Medico Research Chronicles
ISSN NO. 2394-3971
DOI No. 10.26838/MEDRECH.2025.12.1.761
Contents available at www.medrech.com

Etiology and Clinical feature of neonatal pneumothorax in inborn and outborn NICU settings in rural tertiary care hospital.

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ARTICLE INFO **ABSTRACT** **ORIGINAL RESEARCH ARTICLE**

Article History
Received: August 2024
Accepted: February 2025
Key Words: Neonatal pneumothorax (NP), NICU, congenital pneumonia

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Background: Neonatal pneumothorax (NP) is a critical condition characterized by air accumulation in the pleural space, leading to lung collapse and respiratory distress. Its incidence varies, with risk factors including prematurity, mechanical ventilation, meconium aspiration syndrome (MAS), congenital pneumonia, and birth asphyxia. **Objective:** This study aimed to analyze the etiology and clinical presentation of neonatal pneumothorax in inborn and outborn neonates admitted to NICUs of a rural tertiary care hospital. **Methods:** A descriptive, longitudinal observational study was conducted over two years (December 2020–December 2022) at Dr. Balasaheb Vikhe Patil Rural Medical College, Loni. A total of 60 neonates diagnosed with pneumothorax were included. Clinical history, diagnostic methods (transillumination and chest X-ray), and management strategies were documented. Statistical analysis was performed to assess associations between etiology and outcomes. **Results:** Out of 60 neonates, 63.3% were inborn, and 36.7% were outborn. The most common etiologies included congenital pneumonia (51.7%), MAS (38.3%), birth asphyxia (25%), and post-surfactant administration in RDS cases (58.3%). Right-sided pneumothorax was more frequent (48.3%), followed by left-sided (28.3%) and bilateral (23.3%). Spontaneous pneumothorax occurred in 26.7% of cases. Mortality was 56.6%, with higher rates among inborn cases (60.5%) than outborn (50%). **Conclusion:** Neonatal pneumothorax remains a significant challenge in NICU settings, with congenital pneumonia and MAS being the primary causes. Early recognition, prompt intervention, and improved resuscitation techniques, particularly in outborn cases, may reduce mortality. Further research incorporating advanced ventilation strategies like high-frequency oscillatory ventilation (HFOV) is recommended.

INTRODUCTION-

Pneumothorax implies the presence of air in the pleural space between the visceral and parietal pleura.[1] With the first inspiratory breath, the newborn creates a transpulmonary pressure greater than 100 cm of water column and opens the lungs that were closed in-utero. After a couple of breaths, this pressure normalizes and the lungs take over their function. If the transpulmonary pressure remains elevated for a long time, the alveoli rupture occurs, accumulating air between the visceral and parietal pleura. The air created in the interpleural space leads to a pathological condition called neonatal pneumothorax (NP). Pneumothorax developed in this way is called spontaneous (primary, idiopathic).[2] The reason for the development of secondary pneumothorax in newborns may be respiratory distress syndrome (RDS), mechanical ventilation (MV), pneumonia, sepsis, aspiration of meconium, blood and amniotic fluid, or congenital lung malformations. [3] The consequences of primary and secondary pneumothorax are high pressure within the pleural space followed by lung collapse on the affected side, immediate hypoxia, hypercapnia and subsequent circulation collapse.[4]

Based on the size of the pulmonary collapse, pneumothorax can be partial or total, unilateral or bilateral. A small amount of air can be asymptomatic and be resorbed by the body, while the presence of a larger amount of air endangers the life of the newborn. [5, 6]

The incidence of pneumothorax in neonates is highly variable depending on several factors. Among many risk factors, prematurity and mechanical ventilation are considered the most important. Risk factors for neonatal PT also include respiratory distress syndrome, meconium aspiration syndrome, congenital malformations, infections, transient tachypnoea of the newborn, immaturity, and specific respiratory procedures such as mechanical ventilation, intubation, endotracheal suctioning, and fraction of inspired oxygen> 0.4. [7]

