



St. Paul Hospital Millennium Medical College
Graduate Study Program

Clinical Profile And Outcome Of Mechanically Ventilated Neonatesin Neonates
Admitted To Intensive Care Unit In St. Paul's Hospital Millennium Medical
Collage

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CLINICAL PROFILE AND OUTCOME OF MECHANICALLY VENTILATED
NEONATES ADMITTED TO THE NEONATAL INTENSIVE CARE UNIT IN
ST. PAULS HOSPITAL MILLENNIUM MEDICAL COLLEGE

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Abstract

Background: The neonatal phase is widely recognized as a highly vulnerable period of life. During this time, the child is at the highest risk of dying. The use of mechanical ventilation is an essential treatment approach for caring for unwell neonates. Even though there is significant mortality rate in mechanically ventilated neonates, its use has helped in survival of sick neonates.

Objectives: To assess the clinical profile and outcome of mechanically ventilated neonates admitted to neonatal intensive care unit in SPHMMC, Addis Ababa, Ethiopia from September 2021 to August 2023.

Methods: A retrospective institution-based cross-sectional study was conducted of neonates who were admitted and mechanically ventilated in the NICU in SPHMMC paediatric and child health department between September 2021 to August 2023. A pretested and structured questionnaire was prepared and used to collect data elements from the respective patient's records, and data was entered & analysed using SPSS version 26. Descriptive statistics, univariate and multivariate binary logistic regression was performed.

Result: Among 161 mechanically ventilated neonates 59.6% were male, 40.4% were females. The most common indication for MV was RDS in 26.1% neonates. The most common complication observed during the course of MV was pulmonary haemorrhage and seizure (22 and 17 cases). There was significant negative association between gestational age and mechanical ventilation and there is also significant negative association between MAS and mortality. Pulmonary haemorrhage has significant association with mortality. The overall survival rate was 39.8%.

Conclusion: RDS was the most frequent reason for the application of Mechanical Ventilation (MV). The complications most often observed were seizures and pulmonary haemorrhage. Preterm infants represent the group most at risk for requiring mechanical ventilation.

Key words: Neonate, mechanical ventilator, outcome, NICU, SPHMMC

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ACRONYMS AND ABBRIVATIONS

DIC- Disseminated intravascular coagulation.

EDHS- Ethiopian demographic and health survey

HDU- high dependence unit

HIE- hypoxic ischemic encephalopathy

HMD hyaline membrane disease

MAS- meconium aspiration syndrome

MOD- multiorgan dysfunction

MV- mechanical ventilator

NICU- neonatal intensive care unit

PPHTN- persistence pulmonary hypertension

RDS- respiratory distress syndrome

SPHMMC- Saint Paul's hospital millennium medical collage

UNICEF- united nations international children's emergency fund

VAP- ventilator associated pneumonia.

WHO- worlds health organization

CHAPTER ONE

1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The neonatal phase is widely recognized as a highly vulnerable period of life, primarily because it is characterized by distinct medical and health issues that predominantly affect infants born prematurely or with low birth weight. Access to health is low in developing countries and these are the places where the majority of new-born deaths occur.(1)

Neonatal morbidity and mortality have reduced significantly in the last decade due to Advances in perinatal and neonatal care. There is marked disparity in neonatal mortality across regions and countries. Neonatal mortality was highest in developing countries and specifically in the sub-Saharan Africa and South Asia. (2) In the developed countries, the main cause of morbidity and mortality in the neonatal period is congenital abnormalities which are mostly non-preventable, but in the developing countries the common causes are infections, jaundice, birth asphyxia and pneumonia.(3)

More deliveries are being conducted at hospitals with the improvement in health care and the education of masses. Hence, more critically ill neonates are reaching the intensive care units. The majority of these neonates admitted to NICUs require mechanical ventilation. (3)

The use of mechanical ventilation is an essential treatment approach for caring for unwell neonates. Even though there is significant mortality rate in mechanically ventilated neonate, its use has helped in survival of sick neonates.(4). The extensive utilization of mechanical ventilation in neonatal intensive care units (NICU) has been linked to significant enhancements in the survival rates of neonates who require critical care (6). SPHMMC is the first government hospital to open a mechanical ventilation unit for neonates. It started in September 2021.

Mechanical ventilation was deemed necessary under the following conditions: when respiratory distress was observed with a Downes score of 7 or higher; in cases of apnoeic spells; and when

oxygen saturation levels were below 88% for preterm infants less than 34 weeks old, and below 94% for infants over 34 weeks old who were receiving oxygen therapy. The oxygen therapy itself involved low flow rates of 0.5-2 l/min administered through nasal prongs for infants weighing less than 2.5 kg, or headbox oxygen for those weighing more than 2.5 kg.(5)

The availability of MV and the introduction of surfactant and total parenteral nutrition have contributed to a significant reduction in neonatal mortality rates in developed nations. (7). Its widespread use in neonatal intensive care units (NICU) has also been associated with cardinal improvement of the survival of critically ill neonates(6) However, the optimal operation of NICUs is reliant not only on costly advanced technology and intricate infrastructure but also on proficient medical and nursing personnel as well as the backing of a multidisciplinary team that includes laboratory and radiological services. (7)

1.2 STATEMENT OF THE PROBLEM

The neonatal period is the most precarious in terms of survival. During their first month of life, children are at the highest risk of dying, with an average global rate of 18 deaths per 1,000 live births in 2021. This is a significant decrease from 37 deaths per 1,000 live births in 1990. In Ethiopia it ranged from 19.9 to 34.3 with a median of 26 deaths per 1000 live birth. By comparison, the probability of dying between the first and twelfth month of life was estimated at 11 deaths per 1,000, and the probability of dying between the first and fifth year of life was estimated at 10 deaths per 1,000 in 2021. In 2021, 2.3 million children died during the neonatal period, which translates to roughly 6,400 neonatal deaths per day worldwide. (2) Most of the neonatal deaths (99%) occur in the lower to middle income countries and half of them occur at home. (3)

According to WHO 2021 data, Sub-Saharan Africa has the highest neonatal mortality rate in the world (27 deaths per 1000 live births) with 43% of global newborn deaths, followed by central and southern Asia (23 deaths per 1000 livebirths), with 36% of global newborn deaths.(8)

whereas The neonatal mortality of Ethiopia as per EDHS 2019 data is 33 per 1,000 live births(9)

Most of the causes of neonatal mortality and morbidity are preventable. The pattern of neonatal diseases varies from place to place. The major causes of neonatal deaths globally were estimated to be infections (35%), preterm births (28%) and asphyxia (23%)(3)

In developed countries 64%-68% of those mechanically ventilated survive to discharge. However in developing countries, the situation is not encouraging where the mortality ranges from 40-60%(10)

1.3 SIGNIFICANCE OF THE STUDY

The prime responsibility of a neonatologist is to reduce the neonatal mortality and reduce the neonatal morbidity. In order to accomplish this job, it is important to know the factors which are associated with high neonatal mortality. Though mechanical ventilation is widely used in many developing countries including Ethiopia, based on my online search we do not have any published data on the survival of these babies along with factors inferring its outcome there in Ethiopia. There is also a paucity of data regarding neonates requiring mechanical ventilation in Africa. 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. SPHMMC is also the first government hospital to start neonatal mechanical ventilation and reflecting its outcome and challenges would be a help for the country.

