Open Access

Original Article

Frequency and Causal Relationship of Pneumothorax in Premature Neonates in a Tertiary Care Hospital

Aamir Aslam Awan, Qudratullah Malik*, Faisal Basheer, Ammara Iftikhar, Hafiz Abdul Quddus***, Hafiz Murtaza Sabir*****

Department of Paeds, Combined Military Hospital Lahore/National University of Medical Sciences (NUMS) Pakistan,
*Department of Paeds, Pak Emirates Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan,
**Department of Paeds, Combined Military Hospital Sialkot/National University of Medical Sciences (NUMS) Pakistan, ***Department of Paeds, Combined Military Hospital Multan/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

***Objective*:** To determine the frequency and causal relationship of Pneumothorax in prematurely born neonates in a tertiary care hospital.

***Study Design*:** Prospective longitudinal study.

***Place and Duration of Study*:** Department of Paediatrics, Pak Emirates Military Hospital, Rawalpindi Pakistan, from Aug 2017 to Jul 2019.

Methodology: A total of 510 premature neonates fulfilling the inclusion criteria were enrolled in the study. In suspected cases, Pneumothorax was confirmed on a chest radiograph. Hemodynamically stable neonates were closely observed for spontaneous resolution, whereas unstable neonates were managed by needle thoracocentesis or thoracostomy with or without ventilator support. The outcome of the study was either death of the neonate or discharge from the NICU (Neonatal Intensive Care Unit).

Results: Of 510 included premature neonates, 43(8.4%) developed Pneumothorax. Pneumothorax was more common in late pre-term (51.2%) and moderate pre-term (46.5%) infants. Underlying diseases causing Pneumothorax were respiratory distress syndrome (RDS) 21(48.8%), meconium aspiration syndrome (MAS) 8(18.6%), transient tachypnoea of the newborn (TTN) 5(11.6%), birth asphyxia syndrome (BAS) 6(14%) and Pneumonia 3(7%). 34(79.1%) patients required thoracostomy, whereas 7(16.3%) required only needle thoracocentesis. Spontaneous resolution occurred in only 2(4.7%) patients. Of 43 patients, 35(81.39%) were discharged, and 8 (18.60%) died.

Conclusion: Pneumothorax is not an uncommon complication, especially in premature neonates. A high index of suspicion is required for early recognition and timely management of Pneumothorax, as delay is associated with significant mortality.

Keywords: Pneumothorax, Prematurity, Neonate, Thoracostomy, Thoracocentesis.

How to Cite This Article: *Awan AA, Malik Q, Basheer F, Iftikhar A, Quddus HA, Sabir HM. Frequency and Causal Relationship of Pneumothorax in Premature Neonates in a Tertiary Care Hospital. Pak Armed Forces Med J 2023; 73(5): 1271-1274. DOI: https://doi.org/10.51253/pafmj.v73i5.5395*

INTRODUCTION

Pneumothorax is a common problem in infants varying from up to 10% (very low-weight infants with prematurity) to 1% (full-term infants).[1] Pneumothorax is more frequent in the neonatal period, especially among premature infants. Around 1-2% of neonates with respiratory distress develop pneumothorax.[2,3] Positive pressure ventilation increases the incidence from 15-25 % in full-term to 34.7 % in Low-weight newborns with prematurity.[4,5] The incidence is further increased by the use of other modalities like n-CPAP (Nasal Continuous Airway Pressure) and HFNC (High flow Nasal Canula).[6,7]

Mortality in neonates with Pneumothorax is as high as 38.6%.[9] High suspicion index, early diagnosis & in-time management are vital to decrease mortality and morbidity.[10] The study aimed to determine the frequency, clinical profile and outcomes of pneumothoraces in neonates and apply the results in a tertiary care NICU to better the clinical process of managing Pneumothorax.

Correspondence: Dr Aamir Aslam Awan, Department of Paeds, Combined Military Hospital Lahore Pakistan

Received: 24 Sep 2020; revision received: 12 Aug 2021; accepted: 16 Aug 2021

METHODOLOGY

The prospective longitudinal study was carried out for two years at the NICU of a tertiary care Hospital after obtaining permission from the Hospital Ethical Review Committee (IERB no A/28/EC/193/2020). The sample size was calculated using the WHO sample size calculator, keeping 0.22 anticipated population proportion and 0.03 absolute precision.[1]

Inclusion Criteria: Pre-term neonates of either gender, with signs and symptoms of respiratory distress were included in the study.

