OUTCOME OF NEONATES ON INVASIVE MECHANICAL VENTILATION GRADUATING FROM NICU, TVMCH

DISSERTATION SUBMITTED

In partial fulfillment of the requirement for the degree of

(BranchVII)M. D. (PAEDIATRIC MEDICINE)

of

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CHENNAI-600032

DEPARTMENT OFPAEDIATRIC MEDICINE

TIRUNELVELI MEDICALCOLLEGE

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MAY-2020

BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled **"OUTCOME OF NEONATES ON INVASIVE MECHANICAL VENTILATION GRADUATING FROM NICU, TVMCH"** submitted by **Dr. RAYEESA.K.K** to the Tamilnadu Dr. M.G.R Medical University, Chennai, in partial fulfillment of the requirement for the award of M.D. Degree Branch – VII (Pediatric Medicine) is a bonafide research work carried out by him under direct supervision & guidance.

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This is to certify that the Dissertation "**OUTCOME OF NEONATES ON INVASIVE MECHANICAL VENTILATION GRADUATING FROM NICU, TVMCH** " presented herein by Dr. RAYEESA.K.K is an original work done in the Department of Pediatric Medicine, Tirunelveli Medical College Hospital,Tirunelveli for the award of Degree of M.D. (Branch VII) Pediatric Medicine. Under my guidance and supervision during the academic period of 2017-2020.

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DECLARATION

I solemnly declare that the dissertation titled **"OUTCOME OF NEONATES ON INVASIVE MECHANICAL VENTILATION GRADUATING FROM NICU, TVMCH"** is done by me at Tirunelveli Medical College Hospital, Tirunelveli Under the guidance and supervision of **Prof.Dr.C.KRISHNAMOORTHY M.D** PEDIATRICS the dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University towards the partial fulfilment of requirements for the award of M.D., Degree (Branch VII) in Pediatric Medicine.

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PROTOCOL TITLE: OUTCOME OF NEONATES ON INVASIVE MECHANICAL VENTILATION GRADUATING FROM NICU, TVMCH
PRINCIPAL INVESTIGATOR: Dr.RAYEESA.K.K, MBBS.,
DESIGNATION OF PRINCIPAL INVESTIGATOR: PG STUDENT
DEPARTMENT & INSTITUTION: TIRUNELVELI MEDICAL COLLEGE, TIRUNELVELI

Dear Dr.RAYEESA.K.K., MBBS, The Tirunelveli Medical College Institutional Ethics Committee (TIREC) reviewed and discussed your application during The IEC meeting held on 15.12.2017.

THE FOLLOWING DOCUMENTS WERE REVIEWED AND APPROVED

1.	TIREC Application Form	☐
2.	Study Protocol	☐
3.	Department Research Committee Approval	☐
4.	Patient Information Document and Consent Form in English and Vernacular Language	☐
5.	Investigator's Brochure	☐
6.	Proposed Methods for Patient Accrual Proposed	☐
7.	Curriculum Vitae of The Principal Investigator	☐
8.	Insurance /Compensation Policy	☐
9.	Investigator's Agreement with Sponsor	☐
10.	Investigator's Undertaking	☐
11.	DCGI/DGFT approval	☐
12.	Clinical Trial Agreement (CTA)	☐
13.	Memorandum of Understanding (MOU)/Material Transfer Agreement (MTA)	☐
14.	Clinical Trials Registry-India (CTRI) Registration	☐

THE PROTOCOL IS APPROVED IN ITS PRESENTED FORM ON THE FOLLOWING CONDITIONS

1. The approval is valid for a period of 2 year/s or duration of project whichever is later
2. The date of commencement of study should be informed
3. A written request should be submitted 3weeks before for renewal / extension of The validity
4. An annual status report should be submitted.
5. The TIREC will monitor The study
6. At The time of PI's retirement/leaving the institute, The study responsibility should be transferred to a person cleared by HOD
7. The PI should report to TIREC within 7 days of the occurrence of the SAE. If the SAE is Death, the Bioethics Cell should receive the SAE reporting form within 24 hours of the occurrence.
8. In the events of any protocol amendments, TIREC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in The original project. (Page no. Clause no. etc.)
   b. The PI must comment how proposed amendment will affect the ongoing trial. Alteration in the budgetary status, staff requirement should be clearly indicated and The revised budget form should be submitted.
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval. If the amendment demands a re-look at the toxicity or side effects to patients, The same should be documented.
   d. If there are any amendments in The trial design, These must be incorporated in the protocol, and other study documents. These revised documents should be submitted for approval of The IEC, only then can they be implemented.
   e. Approval for amendment changes must be obtained prior to implementation of changes.
   f. The amendment is unlikely to be approved by the IEC unless all the above information is provided.
   g. Any deviation/violation/waiver in The protocol must be informed.

STANDS APPROVED UNDER SEAL

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CERTIFICATE–II

This is to certify that this dissertation work title "**OUTCOME OF NEONATESON INVASIVE MECHANICAL VENTILATION GRADUATING FROMNICU, TVMCH** " of the candidate **Dr. RAYEESA.K.K** with registration Number 201717356 for the award of M.D.Degree in the branch of PAEDIATRIC MEDICINE (VII). I personally verified the urkund.com website for the purpose of plagiarism check.I found that the uploaded thesis file contains from introduction to conclusion page and result shows **14 percentage** of plagiarism in the dissertation.

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CONTENT

1.INTRODUCTION

Advances in perinatal and neonatal care has significantly decreased neonatal morbidity and mortality rates and improved the outcome in sick neonates , mostly due to more effective neonatal intensive care. Introduction of mechanical ventilation has revolutionized the outcome and survival of sick newborns. A significant number of neonates admitted to NICU requires mechanical ventilation, even mechanically ventilated neonates have a high fatality. The use of Neonatal mechanical ventilation is probably one of the most important factor which contributed to the drastic reduction in neonatal mortality within the last two decades[24]

Mechanical ventilation means various artificial means to support oxygenation and ventilation. Emerson (in 1949) was the one who first used artificial positive pressure ventilation in operation theatre with anesthesia. Since then the mechanical ventilation has revolutionized our management of critically ill patients.[1,2]

Neonatal mortality rate accounts for nearly two thirds of infant mortality rate and half of under 5 mortalities rates in India.[3] It is possible to increase the neonatal survival and improve quality of life only through prompt and adequate management of the critically ill newborn. Neonatal respiratory failure, which is one of the leading cause of neonatal fatality, which is a condition of impaired gas exchange that results from number of lung parenchymal problem or vascular abnormalities. Such a diverse disease process needs specific strategies to achieve cure. The aim of mechanical

ventilation is to treat hypoxemia and hypercarbia associated with the respiratory failure while reducing the ventilator associated lung trauma and oxygen toxicity. Technologic advances in the microprocessor based sophisticated neonatal ventilators and monitoring equipments, which are patient- and disease- specific, is the single most important advancement in newborn care. Goal of mechanical ventilation is to maintain adequate pulmonary gas exchange with minimimum lung injury, oxygen toxicity and to minimize patient work of breathing .Hence, the mechanical ventilation has become a must to enhance the neonatal survival and is an essential component of the neonatal intensive care.[4,5] Since the outcome of such neonates on mechanical ventilation is dependent on numerous factors (like, primary disease condition, gestational week, birth weight, associated comorbid clinical conditions), we decided to study the outcome of mechanical ventilation in neonates in tertiary level neonatal intensive care unit.

2.STUDY JUSTIFICATION

Various studies have shown that mortality of 40-60% in mechanicaly ventilated babies. Even with the use of advanced mechanical ventilation, the mortality rate is high in sick neonates. So to improve the survival rate in ventilated neonates, identification of the poor prognostic factors, and their remedy becomes mandatory. Aim of the present study is to find the risk factors responsible for the poor outcome in ventilated neonates and to prevent it. The clinical profile in the ventilated newborns will be studied and correlated with the outcome. Many advances in the neonatal care have led to increased survival of the critically ill. Neonates particularly the preterm babies are being given mechanical ventilation. Sound application of basic concepts of gas exchange, pulmonary mechanics, and control of breathing is essential to optimize mechanical ventilation.

Primary objective of the mechanical ventilation is to support breathing until babies respiratory efforts are sufficient enough. Mechanical ventilation may be needed during the immediate care of the neonate who is depressed or apneic or during the prolonged periods of respiratory failure treatment. Respiratory disorders are the leading cause of admission for special care in both term and preterm infants,

within initial 48-72 hrs.. Respiratory distress is one of the major causes of mortality and morbidity among neonates.

In my study the following are the indications for mechanical ventilation: respiratory distress syndrome , meconium aspiration syndrome, congenital pneumonia, sepsis, perinatal hypoxia. Case fatality rate is highest in babies with respiratoy distress syndrome and sepsis on mechanical ventilators. Early recognition of a critical illness and its management with mechanical ventilation will improve the outcome.

3.AIMS AND OBJECTIVES

- To describe the influence of the gestational age and birth weight on immediate outcome in ventilator therapy

- To describe the mean duration of mechanical ventilation needed in newborns

- To describe the mechanical ventilation associated complications.

4. REVIEW OF LITERATURE

Era of the Respiratory Intensive Care

After the polio epidemics, 1960's has become an era of respiratory intensive care where many of the patients life were saved using negative pressure ventilation. The Positive pressure ventilation with the aids of an artificial airway has very much replaced the bulky and cumbersome negative pressure technology of the respiratory support. Ventilators of two types and two modes of mechanical ventilation were developed in this period. The First one was pressure cycled –PCV. The volume cycled ventilator – VCV was the second one which got evolved from the historical perspective. The new advancement in the ventilators made it be much operator friendly. The Term 'weaning' was used for explaining various techniques for testing the quality of patient's spontaneous ventilation before the extubation[6]

II. TYPES OF THE VENTILATORY SUPPORT

Robert Chatburn (1992) was the person who proposed a newer way to classify the mechanical ventilators based on the related features, physics and engineering[14]

A. Continuous positive airway pressure

Continuous positive airway pressure (CPAP) is usually administered by the means of a ventilator, stand- alone continuous positive airway pressure (CPAP) delivering system, or "bubble" CPAP method. Any of the system used for delivering CPAP should be allowed for continuous monitoring of pressure delivered and must be having inbuilt safety alarms to indicate the pressure variation from the desired level. In other way, the CPAP may be delivered by a simple method by giving the blended oxygen which is flowing into the infant's airway, with the end of the tubing submerged in acetic acid (0.25%) in a sterile water solution up to the needed depth for producing the adequate pressure ("bubble CPAP"). The Stand-alone variable flow CPAP devices, in which the expiratory resistance is decreased via "fluidic flip" of flow at the nasal piece at the time of expiration.

A continuous flow of the heated and humidified gas was then circulated past the infant's airway, usually at the set pressure of 3 to 8 cm water, by maintaining an high end-expiratory lung volume when infant breathes spontaneously. Air-oxygen mixture and the airway pressure can be adjusted. The Variable flow CPAP systems may decrease the work of breathing and may improve the lung recruitment in infants on the CPAP but it has not been shown or sure to be clearly superior to the conventional means of delivery. The CPAP is usually delivered by means of the nasal prongs, the nasopharyngeal tube, or by means of nasal mask. The Endotracheal

CPAP should not be used because of the more resistance of the endotracheal tube which increases work of the breathing, more commonly in small infants. It is not usually recommend the use of positive pressure hoods and continuous –mask CPAP

Advantages:-

a. The CPAP is less invasive than mechanical ventilation and thus causes less lung injury.

b. When it is used early in infants with respiratory distress syndrome (RDS), the CPAP can help to prevent the alveolar and the airway collapse and thereby reduce the need for the mechanical ventilation.

c. Use of immediate delivery room CPAP for spontaneously breathing the immature infants'(≥24 weeks' gestation) may decrease the need for mechanical ventilation and administration of the surfactant. Though individual trials comparing initial CPAP and the mechanical ventilation and early management by surfactant treatment shows similar rates of the Broncho pulmonary dysplasia (BPD), the meta-analyses of prospective randomized trials of the providence of early CPAP show that the use of the early CPAP is associated with decreased risk of death or BPD.

d. In some infants, the CPAP decreases the frequency of obstructive apneic spells and mixed apneic spells.

Disadvantages:-

a. The CPAP is usually not effective in patients with frequent apnea or with the inadequate respiratory drive.

b. The CPAP provides an inadequate respiratory support in the face of a severely abnormal pulmonary compliance and resistance.

c. Maintaining the nasal or nasopharyngeal CPAP in large and active infants will be technically difficult.

d. Infants on the CPAP frequently swallow air, which may leads to gastric distension and elevation of the diaphragm may necessitate to a decompression of the stomach by gastric tube.

B. High flow nasal cannula

Now, many units have switched to use of a high flow nasal cannula (HFNC) as the alternative method to the conventional CPAP devices. The HFNC delivers the distending pressure to infant's airway by a simpler patient interface.

The HFNC usually refers to the supply of the blended, heated, and the humidified oxygen at flows greater than1 L/minute through the small binasal prongs. There are two commercial devices available for delivery of HFNC for the use in newborns.

While the use of a high-flow nasal cannula has increased in premature infants because of its ease of use, the less risk of nares injuries, and the perceived

improvement in patient's comfort, there is little evidence of the improved outcomes when compared with the use of the nasal continuous positive airway pressure[18].

Advantages:-

a. Reported advantages to HFNC include the easy to use, simple patient interface, and the lesser incidence of nasal breakdown when it is compared with conventional CPAP.

b. Randomized trials comparing HFNC to the CPAP as post extubation support in the extremely preterm infants are limited but in many infants it is suggested that HFNC can be used as an acceptable alternative to the CPAP.

The available data suggests that the failure of HFNC may be more than the conventional CPAP in infants less than 26 weeks' of pregnancy.

Disadvantages:-

a. The Probable disadvantages comprises more variable distending pressure delivery (low and high) and an inclination for longer duration of respiratory support when this is comparing with CPAP.

C. Pressure-limited, time-cycled, the continuous flow ventilators**:-**

Historically, these ventilators have been in use in newborns with respiratory failure but now this has been replaced in most of the US' intensive care units of neonates by ventilators such as patient-triggered and the volume-targeted ventilators.

An incessant flow of heated, humidified gas is being circulated past the airway infant; Gas is a mixture of air, combined with the oxygen to maintain the required oxygen saturation level. Peak inspiratory pressure (PIP of PI), respiratory timing (rate, duration of expiration and inspiration), positive end-expiratory pressure (PEEP) are chosen.

Advantages:-

a. Uninterrupted flow of fresh gas allows the child for making the spontaneous respiratory attempts between ventilatory breathing (intermittent mandatory ventilation [IMV]).

b. A very Good control is well preserved over the respiratory pressures.

c. Inspiratory and the expiratory time is controlled independently.

d. Comparatively, the system is simple and less expensive.

Disadvantages:-

a. VT is badly controlled.

b. The system will not respond to changes in compliance of respiratory system.

c. In infants with spontaneous breathing , who breathe out of phase with many IMV breaths (“bucking” / “fighting”), may receive the insufficient ventilation and therefore there are are chances for increased risk of air leak.

D. Synchronized & patient-triggered (assist or pressure support or control) ventilators

These ventilators are adaptations of conventional pressure-limited ventilators used in newborns.

This type ventilators affiliates the features of pressure-limited, time-cycled, and incessant flow ventilators with airway pressure, airflow and the respiratory movement sensor. Measuring inspiratory flow or movement, these ventilators produces intermittent positive-pressure breaths in a fixed rate, in synchrony with the efforts of the baby (“synchronized IMV,” or synchronized intermittent mandatory ventilation). During the period of apnea, SIMV ventilators continue generating in the set IMV rate. In patient-triggered ventilation, with every inspiratory effort of the infant, a positive pressure breath is generated. As a result of this, ventilator generate more frequent positive pressure breaths, generally allowing a reduction in inspiratory pressure (PIP) that required for adequate gas exchange. During apnea, patient triggered ventilator generates operator-selected IMV (“control”) rate. Some

of the ventilators, synchronized IMV breaths can be supplemented by the pressure-supported breaths in spontaneously breathing infant. Ventilators that are equipped with flow sensor can be used to monitor delivered VT continuously by flow signal integration. There are two types of patient triggered ventilation are usually available to the following:

a. In the assist or control (A/C) ventilation, ventilator generates a breath with each effort of the inspiration. Clinician sets the inspiratory time and the peak inflation pressure or target VT. The Clinician sets a minimum mandatory ventilator rate to maintain an adequate minute ventilation should the spontaneous respiratory rate fall lower than to the minimum selected rate.

b. The Pressure support ventilation (PSV) is almost alike to A/C mode, in that the each of the spontaneous patient breath concluding in a ventilator support breath. However, the each breath is terminated when the inspiratory gas flow lowers to a predetermined proportion of peak flow (normally 15% to 20%). As a result of this, patient determines rate and pattern of the breathing (inspiratory time or inspiratory: expiratory ratio). The PSV counteracts the resistance imposed by the endotracheal tube (ET) and ventilator circuit by supplying an additional inspiratory flow that is limited to a preset pressure, selected by clinician. A higher inspiratory flow rate (slope or a shorter inspiratory rise time) may shorten the time to achieve maximal airway pressure, which in turn decrease the work of breathing.

Advantages:-

a. Synchronizing the generation of positive pressure breaths with the infant's inspiratory effort will reduce the phenomenon of breathing out of phase with the IMV breaths ("fighting" the ventilator). This may reduce the need for sedatives and help in weaning the mechanically ventilated infants.

b. The Pronounced asynchrony with ventilator breaths, during conventional IMV, is associated with development of the air leak and the intraventricular bleed. It is not clearly known that whether use of SIMV or A/C ventilation decreases these complications.

Disadvantages:-

a. Under certain conditions, the ventilators may improperly trigger a breath because of a signal artifacts or fail to trigger due to problems with sensor.

B.In newborns, limited datas are available comparing the patient-triggered ventilation to the other modes of ventilation. The PSV may not be appropriate for the small premature infants with the irregular respiratory patterns and the frequent apnea due to the potential for the significant variability in ventilation. However, some datas suggest that use of the patient- triggered modes of ventilation in the premature infants may reduce the markers of lung inflammation and will facilitate

early extubation, while the patient triggered is using as initial mode mechanical ventilator support.

Indications:-

When a conventional pressure-limited ventilator indicated, the SIMV can be used. When the infant is on IMV, it is the most preferable mode of ventilator therapy, if available, in the infants breathing spontaneously. The indications for A/C and PSV is not yet established, even though many of the new born intensive care units uses these modes because of perceived benefits of using the smaller VTs and the lower peak inspired pressure.

E. Volume-targeted ventilators**.**

The Advances in medical technology for measuring the delivered VTs have made these ventilators the first-line therapy for the newborn child with respiratory failure. Only the volume-targeted ventilators specifically designed for the newborns must be used. These ventilators (Volume-targeted ventilators) are always patient-triggered.

The Volume-targeted ventilators are almost similar to the pressure-limited ventilators except that the operator selects VT delivered rather than PIP. “Volume guarantee” is a mode of pressure limited SIMV, where ventilator targets the

operator-chosen VT (generally 4 to 6 mL/kg) during the mechanically delivered breaths. Volume guarantee permits rapid response of ventilator pressures to change in the lung compliance and may be useful in infants with RDS those receive the surfactant therapy. The Pressure-regulated volume control (PRVC) is a modified form of pressure-targeted ventilatory mode, where the inspiratory pressure is sequentially adjusted for generating a target inspiratory volume with the lowest possible pressures.