In conclusion, this study will help strengthen the neonatology unit in SPHMMC by promoting effective practices and providing quality service to the patients seen in the department as well as be a baseline data for those interested in carrying out further studies in the future in this area.

And this will also provide data that may guide the people involved to include children within discussions, policy development, and tangible outcomes.

2 CHAPTER TWO

2.1 LITERATURE REVIEW

Hospital based retrospective study conducted at Chitwan Medical College (CMC) in Nepal for the duration of 2 years, from February 2015 to January 2017 showed that sepsis was the most common indication for MV, followed by Birth asphyxia (BA), respiratory distress syndrome/hyaline membrane disease (RDS/HMD) and Meconium Aspiration Syndrome (MAS)

The study also found that the overall survival rate was 37.8% with best survival rate observed in cases of birth asphyxia. During ventilation, shock and DIC were the most commonly encountered complications. Increasing birth weight, higher gestational age and Downes Score at intubation of 6 or less was associated with a better outcome. Statistical analysis revealed that shock, multi organ dysfunctions (MODS), and ventilator associated pneumonia (VAP) were individual predictors of outcome.(4)

In a study conducted in Cairo university in Egypt found that the incidence of complications associated with mechanical ventilation was 43.3%, with an observed increased in ventilator-associated pneumonia (VAP) of 20%. Disease pattern related complications were reported at 56.7% and 22.5% for sepsis and septic shock respectively. Of the neonates studied, 51.7% had favorable outcomes, while the remaining 48.3% passed away, with a significant increase in the incidence of VAP ($P=0.013$). The study also identified smaller gestational age and lower birth weight as the most significant risk factors. (7)

A study conducted at Deenanath Hospital in Pune, Maharashtra, India in 2017 found that out of 72 neonates studied, most preterm cases were ventilated for respiratory distress syndrome (RDS) at 89.5%, and the majority of full-term cases were ventilated for meconium aspiration syndrome (MAS) at 100%, followed by hypoxic-ischemic encephalopathy (HIE) at 88.89%. The study also revealed that the duration of ventilation was not statistically associated with the indication of mechanical ventilation, with a p-value of 0.301.(11)

A study conducted at Jawaharlal Institute of Postgraduate Medical Education and Research in Puducherry, India involved 100 babies, of which 54 were preterm, 44 were term, and 2 were post-term. The overall survival rate was 58%. Meconium aspiration syndrome was the most

common indication for ventilation in term babies, while hyaline membrane disease was common in preterm cases. Babies ventilated for pneumonia had the best outcome, while the poorest outcome was observed in cases of sepsis. The study found that survival significantly increased with increasing birth weight and gestational age. Downes score, Apgar score, and pH at birth did not correlate significantly with outcome. Shock was the most common complication, and the incidence of disseminated intravascular coagulation, pulmonary hemorrhage, and pneumothorax was significantly higher in non-survivors. However, none of these factors independently predicted mortality.(12)

A study conducted at Government Medical College in Ernakulam, Kerala, India involved 100 ventilated babies, of which 72 were preterm, 25 were term, and 3 were post-term. The overall survival rate was 75%, and the most common indication for ventilation was hyaline membrane disease (HMD). The study found that higher birth weight and gestational age were significantly associated with a better outcome, with birth asphyxia having the best outcome at 100% survival. The age at the initiation of ventilation was significantly lower in the survivors. The complications that were independently predictive of death were disseminated intravascular coagulation (DIC) and pulmonary hemorrhage..(5)

A study conducted in Department of Paediatrics and Adolescent Medicine, B P Koirala Institute of Health Sciences, Dharan, Nepal involved a total of 361 neonates were admitted to the NICU. Of these, 86 neonates (23.8%) were admitted due to prematurity and 73 (20.2%) due to birth asphyxia. Among those with birth asphyxia, 40 (54.8%) were in HIE III, 27.4% in HIE II and 17.8% in HIE I. One hundred eighteen (32.6%) cases were diagnosed as sepsis. The overall mortality rate during hospital stay was 20.2%.(3)

A study conducted at the Combined Military Hospital/National University of Medical Sciences (NUMS) in Rawalpindi, Pakistan found that 67 neonates were ventilated during the study period for various reasons. Of these 67 neonates, 35 (52.23%) died and 32 (47.76%) survived to be discharged home. Ten babies were born less than 28+0 weeks gestation, and all (100%) expired. Of seven babies born between 28+1-31+6 weeks gestation, only one (14.28%) survived. Of 50 newborns between 32+0-36+6 weeks, 20 (40%) died and 30 (60%) survived to be discharged home. In the cohort of ventilated babies, seven weighed less than 1000 gm of which six (85.71%) died and only one (14.28%) survived. Of 18 babies born weighing between 1000-1499

gm, 14 (77.77%) died and four (22.22%) survived. Of 14 babies born weighing between 1500-2499 gm, six (42.85%) died and eight (57.14%) survived. Out of all ventilated babies, 28 weighed more than 2500 gm, of which ten (35.71%) died and eighteen (64.28%) survived. Fourteen were diagnosed with hypoxic ischemic encephalopathy grade 3, of which eleven (78.57%) died and three (21.42%) were discharged. Twenty-three had RDS, of which eleven (47.82%) died and twelve (52.17%) survived. Ten babies were ventilated due to sepsis, of which six (60%) died and four (40%) survived.(10)

