



## Characteristics of Pneumothorax in a Neonatal Unit at Al Yarmouk Teaching Hospital

Farah Yassen Flayyih<sup>1</sup>, Saja Mohammed Adil<sup>1</sup>, Sawsan Ali Hussein<sup>1</sup>,  
Tala A. AL-Awqati<sup>2</sup>

### ABSTRACT:

#### BACKGROUND:

Pneumothorax is the most common air-leak syndrome in neonatal period. It can be defined as accumulation of air between the parietal and visceral pleura.

#### OBJECTIVE:

To study the general characteristics, risk factors, causes, management details, and the outcomes of neonatal pneumothorax.

#### PATIENTS AND METHODS:

It is a prospective observational study included thirty infants at neonatal intensive care unit at Al-Yarmouk teaching hospital from 1st of October 2018 to the 30th of September 2019 and Patients were evaluated for: gender, gestational age, birth weight, Apgar score at 1&5 minutes, mode of delivery, time of pneumothorax development, localization, and the presence of lung pathology.

#### RESULTS:

During the study period, 1967 neonates admitted to Neonatal Intensive Care Unit, thirty infants were diagnosed. The incidence was 1.52%. This study showed that (70%) of neonates were male and (60%) had low birth weight. Respiratory distress syndrome was found in (60%). It occurs spontaneously in (23%), after invasive mechanical ventilation in 6 cases, and after noninvasive ventilation in 17 cases. Tube thoracostomy and closed underwater drainage were performed in 26 cases. Mortality rate was 43,3%.

#### CONCLUSION:

Pneumothorax occur more frequently with use of assisted ventilation, especially those with underlying medical illnesses, and it carries high risk mortality.

**KEYWORDS:** Early Cesarean Section, Neonatal Intensive Care Unit, Respiratory Distress Syndrome.

<sup>1</sup> Pediatrician, Central Child Teaching Hospital, Baghdad, Iraq.

<sup>2</sup> Consultant Pediatrician, Al-Yarmuk Teaching Hospital, Baghdad, Iraq.



### INTRODUCTION:

Pneumothorax is the most common air-leak syndrome resulting in significant morbidity and mortality in neonates<sup>(1,2)</sup>. It can be defined as the accumulation of gas in the pleural space between the parietal and visceral pleura<sup>(3,4)</sup>.

Among term infants, 1% have an asymptomatic pneumothorax, while symptomatic one is less commonly, occurring in about 1 in 1000 live births and constituting about 5-7% of those with birth weight of <1500 grams. Since introduction of surfactant therapy, the incidence of pneumothorax has fallen to about 5% overall<sup>(5,6)</sup>.

It is classified into<sup>(4,7,8,9)</sup>

- Spontaneous pneumothorax
- Secondary pneumothorax: which occurs with underlying lung disease such as RDS or MAS.
- Traumatic pneumothorax:
- Tension pneumothorax
- Persistent pneumothorax: A pneumothorax that persists >7 days in the absence of mechanical problems.

The common Clinical manifestations are Signs of respiratory distress as tachypnea, grunting, pallor, or cyanosis. Physical examination may reveal chest asymmetry, decreased breath sounds on the affected side, and a shift of the maximal cardiac impulse away from the affected side<sup>(6,10,11)</sup>. The diagnosis of pneumothorax relies on: *Chest radiographs, Trans-illumination test, Arterial blood gases and Needle aspiration*<sup>(12,13,14)</sup>.

The Management: either preventive (Avoidance of unnecessary or early cesarean section, Appropriate management of high-risk pregnancy and labor (including administration of antenatal corticosteroids)<sup>(6)</sup>, the administration of rescue exogenous surfactant (early within 2 hours of birth or late after 2 hours of birth) to a newborn with RDS will lower alveolar surface tension and improve pulmonary compliance AND Gentle ventilation strategies<sup>(6,15,25)</sup>, or abortive measures (conservative, *Needle aspiration, Thoracentesis, and Chest tube*)<sup>(10,16,17)</sup>. The current study was planned to assess the general characteristics, risk factors, causes, management details, and the outcomes of neonatal pneumothorax.