Advantages:-

The pressure automatically changes with the respiratory system compliance to deliver the selected VT, so that minimizing the variability in minute ventilation and avoiding the wide swings in VT which repeatedly seen with pressure-limited ventilators. The recent datas suggest that the volume-targeted ventilation decreases risk of death or the Broncho pulmonary dysplasia (BPD) in the extremely low birth weight infants, presumably by the reduction in risk of volume trauma.

Disadvantages:-

a. The system may be complicated which requires more skill for operating

b. Because of the VTs in infants are small ,the some of VTs selected are lost in ventilator circuit or from the air leakings around the uncuffed endotracheal tubes

(ET). Some of the ventilators compensate for the losses by targeting the expired rather than the inspired VTs or by accounting for dead space in the circuit.

Indications:-

The Volume-targeted ventilators are particularly useful if the lung compliance is suddenly or rapidly changing, as in the infants who is receiving surfactant therapies.

F. The High-frequency ventilation (HFV)

The HFV is one of the most important adjuncts to the conventional mechanical ventilation in the newborns. The HFV are primarily used as a rescue therapy to the infants failing conventional ventilatiors[15]. There are three types of high-frequency ventilators (HFV) approved for the use in newborns in US: high frequency oscillator (HFO), high-frequency jet (HFJ) ventilator and high-frequency flow interrupter (HFFI) .

The Available high-frequency ventilators are similar despite markedly considerable differences in the designs. All these are capable of delivering in rapid

rates (300 to 1,500 breaths per minute, 5 to 25 Hz; 1 Hz is equal to 60 breaths / minute), with VTs equivalent to or shorter than the anatomic dead space. These ventilators apply continuous distending pressure for maintaining an elevated lung volume; the small VTs are superimposed at a rapid rate. The High frequency Jet (HFJ) ventilators are paired with a conventional pressure-limited instrument, which is used for delivering the intermittent "sigh" breaths helping to prevent atelectasis. The Sigh breaths are not used with the HFO ventilation. The Expiration is passive (i.e., dependent on lung recoil and chest wall) with the HFFI and the HFJ machines, whereas expiration will be active with the HFO. Here, the mechanisms of gas exchange are not completely understood.

Advantages:-

a. The HFV can attain an adequate ventilation while avoiding the large swings in the lung volume required by the conventional ventilators and associated with the lung injury. Because of this, the HFV may be useful in pulmonary air leak syndromes (pulmonary interstitial emphysema, pneumothorax) or for the infants failing conventional mechanical ventilation.

B. The HFV allows to make use of the high mean airway pressure (MAP) for the alveolar recruitment and for the resultant betterment in ventilation-perfusion ([V with dot above] or [Q with dot above]) matching. This can be beneficial in infants

with severe respiratory failure, which require the high MAP for maintaining sufficient oxygenation on a conventional mechanical ventilator.

Disadvantages:-

Despite the theoretical advantages of the HFV, no remarkable benefits of this method has been illustrated in normal clinical use over the more conventional ventilators. The only one rigorously controlled study revealed that a small decrease in BPD found in infants at high risk managed with the HFO ventilation as primary mode of ventilation. Likely, this experience is not routinely applicable, however, because the other studies have not been shown any difference. These ventilators are largely complex, expensive, also there is much less long-term clinical experience .In the Initial studies with HFO, it is suggested that there is an increased risk of significant intraventricular bleed, though this complication has not been made out in any of the recent clinical trials. The Studies comparing the different types of the high- frequency ventilators are not available; therefore, any relative advantages or disadvantages of High frequency oscillator, High Frequency Flow Interreptor, and High frequency jet, are not characterized, if any

Indications:-

The High flow ventilator is primarily been used as one of the rescue therapy for infants failing the conventional ventilation. Both the High flow oscillatory(HFO)

and the high flow jet ventilators(HFJ) have been shown to be superior to the conventional ventilation in infants with the air leak syndromes, especially the PIE. We don't use HFV as the primary mode of the ventilatory support in infants, because of its potential for complications and the equivalence to conventional ventilation in the incidences of BPD,

G. Noninvasive mechanical ventilation.

The Neonatal nasal intermittent positive pressure ventilation (NIPPV) gives a noninvasive respiratory support to the preterm infants otherwise infants would have required the endotracheal intubation and ventilation. It is an add- on supplement to the CPAP. NIPPV superimposes inflations set to a peak pressure given through the nasal prongs or mask. Some devices try to synchronize inflations with infant's spontaneous inspirations. It remains still not very clear if the NIPPV is superior to conventional CPAP or preventing the requirement for the mechanical ventilation.

1. The NIPPV is used for the following clinical settings:

a. For the Apnea of prematurity

b. Following extubation, NIPPV compared with nasal CPAP has been described to be shown to lessen the extubation failure in infants who needs the intubation and ventilation.

c. Primary mode of ventilation in preterm infants those with RDS

III. INDICATIONS FOR THE RESPIRATORY SUPPORT

A. The following are the Indications for CPAP in the case of preterm infant with RDS:

1. Recently delivered preterm baby with minimal respiratory distress and low supplemental oxygen requirement (for preventing the atelectasis)

2. The respiratory distress and the infants who requirement FiO2 above 0.30 by the hood

3. The FiO2 above 0.40 by the hood

4. The Initial stabilization in labour room room for spontaneously breathing, in extremely preterm infants (25 to 28 weeks' gestation)

5. for the initial management of premature infants with the moderate respiratory distress

6. The Clinically significant retractions and/or the distress occurred due to recent extubation

7. In general, the infants with the RDS those require FiO2 more than 0.35 to 0.40 on CPAP should be intubated and ventilated, and also given the surfactant replacement

therapy. In some NICUs, in infants with the RDS who have undergone intubation for surfactant therapy is followed by the immediate extubation to CPAP. We generally apply the mechanical ventilation for all the infants who are given surfactant.

8. After extubation, for facilitating the maintenance of lung volume

9. The HFNC is likely equivalent to CPAP in the post extubation stabilization; it remains still not clear that whether it is as useful in stabilization of infants with highly severe respiratory distress or in the infants less than 26 weeks' gestation.

B. The following are the relative indications for the mechanical ventilation in any infant:

1. The Frequent intermittent apnea which is unresponsive to the therapy with methyl xanthine

2. Initiation of early treatment when use of mechanical ventilation is expected due to the deteriorating gas exchange.

3. In case of an infant with the signs of moderate-to-severe respiratory distress for relieving “increased work of breathing”

4. For the administration of surfactant therapy in the infants with RDS

C. The following are the absolute indications for the mechanical ventilation

1. The Prolonged apnea

2. PaO2 when below 50 mm Hg, or FiO2 when above 0.80. To the infant with the cyanotic congenital heart disease (CHD), this indication may not apply

3. The persistent acidemia where PaCO2 is above 60 to 65 mm Hg

4. The General anesthesia[7]

IV The Specific disease states.

1. Respiratory Distress Syndrome(RDS)

It is caused by the deficiency of surfactant, which will results into a severe decrease in lung compliance (stiff lung). It causes the diffuse collapse of the alveoli with [V with dot above] or [Q with dot above] the mismatching and increased work of breathing.

Early initiation of CPAP, normally starts in delivery room, may avoid the need for the mechanical ventilation and surfactant therapy in many of the infants, even at very early gestational ages. Alternatively, some recommends the early intubation and use of mechanical ventilation during RDS so as to provide the prompt therapy with surfactant. In classic RDS, the Surfactant therapy modifies distinctive time course of the escalation, the plateau, and the weaning. In Ventilatory strategy one should anticipate the high risk of the pneumothorax because, the compliance

increases and the time constants lengthens, especially with rapid improvement which is seen after the surfactant administration. In all these approaches, a PaCO2 value is more than the physiologic value is agreable to minimize the ventilator-induced lung injury.

Ventilator strategy:-

In infants who are mild to moderately affected may not require the intubation and the surfactant administration, the CPAP is used very early in disease course for preventing further atelectasis. The CPAP is started initiating at 5 to 6 cm H2O and it is increased to a maximum of 7 to 8 cm H2O. At the higher levels of CPAP pressure, the risk of pneumothorax may be increased. CPAP is titrated by the method using clinical assessment of retractions, the respiratory rate and by the observation of O2 saturation. In this setting, the NIPPV may be an alternative approach to CPAP. Additionally, in the infants with more severe RDS, consideration can be given to the intubation for the surfactant administration with a prompt extubation followed by a CPAP (INSURE technique).

The Mechanical ventilation is used when [V with dot above] or [Q with dot above] mismatching is too severe that the increased FiO2 and the CPAP are not adequate for maintaining the gas exchange, or in the infants who got tired due to the increased work of breathing. The Data shows that a ventilator strategy that which

avoids the large changes in VT may lessen the ventilator- induced lung injury; hence, the volume-targeted ventilation, as narrated earlier above, is the selected and preferred method in infants with the RDS. The objective of all the strategies of assisted ventilation in infant with RDS should be there to dispense the lowest level of the ventilator support which is possible for supporting the adequate oxygenation and ventilation while attempting to reduce the acute and chronic injuries of lung secondary to the barotrauma/volutrauma and the oxygen toxicity. Our preferred approach is for maintaining suitable MAP with a TI which in the beginning it is set at 0.3 second and approximately at a rate of 20 to 40 breaths/minute. A longer TI is needed, sometimes , to provide sufficient oxygenation,

Generally, VT is initially set at 4 to 6 mL/kg and is adjusted for adequate minute ventilation. If the pressure-limited ventilation is used, PIP is initially roughly calculated by the visible chest excursion and generally it is 20 to 25 cm H2O.

The PEEP is normally set at 4 to 6 cm H2O. Higher PEEP may interfere with the cardiac output.

A Flow rate of 7 to 12 L per minute are required to provide a relatively square pressure waveform. Higher flows also may be needed at the very high PIP (more than 35 cm H2O).

Rates are normally set initially at 20 to 40 breaths / minute and are modified according to the blood gas results. Weaning, When the patient become improves, FiO2 and PIP or VT are weaned initially, alternating with rate, in response to assessment of the chest excursion, the oxygen saturation level, and the blood gas results. In case of volume-targeted ventilation, the PIP will automatically get decreased in response to improved compliance; weaning may be accomplished by reducing the targeted level of VT. In case of the patient triggered modes, back-up rate of ventilator is generally not changed, and the progressive decreases in PIP are used to wean ventilator. Usually the Extubation is successful when ventilator rates are less than 20 to 25 breaths / minute, or PIP is less than 16 to 18 cm H2O for delivering the desired VT. Before the extubation, the caffeine citrate therapy must be started for facilitating the spontaneous breathing. In very low birth weight infants, prophylactic caffeine enhances the success rate of the extubation.

Advantages and disadvantages:- The ventilatory strategy maximizes the alveolar recruitment but with a possibility for larger injury of lung secondary to the higher PIP and the volutrauma which is secondary to higher VT.

The HFV may be initiated if the conventional ventilation stops maintaining an adequate gas exchange at acceptable settings. The HFV should only be used by clinicians who are familiar with its use. The use of HFV is considered by us, when the MAP is required for adequate gas exchange which exceeds 10 to 11 cm H2O in

smaller infants, and 12 cm H2O in larger infants, or if an air leak occurs. Strategies may differ depending on whether a HFJ, HFO, or HFFI is used. We prefer a HFO ventilation over other available HFV because, it can be used easily and its applicability in a wide range of the lung diseases and the infant weights.

a) HFJ ventilation: - The HFJ needs a special adapter for standard endotracheal tube to permit a connection to the jet port of ventilator.

1) PIP and PEEP. The Peak pressures on jet ventilator are at the beginning set to approximately 20% lower than on those being used with the conventional ventilation and is adjusted for providing an adequate chest vibration assessed clinically and by the blood gas determinations. PIP, PEEP, and FiO2 are adjusted as required for maintaining the oxygenation. Elimination of CO2 is depending on pressure difference (PIP - PEEP). Because of the lower peak pressures needed to ventilate, the PEEP shall be increased to 8 to 10 cm H2O if it is required to improve the oxygenation level.

2) Rate. The frequency is normally set at 420 breaths per minute, with an inspiratory jet valve on-time of 0.02 second.

3) Conventional ventilator settings. Once the High frequency jet ventilator is adjusted properly, conventional ventilator rate is to be decreased to 2 to 10 breaths

/ minute for maintaining alveolar recruitment, with the PIP which is set at 2 to 3 cm H2O less than jet PIP. In the air leak syndromes, it may be very useful to supply no sigh breaths from conventional ventilator as long as the PEEP is set high enough to maintain the lung volume.

4) Weaning from the HFJ ventilation is accomplished by reducing the jet PIP with response to the blood gas determinations and FiO2. PEEP is weaned as tolerated if the pressures greater than 4 to 5 cm H2O are used. The Frequency and the jet valve on time are generally not adjusted.

5) In case of use of the HFFI, similar strategies are outlined for applying HFJ.

b) HFO ventilation: - With the use of HFO, operator-selected parameters includes the MAP, frequency, and also piston amplitude.

1) MAP. In the RDS, usually the initial MAP selected is 2 to 5 cm H2O higher than that which is used on the conventional ventilator for alveolar recruitment enhancement. The MAP used with the HFO is titrated to O2 requirement and to provide an adequate lung expansion on chest x-ray. Care should

be exercised to avoid the lung hyperinflation, which might adversely affect oxygen delivery by the reduction of cardiac output.

2) The Frequency is usually set at 10 to 15 Hz. The Inspiratory time is set at 33%.

3) Amplitude. The Changes in piston amplitude primarily affect the ventilation. It is set to provide an adequate chest vibration, which is assessed clinically and by blood gas determinations.

4) The Flow rates of 8 to 15 L per minute are usually adequate.

5) Weaning: The FiO2 is weaned first in general, which is followed by MAP in decrements of one to two cm H2O once the FiO2 falls below 0.6. The Piston amplitude is adjusted by frequent assessment of the chest vibration and blood gas determinations. Frequency normally not adjusted unless sufficient oxygenation or ventilation is otherwise achieved. In contrast to the conventional mechanical ventilation, decreasing frequency of breaths in HFO ventilation will improve ventilation because of the effects on delivered VT. In both HFO and HFJ, we usually wean to extubation after transfer back to conventional ventilation eventhough infants could be extubated directly from HFV.

2. Meconium aspiration syndrome (MAS)

The MAS results from aspiration of a meconium-stained amniotic fluid. Severity of the MAS is related to the associated asphyxial trauma and the amount of fluid that has been aspirated. The Aspirated meconium is causing acute obstruction of airway, significantly increasing airway resistance and scattered atelectasis with

[V with dot above] or[Q with dot above] mismatching, and the hyperexpansion due to the obstructive ball-valve effects. After 12 to 24 hours, the obstructive phase is followed by an inflammatory phase, which ends with further alveolar involvements . Aspiration of other fluids (such as blood or amniotic fluid) has a similar but milder effects.

Ventilator strategy:-

Due to ball-valve effects, application of the positive pressure may caue pneumothorax or other air leak, so initiating mechanical ventilation needs a careful calculation of risks and benefits. The Low levels of PEEP (4 to 5 cm H2O) is useful in splinting open the airways that are partially obstructed and equalizing [V with dot above]or[Q with dot above] matching. The Higher levels may lead to hyperinflation. If the airway resistance is high and the compliance is normal, a slow-rate, moderate-pressure or volume strategy is required. If pneumonitis is more significant, more rapid rates may also be used. Sedation or muscle relaxation may be used to reduce the risks of air leak in severe meconium aspiration syndrome because of the high transpulmonary pressures can generate while “fighting” with ventilator and ball-valve hyperexpansion caused by their disease process. The use of patient triggered ventilation may be helpful in some infants and so the need for muscle relaxation can be avoided. If the illness is related to airway obstruction, the weaning will be rapid and prolonged if complicated by the injury of lung and severe inflammation. Due to

the secondary surfactant inactivation, use of surfactant therapy may improve the lung compliance and oxygenation and must be considered in more severe cases of MAS.

The HFV has been used in the infants successfully, with MAS who had failed with conventional ventilation or who have air leak. Strategies are almost similar to those which were described in the preceding text. In HFO, slower frequencies (8 to 10 Hz) are helpful to improve the oxygenation and ventilation in severe cases.

3. Bronchopulmonary Dysplsia (BPD)

BPD results from the injury to alveoli and the airways. Formation of bleb may lead to poor recoil. The Fibrosis and the excess lung water may cause stiffer compliance. Airways are narrowed and fibrotic or hyperreactive. Upper airways are over distended and may conduct airflow poorly. BPD is marked by shifting focal atelectasis, hyperinflation with [V with dot above] / [Q with dot above] mismatch, acute and chronic increases in airway resistance, and a marked rise in the work of breathing.

Ventilator strategy:-

Optimal strategy is to wean infants out from the ventilator as early as possible in order to prevent further mechanical injury and the oxygen toxicity. If it is not feasible, the ventilator settings must be minimized for permitting tissue repair and

for long-term growth. Rates lesser than 20 breaths/ minute must be generally avoided for the prevention of increased work of breathing, but longer TI (0.4 to 0.5 second) is used to maintain the FRC. In some centers they use SIMV in combination with the PSV in severe cases for improving the work of breathing and the ventilation. The higher PIPs are occasionally required (20 to 30 cm H2O) due to the stiff lungs, though ,high resistance obstructs transfer of most of this to alveoli. Oxygenation must be maintained (90% to 92% saturation), but higher PaCO2 values may be allowed (55 to 65 mm Hg), if pH is acceptable. Acute decompensations may result from the bronchospasm and from interstitial fluid accumulation. These should be treated by adjustment of PIP, by bronchodilators, and diuretics. Acute BPD "spells" where the oxygenation and airway resistance worsens rapidly are generally due to larger airway collapse and can be successfully treated with higher PEEP (7 to 8 cm H2O). Rapid and frequent desaturations those are secondary to the acute decreases in FRC with crying or the infant movement respond to the changes in FiO2 but can also be partially ameliorated by using the higher PEEP. Weaning is a slow and a difficult process, decreasing the rate by 1 to 2 breaths per minute or by 1 cm H2O decrements in PIP every day when it is tolerated. Fortunately, with the improved medical and better ventilatory care of these infants, it is very minimal and rare for infants with BPD who needs to undergo tracheostomy for chronic ventilation.

4. Air leak

Pneumothorax and PIE are the two most common air leak syndromes . The Pneumothorax results when air ruptures into pleural space. In the PIE, interstitial air substantially decreases the tissue compliance and the recoil as well. In addition, peribronchial and perivascular air may also compress the airways and vascular supply, causing the "air block."

Ventilator strategy:-

Due to the air which is driven into interstitium throughout ventilatory cycle, the initial goal is to decrease the MAP through any of its components (PEEP or PIP or VT, TI,) and to rely on the increased FiO2 for providing oxygenation. This strategy holds for all the air leak syndromes. If dropping the MAP is not tolerated, some other methods also can be tried. Because of the time constants for interstitial air are too longer than those for alveoli, we, sometimes use very rapid conventional rates (up to 60 breaths per minute), which may preferentially ventilate alveoli.