A study conducted in the Intensive Care Unit (ICU) of Dhaka Shishu (Children) Hospital (DSH) found that during the study period, a total of 51 out-born critically sick neonates were ventilated due to different causes. Out of these 51 neonates, 58.8% were male with a male to female ratio of 1.42:1. The mean age, weight and gestational age were 5.3 ± 6.5 days, 2171 ± 796.2 gm and 34.8 ± 4.1 weeks respectively. Out of the 51 mechanically ventilated neonates enrolled for this study, 70.6% died. Factors significantly different in no survivors were mean weight, mean gestational age, initial arterial pH and duration of hospital stay ($p < 0.05$). Weight < 2500 gm, gestation < 34 weeks, initial pH < 7.1 , $\text{PaCO}_2 > 60$ mmHg, serum sodium < 130 mmol/l, serum potassium < 3.5 mmol/l and $\text{FiO}_2 > 60\%$ were significantly associated with mortality in neonates requiring mechanical ventilation ($p < 0.05$). A significant relation with mortality was found in those neonates who developed complications during ventilation ($p = 0.01$). (13)

In a research carried out in the Neonatal Intensive Care Unit (NICU) of a tertiary care referral hospital in North India. The study involved 300 neonates who required ventilation. Of these, 52% were boys. The average age, weight, and gestational age were 21 ± 62 hours, 2320 ± 846.2 grams, and 35.2 ± 4.9 weeks, respectively. Unfortunately, 43% (130) of these neonates did not survive. The primary reasons for ventilation were Respiratory Distress Syndrome (RDS) (31.1%), sepsis (22.7%), and birth asphyxia (18%). The mortality rates for ventilated patients with sepsis, pneumonia, RDS, or birth asphyxia were 64.7%, 60%, 44.6%, and 33.3%, respectively. Factors significantly associated with mortality ($P < 0.05$) included weight less than 2500 grams, gestation less than 34 weeks, initial PH less than 7.1, presence of sepsis, apnea, shock, Pulmonary hemorrhage, pneumothorax, hypoglycemia, neutropenia, and thrombocytopenia. However, resuscitation at birth, seizures, intraventricular hemorrhage, pneumothorax, ventilator-associated pneumonia, PO_2 , or PCO_2 did not show a significant

association with mortality. Upon logistic regression analysis, gestation less than 34 weeks, initial PH less than 7.1, pulmonary hemorrhage, and shock emerged as independently significant predictors of mortality.(14)

a study conducted at El-Zahraa University Hospital in Egypt, involving 110 neonates who required mechanical ventilation. The gender distribution was 58.2% males and 41.8% females. The primary reason for mechanical ventilation was respiratory distress syndrome (RDS), affecting 30% of the neonates. The most frequent complications related to mechanical ventilation were Ventilator Associated Pneumonia and Device Associated Infection, occurring in 19.1% and 11.8% of the cases, respectively. Septic shock and multiorgan failure, occurring in 24% of the cases, were the most common complications related to the underlying disease. There was a significant negative correlation between gestational age, birth weight, and mortality in mechanically ventilated neonates. The overall recovery rate among the studied neonates was 59.1%..(15)

3 CHAPTER THREE

3.1 OBJECTIVES

3.1.1 General Objectives

To assess the clinical profile and outcome of mechanically ventilated neonates admitted to the neonatal intensive care of St Paul's hospital millennium medical college.

3.1.2 Specific Objectives

- ✓ To assess the indication for mechanical ventilation in neonates admitted to NICU.
- ✓ To assess the complications associated with mechanical ventilation in neonates admitted to NICU.
- ✓ To determine the outcome of neonates that required mechanical ventilation in NICU.

4 CHAPTER FOUR

METHODS AND MATERIALS

4.1 Study Area and Period

4.1.1 Study area

- This study was conducted in St. Paul's hospital millennium medical college. SPHMMC is the second largest hospitals in the capital Addis Ababa with a catchment population of more than 5 million. The hospital was established in 1969 GC by the late emperor Haile Selassie and is currently governed by a board under the federal ministry of health. In addition to an inpatient capacity of more than 700 beds, on average 1200 emergency and outpatient clients are seen daily in the hospital. Neonatal Intensive care unit has 4subunits, HDU, Subcritical, stable and KMC.

SPHMMC is the first government hospital to open a mechanical ventilation for neonates. It started on September 2021

4.1.2 Study period

- The study was conducted over 2years period (September 2021 – August 2023)

4.2 Study design

- A retrospective hospital based descriptive cross-sectional study design was implemented.

4.3 Source Population

- All neonates who were admitted in the NICU Saint Paul's hospital millennium medical college.

4.4 Study population

- All neonates who were admitted and mechanically ventilated in the NICU saint Paul's hospital millennium medical collage during the study period.

4.5 Eligibility criteria

4.5.1 Inclusion criteria

- Subjects for the study included all neonates who were admitted to NICU and treated with mechanical ventilation at the study period

4.5.2 Exclusion criteria

- Neonates with incomplete or missing charts
- Neonates who were intubated for surgical procedures and extubated thereafter.
- Neonates who were initially mechanically ventilated and later diagnosed to have lethal congenital anomaly and extubated.

4.6 Sample size determination

4.6.1 Sampling techniques and procedures for record reviews.

- All neonates admitted to NICU and mechanically ventilated from September 2021 to August 2023 and met the inclusion criteria were included in this study.

4.7 Methods of Data Collection for record reviews

- Data was collected by trained residents using structured questionnaire. The Card number of the patient as also documented to prevent missing and duplication of data & it was erased after data collection was completed.

4.8 Variables

4.8.1 Dependent variable

- Outcome of mechanically ventilated neonates

4.8.2 Independent variables

- Age
- Sex
- GA
- BW
- Place of delivery
- Mode of delivery
- Downes score
- Diagnosis
- Indication for mechanical ventilation
- Age at mechanical ventilation
- Duration of mechanical ventilation

- Complication during mechanical ventilation

4.9 Data Quality Control

- To assure the quality of data, structured questioner was used, and the principal investigator had an ongoing supervision each day during the data collection to ensure the quality of data by checking field format for their completeness and consistency

4.10 Methods Data Analysis and interpretation

- After data collection the completeness of each questionnaire was checked based on the code given during data collection
- Data was entered, cleared, and analysed using SPSS version 26 software package. The generated data was compiled by frequency tables, graphs, and pie charts. Univariate binary logistics regression was used for each independent variable with the outcome. Variables with significant association ($P < 0.25$) were entered into multivariate binary logistic regression model to detect predictors of mortality in mechanically ventilated neonates. A $P < 0.05$ was considered as statistically significant and $p < 0.01$ was considered highly significant.