The incidence of pneumothorax in preterm infants who are supported with mechanical ventilation varies from as high as 33% [7] to as low as 6%.[8,9] The risk also increases with the presence of meconium aspiration, hyaline membrane disease, pneumonia, and pulmonary hypoplasia. [7-11] Use of positive pressure ventilation during resuscitation also increases the risk of pneumothorax in the newborn. [12] Nasal continuous positive airway pressure (CPAP) at birth has recently been considered as a treatment modality in preterm infants. Multiple reports have indicated that the use of early CPAP is associated with decreased intubation, fewer oxygen days and lower rates of bronchopulmonary dysplasia (BPD). [13,14] The relationship between the early use of CPAP and pneumothorax has not been settled. A single trial demonstrated that infants receiving CPAP at birth had a higher rate of pneumothorax compared to those randomized to receive mechanical ventilation (9% versus 3%). [15] However, this finding was not replicable in other reports.[13,14]

It has been postulated that the increased rate of pneumothorax in CPAP supported babies may be due to a decreased rate of surfactant administration, since surfactant use has been associated with reduced rates of pneumothorax in mechanically ventilated infants.[16,17] However, the relationship of surfactant and pneumothorax in spontaneously breathing infants supported with CPAP has not been explored. [17]

Hence, we planned this descriptive observational study with the objective to study the clinical feature and outcome of neonatal pneumothorax in preterm and term neonates in rural tertiary care hospital.

Aim

To study etiology and clinical feature of neonatal pneumothorax in inborn and outborn NICU settings in rural tertiary care hospital

Objective

1)To study etiology of neonatal pneumothorax.
2) To study the clinical feature of neonatal pneumothorax in inborn and outborn NICU.

MATERIALS AND METHOD

Our study is a descriptive longitudinal observational study with all the neonates who developed pneumothorax in inborn and outborn NICU. It was conducted from 2 years from December 2020- December 2022 at Dr Balasaheb Vikhe Patil Rular Medical College, LONI after obtaining approval from the ethical committee.

Due written and informed consent was taken from the parents of neonates before including them in the study.

Inclusion Criteria

1. All neonates with pneumothorax
2. Babies whose parents are giving informed written consent for inclusion in study

Exclusion Criteria

1. Babies having major congenital malformations.

Data Collection:

All neonates with pneumothorax in inborn and outborn NICU meeting the inclusion criteria had included in the study.

Sample size

60 new born babies in Pravara hospital medical college having sign and symptoms of pneumothorax

METHODS

Method of collection of data

The data was obtained from neonates that were delivered in our hospital which were admitted in inborn NICU and referred from another hospital which were admitted in outborn NICU and met the inclusion and exclusion criteria. As soon as we noticed any neonate who had sudden increased in distress, fluctuation in saturation or unexplained event of cyanosis, we had screen that neonate for pneumothorax.

Initially we had done bedside screening tans-illumination test and if transillumination test is positive we did chest x-ray to diagnosed pneumothorax. As soon as we diagnosed the case of pneumothorax, we retrospectively had taken details history like maternal history of PV leak, significant ANC scan, antenatal received steroids dose, any major illness, details about delivery like type of delivery, gestational age, mode of resuscitation of, APGAR score, use of AMBU bag required for resuscitation and need for use of oxygen in labor room itself and all the similar history we record from the baby that had referred to us.

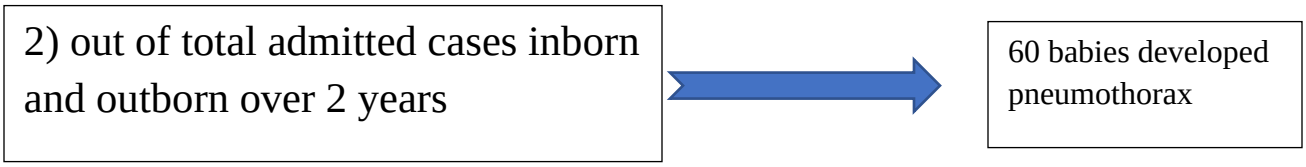
We recorded all the details if the neonate had RDS and required surfactant, if they had congenital pneumonia, MAS, history of birth asphyxia.

If baby presented with small pneumothorax like pockets and with no distress then we had done observation to check spontaneous resolution of pneumothorax. If it had not resolved or increased in size causing respiratory distress then we had taken baby on CPAP followed by needle aspiration of that pneumothorax.