### **PATIENTS & METHODS:**

- A prospective observational study included thirty infants diagnosed with pneumothorax from 1967 neonates admitted to Neonatal Intensive Care Unit at Al-Yarmouk teaching hospital in Baghdad, over a period of 12 months, from 1st of Oct. 2018 to the end of Sep. 2019.
- Neonates with congenital heart diseases and dysmorphic features were excluded from the study.
- Neonatal birth characteristics were studied as follow: Gender, Birth weight, Gestational age, Type of birth, Mode of delivery, and Apgar score at 1&5 minutes.
- Information regarding to Maternal history had include: Age, Parity, Antenatal steroid administration, and risk factors such as hypertension, diabetes mellitus, or others.
- Characteristics of pneumothorax include: Timing, Site, and Type of PTX whether spontaneous or secondary to underlying lung disease or assisted ventilation.
- Oxygen saturation was measured during the time of pneumothorax development.

- Administration of surfactant post-natally was recorded.
- Management was done either by conservative method or inserting chest tube.
- The duration of chest tube and hospitalization was recorded.
- The patients were followed till discharge or death.

The data was analyzed using (SPSS) version 25. data presented as mean, standard deviation, ranges, frequencies and percentages. Independent t-test (two tailed) was used to compare the continuous variables accordingly. A level of P-value less than 0.05 was considered significant.

### **RESULTS:**

The total number of births during our study period was 1967 births. Thirty newly-born infants with the diagnosis of pneumothorax were included in our study; thus, the incidence of neonatal pneumothorax was 1.52%.

Regarding gender, 21 (70%) of the studied newborns were boys and 9 (30%) were girls, with male to female ratio of 2.33:1. Birth weight less than 2500g was recorded in 18 (60%) of newborns. In concern to the gestational age, two thirds (70%) were preterm and one third (30%) were term. The distribution of neonates according to certain characteristics of their mothers: The age of the mothers was ranging from 15 to 40 years. Two thirds of mothers (63.3%) were aged between 25-35 years and the highest proportion (66.7%) was primiparous.

In this study, neonates were born by cesarean section 76.7%, and 23.3% by spontaneous vaginal delivery. Multiple pregnancy was recorded in 8 (26.7%) births. Regarding the maternal diseases, 5 (16.7%) of neonate's mothers were hypertensive, 3 (10%) diabetic, and 10 (33.3%) complained from other diseases.

In this study, we recorded that 17 (56.6%) of mothers received dose of steroid during antenatal care period, were not significant different  $p > 0.05$ .

Apgar score at first minute was in the range of 4-6 in 17 (56.7%) of neonates, while score at five minutes of birth was  $\geq 7$  in 21 (70%) of them, significant relationship ( $P = 0.001$ ) existed between mortality and Apgar score at one minutes, as 6 from 10 neonates with 0-3 score were demised, as shown in table (1).

**Table 1: Distribution by mortality and certain risk factors regarding clinical findings**

Risk Factors	Outcome		Total (%) n= 30	P- Value
	Died (%) n= 13	Survived (%) n= 17		
<b>Spo2 (%)</b>				
< 85	6 (85.7)	1 (14.3)	7 (23.3)	0.432
85 – 90	6 (66.7)	3 (33.3)	9 (30.0)	
91 – 95	1 (7.1)	13 (92.9)	14 (46.7)	
<b>Tension Pneumothorax</b>				
Yes	11 (78.6)	3 (21.4)	14 (46.7)	0.732
No	2 (12.5)	14 (87.5)	16 (53.3)	
<b>One Min. Apgar Score</b>				
0 – 3	6 (60.0)	4 (40.0)	10 (33.3)	0.001
4 – 6	7 (41.2)	10 (58.8)	17 (56.7)	
7 – 10	0 (0)	3 (100.0)	3 (10.0)	
<b>Five Min. Apgar Score</b>				
0 – 3	1 (100.0)	0 (0)	1 (3.3)	0.147
4 – 6	5 (62.5)	3 (37.5)	8 (26.7)	
7 – 10	7 (33.3)	14 (66.7)	21 (70.0)	
<b>Respiratory Support Before Diagnosis</b>				
Oxyhood	1 (14.3)	6 (85.7)	7 (23.3)	0.221
Nasal Cannula	2 (66.7)	1 (33.3)	3 (10.0)	
nCPAP	6 (42.9)	8 (57.1)	14 (46.7)	
MV	4 (66.7)	2 (33.3)	6 (20.0)	
<b>Surfactant administration</b>				
Yes	9 (60.0)	6 (40.0)	15 (50.0)	0.065
No	4 (26.7)	11 (73.3)	15 (50.0)	
<b>Duration of MV (days)</b> n= 4      n= 2      n= 6				
≤ 2	2 (100.0)	0 (0)	2 (33.3)	0.220
> 2	2 (50.0)	2 (50.0)	4 (66.7)	
<b>Duration of nCPAP (days)</b> n= 6      n= 8      n= 14				
≤ 2	2 (20.0)	8 (80.0)	10 (71.4)	0.013
> 2	4 (100.0)	0 (0)	4 (28.6)	

Non-significant association was found between the mortality and each of the time of diagnosis, site, classification, and risk factors of pneumothorax, duration of chest tube, and type

of management with P- value of 0.691, 0.383, 0.371, 0.423, 0.351, and 0.787 respectively, as shown in table (2).