The HFV which is an important alternative mode of therapy for severe air leak and, it may be the ventilatory treatment of choice if it is readily available for use. The HFV strategies for the air leak are different from those used in case of the management of diffuse alveolar disease. As narrated, for the conventional ventilation, ventilatory target in air leak syndromes is to reduce the MAP, relying on FiO2 to provide oxygenation. With HFJ and HFFI, the PEEP is maintained at lower

levels (4 to 6 cm H2O), and a few to no-sigh breaths are provided. With HFO, MAP initially required is the same as that of being used on conventional ventilator and the frequency is set at 15 Hz. While weaning, the MAP is decreased progressively, tolerating the higher FiO2 in the attempt to limit MAP exposure.

5. Apnea

In some occasions, apnea is severe enough to warrant the support of ventilator, even in the absence of pulmonary disease. It may have occured from apnea of prematurity, or during the course or following a general anesthesia.

Ventilator strategy:-

Infants who are completely dependent on ventilator, the goal should be to provide "physiologic" ventilation with the help of the moderate PEEP (3 to 4 cm H2O), low gas flow, and normal rate of breath (30 to 40 breaths / minute), with PIP or VT adjusted for preventing hyperventilation (10 to 18 cm H2O). Prolonged TI is unnecessary. Infants who requires a ventilator due to the intermittent but prolonged apnea, low rates (12 to 15 breaths per minute) may be sufficient.

V. ADJUNCTS TO MECHANICAL VENTILATION

A. Sedation:- Sedation may be used when distress/agitation is associated with excessive or additional requirement of oxygenation and the hypoxemia. Though this problem is more commonly seen in neonates who receives long-term ventilation,

acutely illed newborns may sometimes seen benefitted from sedation. The drug Morphine (0.05 to 0.1 mg/kg or fentanyl (1 to 3 μg/kg.) can be also be used but it may sometimes cause neurologic depression. Prolonged use may also lead to drug dependence. Lorazepam (0.05 to 0.1 mg/kg per dose given every 4 to 6 hours interval) or midazolam (0.05 to 0.1 mg/kg per dose given every 2 to 4 hours interval) is used in more mature infants and also in more chronic situations. In the preterm infants, nonpharmacologic techniques, such as limiting the environmental light , noise and by providing behavioral supports, can help to reduce agitation and may limit the need for sedative medications. As we discussed, synchronized IMV or the patient-triggered ventilation may also help to diminish agitation and ventilatory liability.

B. Muscle relaxants:- Muscle relaxation with the drug pancuronium bromide (0.1 mg/kg per dose, repeated as and when needed) or the drug vecuronium (0.1 mg/kg/ dose) is very rarely used but it may be indicated in some of the infants who continue to breathe out of phase with ventilator after some attempts and sedation have failed; the demand for muscle relaxation is reduced in patient-triggered ventilation as the babies will breathe “in sync” with delivered ventilator breaths.

Even if the unequivocal data are not available, gas exchange is improved in some of the infants following muscle relaxation. The Prolonged muscle relaxation

will leads to fluid retention and thus it can result into deterioration in compliance. Sedation is usually administered to infants receiving the muscle relaxants.

C. Arterial Blood gas monitoring:- All the infants who receives mechanical ventilation requires continuous recording of the levels of oxygen saturation and the intermittent blood gas measurements.

VI. COMPLICATIONS AND SEQUELAE.

As a complex and invasive technology, the mechanical ventilation may result in numerous negative outcomes, as both iatrogenic and unavoidable.

A. Mechanical

1. The Obstruction in endotracheal tubes will cause hypoxemia and respiratory acidosis.

2. Equipment breakdown, disconnection, is common may require functioning alarm systems and vigilance as well.

B. Oxygen toxicity and lung injury

1. BPD is related with airway pressure increase and lung volume changes, though oxygen toxicity, the anatomic and physiologic immaturity, and the individual susceptibility also contribute.

2. Air leak is directly connected to rise in airway pressure. Risk is high at MAPs in excess of 14 cm H2O.

C. Complications of invasive monitoring are as follows

1. Occlusion with infarction of peripheral arteries

2. Aortic thrombosis occurring from umbilical arterial catheters, sometime leading to renal impairment and also hypertension

3. Emboli caused from flushed catheters, particularly in the lower extremities, the splanchnic bed, or even in the brain

D. Anatomic

1. Subglottic stenosis occurring from prolonged intubation; risk is high with frequent / multiple re intubations

2. Tracheobronchomalacia which acquires from the prolonged mechanical intubation

3. Palatal grooves causing from prolonged orotracheal intubation

4. Damage of vocal cord

Trotman et al, in his study says that a birth weight less than 750gm and a gestational term of 27 weeks there is a little impact on mortality because of the introduction of mechanical ventilation[9]

There is a considerable drop in neonatal mortality rate in developed countries with the introduction of mechanical ventilation and the neonatal intensive care concept.[10,11]

MONITORING OF VENTILATED CHILD

Mechanical ventilator in children is lifesaving, however it involves careful observation and a meticulous care of ventilated babies to make sure the safety and for successful result

Monitoring includes:-

1.Clinical evaluation and assesssment

2.Multi parameter observation

3.Monitoring of ventilator

4.Radiological evaluation and assessment

5.Laboratory assessment

CLINICAL ASSESSMENT

Assess for adequacy and the symmetry of the chest rise as well the air entry.

Assess the frequency and the strength of the mechanical as well as spontaneous breaths and find out whether ventilator breaths are synchronizing with patients efforts.

Find out whether there is any signs of tachypnea or increased workload of breathing.

Clearly monitor the vitals hourly interval including heart rate, blood pressure, rate of the respiration, temperature recording, central and distal pulse recording, CFT, GCS, size of the pupil and its reaction.

MULTI PARAMETER MONITORING

1. Oxygen saturation level

   The oxygen saturation reflects the amount of blood oxyhemoglobin that is the predominant form of oxygen transport . Oxygen saturation is mandatory and that helps in titrating FiO2 as well. Aim should be to fix FiO2 as low as

possible and the same time bringing down hypoxia. Target saturation is depending upon the disease condition.

2. End tidal CO2

   This is an optimal monitoring which is helping to monitor blood co2 levels indirectly by measuring co2 in each of the expiratory breath. ETCO2 greatly bring down the need for ABG and helps to partial tube block, disconnection and displacement much before clinical signs becomes clear

3. Central venous pressure (CVP)

   CVP must be measured at the end of the expiration and allowance must be given for high PEEP for accounting the high CVP. In ventilated patients a low CVP usually denotes hypovolemia whereas the high CVP does not rule out hypovolemia

VENTILATOR MONITORING

1. Measured parameters are

Expired tidal volume, Peak airway pressure, mean airway, minute ventilation, and percentage of leak, compliance and resistance. These are measured and displayed in most of the ventilators.

2. Alarms

The ventilator alarm setting must be set as soon as the ventilator settings are made. If settings are narrow, it will be resulting into too frequent alarms where as if the alarm are set too wide, serious events may not be pointed out by the alarm

a) High pressure alarm- This alarm is usually set at around 10cm above PIP. Inspiratory flow to patient ends and excess gas are vented out when the high pressure is activated. High pressure alarm denotes to the ETT related issues like secretions, biting the tube by the patient or worsening of the lung or airway
b) Low pressure alarm-This usually sets 5cmbelow the PIP. It indicates circuit leak/ disconnection. The common sites of leaks are around the humidifier, water traps or any point around where there are joints in the circuit.

c) Low minute ventilation or low tidal volume- This is usually set depending on rate of the respiration and the tidal volume of 6-8 ml/kg. It indicates ETT related problems like secretions/ worsening of airway pathology especially in the pressure control mode where pressure will not shoot up but tidal volume will come down.

3. Graphics display-

In most of the modern ventilators it display the real time pressure, volume and flow changes in the graphics formation in screen

RADIOLOGICAL EVALUATION

x-ray of the chest should be done at once

Things are to be checked in the chest x-ray includes the following:-

1. Position of the Endo tracheal Tube – it must be at least 1cm above carina ,at T2 or T3 vertebrae level.
2. Position of the NG must be inside the stomach
3. Lung volume- must be able to count 8 posterior ribs
4. Presence of the new lung infiltrates, atelectasis and pulmonary edema
5. Presence of any air leaks
6. Size of the heart and presence of any chest wall edema

LABORATORY EVALUATION

1. ABG- This must be done in 30mins of initiation of ventilation and there after 4-6 hourly interval
2. Biochemical parameters and blood count
3. Microbiological testing- Culture of the ET secretions

GENERAL CARE

Positioning by the head end elevation by 30-45 degree so as to prevent micro aspiration and VAP.

Frequent position change – In every two hours patient should be turned on to right lateral and left lateral position every by placing a pillow or rolls on the sides of the patient

Ventilator circuit must be kept free from the codensates keeping water traps in dependent position so that condensate will not be able to drain into patients ETT. Unless it is visibly soiled, there is no need for a change of the circuit

1. Care of ET tube

Do the suction when there is secretions and also based on time. Reduction in tidal volume, airway pressure increase, rise in ETCO2 usually denotes the accumulation of secretions

Before suctioning child must be given an one minute pre oxygenation.

Sterile technic must be applied while doing suctioning of the tube.

2. Oral hygienic care

Before and after ETT suctioning, care should be taken for frequent suctioning of the oral and pharyngeal secretions,

3. Proper Eye and skin care is ensured

DETERIORATION IN VENTILATED CHILDREN :

SUDDEN DETERIORATION ;

D- Displacement of the tube

O- Obstruction in tube

P- Pneumothorax

E- technical failure of the equipment

GRADUAL DETERIORATION

- Partial obstruction of tubes

- Occurrence of pneumonia or sepsis
- Myocardial dysfunction
- Biochemical change/ abnormalities

VAP BUNDLE to prevent VAP

For improving patient care outcomes, there developed a Bundle concept by the institute. . A bundle is defined as set of the evidence based practice which when performed collectively, it results in decrease in the incidence of VAP.

The components of VAP bundle for children are:

- Proper hand hygiene should be ensured before and after touching the patient
- Head end must be elevated position of 30-45 degree
- The Daily sedation vacation when the sedatives doses are decreased or ceased
- Assess on daily basis for the readiness to extubation
- Apply prophylactic measures against peptic ulcer diseases
- Oral hygienic care protocol using 2% chlorhexidine mouthwash, three times daily at least and the frequent clearance of pharyngeal secretions[11,12,13]

5.MATERIALS AND METHODS

SUBJECT SELECTION

Neonates put on invasive mechanical ventilator in NICU, Tirunelveli Medical College Hospital fulfilling the inclusion criteria

STUDY PERIOD

January 2018 to june 2019

SAMPLE SIZE

100 (Consecutive babies fulfilling the inclusion criteria put on invasive mechanical ventilator). The formula used for calculation of sample size is

$$n=2 (Z\alpha - Z\ 1-\beta \times S \div d)\ 2$$

TYPE OF STUDY

Prospective COHORT study of Neonates put on invasive mechanical ventilator in NICU, Tirunelveli Medical College Hospital

INCLUSION CRITERIA

All the babies both inborn and outborn admitted in NICU TVMCH requiring invasive mechanical ventilation with etiological diagnosis of

i)Respiratory distress syndome

ii) Meconium aspiration syndrome

iii) Perinatal hypoxia

iv) Sepsis

v) Congenital pneumonia

EXCLUSION CRITERIA

i. Tracheo esophageal fistula
ii. Congenital diaphragmatic hernia
iii. Necrotizing enterocolitis
iv. Kernicterus
v. PPHN
vi. Congestive cardiac failure
vii. Patient not giving consent

Following PARAMETERS are included and monitored in the present study.

a. Baby mother name
b. Age in days
c. Sex

d. Birth weight

e. Gestational age

f. Mode of birth

g. Apgar score

    a. 1 min

    b. 5 min

h. Day of admission

i. Diagnosis

j. Indication of ventilation

k. Day of ventilation

l. Duration of ventilation

m. Outcome

n. Day of death

o. Complications

6.METHODOLOGY

This study was approved by ethical committee of our institute.Our study is a prospective observational study done during the period of January 2018 to june 2019 was conducted on 100 consecutive neonates admitted in neonatal intensive care units Tirunelveli Medical College Hospital who was put on invasive ventilation. Detailed history regarding of antenatal, natal and postnatal, the birth weight, gestational age, type of delivery, APGAR score, onset of respiratory distress, and other details are recorded in a previously defined proforma, at the time of admission. Diagnosis is made with the standard clinical, laboratory and radiological criteria. Babies were initiated on Intermittent positive pressure ventilation who satisfy the inclusion and exclusion criterias after taking consent from the parents. Time cycle, pressure limited, continous flow ventilator was used and the settings was adjusted according to the underlying disease. Our aim is to use minimum possible pressure and FiO2 to maintain normal saturation . Babies were nursed under servo control open care system. Peripheral or low umblical catheters were used. Some babies required femoral or subclavian catheters. Continuous non-invasive oxygen saturation monitoring is done. Chest Xray were taken whenever indicated. Babies

are managed according to the NICU protocol. Screening of the sepsis including C-reactive protein, total and differential count, band cell count and blood culture are undertaken. Cefotaxime and amikacin are given initially to babies. These are

changed according to the sensitivity pattern, if necessary. Other drugs were used, whenever indicated. All the babies are monitored for the development of any complications like air leak, shock, ventilator associated pneumonia etc.. ,chest physiotherapy is given during and after ventilation. Babies were weaned from the ventilator if there is a clinical and radiological improvement with minimum ventilatory settings. Steroid was started 24 hours before the expecting extubation time. After extubation the child was placed under Bubble CPAP/oxygen hood until indicated.

The endpoint of the study is

1) Hemodynamically stable newborn tolerating feeds.

2) Fit to be shifted out from NICU.

3) When the baby succumbs during the ventilatory care.

6.STATISTICAL ANALYSIS

The study subjects namely neonates were described. In respect of continuous variables have been described in terms of averages and interpreted between two groups by independent “t” test. The categorical variables were described in terms of percentages and interpreted by χ^2 (Chi-square) test. The above statistical procedures were performed with the help of the statistical package namely IBM SPSS statistics version -20. The P-values less than or equal to 0.05 ($P \leq 0.05$) were considered as statistically significant.

7. RESULTS:

Table-1: Age at admission of neonates and its effect on their outcome

Age (days)	Survived		Expired		Total	
	Frequency	%	Frequency	%	Frequency	%
1	46	88.5	47	97.9	93	93.0
2	3	5.8	0	0.0	3	3.0
3	2	3.8	1	2.1	3	3.0
4	1	1.9	0	0.0	1	1.0
Total	52	100.0	48	100.0	100	100.0
Mean± SD	1.2±0.6		1.0±0.3		1.1±0.5	
Significance	"t" =1.589, df=98 P=0.115.				Range=1-4 days	

93% of the total admitted babies were admitted on the day 1of life .Out of 52 survived 46 (88.5%) babies were admitted on day 1 of life.

The table-1 describes the out come of neonates according to their age of admission. The mean age of survived was 1.2±0.6 days. The mean age of expired was 1.0±0.3 days. The difference of ages was not statistically significant (P>0.05).

Fig-1: Age distribution and comparison between the survived and expired:

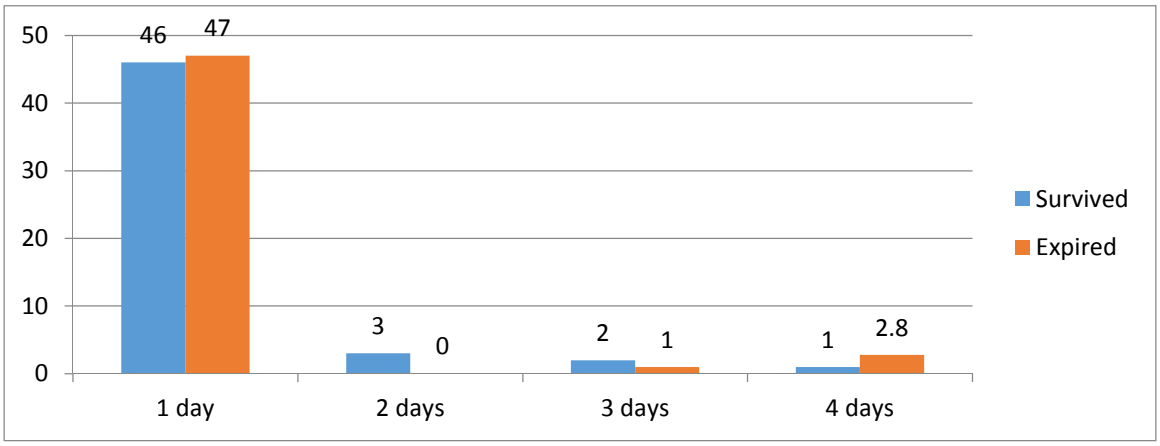


Table-2: Gender wise distribution of neonates:

Gender	Survived		Expired		Total		Results
	n	%	n	%	N	%	
Males	24	46.2	23	47.9	47	47.0	χ^2=0.031
Females	28	53.8	25	53.1	53	53.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.860

24(46.2%) out of the 52 survived were males and 23(47.9%) out of 48 expired were females

The above table describes the genders of the neonates . The males were 47% and females were 53%. The outcome did not have any statistically significant association with gender (P>0.05).

Fig-2: Gender wise comparison of survived and expired (%)

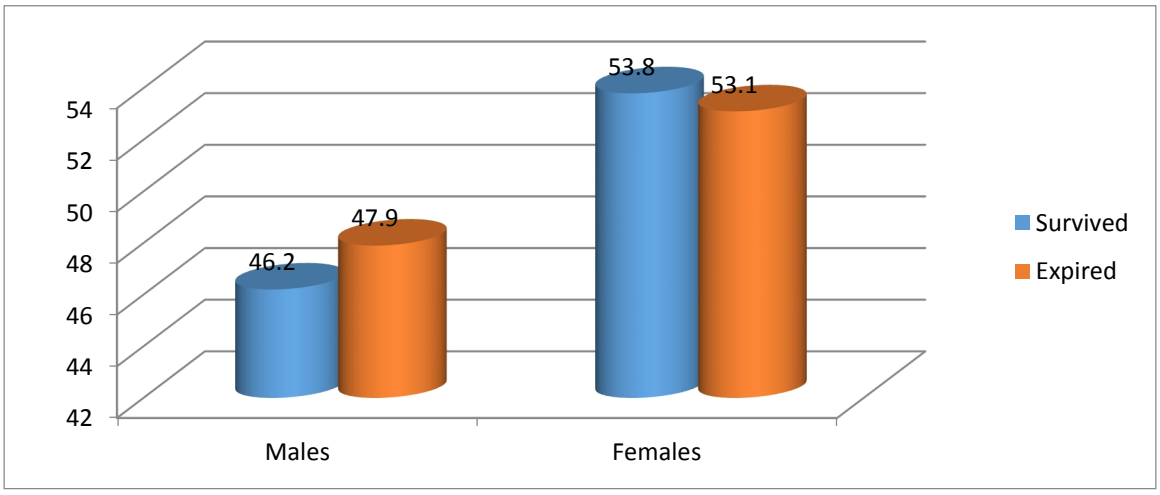


Table-3: Comparison of birth weight between the survived and expired:

Birth weight (kg)	Survived		Expired		Total	
	Frequency	%	Frequency	%	Frequency	%
<1	-	0	2	4.1	2	2
1-1.5	4	7.9	11	22.4	15	15
1.5-2.0	6	11.8	12	24.5	18	18
2.0-2.5	17	33.3	10	20.4	27	27
2.5+	24	47.1	14	28.6	38	38
Total	51	100.0	49	100.0	100	100.0
Mean± SD	2.5±0.7		2.2±0.7		2.4±0.7	
Significance	"t" =2.367, df=98 P=0.020.				Range=1.01-3.9 kg	

24(47.1%) out of 51 babies from the survived group were birth weight of more than 2.5 kg..

