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Original Research Article

Radiological evaluation of neonatal thoracic lesions in 118 neonates

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Abstract

Background: within 48 – 72 hours, most common disorder that occurs in neonate is respiratory distress. Post natal respiratory distress is the most important indication for chest X-ray. Clinically it is very difficult to distinguish between pulmonary and extra pulmonary causes.

Aim: To show the radiographic appearances of various causes of neonatal respiratory distress, and varied appearances of each pathology.

Material and methods: This was a prospective observational study that was conducted in Dhiraj General Hospital. Antero-posterior chest radiograph in supine position of (118) neonates were taken, presented with a chief complaint of respiratory distress. Chest X-ray was taken with the help of portable X-ray machine in NICU department. Chest X-rays were taken on first day of admission and then follow up chest X-rays were taken.

Results: The commonest cause of respiratory distress in neonates which presented with respiratory distress was transient tachypnoea of new born, which was (32.20%), followed by hyaline membrane disease (20.33%) , neonatal congenital pneumonia (16.94%), meconium aspiration syndrome (11.86%), cardiac causes (5.08%), trachea-oesophageal fistula (4.23%), congenital diaphragmatic hernia (2.54%), aspiration pneumonia (2.54%), idiopathic persistent pulmonary hypertension (1.69%), eventration of diaphragm (1.69%) followed by pneumoperitonium (0.84%).

Conclusion: Any sign of respiratory distress is an indication for roentgenogram of the chest which should be taken as early as possible.

Key words

Neonatal thoracic lesions, Radiological evaluation, Chest X-ray.

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Introduction

The first breath and first cry have always been mystical signalling the beginning of a new life. A newborn is considered neonate till the age of 28 postnatal days. Respiratory distress constitutes the commonest morbidity requiring admission of neonate in an intensive care unit. Improved diagnosis and treatment due to technological advancements and increased pediatric and radiological specialization have led to an impressive fall in neonatal mortality. The role of diagnostic imaging is to provide the clinician probable underlying etiology of the patients' symptomatology with the knowledge of the relative advantages and disadvantages of the various modalities for the wide range of disorders in infants keeping the dosage of radiation minimum to the patient.

Respiratory distress is defined by presence of at least two of following three features.

- Tachypnea (respiratory rate >60 per minute)
- Retractions (intercostal, subcostal, sternal and suprasternal)
- Noisy respiration (grunt, stridor or wheeze)

Chest radiography is very essential in neonates with acute respiratory distress to exclude the surgical and medical causes of respiratory distress. It is the most important indication for neonatal respiratory distress. Clinically it is very difficult to distinguish the difference between pulmonary and extra pulmonary causes of respiratory distress as a neonate can develop respiratory distress in utero, during delivery of in post natal period [1].

Materials and methods

Prospective study of 118 newborns born with respiratory distress in Dhiraj general hospital, Piparia, Waghodia, Vadodara was conducted during a period of 1 year.

Sources of data

Newborns admitted to NICU department of Dhiraj general hospital, Vadodara due to respiratory distress. Chest X-ray AP view was done with portable X-ray machine Model GE Stalium.

Method of collection of data inclusion criteria

- All newborns admitted to NICU of Dhiraj General Hospital, Vadodara within 72 hours of birth due to respiratory distress.
- All institutional delivered and delivered outside the institution are included within the 72 hours of birth.

Exclusion criteria

All Newborns admitted to NICU with onset of respiratory distress after 72 hours.

Method of collection of data

This was prospective observational study of 118 neonates presented with respiratory distress. Neonates admitted in NICU department, within 72 hours of birth with respiratory distress were included in study.

Chest X-ray was done on 1st day of admission and then follow up X-rays were taken from 2nd day of admission till date of discharge as required. Findings of chest X-ray on 1st day of admission along with clinical history, birth history, maternal history, APGAR score at 1 minute, liquor, history of immediate cry and gestational age were noted. Then treatment history along with follow up chest X-ray findings was taken, on the basis of which, final diagnosis was concluded.

Compilation of all the observational data of Dhiraj General Hospital was done in the form of frequencies and percentage which has been

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depicted in the form of pie-charts and graphs.