Exclusion Criteria: Neonates with Neonatal sepsis, congenital malformations and NEC were excluded from the study.

All premature neonates born inside the hospital or admitted from outdoors (28-36 weeks of gestation) between the ages of 0-28 days were enrolled and divided into three groups (1-28-31 weeks Early Pre-term, 2-32-33 weeks Moderate pre-term, 3- 34-36 weeks Late Pre-term), using a non-probability consecutive sampling technique and informed written consent from the parents of the neonates. Respiratory distress, cyanosis or increased oxygen requirement were clinical indicators for pneumothorax suspicion. Keeping a high index of suspicion, an urgent portable chest radiography/chest X-ray (CXR) was performed to confirm the presence of Pneumothorax. The patients with confirmed Pneumothorax were observed for outcomes after various management techniques based on the extent and severity of Pneumothorax. The outcomes included the resolution of Pneumothorax spontaneously, Needle thoracocentesis, and Needle thoracocentesis with thoracostomy or tube thoracostomy directly after thoroughly explaining the procedure to the parents and obtaining informed consent. In all cases, the on-call General or Paediatric Surgeon did chest intubation (if needed). Removal of chest tube was done if Pneumothorax resolved on follow-up X-ray chest, and there were no signs and symptoms of respiratory distress even after clamping the chest tube for 8 hours. A chest radiograph was taken in all cases after removal of the chest tube.

Statistical Package for Social Sciences (SPSS) version 20.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value lower than or up to 0.05 was considered as significant.

RESULTS

Five hundred ten patients with symptoms of respiratory distress were enrolled in this study. There were 215 (42.2%) males and 295 females (57.8%). 15 (2.94%) patients were Early pre-term (28-31 weeks), 230 (45.09%) were moderate pre-term (32-33 weeks), and 265 (51.96%) were late pre-term (34-36 weeks). The main diseases causing distress in these neonates were RDS or Respiratory Distress Syndrome 21(48.8%), MAS or Meconium Aspiration Syndrome 8(18.6%), TTN or Transient Tachypnea of Newborn 5(11.6%), BAS or Birth Asphyxia Syndrome 6(14%) and Pneumonia 3(7%). 43(8.4%) out of the 510 patients were conformed to develop Pneumothorax.

Of 43 neonates who developed Pneumothorax, 23(53.48%) were females, and 20(46.51%) were male. Only 1(2.3%) Early pre-term infant developed Pneumothorax, whereas 20(46.5%) in Moderate pre-term group and 22(51.2%) of late pre-term developed Pneumothorax. Pneumothorax spontaneously resolved in 2 patients (4.7%). In all 43 patients with Pneumothorax, radiological evidence of pneumothorax resolution was documented. Out of 43, 35(81.39%) patients were discharged and 8(18.60%) died. The average length of hospital stay was 11.96±2.2 days for the entire population. The Mean gestational age was 33.851±1.511 weeks. There was no statistically significant difference between genders (*p*-value=0.547) and gestational age groups (*p*-value=0.982) for Pneumothorax (Table-I). Similarly, no statistically significant difference was seen in genders (*p*-value=0.241) (Table-II) and Gestational age groups (*p*-value=0.960) when compared for outcome.

Table-I: Comparison of Mean Hospital Stay, Gestational Age in Pneumothorax versus non-Pneumothorax Groups (n=510)

	Pneumothorax-Group	No Pneumothorax-Group	*p*-value
Hospital Stay (Days) (Mean±SD)	10.69774.073	12.068±1.960	-
Gestational Age (Weeks) (Mean±SD)	33.883±1.591	33.848±1.505	0.982
Patients with Pneumothorax (n=43)	Male Neonates	Female Neonates	
Hospital Stay (Days) (Mean±SD)	11.350±3.645	10.134±4.413	0.547
Gestational Age (Weeks) (Mean±SD)	34.0±1.835	33.782±1.380	

DISCUSSION

In infants, Pneumothorax is a fairly common complication (around 1% in term infants and 6–10% in VLBW pre-term infants).[11] Neonatal Pneumothorax has high mortality rates, with rates as high as 38.6%.[12] Neonatal Pneumothorax is more often seen in neonates with low birth weight and premature infants. The combination of weak lungs and high ventilator pressures is believed to result in Pneumothorax in such neonates.[13,14]