The above table 3 compares the birth weight of the survived and expired neonates. The mean birth weight of the survived was 2.5±0.7 kg and expired neonates birth weight of the neonates was 2.2±0.7 kg.

Fig-3a: Comparison of birth weights between the survived and expired.

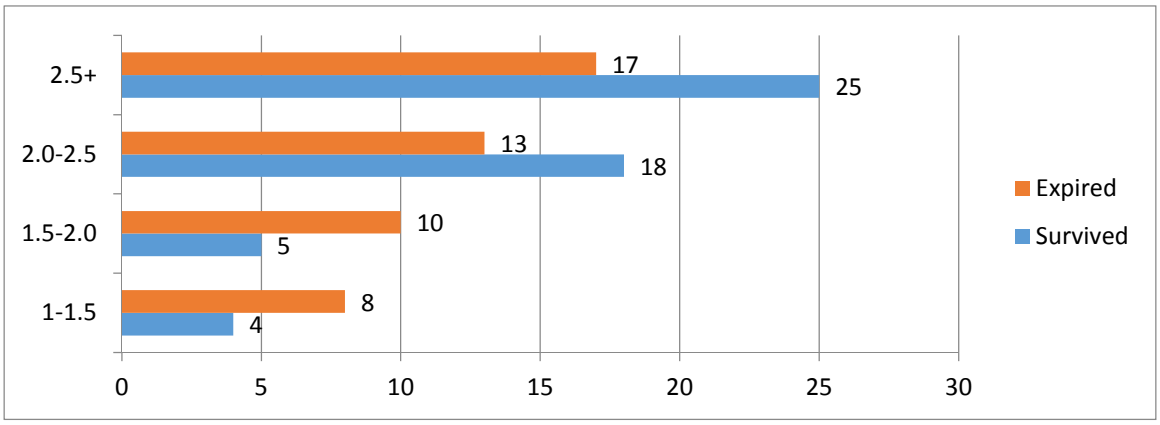
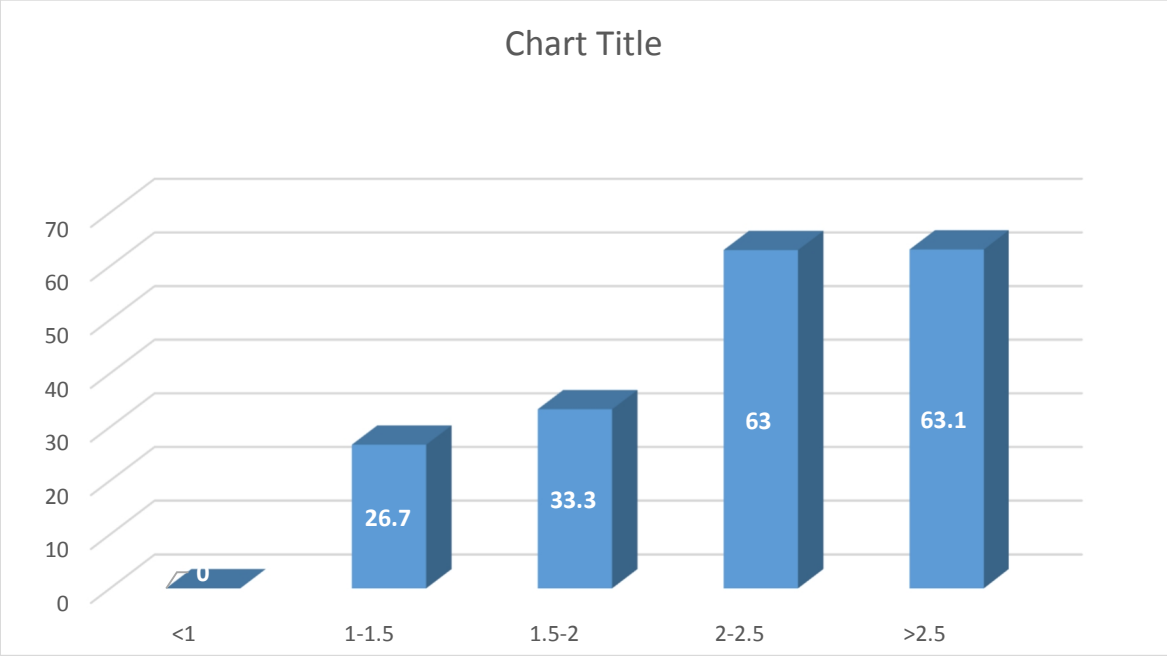


Fig 3b:-Comparison of survival rate among different birth weight



From the above data we analysed that survival rate was directly propotional to the birth weight

Table-4a: Comparison of gestational age between the out come:

Gestational age (weeks)	Survived		Expired		Total	
	n	%	n	%	N	%
≤28	2	3.8	9	18.8	11	11.0
29-32	7	13.5	11	22.9	18	18.0
33-36	22	42.3	10	20.8	32	32.0
≥37	21	40.4	18	37.5	39	39.0
Total	52	100.0	48	100.0	100	100.0
Mean± SD	35.4±3.1		33.8±4.2		34.6±3.8	
Significance	"t"=2.209, df=98, P=0.030				Range=26-40	

Among survived group 40.4% and 42.3% were ≥ 37 weeks and 33-36 weeks respectively, and only 3.8% were ≤28weeks

The table-4a compares the gestational ages between the two out comes. There mean gestational age of survived group was 35.4±3.1 weeks and expired group mean gestational age was 33.8±4.2 weeks. The difference of mean gestational ages between the two groups was statistically significant (P<0.05).

Fig-4a: Comparison of gestational age between the two groups:

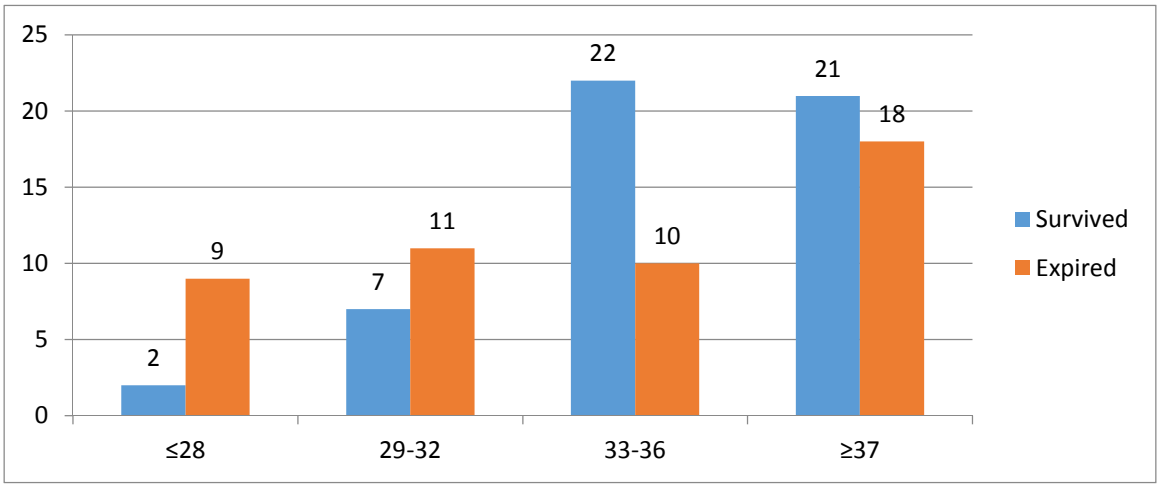
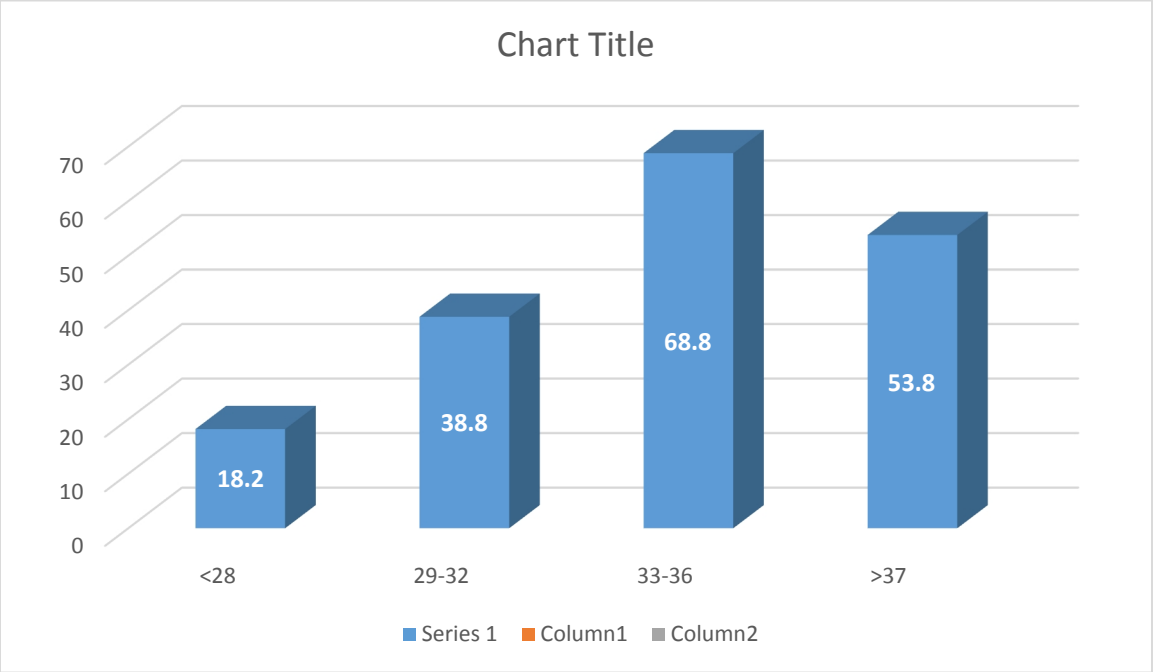


Table 4b:-Survival rate among different Gestational age

Gestational age (weeks)	Survived		Total
	n	%	No
≤28	2	18.2	11
29-32	7	38.8	18
33-36	22	68.8	32
≥37	21	53.8	39
Total	52	52	100

Fig 4b:- Survival rate among different gestational age



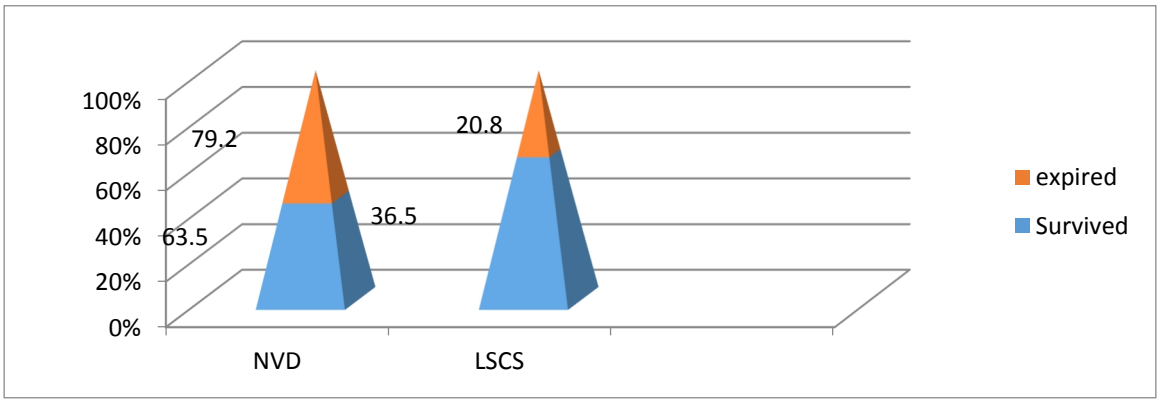
From the above data we noted that survival rate and outcome of the baby was good with increasing gestational age

Table-5: Comparison of mode of birth between the two groups:

Mode of birth	Survived		Expired		Total		Results
	No	%	No	%	No	%	
NVD	33	63.5	38	79.2	71	71.0	χ^2=1.659
LSCS	18	36.5	11	20.8	29	29.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.198

The above table 5 compares the correlates of mode of birth between the two out come. There was no statistically significant relationship between the two groups in respect of their mode of birth (P>0.05).

Fig-5: Comparison of mode of birth between the two groups



In our study we noted that more number of the baby was born by NVD , survival rate was better with the babies delivered by LSCS

Table-6: Comparison APGAR score between the survived and expired neonates.

APGAR Score	Survived		Expired		Difference b/w means	"t"	df	Sig
	Mean	SD	Mean	SD				
1st Min	3.4	1.8	2.8	2.1	0.6	1.372	98	P=0.173
5th Min	5.9	1.5	5.3	2.0	0.6	1.643	98	P=0.104

The above table-6 compares the APGAR scores of 1st and 5th minutes between the two groups. The mean APGAR scores of 1st and 5th minutes of survived group was 3.4±1.8 and 5.9±1.5. The expired groups mean APGAR scores 1st and 5th minutes was 2.8±2.1 and 5.3±2.0. The differences between the groups were not statistically significant (P>0.05).

Fig-6: Comparison of APGAR scores at 1 and 5 minutes between the two groups.

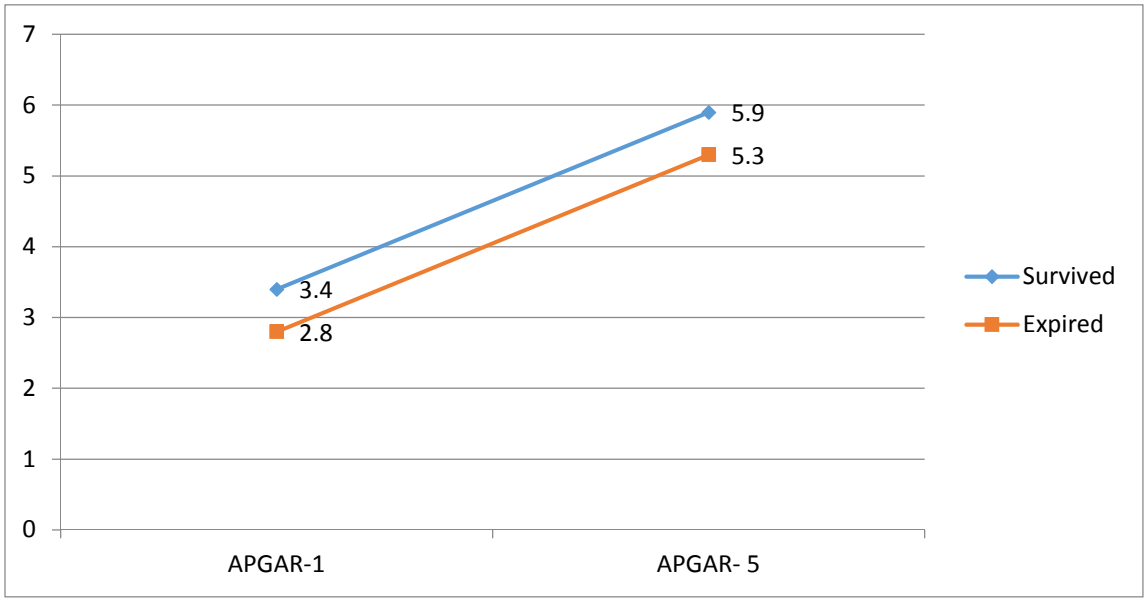


Table-7a: Comparison of diagnosis between the two groups:

Indication for Ventilation	Survived		Expired		Total		Results
	No	%	No	%	No	%	
Congenital pneumonia	1	1.9	1	2.1	2	2.0	
MAS	9	17.3	8	16.7	17	17.0	χ^2=2.510
PNH	21	40.4	13	27.1	34	34.0	df=4
RDS	15	28.8	17	35.4	32	32.0	P=0.643
Sepsis	6	11.5	9	18.8	15	15.0	
Total	52	100.0	48	100.0	100	100.0	

The diagnosis were shown in the above table-7a. The indications between the two groups were not statistically significant (P>0.05).

Fig-7a: Comparison of diagnosis between both groups(%).

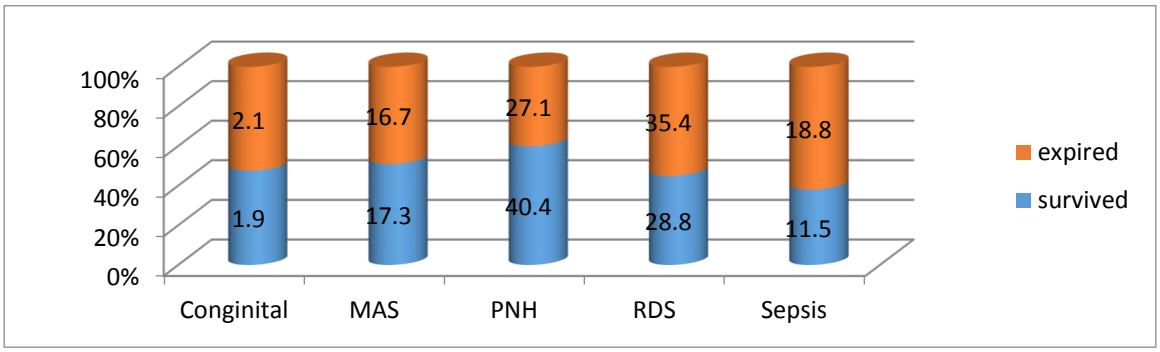
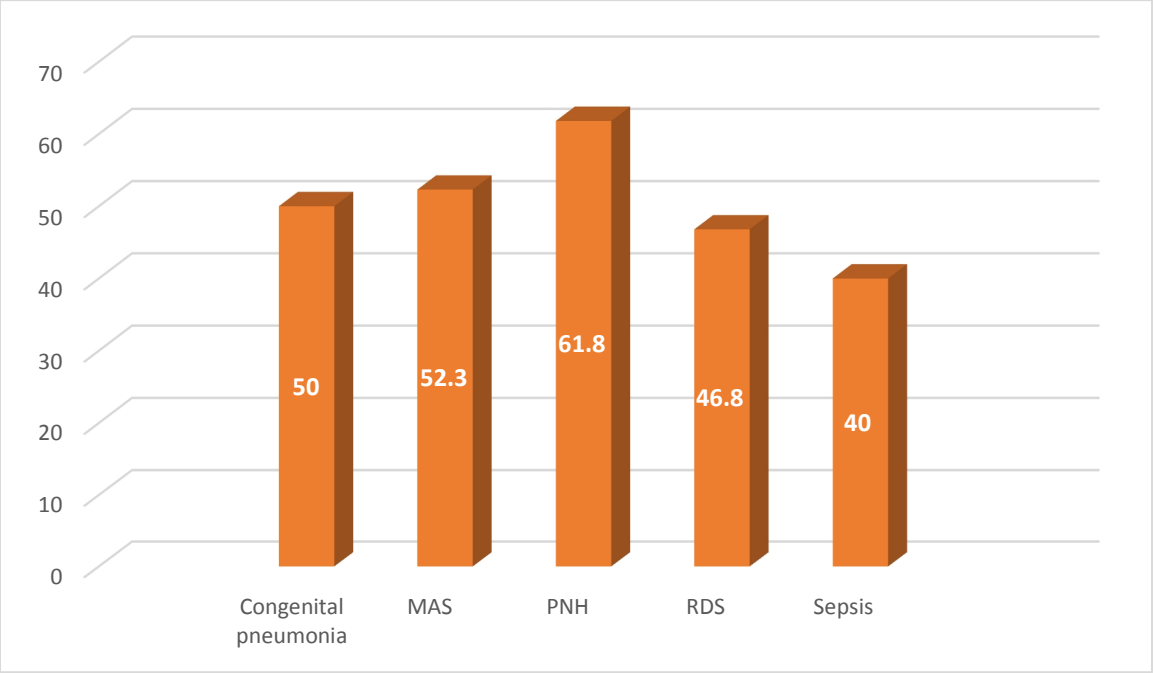


Table- 7b: Survival rate among different disease condition

Disease condition	Survived		Total
	No	%	No
Congenital pneumonia	1	50	2
MAS	9	52.3	17
PNH	21	61.8	34
RDS	15	46.8	32
Sepsis	6	40	15
Total	52	52	100

Fig-7b: Comparison of survival rate among different diagnosis



From the above data we noticed that survival rate was high among PNH followed by MAS

Table-8: Comparison day of ventilation between the two groups:

Day of ventilation	Survived		Expired		Total		Results
	No	%	No	%	No	%	
1st	23	44.2	25	52.1	48	48.0	
2nd	22	42.3	13	27.1	35	35.0	χ^2=13.259
3rd	6	11.5	2	4.2	8	8.0	df=4
4th	1	1.9	0	0.0	1	1.0	P=0.010
5th	0	0.0	8	16.7	8	8.0	
Total	52	100.0	48	100.0	100	100.0	

The above table-8 states the day of ventilation between the two groups were statistically significant (P<0.05). The 1st and 2nd day of ventilation were statistically significantly differed between the two groups.