Results

Among neonates who presented with respiratory distress, 38.9% had vaginal delivery and 61.02% had Cesarean section as per **Table - 1**. 32.20% diagnosed with transient tachyponea; 20.3% diagnosed with hyaline membrane disease; 16.94% diagnosed with congenital neonatal pneumonia; 11.86% diagnosed with meconium aspiration syndrome; 2.54% diagnosed with aspiration syndrome; 5.08% diagnosed with cardiac causes; 4.23% diagnosed with trachea-oesophageal fistula; 2.54% diagnosed with congenital diaphragmatic hernia; 1.69% diagnosed with idiopathic persistent pulmonary hypertension; 1.69% diagnosed with eventeration of diapghram; 0.84% diagnosed with pneumoperitoneum, presented to radiology department with respiratory distress as per **Table - 2**.

Neonatal pneumonia

40% males and 60% females were diagnosed with neonatal pneumonia as per **Table - 3.** Among neonate with neonatal pneumonia, 55% where delivered by lower segment Cesarean section and 45% by vaginal delivery as per **Table - 4.** 30% of neonates delivered in our institution and 70% where delivered outside our institution were diagnosed with neonatal pneumonia as per **Table - 5.** 60% of neonates were preterm and 40% were full term as per **Table - 6.** Among maternal antenatal complaints in neonatal pneumonia, 55% presented with fever; 30% presented with premature rupture of membrane; 5% with diabetes and 10% with no complaints as per **Table - 7.** Presentation of neonatal pneumonia on chest X-ray showed soft tissue opacity with air bronchogram, 35% presented in right upper lobe; 25% in right middle lobe; 30% in right lower lobe; 40% in left upper lobe and 55% in left lower lobe as per **Table - 8.** Among complications of neonatal pneumonia, 5% diagnosed with pneumothorax; 10% with persistent pulmonary hypertension and 5% with aspiration pneumonia as per **Table - 9.**

Hyaline membrane disease

Among neonates of hyaline membrane disease, 66.67% were males and 33.33% were females out of 24 patients as per **Table - 10.** Among neonates with hyaline membrane disease, 45.83% had ground glass opacity (white out lungs); 12.51% had ground glass haziness; 20.83% had haziness with air bronchogram; 20.83% had fine reticulogranular appearance out of 24 patients as per **Table - 11.** Among gestational age of neonate with hyaline membrane disease, 50.00% of neonates were between 28-30 weeks; 29.17% were between 31-33 weeks and 20.83% were between 34-36 weeks out of 24 neonates as per **Table - 12.** Among complications of hyaline membrane disease, 8.34% diagnosed with pneumothorax; 4.17% with pneumo-mediastinum; 4.17% with pulmonary hemorrhage and 4.17% with persistent pulmonary hypertension out of 24 patients as per **Table - 13.**

Transient tachypnea of newborn

Among transient tachypnea of newborn, 63.16% were males and 36.84% were females; out of 38 newborns as per **Table - 14.** Among transient tachypnea of newborn, 86.85% were delivered by lower segment Cesarean section and 13.15% were by vaginal delivery out of 38 neonates as per **Table - 15.** Among varied appearances of transient tachypnea of newborn on chest X-ray, 21.05% presented with hyperinflation in both lung fields; 5.26% with linear streaky opacities arising from perihilar region; 7.88% with prominence of inter lobar fissure; 26.33% with hyperinflation with linear opacities with prominence of inter lobar fissure; 2.63% with hyperinflation with prominence of inter lobar

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fissure; 21.05% with hyperinflation with linear streaky opacities; 2.63% with linear streaky opacities with prominence of inter lobar fissure and 13.15% had normal chest X-ray as per **Table - 16**. Among gestational age of newborns presenting with transient tachypneas, 2.63% were between 34-35 weeks; 2.63% were between 35-36 weeks; 26.32% were between 36-37 weeks; 34.21% were between 37-38 weeks; 31.58% between 38-39 weeks and 2.63 % between 39-40 weeks out of 38 patients as per **Table - 17.**

Meconium aspiration syndrome

Among meconium aspiration syndrome in neonates, 57.14% were males and 42.86% were females as per **Table - 18.** Among meconium aspiration syndrome, 71.43% had mode of delivery by lower segment Cesarean section and 28.57% by vaginal delivery as per **Table - 19.** Among meconium aspiration syndrome, 57.14% presented with multiple coarse soft tissue patchy opacities on chest X-ray; 28.57% presented with coarse opacities with collapse of lung and 7.14% with coarse patchy opacities with air leak on chest X-ray as per **Table - 20.** Among neonates with meconium aspiration syndrome, 28.57% had lung collapse; 21.43% presented with persistent pulmonary hypertension and 7.14% with pneumothorax as per **Table - 21.** Among meconium aspiration syndrome in neonates, 50.00% were between 37-38 weeks; 28.57% were between 38-39 weeks and 21.43% were between 39-40 weeks out of 14 patients as per **Table - 22.**

