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Research Article

Clinical Characteristics of Cases Developing Neonatal Pneumothorax: 10 Years of Experience

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Abstract

Aim: Pneumothorax is a serious emergency condition that increases mortality and morbidity due to the accumulation of air between the visceral and parietal pleura layers. Neonatal pneumothorax is more frequently encountered in neonates admitted to neonatal intensive care units. It is known that the most important risk factors are prematurity and ventilation with a bag mask.
Material and Method: Forty-two pneumothorax cases followed in the neonatal intensive care unit (NICU) were included in our study. The characteristics, risk factors, treatment methods and prognoses of the cases were retrospectively analyzed.
Results: Twenty eight of the cases (66.67%) were male, and Pneumothorax developed within the first 3 days of life in 41 cases (97.61%). Nineteen cases (45.24%) were premature, 16 cases (38.10%) underwent resuscitation at birth, and 15 cases (35.71%) received surfactant therapy. An intercostal chest tube was placed for treatment in 34 cases (80.95%), and invasive mechanical ventilation was required in 33 cases (78.57%). Thirty six cases (85.71%) were regained the health, while those who passed away were found to be more premature.
Conclusion: In our study, prematurity, resuscitation at birth, and surfactant therapy were identified as risk factors for neonatal pneumothorax. Newborns with these risk factors should be closely monitored, and neonatal pneumothorax should be kept in mind if respiratory distress develops.

Keywords: Neonatal pneumothorax, prematurity, resuscitation

INTRODUCTION

Pneumothorax is a serious emergency condition that increases mortality and morbidity due to the accumulation of air between the visceral and parietal pleura layers. The increase in intrathoracic pressure can lead to decreased venous return, hypoxia, and hypercarbia, which can be life-threatening (1). Neonatal pneumothorax occurs in 1-2% of neonates admitted to neonatal intensive care units, but this rate exceeds 40% in the presence of respiratory distress syndrome (RDS) (2). It is more common within the first 3 days of life. The most important risk factors are prematurity and ventilation with a bag-valv mask. Other known risk factors include male gender, low APGAR score, low birth weight, hyaline membrane disease, transient tachypnea of the newborn, meconium aspiration syndrome, and pulmonary hypoplasia (3,4). Although small pneumothorax may be asymptomatic, as the size of the pneumothorax increases, symptoms such as respiratory distress, tachypnea, apnea, cyanosis, and bradycardia can occur (5). While computed tomography (CT) is the gold standard for diagnosis, it is rarely used due to the high risk of ionizing radiation. In neonates, chest radiography and transillumination are the most commonly used methods for diagnosing pneumothorax. However, detecting small pneumothoraces, especially in premature and low birth weight infants, can be challenging. Due to the thin skin and narrow thorax of neonates, lung ultrasound can be used with high accuracy and reliability for diagnosis (6). The treatment of pneumothorax varies depending on the patient's symptoms and the size of the pneumothorax. Patients with asymptomatic and small pneumothorax can be monitored with non-invasive mechanical ventilation

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and positioning the affected side down. However, in life-threatening situations, needle aspiration with thoracentesis should be performed, or a intercostal chest tube should be placed (7).

In this study, we aimed to retrospectively analyze neonatal cases that developed pneumothorax in our hospital since 2014, to determine their clinical characteristics and predisposing factors.

MATERIAL AND METHOD

The study included 42 cases of pneumothorax that were followed and treated in the Neonatal Clinic of Düzce University Faculty of Medicine Training and Research Hospital between 2014 and 2024. All cases were diagnosed with anteroposterior chest radiography. In cases where it was deemed necessary, confirmation was made with lateral or decubitus position chest radiography. The cases were retrospectively evaluated for gestational age, birth weight, types of delivery, postnatal day of pneumothorax occurrence, gender, side of pneumothorax, need for postnatal resuscitation, meconium-stained birth, underlying primary lung disease, respiratory support, treatment method, and prognosis.

Cases with major congenital anomalies and those who had a thoracic tube placed due to thoracic surgery were excluded from the study.

Before inclusion in the study, the parents of the participants were informed about the content, purpose, and implementation of the study, and written consent was obtained.

This research involving human subjects complied with all relevant national regulations and institutional policies and was conducted in accordance with the tenets of the Helsinki Declaration. This study was approved by Düzce University Faculty of Medicine Ethics Committee (Decision no: 2024/94, Approval Date: 06.05.2024).