4.11 Ethical considerations

- Ethical clearance was obtained from SPHMMC research review board. None of the information on the charts and reports was used for purposes other than the study mentioned. Patient anonymity, privacy and confidentiality of records was respected.

4.12 Operational Definition

Neonate: an infant from birth to 28days of age

Neonatal mortality: number of deaths during the first 28 completed days of life per 1000 live births in a given year or another period. (WHO)

Mechanical ventilation: technique through which gas is moved toward and from the lungs through an external device connected directly to the patient.

Intubation: the insertion of a tube either through the mouth or nose and into the airway to aid with breathing or deliver anaesthesia.

RDS: Respiratory distress which occurs within the first 6hrs after birth in preterm neonates due to possible surfactant deficiency as described by the treating physician.

Sepsis: life-threatening organ dysfunction caused by an unregulated response of a host. It is SIRS in the presence of or as a result of suspected or proven infection.

Birth asphyxia: failure to initiate breathing manifested by APGAR score of <3 for 10min and need for resuscitation.

MAS: respiratory distress in new-born infants born through meconium-stained amniotic fluid (MSAF) whose symptoms cannot be otherwise explained

VAP: pneumonia (lung infection) that develops in a patient who has been on mechanical ventilation for more than 48 hours.

Apnoea: cessation of breathing for more than 20 seconds, or a shorter respiratory pause associated with oxygen desaturation and/or bradycardia.

Downe's score: a clinical scoring system for the assessment of the severity of respiratory distress objectively. A total score of 0 suggests no distress, score of 1–4 mild RD, score of 5–7 moderate RD, and score of >7 severe distress or impending respiratory failure.

Score	0	1	2
Respiratory(rate/min)	<60	60-80	>80
Cyanosis	None	At room air	With 40% O ₂
Retraction	None	Mild	Moderate-Severe
Grunting	None	Audible with stethoscope	Audible without stethoscope
Air entry	Clear	Mildly decreased	Markedly decreased

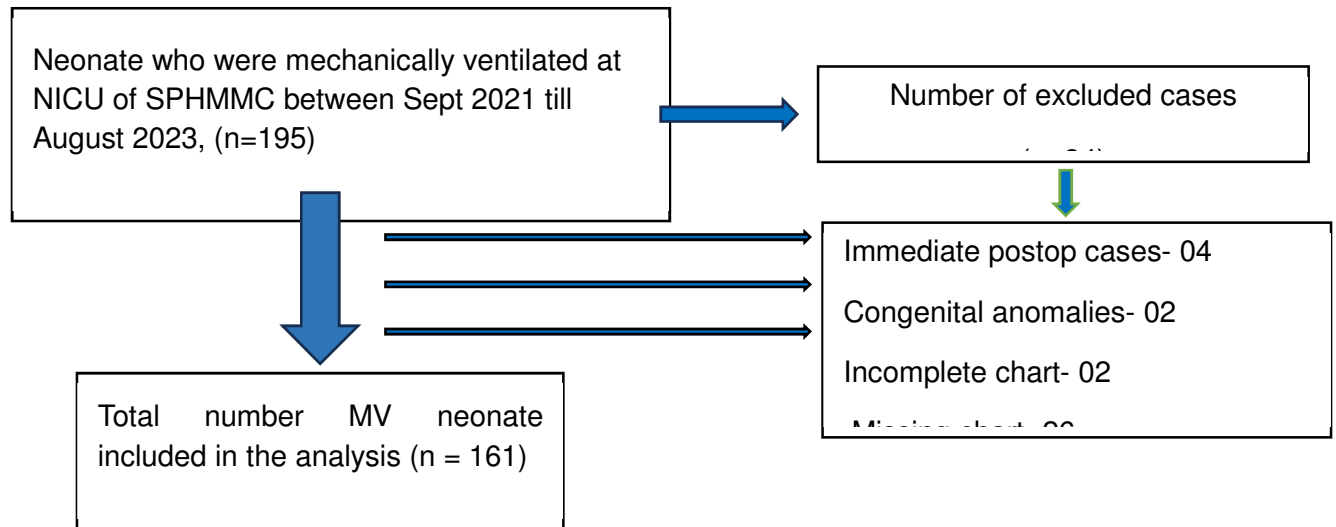
Pulmonary haemorrhage: Appearance of frank blood originating from the airway (usually seen in the ET tube) which is accompanied by acute clinical deterioration.

4.13 Plan for dissemination of results

After completion of the data, the results of the research will be presented to SPHMMC's department of pediatrics and child health. The findings will be sent for publication on relevant scientific journals and disseminated online so that they can be of use for other academic researchers and clinical practitioners. They might also be presented on different conferences and professional society meetings like Ethiopian Society of pediatrics and child health. The data can also serve as a base line for future studies.

5 Result

In this study a total of 161 neonates were analysed.



The male to female ratio was 1.47:1 with male predominance of 96(59.6%) and females were 65(40.4%).