## PNEUMOTHORAX IN A NEONATE

**Table 2: Distribution of the study neonates by mortality and details of pneumothorax and management**

Pneumothorax	Outcome		Total (%) n= 30	P- Value
	Demised (%) n= 13	Survived (%) n= 17		
Time of Diagnosis (hours after birth)				
≤ 24	10 (47.6)	11 (52.4)	21 (70.0)	0.691
> 24	3 (33.3)	6 (66.7)	9 (30.0)	
Site				
Left	4 (36.4)	7 (63.6)	11 (36.7)	0.383
Right	6 (40.0)	9 (60.0)	15 (50.0)	
Bilateral	3 (75.0)	1 (25.0)	4 (13.3)	
Classification of pneumothorax according to type of ventilation				
Spontaneous	1 (14.3)	6 (85.7)	7 (23.3)	0.371
Invasive	4 (66.7)	2 (33.3)	6 (20.0)	
Non invasive	8 (47)	9 (53)	17 (56.7)	
Risk factors				
Congenital Pneumonia	3 (100.0)	0 (0)	3 (10.0)	0.423
MAS	1 (20.0)	4 (80.0)	5 (16.7)	
RDS	8 (44.4)	10 (55.6)	18 (60.0)	
TTN	1 (25.0)	3 (75.0)	4 (13.3)	
Duration of Chest Tube (days) n= 13                      n= 13                      n= 26				
≤ 2	4 (66.7)	2 (33.3)	6 (23.1)	0.351
> 2	9 (45)	11 (55)	20 (76.9)	
Type of management				
Conservative	0 (0)	4 (100.0)	4 (13.3)	0.787
Interventional	13 (50.0)	13 (50.0)	26 (86.7)	

Risk factors of neonatal pneumothorax were analyzed in two groups of neonates, depending on the outcome (died and survived). The comparison in two groups by birth weight, gestational age, and duration of hospitalization is shown table (3). Significant differences were found between the two groups regarding birth weight and gestational age, which were

significantly lower in the demise group in comparison to those who survived (2075 vs 2946, P= 0.020) and (32.7 vs 36.5, P = 0.013), respectively. The duration of hospitalization was significantly longer in survived neonates compared to demised neonates (8.41 vs 4.61, P= 0.021).

**Table 3: Comparison between the study neonates by birth weight, gestational age, and duration of stay in NICU**

Risk Factors	Demised Group Mean ± SD	Survived Group Mean ± SD	P - Value
Birth Weight/grams	2075 ± 817.2	2946 ± 761.5	0.02
Gestational Age/weeks	32.7 ± 3.95	36.5 ± 2.59	0.013
Duration of hospitalization/ days	4.61 ± 5.95	8.41 ± 2.18	0.021

### DISCUSSION:

The incidence of neonatal pneumothorax was 1.52%, which was approximately similar to that found by Lim et al<sup>(4)</sup> and Silva et al<sup>(18)</sup> with 1.3% & 1.5% respectively.

Regarding gender, the majority (70%) of the study population were males, this result is similar to that found by Pacharn et al<sup>(19)</sup>, Al Fahham et al<sup>(20)</sup>, and Apiliogullari et al<sup>(21)</sup>.

In regard to birth weight and gestational age, 60% of patients had low birth weight (<2.5 kg), and 70% were preterm. These results are approximately similar to that found by Hadzic et al<sup>(8)</sup>, Al Fahham et al<sup>(20)</sup>, and Malek et al<sup>(22)</sup>, these results can be explained by higher incidence of RDS in preterm and low birth weight infants. Regarding Apgar score;

the study found that 56.7% had Apgar score 4-6 at 1 minute of life, and 70% had Apgar score 7-10 at 5 minutes, these results are supported by Al Matary et al<sup>(23)</sup> and Hadzic et al<sup>(8)</sup>.