Congenital diaphragmatic hernia

Among side distribution in new born with congenital diaphragmatic hernia, 66.67% had left sided hernia and 33.33% had right sided out of 3 patients as per **Table - 23.**

Persistent pulmonary hypertension

Among causes of persistent pulmonary hypertension, in 25% cause is idiopathic, in 75% cause is secondary to respiratory disease as per **Table - 24.**

Discussion

In the this study commonest cause of respiratory distress in neonates which presented with respiratory distress was transient tachypnoea of new born, which was (32.20%), followed by hyaline membrane disease (20.33%) , neonatal congenital pneumonia (16.94%) , meconium aspiration syndrome (11.86%), cardiac causes (5.08%), trachea-oesophageal fistula (4.23%), congenital diaphragmatic hernia (2.54%), aspiration pneumonia (2.54%), idiopathic persistent pulmonary hypertension (1.69%), eventration of diaphragm (1.69%) followed by pneumoperitonium (0.84%).

Chest radiographic finding in patients with transient tachypnea of newborn in this study showed that hyperinflation with linear streaky perihilar opacities with prominence of inter lobar fissure was most common finding of transient tachypnea of newborn (26.32%), followed by only hyperinflation noted as sole finding on chest x ray (21.05%), hyperinflation with linear streaky opacities(21.05%), prominence of inter lobar fissures (7.88%), linear streaky perihilar opacities (5.26%), hyperinflation with prominence of inter lobar fissures (2.63%), linear opacities with prominence of inter lobar fissures (2.63%). Normal chest X-rays were noted in 13.15% cases of transient tachypnea of newborn.

The commonest radiographic appearance of neonatal pneumonia in this study was soft tissue opacity with air bronchogram. Left lung was more commonly involved in our study. Left lower zone was most commonly involved (55%). Raed H AL-Saed, et al. [1] found commonest

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radiographic appearances seen in cases of pneumonia were bronchopneumonia and right upper lobe consolidation. Mathur, et al. [2] in 2001, found that alveolar infiltrate was seen in (44.6%), lobar consolidation in (9.7%) and clear lungs in (14.5%), reaching a conclusion that clinical features and chest X– ray would miss the diagnosis of pneumonia in (15%) of neonates with dyspnea and had to be collaborated with sepsis screen and blood culture [1]. In this study, the diagnosis of neonatal pneumonia depends on radiological and clinical findings. No case was found with normal chest X-ray in this study. In our study hyaline membrane disease on chest X-ray showed ground glass opacity (complete white out lungs) in 45.83% as the most common appearance on chest x ray, followed by haziness with air bronchogram (20.83%), fine reticulogranular appearance (20.83%) and only haziness (12.51%). Out of 24 neonates with hyaline membrane disease developed complications of pneumothorax (8.34%), pneumo mediastinum (4.17%), pulmonary hemorrhage (4.17%) and persistent pulmonary hypertension (4.17%). Raed H AL-Saed, et al. [1] found chest radiographs showed a reticuloglandular appearance as the commonest abnormality (52%). Ground glass appearance was seen in (23%). Only one case had normal chest radiograph. Complication was seen in 2 patients who showed small pneumothorax. Marini, et al. [3], found that (10 of 62) patients with hyaline membrane disease had negative chest radiograph, 26 had fine granular opacities and had marked hypo expansion with reticulonodular opacities. While finely granular evenly distributed structures combined with signs of hypoventilation are the chest X-ray finding in hyaline membrane disease seen by Ponhold [4] in 1982.

This study shows most common chest X-ray appearance of meconium aspiration syndrome as multiple coarse soft tissue patchy opacities seen in both lung fields in 57.14%. In rest of cases with meconium aspiration syndrome chest X-ray showed multiple patchy opacities with collapse of lung (meconium aspiration syndrome) in 28.57% and patchy opacities with air leak in 7.14% cases.

Present study had 3 cases of congenital diaphragmatic hernia, out of them 2 were on left side (66.67%) and 1 on right side (33.33%). later on these cases were operated.

Respiratory distress due to cardiac conditions was in 6 neonates (5.08%). Out of 6 neonates 4 (66.67%) were diagnosed with cardiomegaly and in 2 (33.33%) chest x ray was normal.

