies ventilated with sepsis as a complication. This observation was statistically significant as p value calculated to be <0.05 emphasizing sepsis as an important factor contributing to mortality of ventilated neonates.

Higher mortality rate of 68% (17/25) and lower survival rate of 32%(8/25) among ventilated neonates developed sepsis was observed.

Study by Riyas et al¹⁰ showed incidence of sepsis in 38.2% ventilated neonates with 64.1% survival rate and 35.8% mortality. Nasreen et al¹¹ found incidence of 67.9% with survival in 25%, karthikeya et al⁶ with 9% incidence, Anantharaj et al⁵ with 44.4% survival rate with sepsis as a complication. Other studies comparing survival and non survival among ventilated children with septicemia is tabulated below.

STUDY	INCIDENCE	SURVIVAL RATE AMONG VENTILATED NEONATES WHO DEVELOPED SEPSIS
Present study	15.4%	32%
Nasreen sultana et al	67.9%	25%
Riyas et al	38.2%	64.1%
Anantharaj et al	18%	44.4%

INCIDENCE AND OUTCOME OF VAP:

In this study among 163 babies studied, 14.75(24/163) had VAP and 85.3%(139/163) had no VAP. Among babies survived, 10.6% (9/85) had incidence of VAP and the incidence was 19.2%(15/78) among non-survival group. This shows a higher incidence of mortality in neonates with VAP. P value was >0.05, statistically insignificant.

Higher mortality rate of 62.5% (15/24) and lower survival rate of 37.5% (9/24) among ventilated neonates with VAP was observed.

Other studies like Nasreen et al¹¹ found incidence of 26.4%, . Shanti et al revealed 8.8% incidence of VAP with 85.7% survival rate.

The use of minimal required pressures, shortest possible duration of ventilation, careful attention to endotracheal toilet and vigorous post-tubation chest physiotherapy possibly have contributed to this relatively low incidence of complications.¹²

SUMMARY

- In the current study, survived on ventilator were 52.1% and mortality was 47.9%
- In the current study, incidence of air leak in the survived group was 2.4% and in non survivor group was 6.4%.
- The incidence of tube block in survived group was 1.2% and in non survivor group it was 5.1%.
- In the current study, incidence of shock was 21.5%. In the survived group it was 14.1% and in non survivor group it was 29.5%.
- In the current study, incidence of pulmonary haemorrhage was 14.7%. In the survived group it was 7.1% and in non survivor group it was 23.1%.
- In the current study, incidence of septicemia was 14.7%. In the survived group it was 9.4% and in non survivor group it was 21.8%.
- In the current study, incidence of ventilator associated pneumonia in survived group was 10.6% and in non survivor group 19.2%.

CONCLUSION

In our study, the survival rate of ventilated babies was 52% and about half of them developed complications. Among the factors analyzed, presence of sepsis and pulmonary hemorrhage were predictive of poor outcome.

REFERENCES

1. Meharban Singh. The Current status and Challenges of Perinatal Services in India. Care of the Newborn, Sixth edition August 2004; 2: 12-19.
2. Meharban Singh. Assisted Ventilation and Advanced Life Support. Care of the Newborn, Sixth edition August 2004; 27: 424-452.
3. Malhotra AK, Nagpal R, Gupta RK, Chhajta DS, Arora RK. Respiratory distress in newborn: treated with ventilation in a level II nursery. Indian pediatrics. 1995 Feb 1;32:207-.
4. Mathur NC, Kumar S, Prasanna AL, et al. Intermittent positive pressure ventilation in a neonatal intensive care unit: Hyderabad experience. Indian Pediatr 1998; 35: 349-352.
5. Ananthraj et al. Outcome of neonates requiring assisted ventilation. The Turkish journal of pediatrics 53(5):547-53
6. Karthikeyan G, Hossain MM. Conventional ventilation in neonates: experience from Saudi Arabia. Indian J Pediatr 2002; 69: 15-18.
7. Shanti et al. Clinical Profile and Outcome of Mechanically Ventilated Neonates in a Tertiary Level Hospital. Journal of Nepal Paediatric Society 35(3):218
8. Monsef et al. Evaluating the Short-Term Outcome of Mechanically Ventilated Neonates Admitted to the Neonatal Intensive Care Unit of Besat Hospital, Hamadan, Iran. International Journal of Pediatrics, 7, 10029-10034.
9. Haneef et al. Study of clinical profile and short-term outcome of neonates requiring assisted mechanical ventilation. MedPulse International Journal of Pediatrics. April 2021; 18(1): 13-
10. Riyas PK, Vijayakumar KM, Kulkarni ML. Neonatal mechanical ventilation. Indian J Pediatr 2003; 70: 537-540.
11. Nasreen et al SN, Khan MM, Islam MT, Afroze S, Jahan I, Dey SK, Mannan MA, Shahidullah M. Clinical Profile and Outcome of Neonates Requiring Mechanical Ventilation. Birth. 2019;37(11):20-8.
12. Bhakoo, Narang A, Ghosh K. Assisted ventilation in neonates: An experience with 120 cases. Paper presented at IX Annual Conference, National Neonatology Forum, Manipal, February 17-20, 1990.