Some neonate presented with respiratory distress, cyanosis and pneumothorax who required ventilator support, so in those cases we had done chest tube insertion by French size 10 or 12 in 4th intercostal space.

After collecting the data, we had analyzed and result are as follows.

1)So Out of total 27954 delivered baby over 2 years → 38 babies developed pneumothorax



RESULTS

Table 1: Distribution of pneumothorax according to inborn vs out born babies

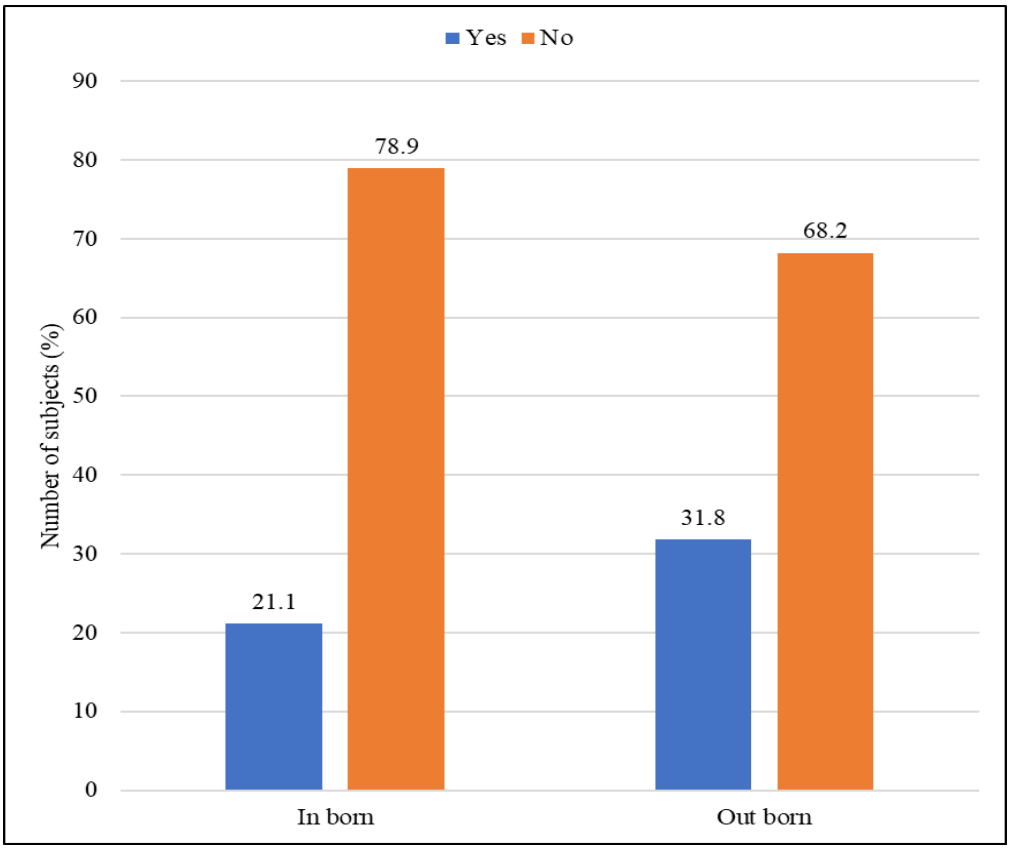
		Frequency	Percent
Inborn/ out born	Inborn	38	63.3
	Out born	22	36.7
	Total	60	100.0

Out of 60 babies with pneumothorax, inborn babies were 38(63.3%) and out born were 22(36.7%)