5 (4.23%) neonates were diagnosed with trachea oesophageal fistula. 4 (80%) were diagnosed with oesophageal atresia with trachea esophageal fistula between distal end of oesophagus and trachea (type C) and 1 (20%) with (type B) only oesophageal atresia with no stomach air shadow seen. Esophageal Atresia and Tracheo-esophageal Fistula 10 Year Review by Chien-Yi Wu, et al. [5] found type C of trachea esophageal fistula in 88% neonates.

Eventration of diaphragm was found in 2 patients, 1 on left and 1 on right side. In extra-pulmonary cause 1 neonate developed respiratory distress due to pneumoperitonium.

In this study, Persistent pulmonary hypertension is found in 6 neonates, in which chest X-ray showed no features. These cases were diagnosed by echocardiography. 2 were due to idiopathic cause and 6 are due to secondary cause after respiratory disease.

Pneumothorax was seen in 4 neonates with other pulmonary diseases out of which 2 in hyaline membrane disease, 1 in meconium aspiration syndrome and 1 in neonatal

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pneumonia. No isolated pneumothorax was noted in present study.

Conclusion

Respiratory distress is one of the most common disorders that occurs within the first (48-72) hours of life. Neonate can have respiratory disturbance in utero, in delivery room or in nursery. There are wide varieties of causes that can cause respiratory distress in neonate. There are pulmonary and extra-pulmonary causes. Pulmonary causes include transient tachypnea of newborn, hyaline membrane disease, congenital neonatal pneumonia and meconium aspiration syndrome. Extra-pulmonary causes include surgical causes like congenital diaphragmatic hernia, trachea-oesophageal fistula, eventration of diaphragm, cardiac causes and pneumo peritoneum can cause external pressure and cause respiratory distress. It is difficult to distinguish pulmonary and extra-pulmonary causes of respiratory distress clinically. Any sign of post natal respiratory distress is an indication for roentgenogram of chest. Chest radiography is most important tool to study the respiratory distress in neonates. In our present study chest X-ray was done in neonates, presented with respiratory distress. Transient tachypnoea of new born is most common cause of neonatal respiratory distress (32.20%), followed by hyaline membrane disease (20.33%), neonatal congenital pneumonia (16.94%), meconium aspiration syndrome (11.86%), cardiac causes (5.08%), trachea-oesophageal fistula (4.23%), congenital diaphragmatic hernia (2.54%), aspiration pneumonia (2.54%), idiopathic persistent pulmonary hypertension (1.69%), eventration of diaphragm (1.69%) followed by pneumoperitonium (0.84%). One should remember post natal respiratory distress is an indication for chest roentgenogram which should be taken as early as possible.

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Table – 1: Mode of delivery.

	Number (118)	Percentage
Cesarean section	72	61.01%
Vaginal delivery	46	38.98%

Table - 2: Etiology of neonatal respiratory distress.

Etiology	Frequency (n = 118)	Percentage
Transient tachypnoea of newborn	38	32.20%
Hyaline membrane disease	24	20.33%
Congenital pneumonia	20	16.94%
Meconium aspiration syndrome	14	11.86%
Aspiration pneumonia	3	2.54%
Cardiac causes	6	5.08%
Tracheooesophageal fistula	5	4.23%
Congenital diaphragmatic hernia	3	2.54%
Idiopathic persistent pulmonary hypertension	2	1.69%
Eventration of diaphragm	2	1.69%
Pneumoperitonium	1	0.84%
Total	118	100%

Table - 3: Sex distribution of neonatal pneumonia (n = 20).

Sex	Frequency (n = 20)	Percentage
Male	12	60%
Female	8	40%

Table - 4: Mode of delivery in neonatal pneumonia (n=20).

Mode of delivery	Frequency (n=20)	Percentage
Lower segment Cesarean section	11	55%
Vaginal delivery	09	45%

Table - 5: Institutional deliveries vs deliveries outside Dhiraj Hospital.

Place of delivery	Frequency (n=20)	Percentage
Our institution	6	30%
Outside our institution	14	70%

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Table - 6: Gestational age of neonates diagnosed with neonatal pneumonia.

Term	Frequency (n=20)	Percentage
Pre-term	12	60%
Full-term	08	40%

Table - 7: Maternal antenatal complaints in neonatal pneumonia.

Maternal complaints	Frequency (n=20)	Percentage
Fever	11	55%
Pre-mature rupture of membranes	6	30%
Diabetes	1	5%
No complaints	2	10%

Table – 8: Distribution of neonatal pneumonia on chest X-ray.