In concern to the characteristics of pneumothorax, most of the cases had developed right sided pneumothorax, and were developed prior to 24 hours of life. These results are supported by Abdul Mannan et al<sup>(9)</sup>, Al Fahham et al<sup>(20)</sup>, Apiliogullari et al<sup>(21)</sup>. We also recognize RDS as the major comorbidity in our cases (60%), which was agreed with Abdul Mannan et al<sup>(9)</sup>, Apiliogullari et al<sup>(21)</sup>, Al Fahham et al<sup>(20)</sup>, Malek et al<sup>(22)</sup>, and Silva et al<sup>(18)</sup>. This result indicates that lung pathology is an important risk factor for neonatal pneumothorax and death.

Regarding management of pneumothorax, most of the cases were treated by chest drain (86.7%), while the rest (13.3%) were treated conservatively with oxygen support and close observation. These results are similar to those found by Silva et al<sup>(18)</sup>, and Litmanovitz et al<sup>(5)</sup>. Regarding the outcomes of our cases; 56.7% recovered completely, while 43.3% died. Approximately lower results had been found by Silva et al<sup>(18)</sup> (30%) and Apiliogullari et al<sup>(21)</sup> (33.3%). These results signify that neonatal pneumothorax is associated with high risk of mortality.

We found significant correlation between neonatal mortality caused by pneumothorax and each of LBW and premature delivery. These results were supported by Al Matary et al<sup>(23)</sup> who found approximately similar results.

This study also found statistically non-significant association between survived and demised groups in regard to maternal age, parity, mode of delivery, pregnancy status, and maternal diseases. Those results are approximately similar to those found by Al Matary et al<sup>(23)</sup>.

This study also showed statistically significant association between 1 minute Apgar score and the neonatal mortality, in which all cases with 1 minute Apgar score  $\geq 7$  were survived. This result is supported by Al Matary et al<sup>(23)</sup> and Kim et al<sup>(24)</sup> which can be attributed to that the lower the score, the greater the need for active resuscitation including PPV, this made those patients more vulnerable for pneumothorax and its complication, including death.

This study found non-significant correlation between administration of surfactant and the outcomes of neonatal

pneumothorax, while Malek et al<sup>(22)</sup> found that surfactant had a protective effect against development of pneumothorax. This variation could be attributed to sample size variation.

Regarding the duration of nCPAP prior to development of pneumothorax, the study shows that all demised group had received nCPAP for more than 2 days, and the majority of the survived group had received nCPAP for  $\leq 2$  days with significant P value, which means that demised group had more severe disease and thus more liable for complications such as pneumothorax, rendering them at increased risk of mortality.

This study also found non-significant association between neonatal mortality and each of the time of diagnosis, site, and oxygen saturation at time of diagnosis, with no comparable studies regarding those parameters.

### CONCLUSION:

1. Prematurity, low birth weight (<2500g), C/S, respiratory distress syndrome, maternal illnesses, and 1<sup>st</sup> minute Apgar score < 7 are considered as risk factors for neonatal pneumothorax.
2. Mortality rate of neonates is more common in the premature babies, on ventilation and those with primary pulmonary pathology.

### REFERENCES:

1. Ianchulev SA, Gupta A, Schumann R. Pneumothorax in neonates: Complication during endotracheal intubation, diagnosis, and management. *Journal of Anaesthesiology Clinical Pharmacology*. 2016;32-3.
2. Ramesh Bhat Yellanthoor and Vidya Ramdas. Frequency and Intensive Care Related Risk Factors of Pneumothorax in Ventilated Neonates. *Pulm Med*. 2014.
3. J. Jane Pillow and Alan H. Jobe. Respiratory Disorders of the Newborn. Taussig Landau Lesouef Martinez, Morgan Sly. *Pediatric Respiratory Medicine*. 2nd edition..ELSEVIER, Philadelphia. 2008:365-86.
4. Ho Seop Lim, Ho Kim, Jang Yong Jin et al. Characteristics of Pneumothorax in a Neonatal Intensive Care Unit. *Journal of the Korean Society of Neonatology*. 2011;18:257.
5. Ita Litmanovitz, Waldemar A. Carlo. Expectant management of pneumothorax in ventilated neonates. *AAP*.2008;122.