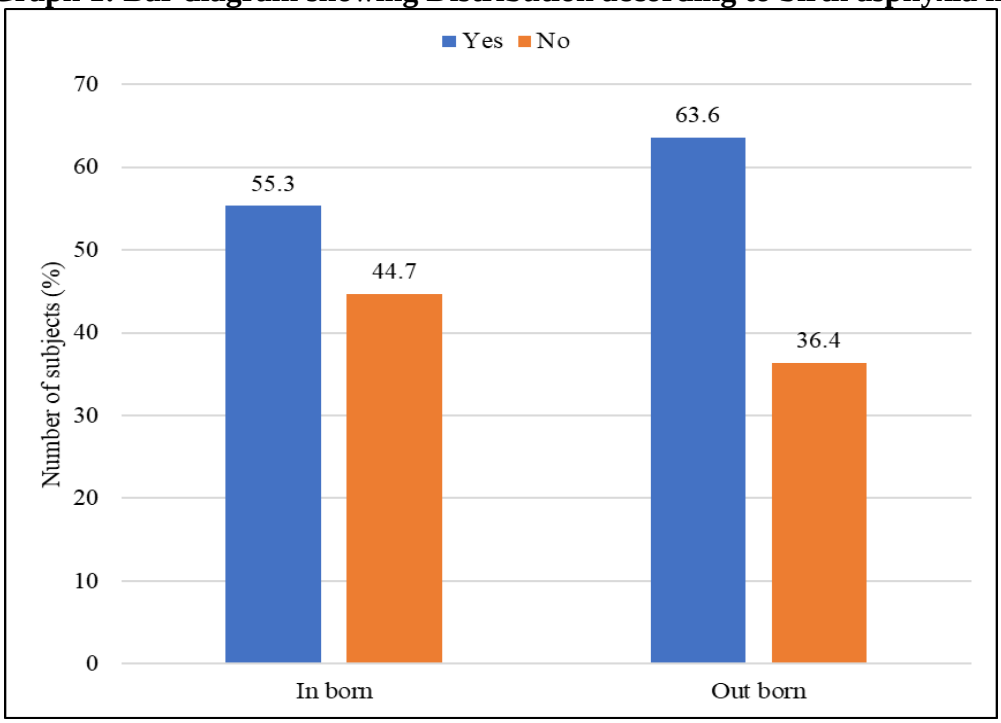
Table 2. Etiology of neonatal pneumothorax according to inborn vs outborn babies

Etiology		Inborn (n=38)	Outborn (n=22)	Total (n=60)	P value
Birth asphyxia	Yes	8 (21.05%)	7 (31.81%)	15	0.37
	No	30 (78.94%)	15 (68.18%)	45	
Surfactant given	Yes	21 (55.26%)	14 (63.63%)	35	0.59
	No	17 (44.73%)	8 (36.36%)	25	
MAS	Yes	14 (36.84%)	9 (40.90%)	23	0.78
	No	24 (63.15%)	13 (59.09%)	37	
Congenital Pneumonia	Yes	17 (44.73%)	13 (59.09%)	30	0.42
	No	21 (55.26%)	9 (40.90%)	30	

