Original Article

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Study of Clinical Outcome of Respiratory Distress in Newborn

Sandeep Patil[1], Varsha Halkude[2], Mahesh Tondare[3], Anand Mudaglimath[4]

Abstract

Background: Respiratory distress is also one of the most common causes of admission in NICU. Despite of advancement, RD is responsible for 40-50% of all the perinatal deaths. It was observed that, there is less clinical studies have been conducted on the neonatal respiratory distress in our country, it has been planned to know the etiology, clinical features, management and outcome of the babies with respiratory distress. *Material and methods:* Newborns admitted to NICU during study duration due to respiratory distress within 72 hours of birth were included in the present study. The severity of respiratory distress was noted according to time of onset, clinical assessment, number of days of oxygen requirement and chest x ray features. *Result:* Respiratory distress is one of the commonest disorders encountered within the first 48-72 hours of life. Incidence of newborns having severe respiratory distress was 48%, Moderate respiratory distress was 46% and Mild distress was 6%. Majority (62%) of newborn with respiratory distress required oxygen treatment for less than 24 hours. *Conclusion:* Clinical assessment of severe respiratory distress against its onset and duration will help in early diagnosis. Immediate clinical outcome of newborn respiratory distress in term of mortality rate is variable and depends on the cause of newborn distress. Chest x-ray taken at 6 hours of onset of respiratory distress in newborn is important diagnostic tool for early identification of the cause.

Keywords: New Born Baby; Respiratory Distress; Chest X-Ray; Duration Of Oxygen Therapy.

Introduction

Neonatal duration is a very susceptible duration of life which can occur because of many problems, but most of the causes of neonatal morbidity and mortality are preventable. Respiratory distress may vary from 7 – 8% among live births. The incidence varies from 30% among preterms, 20% among post-terms to 4% in term babies [1]. Respiratory distress is also one of the most common causes of admission in NICU within 48-72 hours [2].

Compared with adult neonatal rib cage is more cylindrical than ellipsoidal in cross section, ribs run parallel in a horizontal plane than obliquely.

Author Affiliation: [1]Assistant Profeesor, Dept. of Paediatrics, Navodaya Medical College, Raichur, Karnataka 584103, India. [2]Resident, Department of Paediatrics, Rural Medical College, Loni, Ahmednagar, Maharashtra 413736, India. [3]Assistant Professor, Department of Community Medicine, Bidar Institute of Medical Sciences, Bidar, Karnataka 585401, India. [4]Associate Professor, Department of Forensic Medicine, S N Medical College, Bagalkot, Karnataka 587102, India.

Corresponding Author: Varsha Halkude, Resident, Department of Paediatrics, Rural Medical College, Loni, Ahmednagar, Maharashtra 413736, India.

E-mail: vhalkude@gmail.com

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The inter costal and accessory muscles there is a shorter course thus less forceful contractions and less mechanical advantage for lifting up the ribs for increasing intra thoracic volume during forceful inspiration.

The angle of insertion of the newborn diaphragm is more horizontal than adult and results in a tendency to more inward rather than upward during respiratory contraction. The soft, pliable ribs present little resistance to inward movement.

The strength and endurance that is resist to fatigue of respiratory muscle determined by the total muscle mass and oxidative capacity of their fibers.

Newborns more so preterms have low total muscle mass and low percentage of Type I fibers (slow twitch high oxidative).

Respiratory muscle fatigue in hence common, the average force generated by a skeletal muscle before it becomes fatigued is inversely proportional to the number of contractions that it effects per unit time.

Elastic recoil is the main driving force during passive expiration. It depends on tissue elastic elements the surface tension produced at the air-liquid interphase and on the bony rib cage.

Newborn especially preterm's have a relatively non-ossified rib cage with largely cartilaginous ribs

and highly compliant chest wall. Thus very little resistance is provided against chest expansion on inspiration.

At rapid rates of breathing, resistive work is increased, whereas with large tidal volumes, elastic work is increased.

In upright position - diaphragmatic contractions cause it to move downwards in a uniform way. In supine position contraction of diaphragm tends to pull the inferior rib cage posteriorly rather than upwards and the cephalad movement of the rib cage is decreased [3].

Congenital heart diseases and surgical causes of respiratory distress account only to a minor degree [4]. Most of the causes of neonatal morbidity and mortality are preventable [5]. Despite these advancement, RD is responsible for 40-50% of all the perinatal deaths [6].