6. McIntosh Neil, Stenson Ben. The newborn. Peter J. Helms, Rosalind L. Smyth et al. *Forfar & Arneil's textbook of pediatrics*. 7<sup>th</sup> Edition. 2008. ELSEVIER.191–367p. Gomella TL,Cunningham MD,Eyal FG et al. *Neonatology Management, Procedures, On-Call Problems, Diseases, and Drugs*. 7<sup>th</sup> edition. 2013: 549-57.
7. Gomella TL,Cunningham MD,Eyal FG et al. *Neonatology Management, Procedures, On-Call Problems, Diseases, and Drugs*. 7<sup>th</sup> edition. 2013:549-57.
8. Hadzic D, Skocic F, Husaric E et al. Risk Factors and Outcome of Neonatal Pneumothorax in Tuzla Canton. *Mater Socio Medica*. 2019;31:66.
9. Mannan MA, Dey SK, Jahan N et al. Spectrum of Neonatal Pneumothorax at a Tertiary Care Hospital of Bangladesh: A Retrospective Observational Study. *Bangladesh Crit Care Journal*. 2019:12–9.
10. Thomas K. McInerny , Henry M. Adam, Jane Meschan Foy et al. *Textbook of pediatric care*. 2nd edition. 2017.
11. Lloyd J. Brown, Ryan J. Collier, Lee Todd Miller. *Board review series: pediatrics*. 2<sup>nd</sup> edition. China. 2019:139-44.
12. Adam A. Rosenberg, MD, Theresa Grover, MD. The Newborn Infant. William W. Hay, Robin R. Deterding, Myron J.et al. *Current Diagnosis & Treatment Pediatrics*. 22<sup>nd</sup> ed. 2014:9-75.
13. McMullan R. Guideline Women and Babies : Management of Pneumothorax in Newborn Infants Women and Babies. Health Sydney local health district.2017:1-16.
14. Rennie JM , Kendall GS. A Manual of neonatal intensive Care. 7th ed.. CRC Press Taylor & Francis Group. london; 2013:40.
15. Waldemar A.Carlo. The fetus and the newborn infant. R.Kliegman, Joseph W.St Geme, Nina F. Schor, et al. *Nelson textbook of pediatrics*. 20<sup>th</sup> edition.. ELSEVIER, Philadelphia. 2016:818-833, 844-867.
16. James M. Greenberg, Thomas A. Parker. Emergencies and Special Intensive Care. Colin D. Rudolph, Abraham M. Rudolph, George E. Lister et al. *Rudolph's Pediatrics*. McGraw-Hill Companies. United States. 22th ed. 2011.
17. Paola Papoff and Corrado Moretti. *Pulmonary Air Leakage* . Giuseppe Buonocore, Michael Weindling, Rodolfo Bracci. In: *A Practical Approach to Neonatal Diseases*. 1<sup>st</sup> edition.. Springer-Verlag Italia. 2012:460-69.
18. Silva ÍS, Flôr-de-lima F, Rocha G, Alves I. Pneumothorax in neonates: a level III Neonatal Intensive Care Unit experience. *Journal of pediatrics and neonatal individualized medicine*. 2016;5:1–8.
19. Sopapan Ngercham, Pornpat Kittiratsatcha, Preeyacha Pacharn. Risk Factors of Pneumothorax during the First 24 Hours of Life. *Journal Med. Assoc. Thai.; Bangkok, Thailand*, 2005;88:135–41.
20. Al-fahham FS, Araj KK, Al-Qazzaz HM. A Prospective Study of Neonatal Pneumothorax in Holy Karbala. *Karbala J. Med*. 2015;8:2093–97.
21. Apiliogullari B, Sunam GS,Ceran S et al. Evaluation of Neonatal Pneumothorax. *The Journal of International Medical Research*. 2011;2436–40.
22. Malek A, Afzali N, Meshkat M et al. Pneumothorax after Mechanical Ventilation in Newborns. *Iran J. Pediatric*. 2011;21:45-50.
23. Al Matary A, Munshi HH, Abozaid S et al. Characteristics of Neonatal Pneumothorax in Saudi Arabia: Three Years' Experience. *Oman Medical Journal*. 2017;32:135–39.
24. Kim E-A, Jung J-H, Lee S-Y et al. Neonatal Pneumothorax in Late Preterm and Full-Term Newborns with respiratory Distress: A Single-Center Experience. *Neonatal Med* 2022;29:18–27.
25. Dhar DH, Paul D. Surfactant replacement therapy: an overview. *International journal of science and healthcare research*.2020;5:399-406