Lobes involved	Frequency (n=20)	Percentage
Right upper zone	7	35%
Right middle zone	5	25%
Right lower zone	6	30%
Left upper zone	8	40%
Left middle zone	9	45%
Left lower zone	11	55%

Table - 9: Complications in neonates diagnosed with neonatal pneumonia.

Complications	Frequency (n=20)	Percentage
Pneumothorax	1	5%
Persistent pulmonary hypertension	2	10%
Aspiration pneumonia	1	5%

Table - 10: Sex distribution of neonates diagnosed with hyaline membrane disease.

Sex	Frequency (n=24)	Percentage
Male	16	66.67%
Female	8	33.33%

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Table – 11: Varied appearances of hyaline membrane disease on chest X-ray.

Appearances on chest X-ray	Frequency (n=24)	Percentage
Ground glass opacity (whiteout lung)	11	45.83%
Ground glass haziness	3	12.51%
Haziness with air bronchogram	5	20.83%
Fine reticulogranular appearance	5	20.83%

Table - 12: Gestational age of neonate with hyaline membrane disease.

Gestational age groups (in weeks)	Frequency (n=24)	Percentage
28-30	12	50.00%
31-33	7	29.17%
34-36	5	20.83%

Table - 13: Complications of hyaline membrane disease.

Complications	Frequency (n=24)	Percentage
Pneumothorax	2	8.34%
Pneumo-mediastinum	1	4.17%
Pulmonary hemorrhage	1	4.17%
Persistent pulmonary hypertension	1	4.17%

Table – 14: Sex distribution of neonates diagnosed with transient tachypnea of newborn.

Sex	Frequency (n=38)	Percentage
Male	24	63.16%
Female	14	36.84%

Table - 15: Mode of delivery in transient tachypnea of newborn.

Mode of delivery	Frequency (n=38)	Percentage
Lower segment Cesarean section	33	86.85%
Vaginal delivery (small for gestational age)	5	13.15%

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Table - 16: Varied appearances in transient tachypnea of new-born on chest X-ray.

Appearances on chest X-ray	Frequency (n=38)	Percentage
Hyperinflation in both the lung fields	8	21.05%
Linear streaky opacities arising from peri hilar region	2	5.26%
Prominence of inter-lobar fissures	3	7.88%
Hyperinflation with linear opacities with prominence of inter lobar fissures	10	26.32%
Hyperinflation with prominence of inter lobar fissures	1	2.63%
Hyperinflation with linear streaky opacities	8	21.05%
Linear streaky opacities with prominence of inter lobar fissures	1	2.63%
Normal chest X-ray	5	13.15%

Table - 17: Gestational age of new-borns presenting with transient tachypnea.

Gestational age (in weeks)	Frequency (n=38)	Percentage
34-35	1	2.63%
35-36	1	2.63%
36-37	10	26.32%
37-38	13	34.21%
38-39	12	31.58%
39-40	1	2.63%

Table – 18: Sex distribution.

Sex	Frequency (n=14)	Percentage
Male	8	57.14%
Female	6	42.86%

Table – 19: Mode of delivery in newborns with meconium aspiration syndrome.

Mode of delivery	Frequency (n=14)	Percentage
Lower segment Cesarean section	10	71.43%
Vaginal delivery	4	28.57%

Table - 20: Varied appearances in chest X-rays of new-borns with meconium aspiration syndrome.

Appearances on chest X-ray	Frequency (n=14)	Percentage
Multiple coarse soft tissue patchy opacities	8	57.14%
Coarse patchy opacities with collapse of lung	5	28.57%
Coarse patchy opacities with air leak	1	7.14%

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Table - 21: Complications in newborns with meconium aspiration syndrome.

Complications	Frequency (n=14)	Percentage
Lung collapse	5	28.57%
Persistent pulmonary hypertension	3	21.43%
Pneumothorax	1	7.14%

Table - 22: Gestational age of new-borns with meconium aspiration syndrome.

Gestational age groups (in weeks)	Frequency (n=14)	Percentage
37-38	4	50.00%
38-39	7	28.57%
39-40	3	21.43%

Table - 23: Side distribution in new-borns with congenital diaphragmatic hernia.

Side distribution	Frequency (n = 3)	Percentage
Left	2	66.67
Right	1	33.33

Table - 24: Causes of persistent pulmonary hypertension.

Cause	Frequency (n= 8)	Percentage
Primary (idiopathic)	2	25%
Secondary (due to respiratory causes)	6	75%