As Transient tachypnea of newborn is the most common cause of Respiratory distress and significant number of newborn with respiratory distress develops severe respiratory insufficiency requiring intensive monitoring. As immediate outcome of respiratory distress in newborn in terms of morbidity and mortality depends on the various risk factors and time of diagnosis and early diagnosis will help in reducing the morbidity and mortality. Hence there is a need for the study to assess the benefit of early diagnosis of respiratory distress.

It was observed that, there is less clinical studies have been conducted on the neonatal respiratory distress in our country. Hence, keeping in mind above facts, the present study has been planned to know the etiology, clinical features, management and outcome of the babies with respiratory distress.

Materials and methods

This is a one year prospective study. Newborns admitted to NICU during study duration due to respiratory distress within 72 hours of birth were included in the present study. The severity of respiratory distress was noted according to time of onset, clinical assessment, number of days of oxygen requirement and chest x ray features.

Sample size: 100, calculated by using the formula $n=1.96X1.96X pXq/ d^2$, n= sample size, p= prevalence of respiratory distress in newborn (50%), q= 100 – p, d= relative precision of 20%. n = 96

In order to compensate for drop outs we studied 100 newborns.

Inclusion Criteria

All newborns admitted to NICU within 72 hrs of birth due to respiratory distress.

Exclusion Criteria

1. All Newborns admitted to NICU with onset of respiratory distress after 72hrs.
2. Outside born newborns admitted with respiratory distress.

Method of collection of data

A pre-structured and pre-tested proforma will be used to collect data. Data was collected from newborns admitted to NICU with respiratory distress within 72 hours of birth after satisfying inclusion and exclusion criteria.

Following details will be noted in all the newborns-

General information, socioeconomic status, history, risk factors and clinical examination findings of mother and newborn were documented. The diagnosis of clinical conditions producing respiratory distress was based mainly on careful scrutiny of the history, clinical and radiological findings. Continuous monitoring of oxygen saturation was done.

Time of onset of distress at birth and subsequent hours was documented. The severity of the distress was documented and the severity will be assessed by using Silverman and Anderson clinical scoring and interpreted as Mild (0-3), Moderate (3-7), Severe (>7) Respiratory distress.

Serial x-rays was done at 1 hour and 6 hours in all newborns and were reported by the radiologist for abnormal findings, and classified as Transient Tachypnea of Newborn (TTNB), Respiratory Distress Syndrome (RDS), Meconium Aspiration Syndrome (MAS), Acyanotic Congenital Heart Disease (ACHD), Congenital Diaphragmatic Hernia (CDH).

Depending on the clinical diagnosis of respiratory distress, relevant investigations were sent and newborns were managed as per protocol.

Duration of O_2 therapy, intervention done in the form of Medical/surgical/ventilator/surfactant therapy and mortality were documented to assess the clinical outcome.

Statistical analysis:

Data for continuous variable will be expressed

as mean SD and actual frequencies or percentages for non continuous variables. Comparison between groups will be made using students "t" test for parametric data and chi-square test for non-parametric data.

SPSS for windows (version 17.0) was employed for data analysis, $p<0.05$ was considered as significant and $p<0.01$ was considered as highly significant.

Results

Majority of the newborns had severe respiratory distress (48%) followed by moderate respiratory distress (46%) and mild distress (6%) (Table 1).

100% of newborns with respiratory distress was diagnosed with RDS and 72.9% was with diagnosis of MAS had developed severe respiratory distress as compared to 30% of the neonates with respiratory distress with diagnosis of TTNB (Table 2).

77% of the newborns with the onset of respiratory distress after 6 hours of birth developed severe distress compared to 45.3 % and 43% newborn with onset of respiratory distress at birth and between 0-6 hours of birth respectively (Table 3).

65.5% of the newborns with duration of respiratory distress more than 24 hours developed severe respiratory distress compared to 40.80% of newborns with duration of less than 24 hours (Table 4).

Majority (62%) of newborn with respiratory distress required oxygen treatment for less than 24 hours as compared to 30% of newborn with respiratory distress (20% for 2 days, 6% for 3 days, 1% for 4 days, 3% for 5 days) required O2 treatment for more than 24 hours. 8% of the newborn with respiratory distress did not require oxygen therapy as they were maintaining oxygen saturation.