The frequency of Pneumothorax in the NICU of our tertiary care hospital was 8.4% in premature neonates. This is higher than some studies carried out in India. The incidences were reported to be 1.85% and 2% in

mechanically ventilated infants 6.[15] A large multicentre international study compared mechanical ventilation to CPAPA (Controlled continuous positive airway pressure) at birth. Morley *et al*.[7] reported an incidence of 3% pneumothorax in infants who were preterm and low birth weight on mechanical ventilator support. Of the small study population, the incidence of Pneumothorax was documented to be 2.5%.[16] Similar results were documented in a study by Al Matary *et al*. 17(3.9%) and another study by Hadzic *et al*. (3.4%).[18]

Table-II: Comparison of Treatment, Gestational Age, Causes and Outcome in Male versus Female Neonates with Pneumothorax (n=43)

Treatment	Male Neonates	Female Neonates	*p*-value
Thoracostomy	14(41.17%)	20(58.82%)	0.342
Needle Thoracostomy	5(71.42%)	2(28.57%)	
Spontaneous Resolution	1(50%)	1(50%)	
Gestational Age			
Early Preterm (28-31 weeks)	1(100%)	0	0.77
Moderate Preterm (32-35 weeks)	8(40%)	12(60%)	
Late Preterm (35-36 weeks)	11(50%)	11(50%)	
Causes			
Respiratory Distress Syndrome	10(47.61%)	11(52.38%)	0.226
Meconium Aspiration Syndrome	4(50%)	4(50%)	
Transient Tachypnea of Newborn	3(60%)	2(40%)	
Birth Asphyxia Syndrome	1(16.66%)	5(83.33%)	
Pneumonia	2(66.66%)	1(33.33%)	
Outcome			
Death	5(62.5%)	3(37.5%)	0.241
Discharge	15(42.85%)	20(57.14%)	

Pneumothorax on the right side was more frequent than on left-sided Pneumothorax. The same was also noted in some other studies.[19-21] Chest intubation was done in most of our study population (79.1%). This is similar to some other studies done by Apiliogullari *et al*. 22(93%) and Ali *et al*.[16] This contrasts a study conducted by Duong et al. which showed the overall rate of Pneumothorax to be 4.0%, 2.6%, and 6.7%, respectively.[23]

The mortality rate of our study was 18.6%, which is relatively lower than Al Matary *et al*. 17(29.1%) and other studies which observed mortality rates ranging from 25% to 35% in comparative studies.[9-22] The strength of this study is that the results of this study would add to the understanding of Neonatal Pneumothorax epidemiology associated with prematurity in our country. In addition, it would serve as a guideline for developing strategies to optimize morbidity and mortality in Neonatal Intensive Care Units while managing Pneumothorax in premature neonates.

CONCLUSION

Pneumothorax is a common complication in premature neonates in a tertiary care Neonatal ICU. The index of suspicion should be high in premature neonates for early recognition and in-time treatment, as delay causes higher mortality.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AAA: & QM: Data acquisition, data analysis, drafting the manuscript,

FB: & AI: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

HAQ: & HMS: Concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Jeng MJ, Lee YS, Tsao PC, Soong WJ. Neonatal air leak syndrome and the role of high-frequency ventilation in its prevention.J Chin Med Assoc 2012; 75(11): 551–559. https://doi.org/10.1016/j.jcma.2012.08.001
2. Drovandi L, Cianchi I, Pratesi S, Dani C. Fibrin glue pleurodesis for pneumothorax in extremely preterm infants: a case report and literature review. Ital J Pediatr 2018; 44(1): 91-94. https://doi.org/10.1186%2Fs13052-018-0533-6
3. Elizur A, Klin B, Vaiman M, Lotan G. Mana-gement of primary spontaneous pneumothorax in children.Clin Pediatr (Phila) 2011; 50(9): 797-802. https:// doi.org/10.1177/ 0009922811404699
4. Malek A, Afzali N, Meshkat M, Yazdi NH. Pneumothorax after mechanical ventilation in new-borns. Iran J Pediatr 2011; 21(1): 45-50. https:// doi.org/10.2214/ 0000005651887
5. Dargaville PA, Gerber A, Johansson S, De Paoli AG, Kamlin CO, Orsini F, et al. Australian and New Zealand Neonatal Network. Incidence and Outcome of CPAP Failure in Preterm Infants. Pediatrics 2016; 138(1): e20153985. https://doi:10.1542/peds.2015-3985.
6. Yellanthoor RB, Ramdas V. Frequency and intensive care related risk factors of pneumothorax in ventilated neonates. Pulm Med 2014; 2014: 727323. https;//doi: 10.1155/2014/727323.
7. Morley CJ, Davis PG, Doyle LW, Brion IP, Carlin JB. Nasal CPAP or intubation at birth for very preterm infants. N Engl J Med 2008; 358(7): 700-708. https://doi.org/10.1056/ nejmoa072788
8. Rodrigo FCM, Martí LU, Henríquez GG, Rodríguez SR, Carreño PT, Amorós SM, et al. Perinatal risk factors for pneumothorax and morbidity and mortality in very low birth weight infants. J Maternal-Fetal Neonatal Med 2017; 30(22): 2679-2685. https://doi.org/10.1080/14767058.2016.1261281