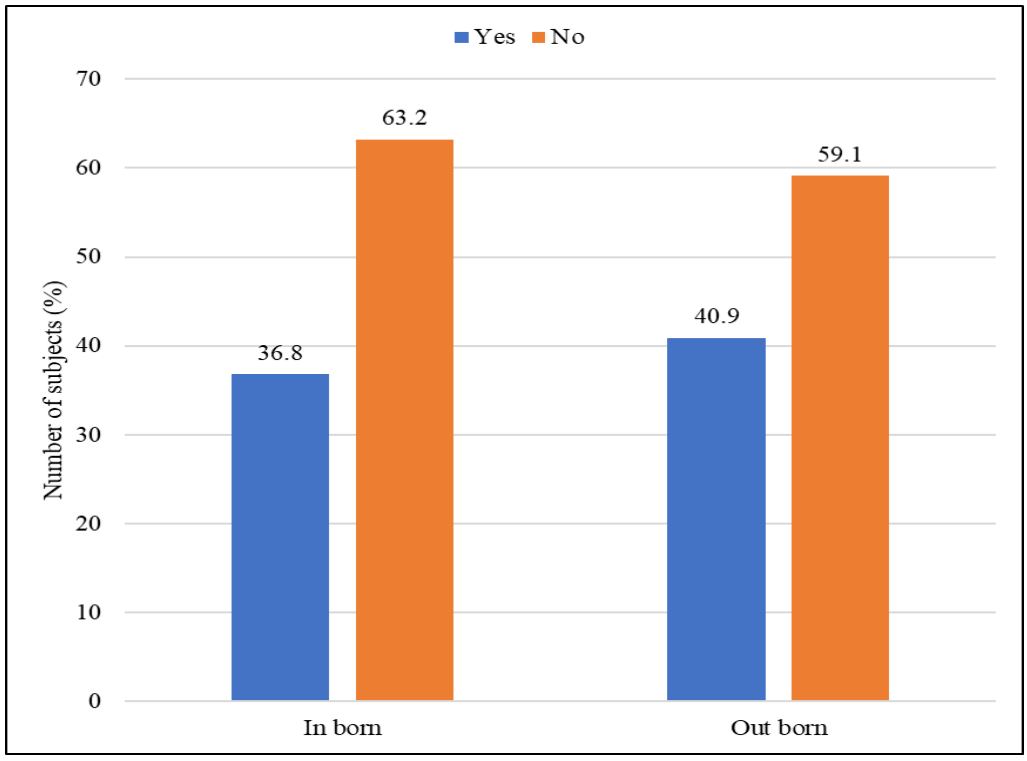
In our study out of 60 babies, 15 (25%) babies had birth asphyxia, out of which 8 (21.1%) were inborn and 7 (31.8%) were outborn which is statistically not significant (p = 0.35). Total 35 (58.3%) babies received surfactant among which 21 (55.3%) were inborn cases and 14 (63.6%) were outborn cases. In our study, 23 (38.33%) cases had developed MAS. Out of which, 14 (36.8%) were inborn and 9 (40.9%) were outborn. Among pneumothorax cases, 31 (51.7%) neonatal pneumothoraxes had risk factor of congenital pneumonia in which 18 (47.4%) were inborn and 13 (59.1%) were outborn.



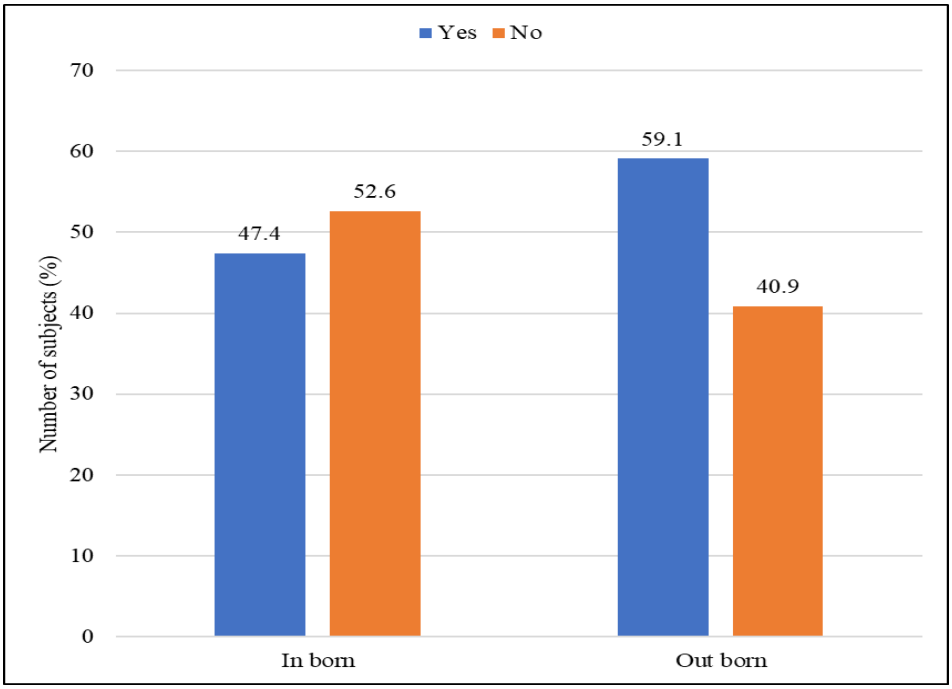
Graph 1: Bar diagram showing Distribution according to birth asphyxia in



Graph 2: Bar diagram showing Distribution according to surfactant given in inborn and out born cases