21 out of 22 newborns of MAS (95.4%) and 6 out of 6 newborn with RDS (100%) who had severe distress required oxygen more than 24 hours. In

Table 1: Severity of respiratory distress

Grading of respiratory distress	S-A score	Frequency	Percentage
Mild	< 3	6	6
Moderate	3 to 7	46	46
Severe	> 7	48	48

Table 2: Final diagnosis versus severity of respiratory distress

Final Diagnosis	Frequency n=100	Severe distress	%
Transient tachypnea of newborn (TTNB)	60	18	30%
Meconium Aspiration Syndrome (MAS)	31	22	72.9%
Respiratory Distress Syndrome (RDS)	6	6	100%
Acyanotic Congenital Heart disease(ACHD)	1	1	100%
Congenital diaphragmatic Hernia (CDH)	1	1	100%
Sepsis	1	0	0.0

Table 3: Onset versus severity of distress

Onset	Frequency n=100	Severe distress n=48	%
At birth	75	34	45.30%
0-6 hrs	16	7	43.70%
>6 hours	9	7	77%

X^2=7.115, p=0.0285 ***significant***

Table 4: Duration of respiratory distress versus severity of respiratory distress

Duration	Frequency n=100	Severe distress n=48	%
< 24 hours	71	29	40.80%
>24 hours	29	19	65.51%

X^2=11.176, p=0.0006 very highly ***significant***

Table 5: Duration of oxygen therapy versus severity of respiratory distress

	Frequency n=100	Severe distress n=48	No of days on oxygen therapy					
			0	1	2	3	4	5
TTNB	60	18	8	52				
MAS	31	22		10	20	1		
RDS	6	6				5	1	
ACHD	1	1						1
CDH	1	1						1
Sepsis	1	0						1

Table 6: Treatment intervention

Final Diagnosis	Frequency n=100	Surgical intervention	Ventilator Support	Surfactant therapy
Transient tachypnea of newborn (TTNB)	60	0	0	-
Meconium Aspiration Syndrome (MAS)	31	0	0	-
Respiratory Distress Syndrome (RDS)	6	0	0	0
Acyanotic Congenital Heart disease(ACHD)	1	0	0	-
Congenital diaphragmatic Hernia (CDH)	1	1	1	-
Sepsis	1	0	0	-

Table 7: Abnormal radiological findings

Final diagnosis	Total cases	Abnormal X ray findings					
		At 1 hour		At 6 hours		Total	
		No	%	No	%	No	%
TTNB	60	2	3.30%	5	8.30%	7	11.50%
MAS	31	10	32.2%	21	67.31%	31	100%
RDS	6	0	0%	6	100%	6	100%
ACHD	1	0	0%	1	100%	1	100%
CDH	1	1	100%	0	0%	1	100%
Sepsis	1	0	0%	0	0%	0	0%
Total	100	13		33		46	

comparison requirement of oxygen was less than 24 hours in all cases of TTNB in spite of severe respiratory distress in 18 out of 60 cases (Table 5).

Surgical intervention was done in one case of Congenital Diaphragmatic Hernia which also required ventilator care. All the cases of RDS and MAS were given oxygen therapy and Antibiotics which lead to initial recovery in these babies (Table 6). 46% of newborn with respiratory distress, abnormal x-ray chest findings were reported. 100% of the newborns with MAS, RDS, CDH, ACHD had abnormal x-ray findings compared to 11.5% of newborns with TTNB. Majority (33%) had abnormal findings at 6 hours as compared to the 13% who had abnormal findings in x- ray taken at 1 hour of onset of respiratory distress. 100% of newborns with RDS and 67.31% of newborns with MAS had abnormal chest x- ray findings at 6 hours. Only one case of CDH and 31% of MAS had abnormal cheat x-ray findings taken at 1 hour (Table 7).

Discussion

Assessment of immediate clinical outcome

Early diagnosis of newborn distress is very important for its management and good clinical outcome. This study has made an attempt in early identification of the cause of newborn distress by clinical assessment of its severity and abnormal Radiological findings.

Etiology and Diagnosis

In the present study out of 100 cases identified with respiratory distress, 98% were respiratory in origin. 48% of the newborn had severe respiratory

distress while 46% had moderate respiratory distress and 6% had mild respiratory distress. The commonest cause for respiratory distress was Transient tachypnoea of Newborn (60%) followed by Meconium Aspiration Syndrome (31%) and RDS (6%). The only surgical cause for respiratory distress in the present study was CDH (1%). Similar result was seen in the study done by Guyon JB et al.[8] where the commonest cause for respiratory distress in newborns was TTNB (72%) followed by MAS (61%) and RDS (38%). However in a study done by Kumar A et al. [8] it was seen that the RDS was found to be the commonest (42.7%) cause of respiratory distress followed by TTNB (17.0%), MAS (10.7%), Sepsis (9.3%) and birth asphyxia (3.3%). Similarly Nagendra K et al. [9] also shows that the commonest cause for respiratory distress in neonates was RDS (18.8%) followed by TTNB (14%) and MAS (12.5%). This variability in the present study was due to increased no. of caesarean deliveries during the study period giving rise to more no. of TTNB cases.