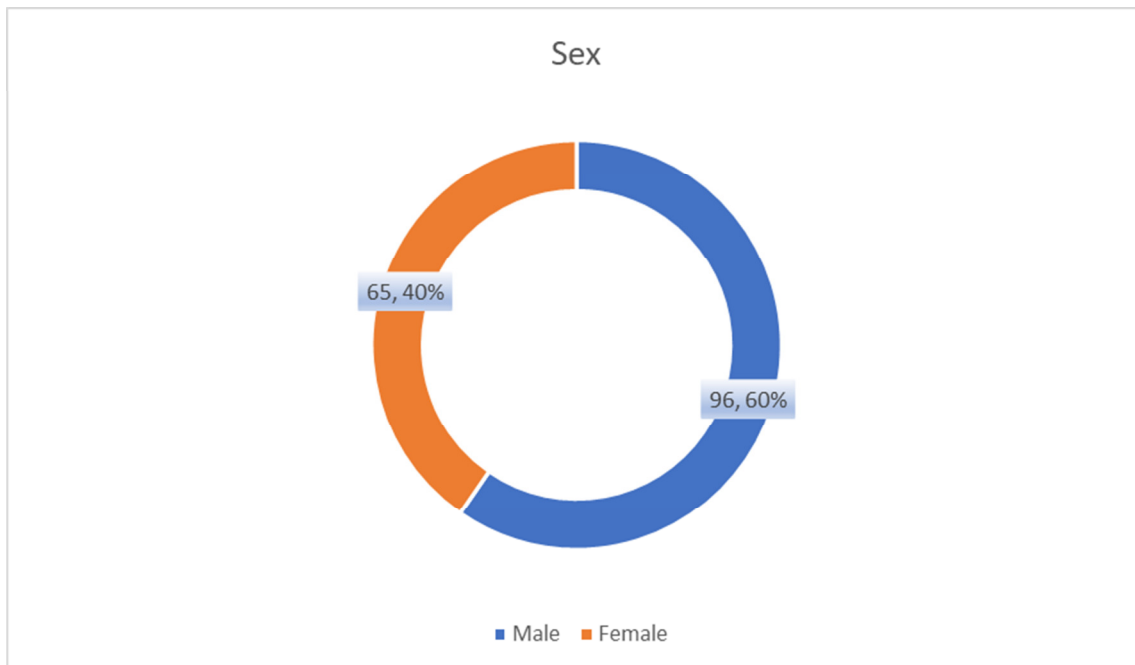


Figure 1 sex distribution of mechanically ventilated neonates in NICU of SPHMMC Addis Ababa, Ethiopia from September 2021- August 2022

In this study majority of neonates were inborn accounting for 97 (60.2%) and those delivered out born were 64 (39.8%).

Regarding the mode of delivery, the rate of vaginal delivery and caesarean section was almost comparable 80 (49.7%) and 81 (50.3%) respectively.

Looking at the gestational age distribution of the neonates, the majority of mechanically ventilated neonates were term which accounted for 83 (51.6%) followed by early preterm 45 (28%) and the least was moderate preterm which accounted for 33 (20.5%).

Table 1 Gestational age distribution of the neonates who were mechanically ventilated in the NICU of SPHMMC, Addis Ababa Ethiopia from September 2021- August 2023

S.No	GA (in weeks)	Frequency	Percent
1.	Early preterm ($\leq 32 \frac{6}{7}$)	45	28%
2.	Moderate Preterm (33- 36 $\frac{6}{7}$)	33	20.5%
3.	Term (≥ 37)	83	51.5%
Total		161	100

The majority of neonates were admitted at the age of <72 hours accounting for 148(91.9%) while those >72 hours were 13 (8.9%).

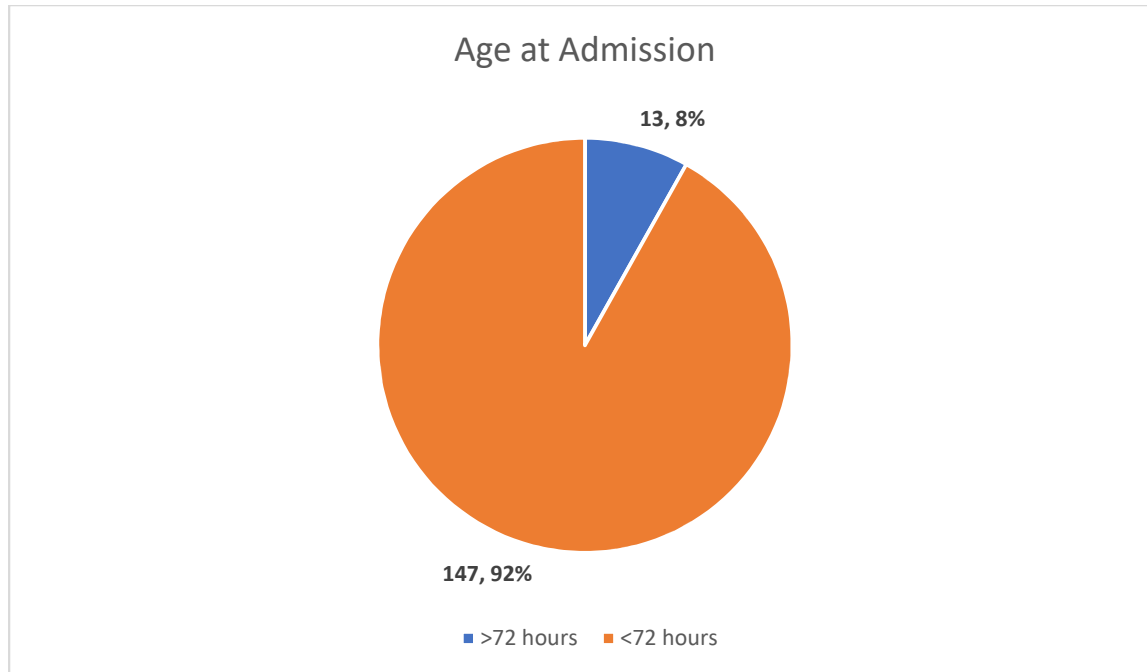


Figure 2: Age at admission of neonates mechanically intubated in NICU of SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023.

The median birth weight of the mechanically ventilated neonates was 2395grams. Most of them were in the birth weight group of >2500 grams accounting for 79(49.1%) followed by those in the group 1000-1499 grams accounting for 31 (19.3%), and the minority group were in the <1000 grams accounting for 8(5%).

Table 2: Birth weight distribution of mechanically ventilated neonates in NICU of SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023

S.No	Birth weight (in gram)	Frequency	Percent
1.	<1000	8	5
2.	1000-1499	31	19.3
3.	1500-1999	24	14.9
4.	2000-2499	19	11.8
5.	<u>≥2500</u>	79	49.1

Total	161	100.0
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The majority of the neonates had a Downe's score of <7 before mechanical ventilation accounting for 145 (90%) while the rest 16 (10%) had a Downe's score of >7.