Fig:8 Comparison day of ventilation between the two groups.

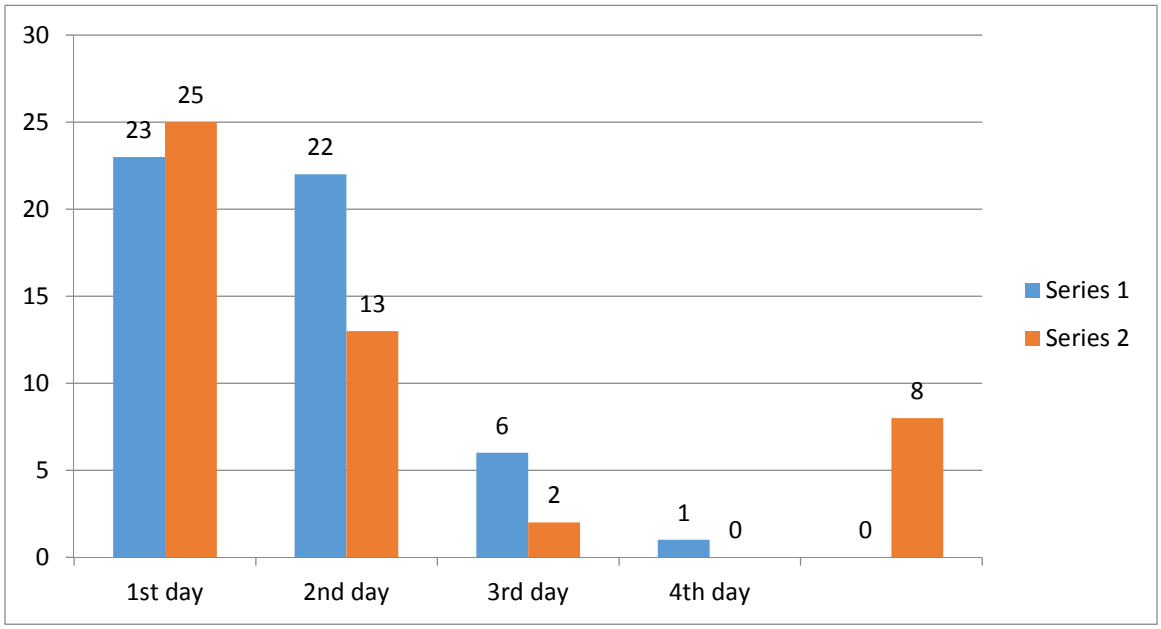


Table-9a: Duration of ventilation between the two groups:

Duration of Ventilation	Survived		Expired		Difference b/w means	"t"	df	Sig
	Mean	SD	Mean	SD				
Hours	68.0	29.2	71.9	29.8	3.9	0.667	98	P=0.506

The above table -9a compares the duration of ventilation between the two groups. The mean duration of survived group was 68.0±29.2 days. The mean

duration of expired group was 71.9±29.8 days. The mean difference of day 3.9 was not statistically significant (P>0.05).

Fig-9a: Duration ventilation between the two group in hours).

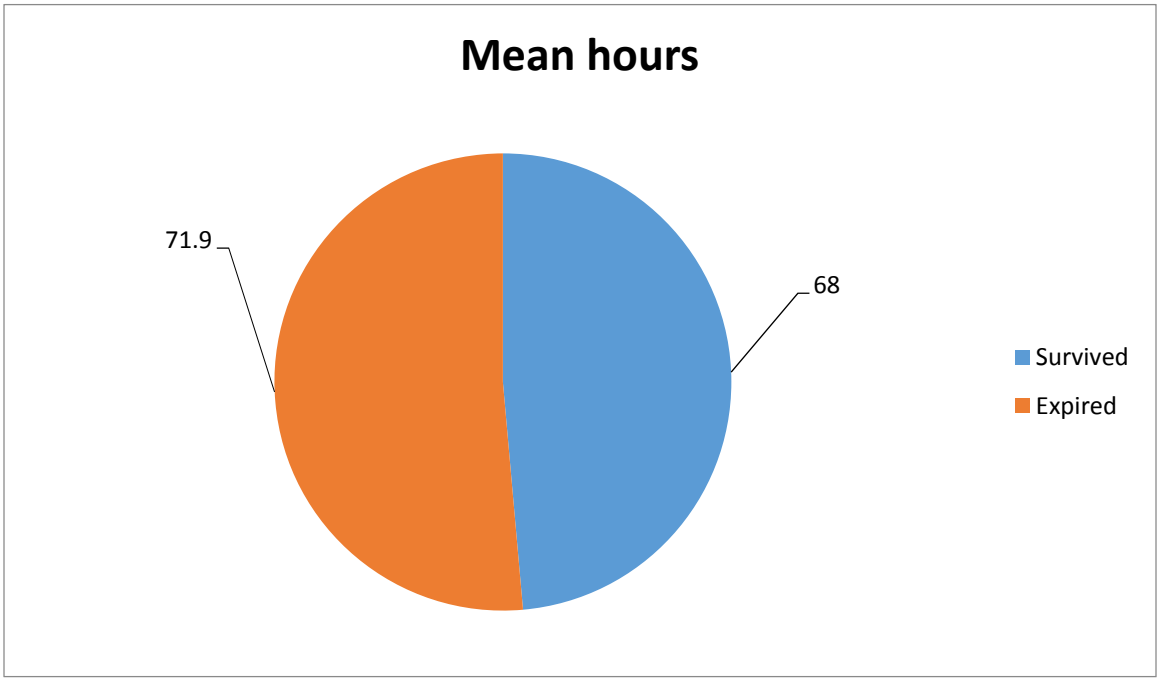
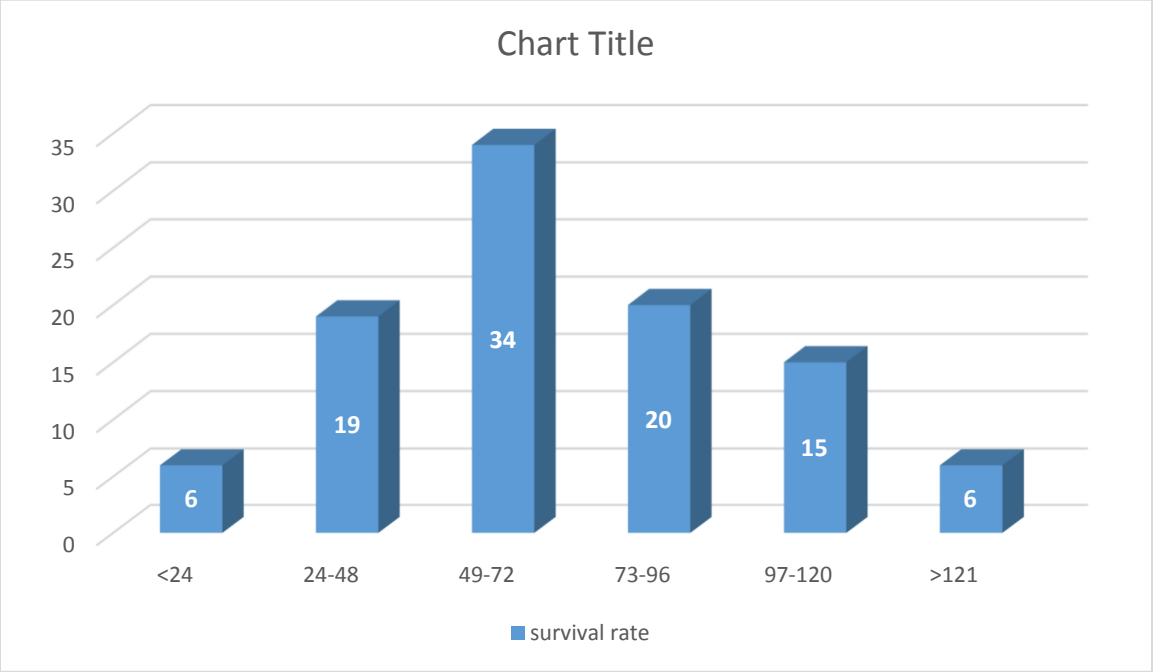


Table-9b: Duration of ventilation and survival rate

Duration of ventilation(in hours)	Survival Rate(in %)
< 24	6
25-48	19
49-72	34
73-96	20
97-120	15
>121	6

Fig-9b: Survival rate among duration of ventilation:



From the above data it is evident that survival rate was more in the duration of ventilation between 49-72hours followed by 73-96 hours

Table-10: Incidence of Air leak between the two groups.:

Air leak	Survived		Expired		Total		Results
	n	%	n	%	N	%	
Yes	2	3.8	4	8.3	6	6.0	χ^2=0.891
No	50	96.2	44	91.7	94	94.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.345

The incidence of air leak of the two groups were shown in the above table-10. The incidences of air leak between the two groups were not statistically significant (P>0.05).

Fig-10a: Comparison of incidences of Air leak between the two groups:

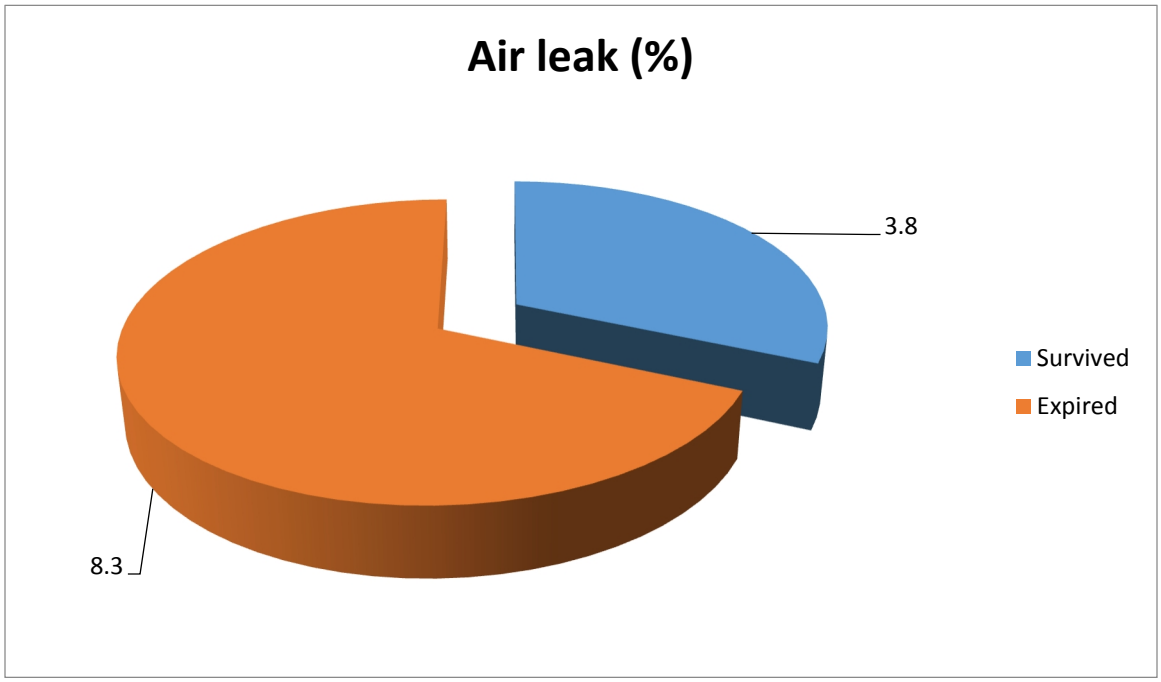


Fig 10b:- Survival rate among babies developed air leak:-

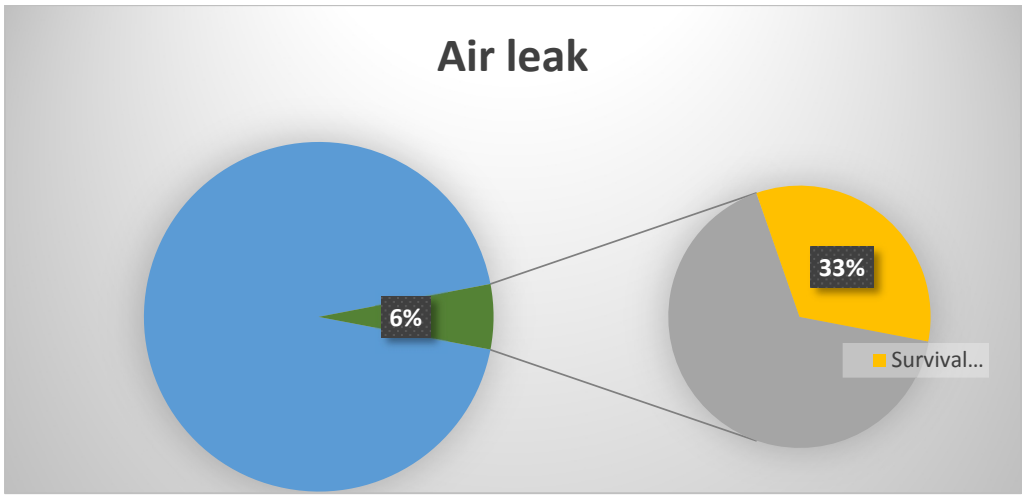


Table-11:Incidence of Septicemia between the two groups.:

Septicemia	Survived		Expired		Total		Results
	n	%	n	%	N	%	
Yes	10	19.2	13	27.1	23	23.0	χ^2=1.812 df=2 P=0.404
NA	7	13.5	9	13.8	16	16.0	
No	35	67.3	26	54.2	61	61.0	
Total	52	100.0	48	100.0	100	100.0	

The incidence of Septicemia of the two groups were shown in the above table-13. The incidences of Septicemia between the two groups were not statistically significant (P>0.05).

Fig-11a:Comparison of incidences Septicemia between the two groups:

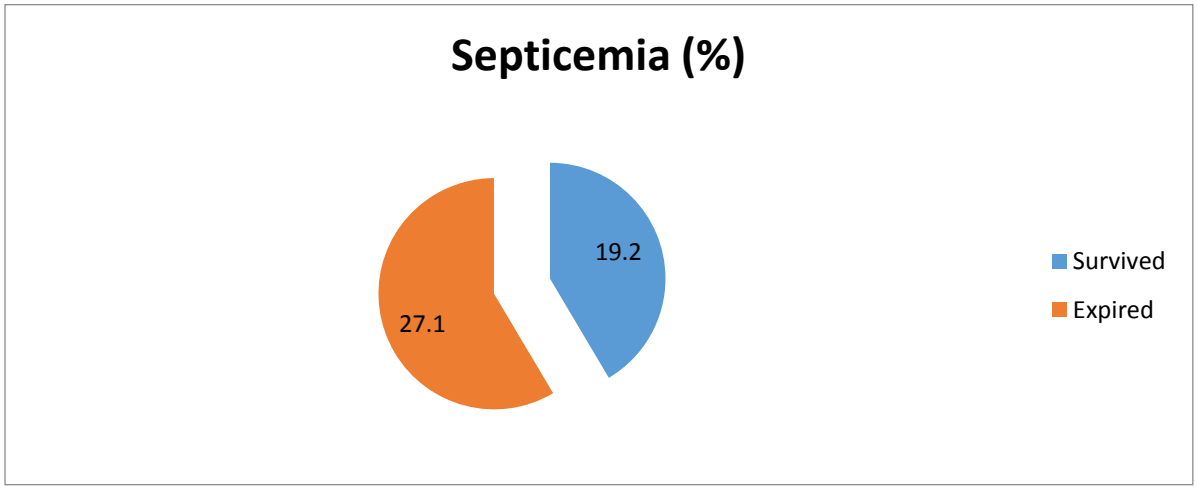


Fig-11b:- Survival rate among babies developed sepsis:-

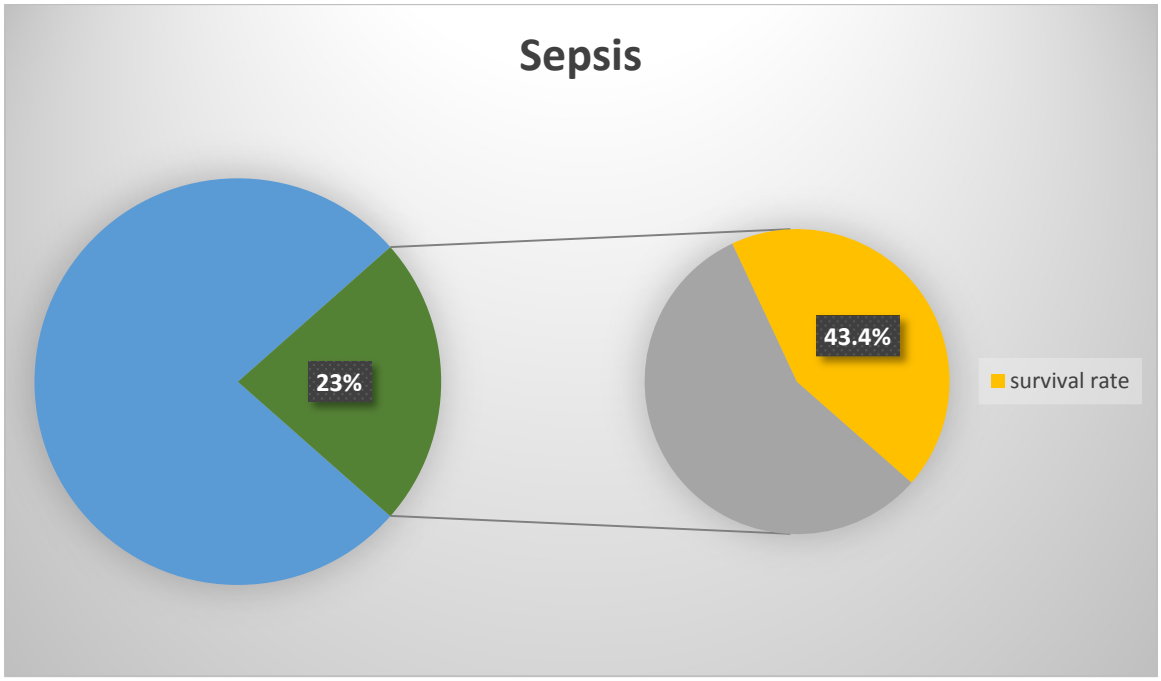


Table-12: Incidence of Tube Block between the two groups.:

Tube block	Survived		Expired		Total		Results
	n	%	n	%	n	%	
Yes	2	3.8	10	20.8	12	12.0	χ^2=6.821
No	50	96.2	38	79.2	88	88.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.009

The incidence of tube block of the two groups were shown in the above table--12. The incidences of Tube block between the two groups were statistically highly significant (P<0.01). The incidences of tube block 20.8% was significantly more among expired group than that of survived (P<0.001).