Graph 3: Bar diagram showing Distribution of pneumothorax in MAS baby



Graph 4: Bar diagram showing Distribution of pneumothorax in baby with congenital pneumonia

Table 3. Clinical feature and outcome of neonatal pneumothorax according to inborn vs outborn babies

Clinical features		Inborn (n=38)	Outborn (n=22)	Total (n=60)	P value
Spontaneous Pneumothorax	Yes	12 (31.57%)	4 (18.18%)	16	0.36
	No	26 (68.42%)	18 (81.81%)	44	
Pneumothorax 1st detected at age	<48 hours	28 (73.68%)	12 (54.54%)	40	0.16
	>48 hours	10 (26.31%)	10 (45.45%)	20	
Side involved	Bilateral	6 (37.5%)	8 (18.2%)	14	0.19
	Left sided	5(31.57%)	12 (27.3%)	17	
	Right sided	5 (31.3%)	24(54.45%)	29	
Outcome	Death	23 (60.52%)	11 (50%)	34	0.58
	Discharge	15 (39.47%)	11 (50%)	26	

Out of 60 cases, 16 (26.7%) babies developed spontaneous pneumothorax, among which 12 (31.6%) babies were inborn and 4 (18.2%) were outborn babies. In this study, 28 inborn cases and 12 outborn cases of pneumothorax was first detected at < 48 hours of age. Whereas, 10 inborn cases and 10 outborn cases of pneumothorax was detected at > 48 hours of age.29 (48.3%) had right sided pneumothorax, 17 (28.3%) left sided pneumothorax and 14 (23.3%) had bilateral pneumothorax. In inborn 6 (37.5%) babies had bilateral pneumothorax, 5 (31.3%) each had left and right sided pneumothorax. In outborn 8 (18.2%) babies had bilateral pneumothorax, 12 (27.3%) had left sided pneumothorax and 24 (54.5%) had right sided pneumothorax. Out of 60 cases of pneumothorax, 34 (56.6%) pneumothorax cases died, out of 38 inborn pneumothorax cases, 23 (60.5%) babies died and out of 22 outborn pneumothorax cases, 11 (50%) babies died.

DISCUSSION:

This is descriptive longitudinal study involving all neonates inborn and outborn who developed pneumothorax during hospital stay during period of December 2020 to December 2022.

1)Neonatal pneumothorax and birth asphyxia cases

Study	Distribution according to birth asphyxia case
Present study	25%
Andersson j et al[28]	25%
Lim HS et al[21]	14.3%

- Present study shows 25 % babies had history of birth asphyxia which is comparable with Andersson j et al[28].Lim HS et al[21] had lower percentage of history of birth asphyxia which is not comparable to present study. Mannan MA et al[24] also showed significant association of pneumothorax and low APGAR score at birth and resuscitation at birth. In present study, most of the birth asphyxia babies were outborn 31.8% out of 22 babies. Bag and mask or IPPV was given outside or came ventilated leading to pneumothorax. This bag and mask or bag and tube ventilation was many time performed by nontrained person in case of outborn referred neonate

2)Neonatal pneumothorax and surfactant given

Study	Distribution according to surfactant given(%)
Present study	58.3% (35)
Al-Anbari AJ et al[26]	41.5%
Lim HS et al[21]	38%
Jovandaric M Z et al[27]	39%
kim E et al[29]	38.9%

- In comparison with present study, Al-Anbari AJ et al[26] , Lim HS et al[21], Jovandaric M Z et al[27] and kim E et al[29] used surfactant 41.5%, 38%, 39% 38.9% cases respectively which is relatively lesser as compared to present study. All of them have less number of patients. Present study shows, 58.3 % (35) cases received surfactant in which 24 (out of 31) were preterm baby and 10 were MAS baby and one neonate who presented with respiratory distress. Development of pneumothorax post surfactant is common so prematurity along with RDS and post surfactant is risk factor for development of pneumothorax.