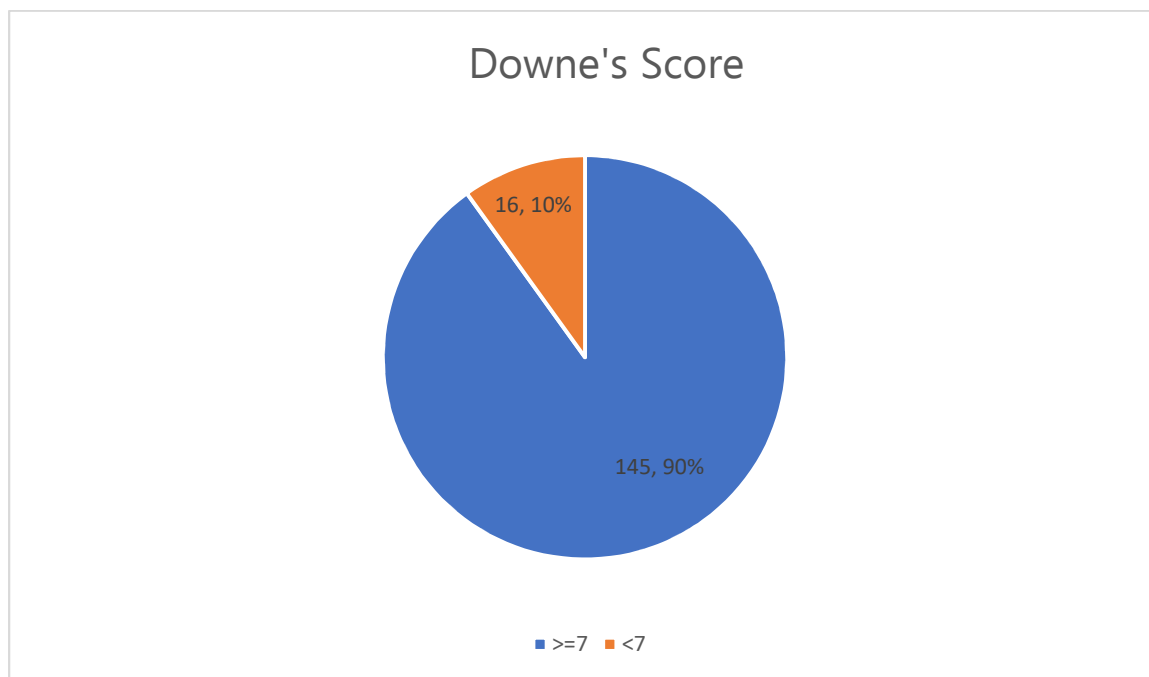


Figure 3 Downe's score of neonates before intubation at NICU, Addis Ababa, Ethiopia from September 2021- August 2023

The age at mechanical ventilation in most of them was <72 hours accounting for 118 (73.3%) the mean hour at admission being 20.73 hours while the rest 43(26.7%) were >72 hours of age and the mean age was 7.0 days.

The most common indication for mechanical ventilation was respiratory distress syndrome accounting for 42 (26.1%), followed by Sepsis and MAS which accounted for 35 (21.7%) and 30 (18.2%) respectively.

Table 3: Indication for mechanical ventilation in neonates admitted to SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023

S.No.	Indication	Frequency	Percentage(%)
1.	Severe RDS	42	26.1
2.	Severe Sepsis	35	21.7
3.	Severe MAS	30	18.6
4.	Asphyxia with stage 3 HIE	22	13.7
5.	Congenital anomalies	9	5.6
6.	Apnea of prematurity	8	5
7.	Status Epilepticus	6	3.7
8.	Shock	5	3.1
9.	Others	4	2.55
Total		161	100.0

There were four types of respiratory support utilized before Mechanical ventilation of which CPAP (Continuous Positive Airway Pressure) was the most common, used in 122 (75.8%) neonates, followed by BMV (Bag-Valve-Mask) which was used in 19(11.8%) neonates and the least used method was atmospheric air which was utilized in 4 (2.5%) of cases.

Table 4: Respiratory Support before mechanical ventilation in NICU of SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023

S.No	Type	Frequency	Percent
1.	Intranasal oxygen	16	9.9
2.	CPAP	122	75.8
3.	Atmospheric air	4	2.5
4.	BMV	19	11.8
Total		161	100.0

The most common ventilation mode used was AC/PCV which accounted for 125 (77.6%) of the cases followed by SIMV which accounted for 27(16.8%) of the cases.

Table 5: Ventilation Mode used in NICU of SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023.

S.No	Ventilation Mode	Frequency	Percent
1.	SIMV	27	16.8
2.	AC/PCV	125	77.6
3.	Undocumented	9	5.6
	Total	161	100

Most of the neonates were mechanically ventilated for <72 hours accounting for 93(57.8%) with a mean of 23.52 hours and a median of 20 hours. The neonates that were mechanically ventilated for more than 72 hours were 68(42.2%) with a mean of 4.5 days and a median of 4days.

In those neonates who were mechanically ventilated for <72hours majority if them died accounting for 67.7%.

Surfactant was given for only 13 mechanically ventilated neonates of which 12 was given for RDS and 1 was given for Severe MAS.

From those neonates who received surfactant 4(30.7%) survived and the rest 9(69.3%) had unfavourable outcome.

Most of the intubated neonates died accounting for 97(60.2%).

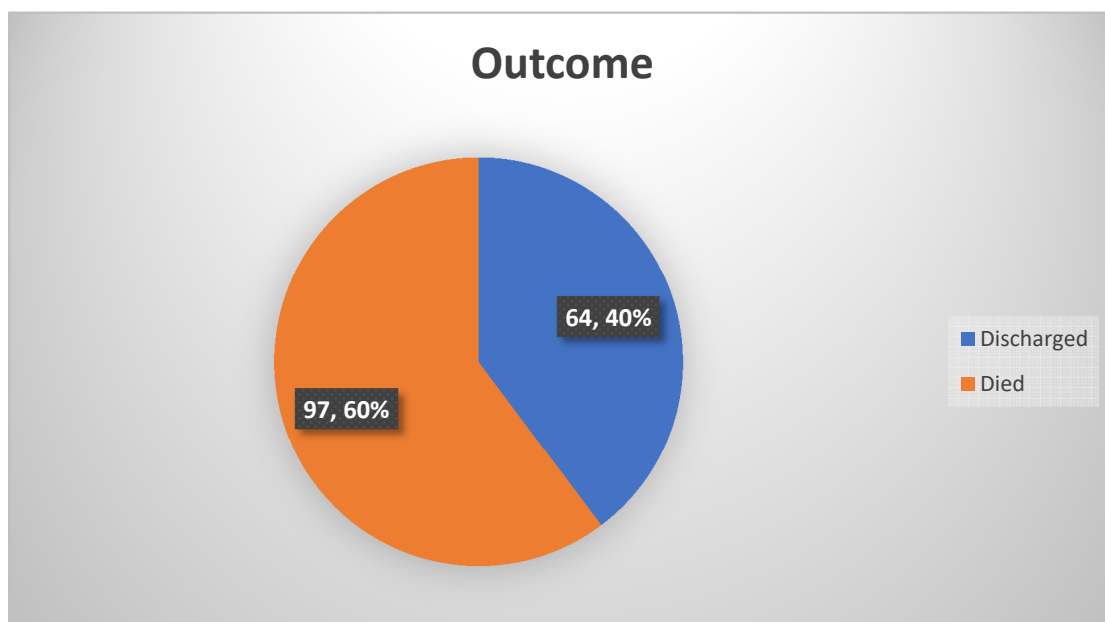


Figure 4: Outcome of mechanically ventilated neonates in the NICU of at SPHMMC, Addis Ababa , Ethiopia from September 2021- August 2023

The best outcome was seen in neonates mechanical ventilated for status epilepticus (66.7%) and MAS(60%) while Shock, RDS and Asphyxia had poor survival rate accounting for 20%, 28.6% and 31.8% respectively.