Fig-12a: Comparison of incidences of Tube Block between the two groups:

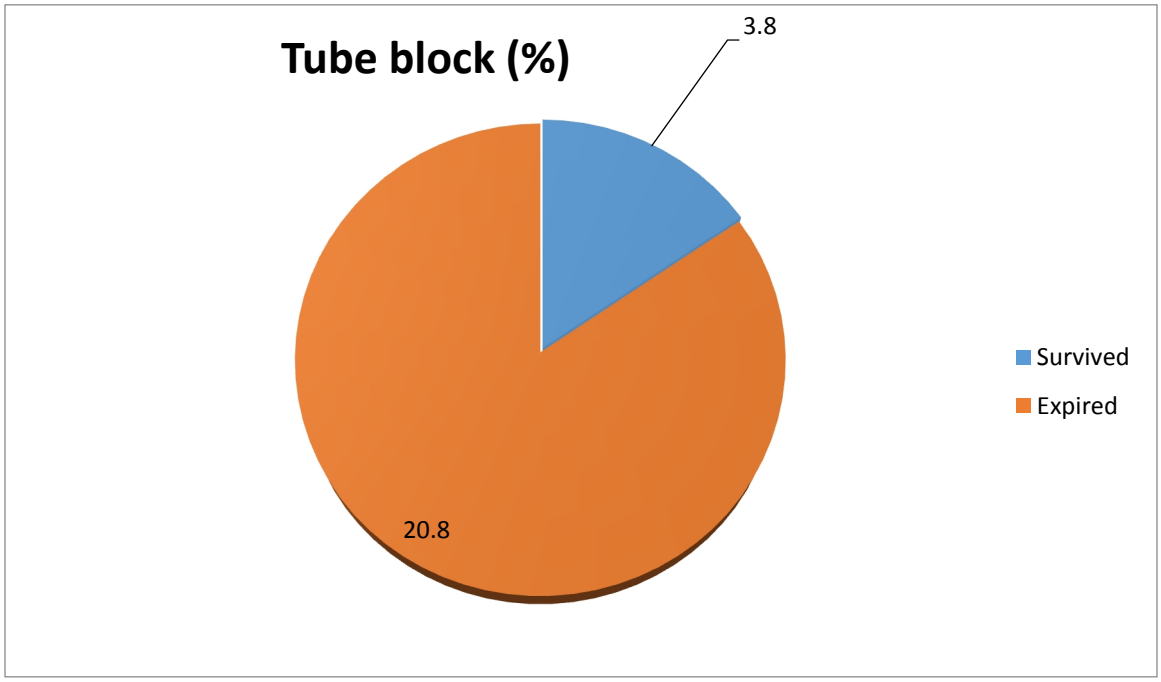


Fig-12b:- Survival rate among babies developed tube block:

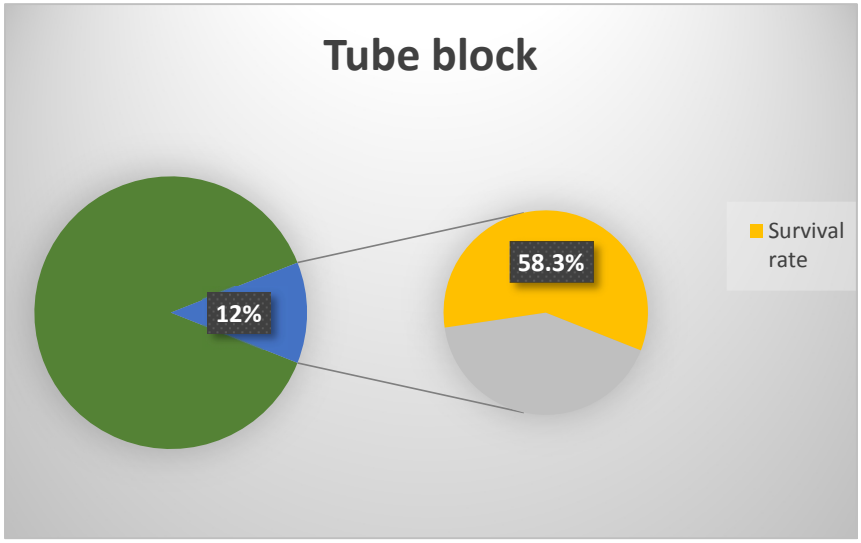


Table-13: Incidence of Shock between the two groups.:

Shock	Survived		Expired		Total		Results
	n	%	n	%	N	%	
Yes	16	30.8	8	16.7	24	24.0	χ^2=2.722
No	36	69.2	40	83.3	76	76.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.099

The incidence of shock of the two groups were shown in the above table-13. The incidences of shock between the two groups were not statistically significant (P>0.05).

Fig-13a: Comparison of incidences of shock between the two groups:

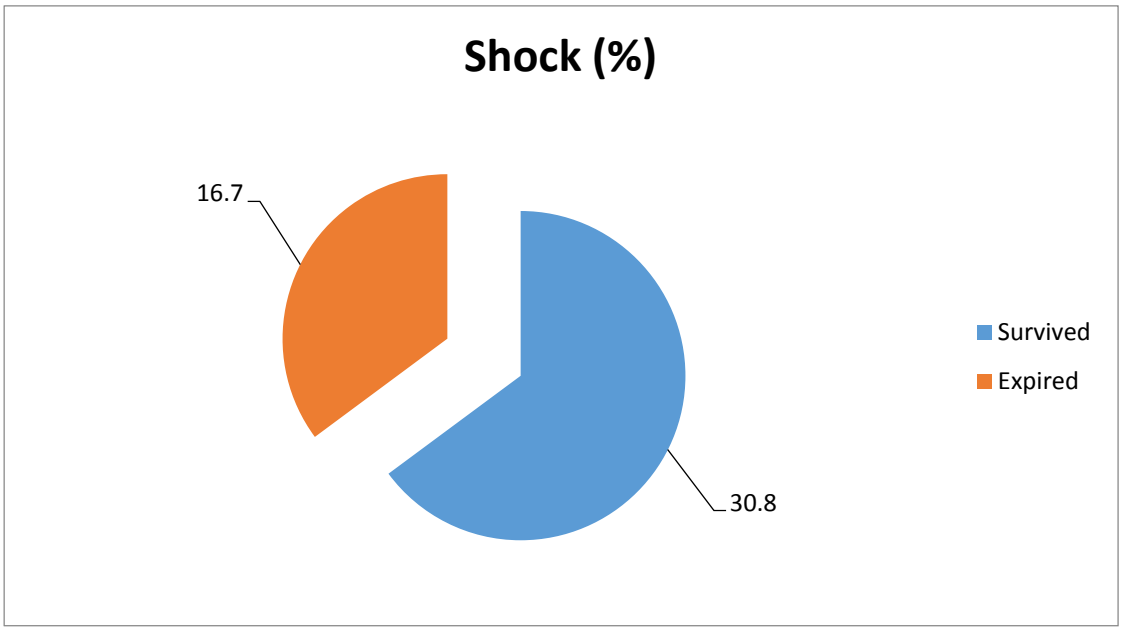


Fig13b:- Survival rate among the babies developed shock

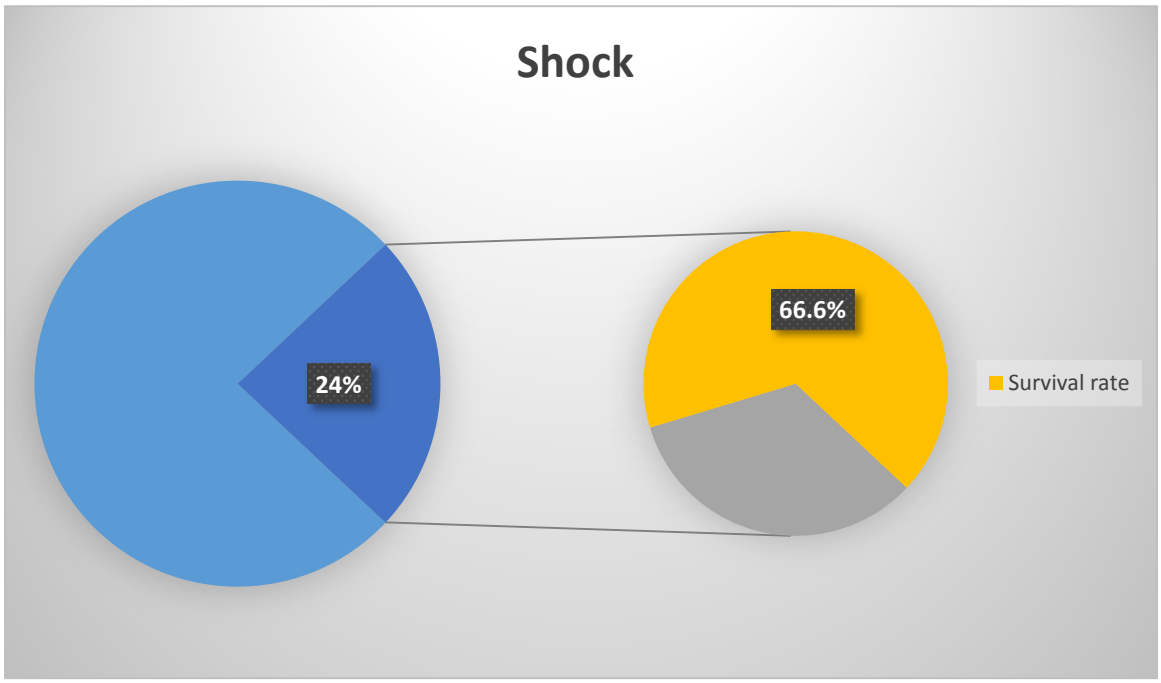


Table-14: Incidence of Pulm heamarrage between the two groups.

Pulm heamarrage	Survived		Expired		Total		Results
	n	%	n	%	N	%	
Yes	6	11.5	12	25.0	18	18.0	χ^2=3.0.64
No	46	88.5	36	75.0	82	82.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.080

The incidence of Pulm heamarrage of the two groups was shown in the above table-16. The incidences of Pulm heamarrage between the two groups were not statistically significant (P>0.05).

Fig-14a: Comparison of Incidence of Pulm heamarrage between the two groups.

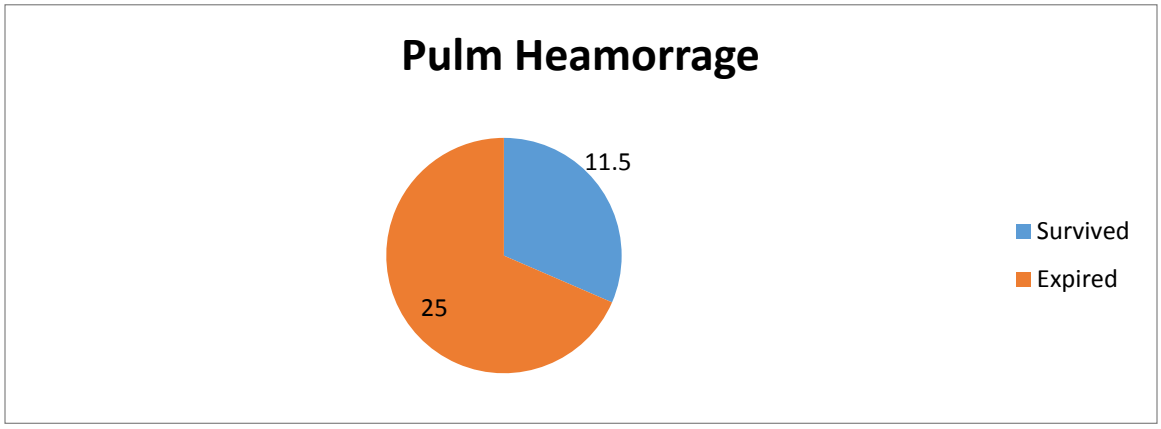


Fig 14b- Survival rate among babies developed pulmonary hemorhage

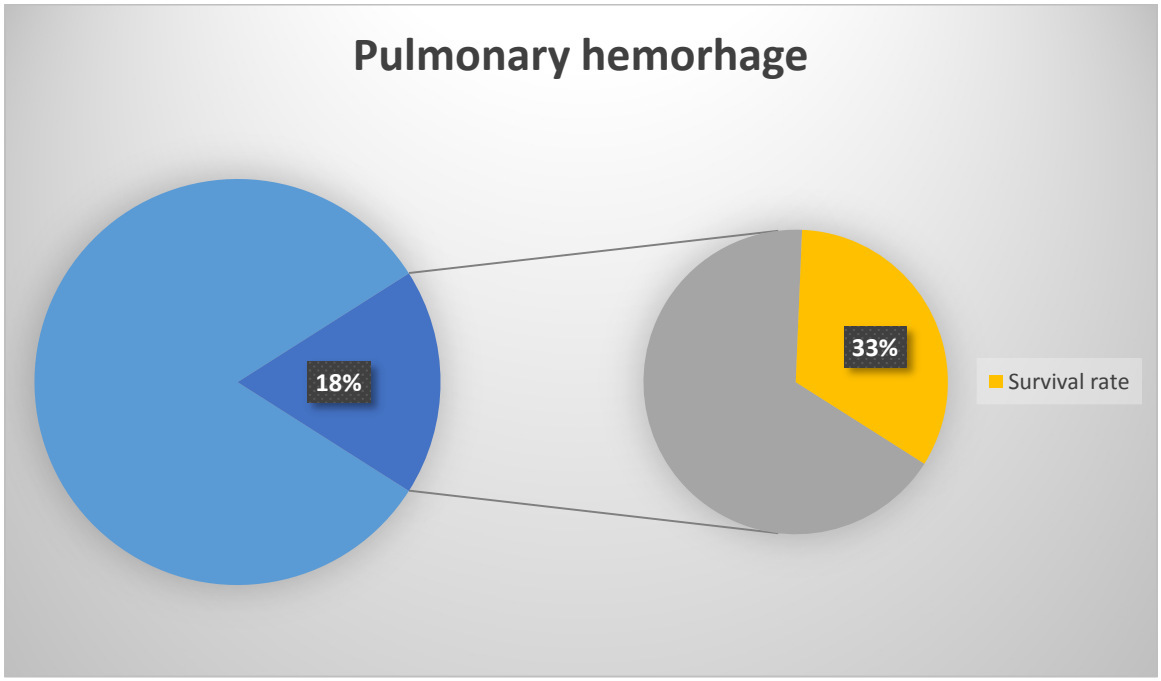


Table-15: Incidence of VAP between the survived and expired groups:

VAP	Survived		Expired		Total		Results
	n	%	n	%	N	%	
Yes	8	15.4	12	25.0	20	20.0	χ^2=1.442
No	44	84.6	36	75.0	80	80.0	df=1
Total	52	100.0	48	100.0	100	100.0	P=0.230

The incidence of VAP of the two groups was shown in the above table-15. The incidences of VAP between the two groups were not statistically significant (P>0.05).

Fig-15a: Comparison of VAP between the two groups.