3)Neonatal pneumothorax and MAS baby

Study	Distribution of pneumothorax cases in MAS babies(%)
Present study	38% (n= 23)
Al-Anbari AJ et al[26]	19.5%
Andersson j et al[28]	22%
Lim HS et al[21]	14%

- In present study, out of 60 cases of pneumothorax, 23 had MAS who developed pneumothorax. In comparison with Al-Anbari AJ et al[26], Andersson j et al[28] and Lim HS et al[21] we had large number of MAS with pneumothorax, as out of 23 cases 9 were outborn babies which reported very late to hospital. Out of 23 (38%) cases of MAS, 10 (43.47%) received surfactant. So MAS along with post-surfactant is predictor of pneumothorax.

4)Neonatal pneumothorax and congenital pneumonia

Study	Distribution of pneumothorax cases in congenital pneumonia babies(%)
Present study	51.7% (n=31)
Al-Anbari AJ et al[26]	7.3%
Andersson j et al[28]	5%
Jovandaric M Z et al[27]	75%

- Present study shows congenital pneumonia with pneumothorax was in 51.7% of cases which is compatible to Jovandaric M Z et al[27].Andersson j et al[28] and Al-Anbari AJ et al[26] had lower percentage of congenital pneumonia cases with pneumothorax. Present study shows higher number of cases of congenital pneumonia which is attributed to large number of cases with maternal history of PV leak and outborn cases. While other study had not included the outborn cases of pneumothorax. Underlying lung pathology like congenital pneumonia is risk factor for pneumothorax.

5)Neonatal pneumothorax and spontaneous pneumothorax cases

Study	Spontaneous pneumothorax cases(%)
Present study	26.7% (n=16)
Al-Anbari AJ et al[26]	26.8%

- In our study, spontaneous pneumothorax cases was seen in 26.7% of cases which is comparable to study done by Al-Anbari AJ et al[26] who reported spontaneous pneumothorax in 26.58% cases.

6)Neonatal pneumothorax and pneumothorax first detected at age

Study	Age of detection of pneumothorax cases(%)	
	<48 hours	>48 hours
Present study	43.3%	56.7%
APILIOGULLARI et al[20]	80%	20%

In our study we detected 43.3% pneumothorax cases within 48 hours of life and 56.7% after 48 hours of life. While APILIOGULLARI et al[20] reported 80% of cases within 48 hours of life, this is not comparable with our study as APILIOGULLARI et al[20] had preterm 83% and LSCS rate was higher 76% which may be the cause for higher number of pneumothorax cases within 48 hours of life.

7)Neonatal pneumothorax and pneumothorax side involved

Study	Distribution of side involved in pneumothorax		
	Right side	Left side	Bilateral
Present study	48.3%	28.3%	23.3%
Silva IS et al[23]	46.3%	43.3%	10%
APILIOGULLARI et al[20]	40%	30%	30%
Al-Anbari AJ et al[26]	65.9%	19.5%	14.6%
Jovandaric M Z et al[27]	47%	36%	16%
kim E et al[29]	63.9%	25%	4%

In present study, we found 48.3% of right sided pneumothorax, 28.3% left sided pneumothorax and 23.3% bilateral pneumothorax. Our study was comparable with Silva IS et al[23], APILIOGULLARI et al[20], Jovandaric M Z et al[27].Al-Anbari AJ et al[26] and kim E et al[29] found right sided pneumothorax cases slightly more higher (65.9% and 63.9% respectively) than left side. It is known fact that right sided pneumothorax is more than left sided as right bronchus is straight causing more infection and meconium aspiration on right side.

8)Neonatal pneumothorax and mortality

Study	Mortality (%)
Present study	56% (n=34)
Silva IS et al[23]	30%
Al-Anbari AJ et al[26]	29.3%

Out of 60 cases of pneumothorax, 34 (56.66%) pneumothorax cases died.

CONCLUSION:

Pneumothorax is relatively frequent in NICU. Etiology included birth asphyxia, MAS, congenital pneumonia, use of surfactant should be identified. Underlying pulmonary disease like hyaline membrane disease (HMD) congenital pneumonia, pneumonia due to meconium aspiration syndrome (MAS) should be identified and treated promptly. As this study had been done in prehfov era so clinical feature and outcome of neonatal pneumothorax need to study further by use of HFOV. Further research with larger sample sizes and longer study periods is recommended to better understand the risk factors and outcomes associated with neonatal pneumothorax.

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