Severity of distress

77% of the newborns with the onset of respiratory distress after 6 hours of birth developed severe distress compared to 45.3% and 43% newborn with onset of respiratory distress at birth and between 0-6 hours of birth respectively. Similar results were seen in a study done by Rygl M [10] the onset of respiratory distress with the survival rate and found that neonates diagnosed with the onset of respiratory distress at birth survived in 89%, with the onset between 2-6 hours survived in 75.4%, while neonates with the onset of respiratory distress after 6 hours survived 45.3%. In the present study there was no mortality.

In the present study it was seen that 65.5% of the newborns with duration of respiratory distress more than 24 hours developed severe respiratory distress compared to 40.80% of newborns with duration of less than 24 hours. Similar results were observed in the study done by Derek C [11] where neonates with the duration of respiratory distress of more than 24 hours developed severe respiratory distress.

Duration of oxygen therapy

In our study majority (62%) required O_2 less than 24 hours which implied O_2 requirement depends on the severity of respiratory distress. Escobar GJ et al. [12] studied the neonates born with respiratory distress requiring supplemental oxygen and it was seen that 8% required supplemental oxygen for at least an hour. The discrepancy in the present study may be due to more number of TTNB (60%) which do not require more O_2 due to less severity of distress On the contrary newborns with MAS (99%) and RDS (100%) required more O_2 as they tend to develop more severe distress. Bhutta ZA et al. [13] studied 200 babies born out of which 81 were diagnosed with respiratory distress. It was seen that these babies required supplemental oxygen while in NICU. But unlike our study the above study has not analyzed O_2 requirement depending on the cause of respiratory distress which would help to determine clinical outcome.

Treatment intervention

Surgical intervention was done in one case of Congenital Diaphragmatic Hernia. The baby with CDH was operated within 48 hours and required ventilator care post operative day. Fetal Care Center Cincinnati [14] Despite the advances in neonatal care, such as "ventilation," high-frequency oscillatory ventilation, inhaled nitricoxide, and ECMO, the mortality rate of isolated CDH remains substantial. RDS did not require any ventilator care and surfactant therapy. This may be due to only 6 cases of RDS in our study. Also 31 cases of MAS did not require any ventilator care. Coates AL et al. [15] studied two groups of infant's i.e infants exposed to a high oxygen (O_2) regimen and those exposed to a low O_2 regimen for the treatment of respiratory distress syndrome (RDS) and it was seen that mechanical ventilation was not used in either group.

Radiological diagnosis

In the present study abnormal x-ray chest was seen in 46 out of 100 cases. This was significant for early diagnosis for newborn respiratory distress despite the fact that majority of the cases was TTNB (Abnormal x-ray chest was only seen in 7 out of 60 newborns). In the present study all the cases of MAS and RDS have abnormal chest x-rays at 1 hour and 6 hour. Our study also shows that 10 cases of MAS had abnormal radiological findings in the 1 hour x-ray.

This may be attributed to the severe meconium aspiration. Studies done by Donald I16 [16] identified the usefulness of x-ray in neonatal respiratory distress. He observed that abnormal x-ray chest was seen more in MAS (30.2%), followed by RDS (29.2%), pneumothorax (2.2%), CDH (1.12%).

Out of the total 46 chest x-ray taken 33 had radiological findings at 6 hours. Hence, x-ray chest at 6 hours is more significant than 1 hour chest x-ray, except for CDH were radiological findings are seen in the 1 hour x-ray. Study done by Nicolaou S et al. shows that serial x-rays are required to help in the management of respiratory distress.

However Heinonen KM [17] shows that diagnoses of respiratory distress agreed in 95% of the cases and that the first chest radiograph taken early during the course of the disease had the greatest impact in the care of neonates with mild respiratory distress. Similarly Kurl S et al. [18] showed that **t**he first chest radiograph taken early during the course of the disease had the greatest impact in the care of neonates with mild respiratory distress.

Conclusion

Transient tachypnea of the newborn is the most common cause of respiratory distress in newborn. Almost 50% of newborn with respiratory distress develop severe respiratory distress which require intensive monitoring. Clinical assessment of severe respiratory distress against its onset and duration will help in early diagnosis. Immediate clinical outcome of newborn respiratory distress in term of mortality rate is variable and depends on the cause of newborn distress. Chest x-ray taken at 6 hours of onset of respiratory distress in newborn is important diagnostic tool for early identification of the cause.

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