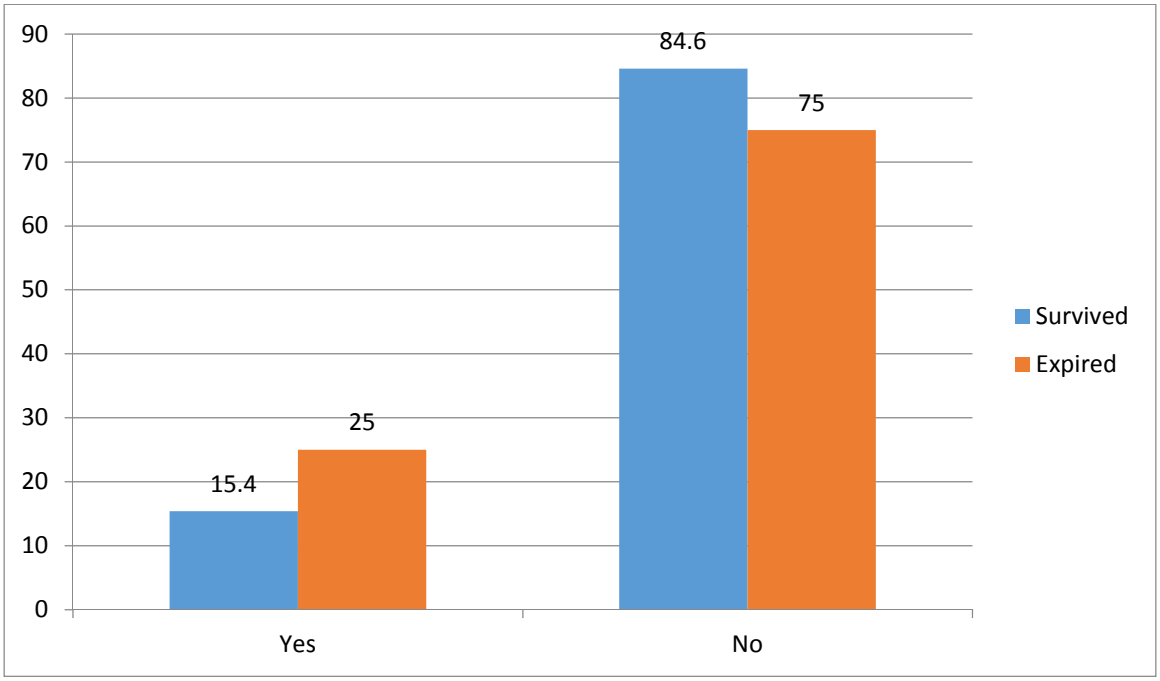


Fig 15b:- Survival rate among babies developed VAP:-

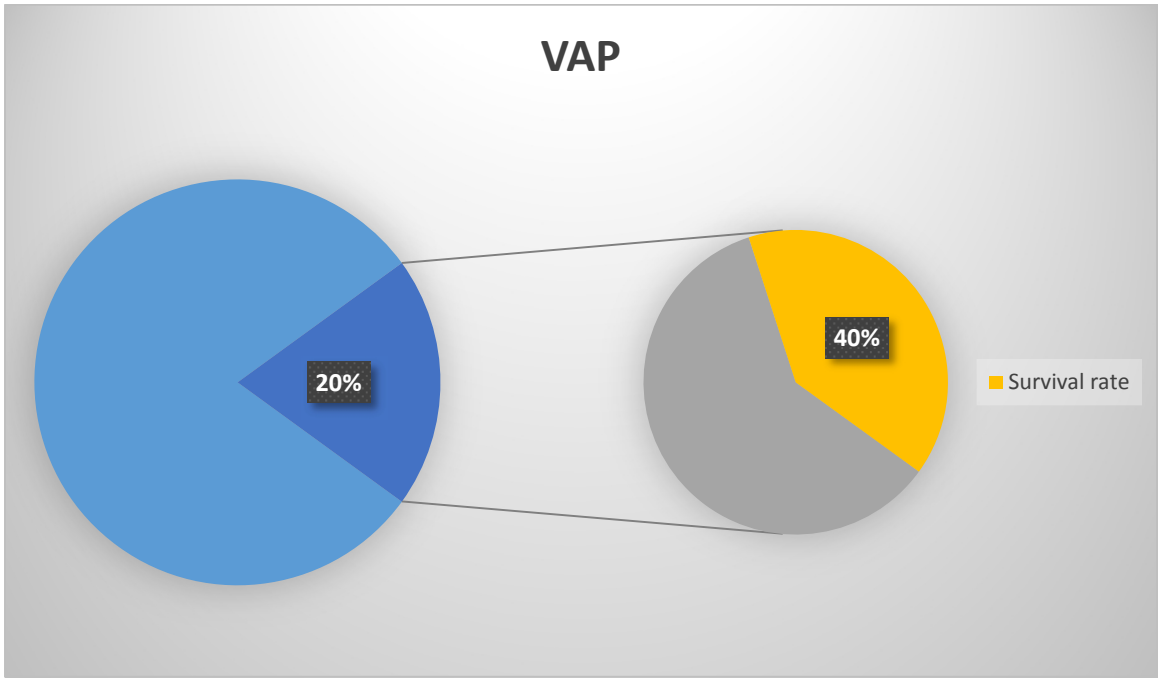
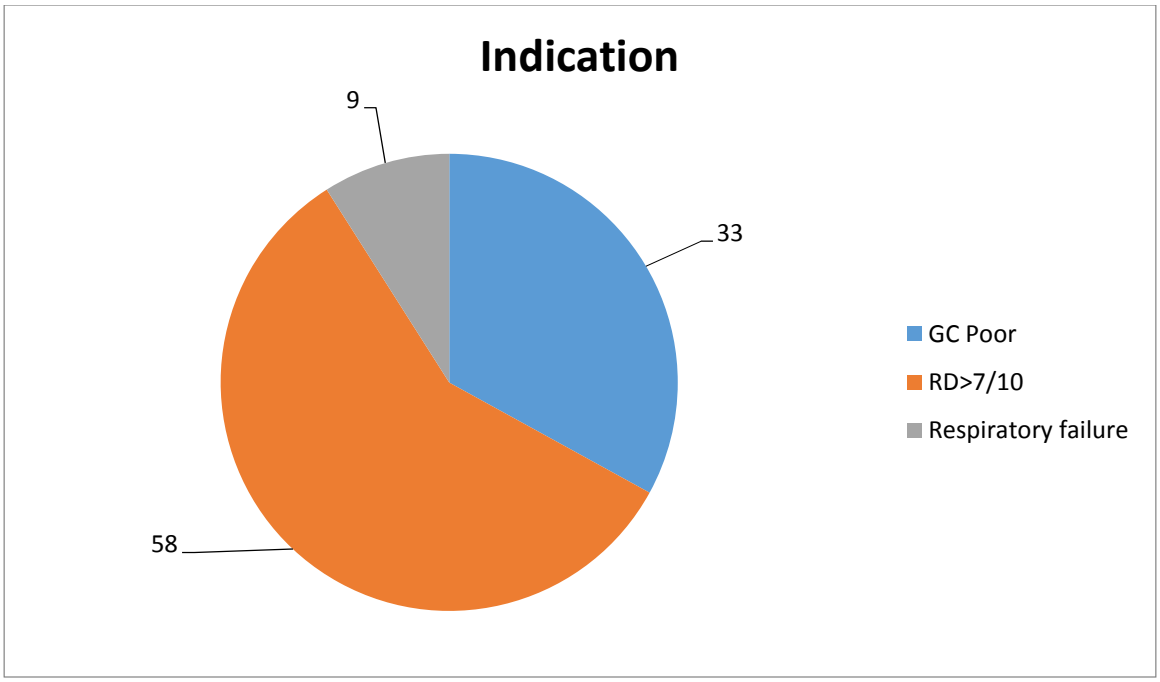


Table 16. Incidence among different Indication of ventilation :

Indication	Frequency	%
GC Poor	33	33.0
RD>7/10	58	58.0
Respiratory failure	9	9.0
Total	100	100.0

From the above data we observed that most of the babies were intubated for the indication of respiratory distress scoring more than 7/10 followed by poor GC


Indication
9
33
58
GC Poor
RD>7/10
Respiratory failure

8.DISCUSSION

Modern neonatal care has been revolutionized by the availability huge number of computerized ventilators to give assisted ventilation. According to their working principle ,there are two types of ventilators, pressure limited and volume limited. Most of the ventilators also provide continuous flow of gases throughout the respiratory cycle and they are termed as constant flow generators. They provide stable and consistent tidal volume minute ventilation, independent of lung compliance[25].

Aim of present study is to find the risk factors responsible for poor outcome in ventilated newborns and to prevent it. The clinical profile in the ventilated neonates will be studied and correlated with the outcome and we studied the influence of gestational age and birth weight on the immediate outcome in ventillatory,mean duration of mechanical ventilator needed and studied the complications associated with mechanical ventilation

The study was conducted in Neonatal Intensive Care Unit, paediatrics department Tirunelveli medical college during the period of January 2018 to june 2019 .

Around 100 consecutive newborns who were meeting inclusion criteria ventilated during the period of January 2018 to june 2019 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 on immediate outcome of mechanical ventilator. Outcome of the neonates have been assessed as survival or death.Also studied about the mean duration of ventilation needed,and the complications associated. Time cycled pressure limited continuous flow ventilator was used and the initial settings was set according to the underlying disease. Continuous non invasive oxygen saturation was monitored. The aim is to use minimum possible pressure and Fio2 to maintain saturation.

Totally 100 neonates were studied, among them 47 % babies were male and 53% females, 71%was born by normal vaginal delivery and 29% by LSCS

In this study below 28 weeks of gestational age are 11%, 29-32 weeks are 18%, 33-36 are 32% and > 37weeks were 39%. This is comparable with the study done by Basavaraj M Patil, Sandeep VH[26] in contrast to the number of babies less than 32 weeks was 43% in a study done by NC Mathur[27]. The smallest survivor on ventilator was 1010 grams and gestational age of 28weeks

In our study weight distribution was found to have 2% in <1kg, 15 % in 1-1,5kg, 14% in 1.5-2kg, 29% in 2-2.5kg and 37% in > 2.5kg. This is comparable with the study done by Basavaraj M Patil, Sandeep VH[26] and contrast to the number of babies between 1 to 1.5kg in a study done by NC Mathur[27] 38.79% and S.Nangia[28] had 61.22%.

Duration of ventilation in relation to different disease condition was studied and found to have perinatal hypoxia needed maximum duration of ventilation, mean duration was 74.79 hours which was comparable to the study done by by Basavaraj M Patil, Sandeep VH[26] with the duration of 89.2 hours, followed by septicemia which had mean duration of 74.53 hours in contrast to the study done by Basavaraj M Patil, Sandeep VH[26] being 92.6hours. Mean duration of ventilation needed in RDS patients were 65.45 hours ,in contrast to the study done by Basavaraj M Patil, Sandeep VH[26].

The mean duration of meconium aspiration syndrome and congenital pneumonia were 64.65 hours and 64 hours respectively. Duration of mechanical ventilation needed was maximum in PNH followed by sepsis in contrast to the study done by Basavaraj M Patil, Sandeep VH[26] which was RDS followed by congenital pneumonia.

During the current study occurrence of complication was found to be 64%. Major complication were shock`(24%), followed by septicemia(23%) and VAP (20%) which was comparable with the study done by NC Mathur[27] who had high incidence of septicemia(36.7%) and Basavaraj M Patil, Sandeep VH[26,] in contrast to the study done by L.Krishnan[29] who reported only 4.4% septicemia and she attriburted which to the use of minimum PIP ,and early extubation from ventilation, endotracheal toilet and timely post extubation chest physiotherapy.In our study pulmonary hemorrhage was occurred in 18% of cases. In contrast to the study done by S.Nangia[28] (9.5%) and comparable with study done by Basavaraj M Patil, Sandeep VH[26] which is 24.49%. Incidence of pneumothorax was found to be 6% in our study which was comparable with the study done by Basavaraj M Patil, Sandeep VH[26](9.1%) and L.Krishnan[29](8.8%). 12% of the baby went for tube block which was comparable with the study done by Basavaraj M Patil, Sandeep VH[26] (12.4%) and contrast to the study done by L. Krishnan[29](5.8%)

In our study overall survival rate is 52%. This was comparable with studies done in other parts of the country by Basavaraj M Patil, Sandeep VH[26](47.8%), M.Singh[30](55.5%) and foreign studies like study done by Richard L[31] (63.7%)and Lindroth et al[32] (53%). In our study female babies better survival with a survival rate of 53.8% compard to 46.2% in male babies. Improvement in survival rate was noted as propotional to the gestational weeks and birth weight. Neonates with the birth

weight of less than 1.5kg was found to have a survival rate of only 23.5% which is comparable with the study done by Basavaraj M Patil, Sandeep VH[26](29.16%), Maiyya P.P(26.3%)[33] . While the other end babies weighing more than 2.5 kg had a survival rate of 62.1% and babies with birth weight between 1.5-2kg,2-2.5kg had a survival rate of 50%,58.6% respectively. This was comparable with study of S.Nangia[28] (1-1.5kg(31%), 1.5-2kg(40.8%),2-2.5kg(51.2%) > 2.5kg(53%). NC Mathur[27] also had a similar kind of result except that he reported a better survival in 1-1.5kg(59%).

Gestational weeks at birth also showed a similar pattern with a better survival rate with increasing gestational age. Newborns who were <32 weeks showed a survival rate of only 31% while >37 weekers had a survival rate of 53.8%.

Survival rate according to the gestational week <28weeks,28-32weeks,33-36weeks,>37weeks was found to have 18%,38.8%,68.7%,53.8% respectively, which was comparable with the study done by S.Nangia[28] and NC Mathur[27].

Irrespective of the diagnosis survival rate was found to have improving with increasing gestational age and birth weight. This pattern was noted in all the other studies. Perinatal Asphyxia had a survival rate of 61.7% which was the highest followed by Meconium Aspiration Syndrome(52%) and congenital pneumonia(50%). Respiratory distress syndrome and sepsis had poor outcome with

survival rate of 40%each. This was comparable with reports of Basavaraj M Patil Sandeep VH[26] (perinatal hypoxia 56.3%,MAS 55.5%,pneumonia 50% RDS , Sepsis 36.8%) and in contrast to the study done by Riyas et al[34] had a better survival rate in MAS(63.6%) followed by pneumonia(62.5%) and also he had a better survival rate among RDS(53.1%) as we had only 40% in our study.

64 % of the babies developed compications in our study among that 27% of the babies survived. Among complications developed shock had a better outcome with a survival rate of 66.6% and Air leak and pulmonary hemorrhage had a least outcome with a survival rate of only 33%. Tube block,Sepsis ,and VAP had a survival rate of 58.3%,43.4%,40% respectively. In contrast to the outcome noted by NC Mathur[27] and Maiyya PP[33] both had a highest survival rate in sepsis.

In our study we noted that majority of the cases (34%) required ventilation hours 49-72 (2-3 days), 6% of the cases needed ventilation >121 hours,in contrast to the study done by Ahmed S M[35] and Sharma R[36] noted that maximum duration of ventilation as 2-7 days and 4-7 days respectively.

9.CONCLUSION

Survival rate was improved with increasing birth weight and gestational age. Babies less than 1.5 Kg had a survival rate of only 23.5% in the same time it was 62.1% in those who had birth weight of more than 2.5 Kg. Babies who are less than gestational age of 32weeks had a survival rate of only 31% as compared to 53.8% in babies with gestational age above 37 weeks. Irrespective of the diagnosis or indication of ventilation, the survival rate improved with increasing birth weight and gestational age. Most Common indications are, Perinatal Hypoxia (34%),Respiratory distress syndrome (32%), followed by meconium aspiration syndrome (17%), Sepsis (15%), congenital pneumonia (2%). PNH had the best survival rate of 61.8%, followed by MAS(52.3%) congenital pneumonia (50%) and RDS (46.8%). Maximum duration of ventilation was needed in sepsis a mean of hours (74.53+15.81) followed by PNH(71.67± 37.33). The overall range noted was 20 to 136 hours and a mean of 68.4±29.5 hours. The commonest complication encountered was shock (24%) followed by sepsis(23%) , VAP(20%), pulmonary hemorrhage (18%), Tube block(12%), and Air leak(6%). Outcome in babies who developed pulmonary haemorrhage and air leak were poor with survival rate of only 33%. Babies with Perinatal Hypoxia developed maximum number of complication (38) followed by respiratory distress syndrome and meconium aspiration syndrome with 30 and 18 cases respectively. The overall survival rate observed

in the present study was 52. We were able to achieve a survival rate among ventilated neonates which is comparable to other studies conducted in past.

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11.ANNEXURE

A) CASE PROFORMA

BABY MOTHER NAME

AGE IN DAYS

SEX

BIRTH WEIGHT

GESTATIONAL AGE

MODE OF BIRTH

APGAR SCORE

1 min

5 min

DAY OF ADMISSION

INDICATION OF VENTILATION

DIAGNOSIS

DAY OF VENTILATION

DURATION OF VENTILATION

OUTCOME

DAY OF DEATH

COMPLICATIONS

- AIR LEAK
- SEPSIS
- TUBE BLOCK
- VAP
- SHOCK
- PULMONARY HEMORRHAGE

Assessment of Severity

Modified Downe's Scoring System

Score	0	1	2
Respiratory Rate (rate/min)	<60	60-80	>80
Cyanosis	None in room air	No cyanosis with oxygen support	Cyanosis in spite oxygen support
Retractions	None	Mild	Moderate to Severe
Grunting	None	Audible with Stethoscope	Audible without Stethoscope
Air Entry	Good	Decreased	Barely Audible

Silverman-Andersen Retraction Scoring

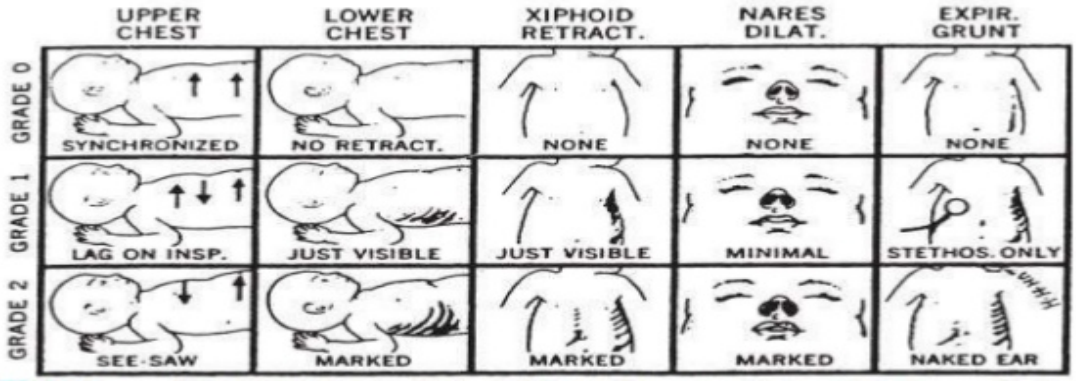

Figure Silverman score. (Adapted from Silverman, W. A. and Andersen, D. H. *Pediatrics* 17 (1956), 1-10.).

Interpretation

Score 0-3 = Mild respiratory distress
Score 4-6 = Moderate respiratory distress
Score > 6 = Impending respiratory failure
Score 10 = Severe Respiratory distress

APGAR

Test Scoring

	Score 0	Score 1	Score 2
Appearance	 Blue all over	 Blue only at extremities	 No blue coloration
Pulse	No pulse	<100 beats/min.	>100 beats/min.
Grimace	 No response to stimulation	 Grimace or feeble cry when stimulated	 Sneezing, coughing, or pulling away when stimulated
Activity	 No movement	 Some movement	 Active movement
Respiration	No breathing	Weak, slow, or irregular breathing	Strong cry

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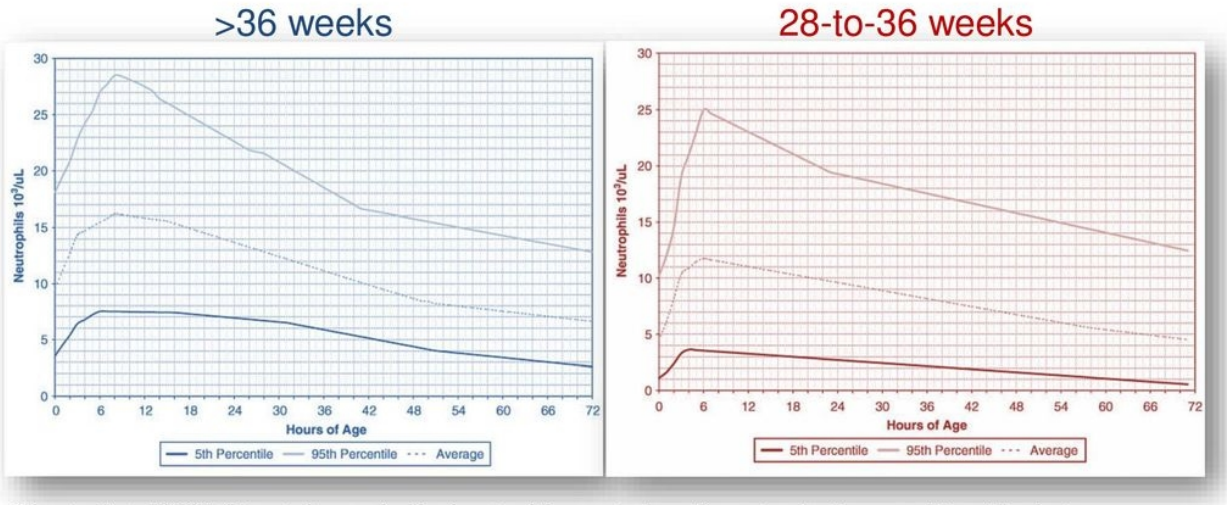
College of Medicine