Statistical Analysis

In the statistical analysis of the study, descriptive statistics for numerical data were presented as mean±sd, if not normally distributed, median (IQR25-75) used, while categorical data were given as numbers and percentages.

In the statistical analysis of the study, descriptive statistics for numerical data were presented as mean+-std, if not normally distributed, median (IQR25-75) used, while categorical data were given as numbers and percentages. The distribution of numerical data was evaluated using histogram graphs. For the comparison of numerical data between two groups, the Student's t-test and Mann-Whitney U test were used. The chi-square test was employed for the comparison of categorical data. A p-value of <0.05 was considered statistically significant. The analyses were conducted using the SPSS 23.0 software package.

RESULTS

A total of 42 infants were included in the study. The mean age of the mothers of the infants in the study was found to be 29.21±6.18 years. The mean gestational age of the infants was 35.86±3.36 weeks. The median birth weight of the infants was 2892.50 grams (min=780; max=4770). Of the cases, 66.67% (n=28) were male. Pneumothorax developed on the 6th day of life in one case. In the other cases, pneumothorax developed within the first 3 days of life. Some demographic data of the patients are shown in Table 1.

Table 1. The parameters of maternal age, gestational age, birth weights, and the day of pneumothorax onset in the cases

Maternal age (year)*	29.21±6.18
Gestational age (week)**	36 (4)
Pneumothorax time(day)**	2 (5)
Birth weight (gr)*	2,861.79±778.82

* mean±SD, **median (IQR)

The majority of the cases, 85.71% (n=36), were delivered via cesarean section. Pneumothorax was predominantly unilateral, with a higher incidence on the right side. It was observed that 21.43% (n=9) of the cases developed bilateral pneumothorax. When comparing bilateral and unilateral pneumothorax cases, a significant difference was found only in the presence of preeclampsia in the mother. Bilateral pneumothorax was detected in both newborns whose mothers developed preeclampsia (p=0.006). Invasive mechanical ventilation was required in 33 (78.57%) cases (Table 2).

Table 2. Types of delivery, side of pneumothorax, and need for respiratory support in the newborns

		n	%
Types of delivery	**C/S**	36	85.7
	NSVD	6	14.3
Side of pneumothorax	**Right**	18	42.8
	Left	15	35.7
	Bilateral	9	21.5
Respiratory support	**Oxigen hood**	4	9.6
	CPAP	5	11.9
	Intubation	33	78.5

C/S: caeserian section, NSVD: normal spontaneous vaginal delivery

Comorbid conditions associated with pneumothorax development in the cases were evaluated in Table 3. Prematurity was present in 45.24% (n=19) of the cases. The rate of resuscitation at birth was found to be 38.10% (n=16). Surfactant was administered to 35.71% (n=15) of the cases. As a result, 14.29% (n=6) of the cases resulted in death. Other comorbid conditions are listed in Table 3.

Table 3. Comorbid conditions associated with the development of pneumothorax in newborns

	n	%
Prematurity	19	45.24
Necrotizing enterocolitis	1	2.38
Extremely low birth weight baby (<1000 g)	2	4.76
Intrauterine growth retardation	1	2.38
Premature membrane rupture	1	2.38
Preeclampsia	2	4.76
Hypoxic ischemic encephalopathy	1	2.38
Congenital heart disease	2	4.76
Neonatal transient tachypnea	1	2.38
Congenital pneumonia	3	7.14
Sepsis	1	2.38
Congenital diaphragmatic hernia	1	2.38
Neural tube defect	1	2.38
Gestational diabetes	3	7.14
Acute kidney failure	1	2.38
Chest tube insertion	34	80.95
Respiratory distress syndrome	12	28.57
Meconium aspiration	1	2.38
Resuscitation at birth	16	38.10
Surfactant replacement therapy	15	35.71
Exitus	6	14.29

g: gram

The numerical data of the cases and their mothers were evaluated according to the exitus status. No significant differences were observed in maternal age, gestational week, day of pneumothorax development and birth weight according to the exitus status of the patients (p>0.05). However, it was observed that the cases who were exitus had lower gestational weeks (Table 4).

Table 4. Evaluation of numerical data of the cases and their mothers according to exitus status

	Exitus	Recovering the health
Mother age (year) *	26.17±4.44	29.72±6.33
Gestation age (week) **	35(12)	37(12)
Pneumothorax time (day) **	1(2)	2(5)
Birth weight (gr) *	2272.50±1513.40	2960.00±560.10

*mean±SD, **median (IQR)

It was observed that the majority of the cases who used surfactant required the insertion of an intercostal chest tube; however, no significant difference was found between surfactant use and the need for chest tube insertion (p=0.128) (Table 5).