Table 6 comparison between survivor and non survivors based on the indications of mechanical ventilation in NICU of SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023

S.no	Indications	Survived (%)	Died(%)	Total
1.	Severe RDS	12(28.6%)	30(71.4%)	42(100%)
2.	Sepsis	15(42.9%)	20(57.1%)	35(100%)
3.	Severe MAS	18(60%)	12(40%)	30(100%)
4.	Asphyxia with Stage III HIE	7(31.8%)	15(68.2%)	22(100%)
5.	Apnea of prematurity	3(37.5%)	5(62.5%)	8(100%)
6.	Congenital anomalies	3(33.33%)	6(66.7%)	9(100%)
7.	SE	4(66.7%)	2(33.3%)	6(100%)
8.	Shock	1(20%)	4(80%)	5(100%)
9.	Others	1(25%)	3(75%)	4(100%)

From the 161 mechanically ventilated neonates 112 of them developed complications which could be single or multiple during their course of mechanical ventilation. The most common one being Pulmonary haemorrhage accounting for 22 cases followed by seizure and VAP accounting for 17 and 15 cases respectively.

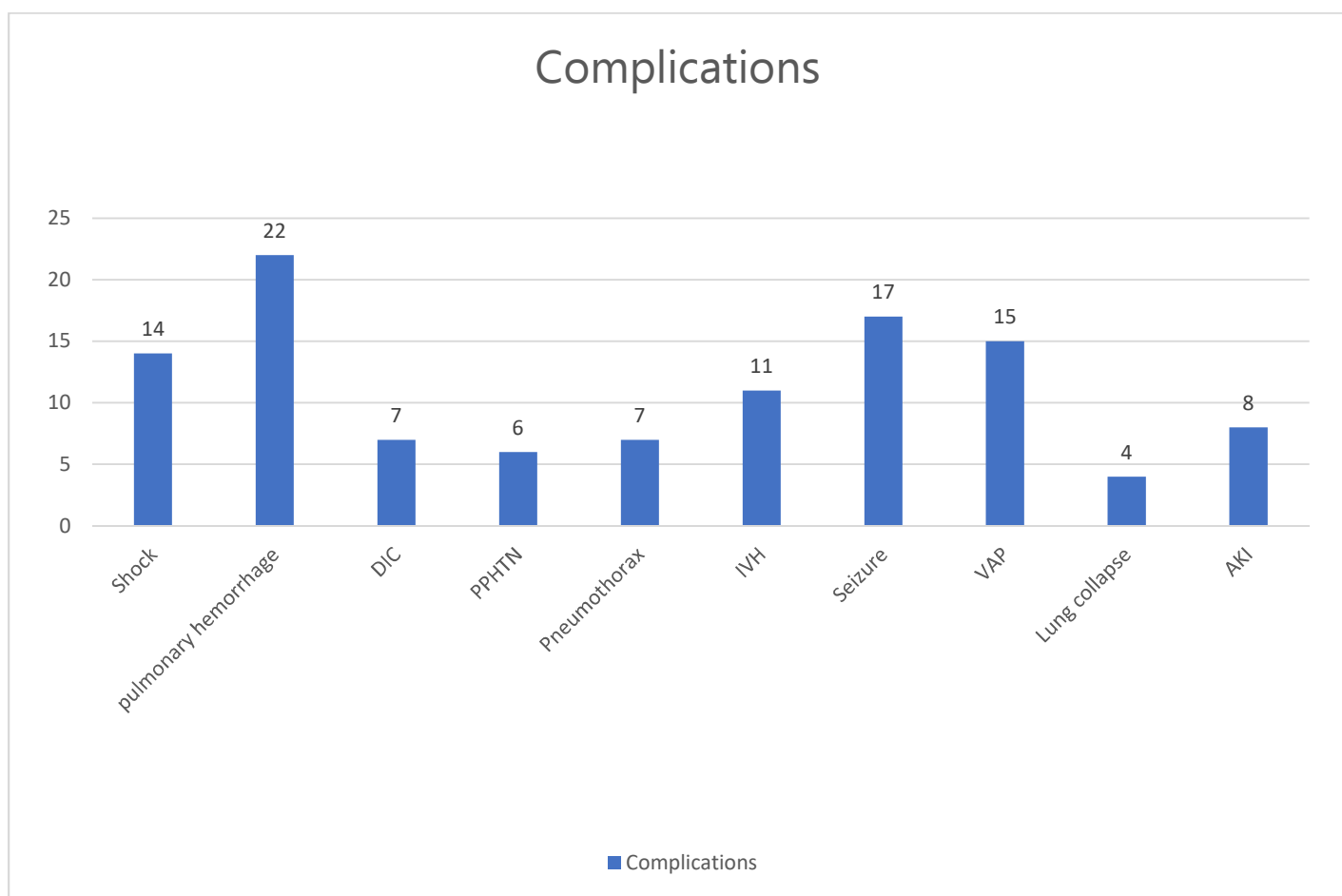


Figure 5 Complications associated with mechanical ventilation in intubated neonates in NICU of SPHMMC, Addis Ababa, Ethiopia from September 2021- August 2023

Table 7 Univariate and multivariate Binary logistic regression of selected factors associated with poor outcome in mechanically ventilated neonates in NICU of SPHMMC addis Ababa, Ethiopia from September 2021- August 2023.