ANC in the First 3 Days of Life: Full Term vs. Premature Neonates



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LIST OF ABBREVIATIONS

- PSV - Pressure support ventilation
- ET- Endotracheal tube
- SIMV- Synchronized intermittent mandatory ventilation
- IMV- Intermittent mandatory ventilation
- A/C- Assist/control
- PSV- Pressure support ventilation
- PRVC- Pressure-regulated volume control
- HFV- High-frequency ventilation
- HFO- High frequency oscillator
- HFFI- High-frequency flow interrupter
- HFJ- High-frequency jet ventilator.
- PIE- Pulmonary interstitial emphysema
- MAP- Mean airway pressure
- NIPPV- Neonatal nasal intermittent positive pressure ventilation
- CHD- Cyanotic congenital heart disease
- MAS- Meconium aspiration syndrome
- ETCO2- End tidal CO2

- CVP - Central venous pressure
- PCV- Pressure controlled ventilation
- VCV- Volume control ventilation
- CPAP- Continuous positive airway pressure
- HFNC- High flow nasal cannula
- PIP- Peak inspiratory time
- PEEP- Peak end expiratory pressure
- Vt- Tidalvolume
- NICU- Neonatal intensive care unit
- RDS – Respiratory distress syndrome
- BPD- Broncho pulmonary dysplasia
- FiO2 – Fraction of inspired oxygen
- PaO2- Partial pressure of oxygen
- PaCO2- Partial pressure of carbon dioxide
- TI- Inspiratory time
- CFT- Capillary refilling time
- GC- General condition
- ABG- Acid blood gas
- VAP- Ventilator associated pneumonia
- PPHN- Persistent pulmonary hypertension in newborn

- RD- Respiratory distress
- GCS- Glasgow coma scale
- NVD- Normal Vaginal Delivery
- LSCS- Lower segment caesarian section

நோயாளிகளுக்கு அறிவிப்பு மற்றும் ஒப்புதல் படிவம்
(மருத்துவ ஆய்வில் பங்கேற்பதற்கு)

ஆய்வு செய்யப்படும் தலைப்பு:
பங்கு பெறுவரின் பெயர்:
பங்கு பெறுவரின் வயது:

		பங்கு பெறுவர் இதனை ✓ குறிக்கவும்
1.	நான் மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்களை படித்து புரிந்து கொண்டேன். என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டுள்ளது என அறிந்து கொண்டேன்.	☐
2.	நான் இவ்வாய்வில் தன்னிச்சையாக தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும், எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.	☐
3.	இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்காள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.	☐
4.	இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக் கொள்ள மறுக்க மாட்டேன்.	☐
5.	இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக் கொள்கிறேன் எனக்கு கொடுக்கப்பட்டஅறிவுரைகளின் படி நடந்து கொள்வதுடன், ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்று உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ, அல்லது எதிர்பாராத, வழக்கத்திற்கு மாறான நோய்குறி தென்பட்டாலோ உடனே இதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்றேன்.	☐

பங்கேற்பவரின் கையொப்பம் / ..... இடம் .....
கட்டைவிரல் ரேகை
பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....
ஆய்வாளரின் கையொப்பம் /..... இடம் .....
ஆய்வாளரின் பெயர் .....
மையம் .....
கல்வியறிவு இல்லாதவற்கு (கைரேகை வைத்தவர்களுக்கு) இது அவசியம் தேவை
சாட்சியின் கையொப்பம் /..... இடம் .....
பெயர் மற்றும் விலாசம் ....

Sl. No.	B/o Name	Age (in days)	Sex	Birth Weight	Gestational Age	Mode of Birth	Apgar		INDICATION OF VENTILATION	DIAGNOSIS	Day of ventillation	Duration of Ventilation (in hours)	Day of Death	Air leak	Septicemia	Tube Block	Shock	Pulm hemorrhage	VAP	Outcome
							1 Min	5 Min												
1	Goldy	1	MCH	2.2	31	LSCS	3	4	GC-Poor	PNH	2	20	0	No	No	No	No	No	No	Survived
2	Chellammal	1	MCH	2	34	LSCS	5	8	RD> 7/10	RDS	1	24	2	No	No	No	No	yes	No	death
3	Shivananthini	1	MCH	2.2	36	LSCS	2	4	GC-Poor	PNH	2	24	0	No	No	No	No	No	No	Survived
4	Madhumathi	1	MCH	2.2	36	LSCS	2	5	GC-Poor	PNH	2	24	0	No	No	No	No	No	No	Survived
5	Raagavi	1	FCH	2.3	37	NVD	3	5	GC-Poor	PNH	3	24	0	No	No	No	No	No	No	Survived
6	Thenmoly	1	FCH	2.25	38	NVD	1	3	Respiratory faiure	PNH	1	26	2	No	No	Yes	No	No	No	Death
7	Chitramala	1	MCH	2.51	33	LSCS	2	5	GC-Poor	PNH	2	27	0	No	No	No	No	No	No	Survived
8	Jeeva	1	FCH	2.01	32	NVD	5	7	RD>7/10	RDS	3	28	5	No	No	No	No	Yes	No	Death
9	Rajathy	1	MCH	1.3	28	NVD	5	7	Respiratory faiure	RDS	1	28	2	No	No	No	No	No	No	death
10	Zahra	1	MCH	3	36	LSCS	2	4	GC-Poor	PNH	2	30	0	Yes	No	No	No	No	No	Survived
11	Esakkiammal	1	FCH	2.8	35	AVD	2	5	RD >7/10	RDS	1	30	0	No	No	No	Yes	No	No	Survived
12	Prithee	1	FCH	2.8	39	NVD	2	4	Respiratory faiure	PNH	1	30	0	No	No	No	No	No	No	Survived
13	Jayamala	4	FCH	2,8	37	NVD	5	7	RD> 7/10	SEPSIS	4	32	0	No	NA	No	No	No	No	Survived
14	Rithuri	1	FCH	1.9	34	NVD	3	4	GC-Poor	PNH	3	32	0	No	No	No	No	No	No	Survived
15	Pappathi	1	MCH	3.1	37	LSCS	1	3	RD>7/10	MAS	1	35	2	No	No	No	Yes	No	No	Death
16	Kavi	1	MCH	1,23	27	NVD	3	7	RD>7/10	RDS	1	36	2	No	No	yes	No	No	No	death
17	Allikodi	1	MCH	2.6	40	LSCS	0	3	RD>7/10	MAS	1	39	3	No	No	No	Yes	No	No	Death
18	Lavanya	1	MCH	2.45	36	LSCS	0	2	RD>7/10	MAS	1	40	3	no	No	No	Yes	No	No	Death
19	Nevatha	1	MCH	2.7	38	LSCS	1	3	RD>7/10	MAS	1	41	3	No	No	No	Yes	No	No	Death
20	Indira	1	MCH	3	37	LSCS	0	3	RD>7/10	MAS	1	42	3	Yes	No	No	Yes	No	No	Death
21	Blessy	1	MCH	2.8	40	LSCS	0	3	RD>7/10	MAS	1	42	3	No	No	No	Yes	No	No	Death
22	Keerthiha	1	MCH	2.81	39	LSCS	0	4	RD>7/10	MAS	1	43	3	Yes	No	No	Yes	No	No	Death
23	Madhumathi	1	MCH	2.7	36	NVD	2	4	GC-Poor	PNH	1	48	3	No	no	No	No	Yes	No	DEATH
24	Malar	1	MCH	1.75	31	NVD	3	5	GC-Poor	PNH	1	48	3	No	Yes	No	No	Yes	No	Death
25	Chandrani	1	MCH	2.2	35	LSCS	7	8	RD>7/10	RDS	1	49	0	no	No	No	Yes	No	No	survived
26	Iswariya	3	FCH	2.3	34	NVD	5	7	GC-Poor	SEPSIS	3	50	0	No	NA	No	Yes	yes	No	Survived
27	Ilakkiya	1	MCH	1.8	32	NVD	5	7	RD>7/10	RDS	1	50	0	No	No	No	No	No	No	Survived
28	Aairah	1	MCH	3.2	38	NVD	2	4	Respiratory faiure	PNH	1	50	0	No	Yes	No	No	No	No	Survived
29	Indhumathi	1	MCH	1.8	33	NVD	5	7	RD>7/10	RDS	1	51	0	No	No	No	No	No	No	Survived
30	Marimuthammal	1	MCH	2.9	36	LSCS	2	5	RD>7/10	MAS	1	51	0	No	No	YES	Yes	No	No	Survived
31	Lalitha	1	MCH	1.45	33	NVD	5	7	RD>7/10	RDS	1	52	0	No	NA	No	No	No	No	Survived
32	Gomti	1	MCH	3	36	NVD	6	8	RD>7/10	CONGENITAL PNEUMONIA	1	52	0	No	Yes	No	No	Yes	No	Survived
33	Saamanthana	1	MCH	2.5	35	LSCS	2	4	RD>7/10	MAS	1	52	3	Yes	No	No	Yes	No	No	Death
34	Esawari	1	MCH	2	32	NVD	6	8	RD>7/10	RDS	1	53	3	No	Yes	No	No	YES	No	DEATH
35	Gowri	1	MCH	1.8	29	NVD	5	7	RD>7/10	RDS	1	54	0	No	No	No	No	No	No	Survived
36	Maalni	1	MCH	2.35	39	LSCS	2	4	RD>7/10	MAS	1	55	0	Yes	No	No	Yes	No	No	Survived
37	Chunni	1	FCH	1.1	28	NVD	5	8	RD>7/10	RDS	2	55	5	No	Yes	No	No	No	No	Death
38	Tamilisai	1	MCH	2.25	36	NVD	3	6	Respiratory faiure	PNH	1	56	0	No	Yes	No	No	Yes	No	Survived
39	Aadhidi	1	MCH	1.01	28	NVD	3	6	Respiratory faiure	RDS	1	56	0	No	yes	YES	Yes	No	No	Survived
40	Mekhala	1	MCH	2.6	32	NVD	2	5	GC-Poor	PNH	1	60	0	No	Yes	No	No	Yes	No	Survived
41	Hari priya	1	FCH	0.9	27	NVD	5	8	RD>7/10	RDS	2	60	5	No	Yes	No	No	Yes	No	Death
42	Kishana	1	MCH	3.4	34	NVD	3	5	GC-Poor	PNH	1	61	0	No	Yes	No	No	Yes	No	Survived
43	Aathavi	1	FCH	1.2	27	LSCS	4	6	RD>7/10	RDS	2	65	4	No	Yes	No	No	No	No	death
44	Yaalini	1	FCH	0.8	26	NVD	3	5	RD>7/10	RDS	2	66	5	No	Yes	No	No	Yes	No	Death
45	Madhubala	1	MCH	2.6	35	NVD	3	5	Respiratory faiure	PNH	1	70	0	No	Yes	No	No	Yes	No	Survived
46	Elavarasi	1	FCH	3.6	38	AVD	0	4	Respiratory faiure	PNH	1	70	0	No	No	No	No	No	No	Survived
47	Roshni	1	MCH	1.2	28	LSCS	5	8	RD>7/10	RDS	2	70	0	No	No	No	No	No	No	Survived
48	AngayarKanni	1	FCH	2.1	34	LSCS	6	8	RD>7/10	RDS	2	71	0	No	Yes	No	Yes	No	No	Survived
49	Zaima	1	FCH	1.35	32	NVD	5	8	RD>7/10	RDS	2	72	5	No	No	No	No	No	No	Death
50	Esakkiammal	1	FCH	1.5	28	NVD	5	8	RD>7/10	RDS	2	72	5	No	No	No	No	No	No	Death
51	Vimla	1	FCH	2.2	38	NVD	3	6	RD>7/10	MAS	2	72	0	No	No	No	No	No	No	Survived

Sl. No.	B/o Name	Age (in days)	Sex	Birth Weight	Gestational Age	Mode of Birth	Apgar		INDICATION OF VENTILATION	DIAGNOSIS	Day of ventillation	Duration of Ventilation (in hours)	Day of Death	Air leak	Septicemia	Tube Block	Shock	Pulm hemorrhage	VAP	Outcome
							1 Min	5 Min												
52	Ilakkiya	1	FCH	1.5	31	NVD	5	8	RD>7/10	RDS	2	72	5	No	No	No	No	No	No	Death
53	Sabeena	1	FCH	2.1	37	NVD	4	6	GC-Poor	SEPSIS	5	72	9	No	NA	No	No	No	No	Death
54	Fathima	2	MCH	2.5	37	LSCS	5	8	GC-Poor	SEPSIS	2	72	0	No	NA	No	No	No	No	Survived
55	Ammu	1	FCH	2.15	31	AVD	6	8	RD>7/10	RDS	2	72	0	No	No	No	No	No	No	Survived
56	Arivu Chudar	1	FCH	1.2	30	NVD	5	8	RD>7/10	RDS	2	72	5	No	Yes	No	No	Yes	No	Death
57	Teepika	1	FCH	1.3	29	NVD	5	8	RD>7/10	RDS	2	72	5	No	No	No	No	Yes	No	Death
58	Chaitali	1	FCH	1.3	29	LSCS	6	8	RD>7/10	RDS	2	72	0	No	Yes	No	No	No	No	Survived
59	Yaathavika	1	FCH	1.9	35	NVD	4	6	RD>7/10	SEPSIS	5	74	8	No	NA	No	No	yes	No	Death
60	Angai	2	MCH	2.6	36	LSCS	5	8	RD>7/10	SEPSIS	2	74	0	No	NA	No	No	No	No	Survived
61	Tamilarasy	1	FCH	1.7	38	NVD	4	6	GC-Poor	SEPSIS	5	75	8	No	NA	No	No	No	No	Death
62	Bhanumathi	1	FCH	2	36	LSCS	6	8	RD>7/10	RDS	2	75	0	No	Yes	No	Yes	No	No	Survived
63	Raji	1	MCH	2.5	34	NVD	6	8	RD>7/10	CONGENITAL PNEUMONIA	1	76	4	No	Yes	No	No	No	YES	Death
64	Kodimalar	1	FCH	2.7	38	NVD	4	6	RD>7/10	SEPSIS	5	76	8	No	NA	No	No	yes	YES	Death
65	Ahila	1	FCH	2	38	NVD	4	6	RD>7/10	SEPSIS	5	77	8	No	NA	No	No	No	YES	Death
66	Amogaa	1	FCH	1.8	34	NVD	4	6	RD>7/10	SEPSIS	5	78	8	No	NA	No	No	No	YES	Death
67	Krishnaveni	1	FCH	3.3	34	NVD	3	5	Respiratory faiure	PNH	2	78	0	No	No	No	No	No	No	Survived
68	Ponmani	1	FCH	3.2	37	AVD	2	6	RD>7/10	MAS	2	79	0	No	No	No	No	No	No	Survived
69	Mariya	1	FCH	1.5	30	NVD	4	6	GC-Poor	SEPSIS	5	79	8	No	NA	No	No	No	No	Death
70	Ekisha	3	FCH	1.7	32	NVD	5	7	GC-Poor	SEPSIS	3	81	0	No	NA	No	Yes	No	No	Survived
71	Chellakumari	1	FCH	2.3	40	NVD	3	7	RD>7/10	MAS	3	82	0	No	No	No	No	No	No	Survived
72	Bhooma	1	FCH	2.02	34	LSCS	6	8	RD>7/10	RDS	2	86	0	No	No	No	Yes	No	No	Survived
73	Iniya	1	FCH	2.11	35	LSCS	6	8	RD>7/10	RDS	2	89	0	No	No	No	Yes	No	No	Survived
74	ArulMaari	1	FCH	2.1	38	NVD	4	6	RD>7/10	SEPSIS	5	90	8	No	NA	No	No	No	No	Death
75	Jayashree	3	FCH	1.2	28	NVD	5	7	RD>7/10	SEPSIS	3	90	4	No	NA	No	No	No	No	death
76	Shurti	1	MCH	2.2	35	LSCS	5	8	RD>7/10	RDS	1	91	0	No	No	Yes	Yes	No	No	Survived
77	Laxshika	1	FCH	2.15	32	NVD	1	3	GC-Poor	PNH	1	92	4	No	No	No	No	No	No	Death
78	Yashwitha	1	MCH	2.4	35	NVD	0	3	GC-Poor	PNH	1	92	5	No	No	No	No	No	No	Death
79	Gyandevi	1	FCH	2	30	LSCS	6	8	RD>7/10	RDS	2	94	6	No	No	No	No	yes	No	death
80	Meenakshi	1	FCH	3.2	40	NVD	2	5	RD>7/10	MAS	2	97	0	No	No	No	No	No	No	Survived
81	Hari priya	2	MCH	2.2	39	LSCS	5	8	RD>7/10	SEPSIS	2	98	0	No	NA	No	Yes	No	YES	Survived
82	Ponmalar	1	FCH	3.2	39	NVD	2	5	RD>7/10	MAS	2	99	0	No	No	No	No	No	No	Survived
83	Chandani	1	FCH	3.2	38	AVD	3	5	RD>7/10	MAS	2	100	0	No	No	No	No	No	YES	Survived
84	Nilsha	1	FCH	3.5	39	AVD	0	4	GC-Poor	PNH	1	100	0	No	No	No	No	No	YES	Survived
85	Nathlini	1	FCH	2	28	NVD	2	4	GC-Poor	PNH	2	100	6	No	Yes	No	No	No	No	Death
86	Velammal	1	MCH	2.9	36	NVD	0	3	GC-Poor	PNH	1	100	5	Yes	No	No	No	No	YES	Death
87	Lilly	1	FCH	3.55	39	AVD	0	4	GC-Poor	PNH	1	101	0	No	No	Yes	Yes	No	YES	Survived
88	Irfana	1	MCH	3.2	37	NVD	0	3	GC-Poor	PNH	1	105	5	No	Yes	YES	No	No	YES	Death
89	Vasugi	1	MCH	3	38	NVD	0	3	GC-Poor	PNH	1	106	5	No	No	No	No	No	YES	Death
90	Arthi	1	MCH	3.1	38	NVD	0	3	GC-Poor	PNH	1	108	5	No	No	No	No	No	YES	Death
91	Fahmeda	1	FCH	3.9	37	AVD	0	4	GC-Poor	PNH	1	112	0	No	No	No	Yes	No	YES	Survived
92	Vidvathi	1	FCH	3.5	39	AVD	2	5	GC-Poor	PNH	1	115	0	No	No	No	No	No	YES	Survived
93	Vihashini	1	FCH	3.2	37	AVD	3	5	RD>7/10	MAS	2	120	0	No	No	Yes	No	No	YES	Survived
94	Kaavyadharshini	1	MCH	3.2	38	NVD	0	3	GC-Poor	PNH	1	120	5	No	Yes	YES	No	No	YES	Death
95	Thanmolli	1	MCH	3.8	39	NVD	0	3	GC-Poor	PNH	1	122	6	No	Yes	YES	No	No	YES	Death
96	Nilaa	1	MCH	3.7	38	NVD	0	3	GC-Poor	PNH	1	124	6	No	Yes	no	No	No	YES	Death
97	Chitra	1	FCH	3.3	37	AVD	0	4	GC-Poor	PNH	1	132	0	No	No	yes	Yes	No	No	Survived
98	Queency	1	FCH	1.9	31	NVD	4	6	RD>7/10	RDS	2	134	4	No	No	No	No	No	YES	Death
99	ArulDevi	1	FCH	2	40	NVD	3	5	GC-Poor	PNH	3	136	0	No	No	Yes	No	No	No	Survived
100	Ananthi	1	FCH	2.17	34	NVD	4	6	RD>7/10	RDS	2	136	7	No	No	No	No	No	YES	Death