9. Ilce Z, Gundogdu G, Kara C, Ilikkan B, Celayir S. Which patients are at risk? Evaluation of the morbidity and mortality in newborn pneumothorax. Indian Pediatr 2003; 40(4): 325-328.
10. AR Hansen, EC Eichenwald, AR Stark, CR Martin. CLoherty and Stark's Manual of neonatal care. Lippincott Williams & Wilkins, 2016. Available at: https://doi.org/10.1524/peds.2010-1381
11. Colin AA, McEvoy C, Castile RG. Respiratory Morbidity and Lung Function in Preterm Infants of 32 to 36 Weeks' Gestational Age. Pediatrics 2010; 126(1): 115–128. https://doi.org/10.1542/peds.2009-1381
12. Correia C, Rocha G, Flor-de-Lima F, Guimarães H. Respiratory morbidity in late preterm infants. Minerva Pediatr 2018; 70(4): 345-354. https://doi.org/10.23736/s0026-4946.16.04580-1
13. Vibede L,Vibede E,Bendsten M,Pedersen L,Ebbesen F. Neonatal Pneumothorax: A Descriptive Regional Danish Study. Neonatol 2017; 111(4): 303-308. https://doi.org/10.1159/ 000453029
14. Aurilia C, Ricci C, Tana M, Tirone C, Lio A, Gambacorta A, et al. Management of pneumothorax in hemodynamically stable preterm infants using high frequency oscillatory ventilation: report of five cases. Ital J Pediatr 2017; 43(1): 114-116. https://doi.org/10.1186/s13052-017-0436-y
15. Nayana PC, George RT, Francis F. Profile and outcome of neonates requiring ventilation: the Kerala experience. Curr Pediatr Res 2014; 18(2): 57-62.
16. Ali R, Ahmed S, Qadir M, Maheshwari P, Khan R. Pneumothoraces in a neonatal tertiary care unit: case series. Oman Med J 2013; 28(1): 67-69. https://doi.org/10.5001%2Fomj.2013.16
17. Al Matary A, Munshi HH, Abozaid S, Qaraqei M, Wani TA, Abu-Shaheen AK, et al. Characteristics of Neonatal Pneumothorax in Saudi Arabia: Three Years' Experience. Oman Med J 2017; 32(2): 135-139. https://doi.org/10.5001/omj.2017.24
18. Hadzic D, Skokic F, Husaric E, Alihodzic H, Softic D, Kovacevic D, et al. Risk Factors and Outcome of Neonatal Pneumothorax in Tuzla Canton. Mater Sociomed 2019; 31(1): 66-70. https://doi.org/10.5455%2Fmsm.2019.31.66-70
19. Tan YL, Zhan Y, Geng J, Chen W, Guo WL. Predictors of chest drainage of pneumothorax in neonates. Braz J Med Biol Res 2020; 53(8): 26. https://doi.org/10.1590%2F1414-431X20209469
20. Bruschettini M, Romantsik O, Zappettini S, O'Donnell CP, Calevo MG. Needle aspiration versus intercostal tube drainage for pneumothorax in the newborn. Cochrane Database Syst Rev 2019; 2(2): CD011724. https;//doi: 10.1002/14651858.CD011724.pub3.
21. Parekh UR, Maguire AM, Emery J, Martin PH. Pneumothorax in neonates: Complication during endotracheal intubation, diagnosis, and management. J Anaesthesiol Clin Pharmacol 2016; 32(3): 397-399. https://doi.org/10.4103%2F0970-9185.188820
22. Apiliogullari B, Sunam GS, Ceran S, Koc H. Evaluation of neonatal pneumothorax. J Int Med Res 2011; 39(6): 2436-2440. https://doi.org/10.1177/147323001103900645
23. Duong HH, Mirea L, Shah PS, Yang J, Lee SK, Sankaran K. Pneumothorax in Neonates: Trends, Predictors and Outcomes. J Neonatal Perinatal Med 2014; 7(1): 29-38. https://doi.org/10.3233/npm-1473813

.....