Variable		n(%)	Bivariate analysis			Multivariate analysis		
			COR	95% CI	p-value	AOR	95% CI	p-value
GA Categories	Early Preterm (≤ 32 6/7)	45(27.9)	2.61	1.16-5.84	0.02	2.07	0.52-8.28	0.3
	Moderate preterm (33- 36 6/7)	33(20.5)	1.01	0.45-2.27	0.97	0.84	0.25-2.84	0.78
	Full Term (≥ 37)	83(51.6)	1					
Birthweight	<2500	82(50.9)	1.61	0.85-3.05	0.14	0.62	0.2-1.9	0.4
	≥ 2500	79(49.1)	1					
Indication								
RDS	Yes	42(26.1)	1.94	0.9-4.15	0.08	0.75	0.24-2.29	0.61
	No	119(73.9)	1					
MAS	Yes	30(18.7)	0.36	0.16-0.81	0.01	0.27	0.1-0.75	0.01
	No	131(81.3)	1					
SE	Yes	6(3.8)	0.31	0.56-1.77	0.19	0.28	0.04-1.72	0.17
	No	155(96.2)	1					
Complications								
Pulmonary	No	139(86.3)	1					
Haemorrhage	Yes	22(13.7)	17.4	2.28-133	0.006	19.3	2.32-160	0.006
VAP	No	148(91.9)	1					
	Yes	13(8.1)	0.17	0.04-0.65	0.01	0.32	0.09-1.1	0.73

AOR-adjusted Odds Ratio; COR-Crude Odds Ratio at level of significance $p < 0.05$; $p < 0.01$ is statistically highly significant; 95% CI confidence interval, GA-gestational age, VAP-ventilator associated pneumonia.

UNIVARIATE ANALYSIS

Gestational Age, pulmonary haemorrhage, and MAS showed statistically significant association. The early preterm group are 2.61 times more likely to die than full term neonates [95% CI= (1 .16-5.84) P=0.02]. Neonates having pulmonary haemorrhage complications were 17.4 times more likely to die as compared to those who didn't develop the complication [95% CI (2.28-133) P=0.006]. Neonates who developed MAS were more likely to survive as compared to those who didn't [95% CI (0.16-0.81) P=0.01].

MULTIVARIATE ANALYSIS

After adjusting for multiple variables, pulmonary haemorrhage also showed highly significant statistically association [AOR 19.3, 95% CI (2.32-160), P=0.006]. Neonates with MAS had statistically significant negative association [AOR 0.27, 95% CI (0.1-0.75), P=0.01]. In all others, no statistically significant difference was found after adjustment (Table 8).

6 Discussion

In this study, a total of 161 neonates were included with male predominance of 96(59.6%) and 65 (40.4%) were female which is consistent with a study done in Egypt (15) which included 110 neonates who required mechanical ventilation among which 58.2% were male and 41.8% were female with male to female ratio 1.39:1. The preference for the male gender might be due to the increased occurrence of respiratory distress syndrome in males compared to females. This could be attributed to the influence of testosterone on the production of surfactant.

In our study it was observed that decreasing in gestational age had poor outcome and Early preterm neonates <33weeks had 2.7times higher chance of mortality than moderate preterm and full term neonates with statistically significant P-value of 0.02 [CI=95% (1.16-5.84)] which was similar to studies done in Bangladesh(13) and Egypt(7)

With regard to the pattern of mechanical ventilation our study showed that the most common indication was RDS followed by sepsis and MAS accounting for 26.1% , 21.7% and 18.6% which was consistent with a study done in india(14) with the commonest indications were RDS (21.3%), Sepsis (22.7%) and Birth asphyxia (18%). A study done at El-zahra university (15) also showed that RDS(30%) was the commonest indication followed by Sepsis and congenital pneumonia both accounting for 16.4% which is also consistent with our finding.

Ventilation related complications are common among the ventilated neonates which influence the outcome. We found complications during the course of ventilation in 112cases, pulmonary haemorrhage was the most commonly encountered complication associated with mechanical ventilation followed by seizure and VAP which was similar to the study done in Nepal (4) in which the common complications was shock.

Regarding the outcome of mechanical ventilation, the overall survival rate of the mechanically ventilated neonates was 39.8%. Our survival rate was comparable to a study done in Nepal (4) which was 37.8% but it was lower than the studies done in Egypt (7) which was 51.7%, Pakistan (10) which was 47.76%. A study done in India (5) had a much higher survival rate of 75%. These differences in survival rate could be due to the difference in the underlying diseases, with

larger incidence of sepsis and preterm prone to neonatal sepsis, RDS/HMD and various complications related to different systems and unavailability of surfactant.

RDS had a survival rate of 28.6% in disagreement to the study done in india (5) which had a survival rate of 82.6%. they explained this by the universal administration of surfactant in all but 1 ventilated neonate (5). Low survival in our setup could be because of lower rate of surfactant administration (28.5%) due to resource constraint and high cost. Sepsis had a survival rate of 42.9% which was consistent with multiple studies (4)(12)(14)

Among all the complications, the one that had significant association with mortality was Pulmonary haemorrhage. 22 developed pulmonary haemorrhage among which all died but 1 having 17.6times more likely to die compared to those who did not develop complications with $P=0.006$ [95% CI (2.28-133)]. Which was similar in study done in india in which Pulmonary haemorrhage occurred in 7 babies, among whom only 1 survived, and the difference was statistically significant (12) this finding was also consistent with the studies done In Sher-I-Kashmir Institute of Medical Sciences india (14)

Limitation

The study was done on review of documented charts.

- The retrospective nature of the study design and missing data that was not properly filled.
- Additionally, paucity of proper chart storage and retrieval were also limitations which lead to missing of patient records.

7 CONCLUSION AND RECOMMENDATION

7.1 Conclusion

- The commonest indication for mechanical ventilation in was severe RDS followed by severe sepsis.
- The most encountered complications during the course of mechanical ventilations are Pulmonary haemorrhage and seizure.

- Preterm and low birth weight are the vulnerable groups who require mechanical ventilation.
- There was a significant inverse association between gestational age and mortality in mechanically ventilated neonates.
- Pulmonary haemorrhage was significantly associated with increased mortality in mechanically ventilated neonates.
- MAS had significant negative association with mechanical ventilation.

7.2 Recommendations

- To uniformly utilize the standard ventilation, follow up chart for mechanically ventilated neonates.
- Making surfactant more widely available to potentially improve the outcome of preterm neonates with RDS.
- Enhancements should be made to infection control measures to mitigate and reduce the incidence of blood-borne infections related to device use in mechanically ventilated newborns.
- Continuing to work more on NICU providing a high-quality intensive care through ongoing training and support focusing on Infection prevention.

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