Table 5. The relationship between surfactant use and the need for chest tube insertion

	Surfactant therapy		p
	Yes	No	
Spontaneously resolved	1	7	0.128
Chest tube insertion	14	20	

DISCUSSION

In our retrospective study evaluating neonatal pneumothorax cases, we identified the most important risk factors as prematurity, the need for resuscitation at birth, surfactant administration, and RDS. Pneumothorax cases were more commonly observed in male infants. Most cases developed unilateral pneumothorax and additionally, most patients required invasive mechanical ventilation support for their treatment. In the majority of cases, a chest tube was inserted as part of the treatment.

In a study conducted in Türkiye by Tandırcıoğlu et al., the most frequently identified risk factor for neonatal pneumothorax was RDS, observed in 47.5% of cases (8). In our study, RDS was detected in 28.57% of cases. In Tandırcıoğlu's study, 42% of the cases were born before 34 weeks of gestation, and 30% were born between 34-37 weeks, all of whom were premature infants. Additionally, 68% of the cases born before 34 weeks were administered surfactant, and it was reported that the need for surfactant decreased as gestational age increased. In our study, 12% of the cases were born before 34 weeks, and 38% were born between 34-37 weeks. The lower rate of RDS in our study may be attributed to the lower proportion of premature infants born before 34 weeks. Consequently, the rate of surfactant administration was also found to be lower.

Many studies have reported that male sex is a risk factor for pneumothorax. Jovandarić et al. also reported that 67.6% of their cases were male (9). In our study, 66.6% of the cases were male as well. Ishak et al. investigated the male disadvantage in respiratory morbidity and mortality in preterm births using a preterm lamb model. They found that female lamb fetuses had higher lecithin/sphingomyelin ratios and higher saturated phosphatidylcholine ratios in amniotic fluid, indicating that female fetuses have a developmental advantage over males in terms of lung maturity (10).

Aly et al. reported that pneumothorax occurring in term or near-term infants had a better prognosis and required less mechanical ventilation (11). Boo et al. studied 505 cases of neonatal pneumothorax and found that pneumothorax was more common in infants with low birth weight and small gestational age. They also reported that mortality was higher the more premature the infant and the lower the birth weight (12). In our study, the gestational age and birth weight of the exitus cases were found to be lower compared to the discharged infants. However, no significant difference was observed between them. The low number of cases in our study may have contributed to the lack of a significant difference.

Smith et al. reported that in their study of infants with neonatal pneumothorax and a gestational age >36 weeks, 29% of the cases required intercostal tube drainage (13). Okumuş et al. found that in a cohort of 124 premature neonates, approximately 95.9% required intercostal tube drainage (14). These studies indicate that more premature infants have a higher need for intercostal tube drainage. In our study, intercostal tube drainage was performed in 80.9% of the cases.

Bhatia et al. reported that the earlier in life neonatal pneumothorax occurs, the higher the mortality rate (15). In our study, the timing of pneumothorax development in exitus cases was earlier compared to discharged infants, but no significant difference was observed.

Significant progress has been made in the care of premature infants with the introduction of surfactant therapy. It is well known that in the pre-surfactant era, pneumothorax developed much later in premature infants compared to term cases. However, after the introduction of surfactant therapy, it has been reported that approximately 20% of preterm infants develop pneumothorax within the first 48 hours (16). This suggests that surfactant therapy is a risk factor for pneumothorax. Studies have reported that newborns may require high distension pressures for ventilation. During the recovery phase of RDS, lung compliance can improve rapidly, which may lead to pneumothorax due to high pressures (17). It is known that surfactant administration is effective in this recovery process. To prevent pneumothorax, it is important to closely monitor the mechanical ventilator pressure settings in infants who have received surfactant. In our study, pneumothorax in infants who received surfactant was found to be more severe, with spontaneous resolution being less common and a greater need for chest tube insertion. However, these differences were not statistically significant. This is likely attributable to the limited number of patients in our study.

CONCLUSION

In our study examining neonatal pneumothorax cases, the most common comorbid conditions associated with pneumothorax were found to be prematurity, resuscitation at birth, and surfactant therapy. Most cases improved with appropriate timing and treatment. Correct identification of risk factors in neonatal pneumothorax and proper management of cases with respiratory distress leads to favorable outcomes.

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