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Predisposing factors, incidence and mortality of pneumothorax in a neonatal intensive care unit in Isfahan, Iran

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Abstract: **Objective** To assess the predisposing factors, frequency and mortality of pneumothorax (PTX) among the newborns hospitalized in a neonatal intensive care unit (NICU) in Isfahan, Iran. **Methods** The data of 43 cases of PTX among the 738 neonates hospitalized in the NICU were analyzed retrospectively according to gestational age, birth weight, Apgar score, type of delivery, age of mother, parity, perinatal asphyxia, resuscitation at birth, side of PTX, mechanical ventilation, surfactant therapy, and underlying lung disorders. **Results** Mean gestational age was 31 weeks and birth weight was 1 596 g in the PTX cases. The gestational age of 12 (28%) neonates was less than 28 weeks. Twenty-eight (65%) neonates were below 1 500 g. In total, PTX occurred in 43 (5.8%) neonates. Sixty-three episodes of PTX (97%) were unilateral and 2 (3%) were bilateral. Respiratory distress syndrome (RDS) (40/43, 93%) and mechanical ventilation (37/43, 86%) were common predisposing factors of PTX. Overall, 28 (65%) neonates with PTX died. Birth weight, gestational age and chest tube duration were significantly different between dead and surviving infants. The mortality rate was significantly higher in neonates who required surfactant therapy than that in those who did not require it. **Conclusions** The incidence and mortality of PTX in this study were higher than some other reports and this might be attributed to lower birth weight and gestational age. RDS and mechanical ventilation were the most common predisposing factors for the development of neonatal PTX, and mortality increased with lower birth weight, lower gestational age and more severe underlying primary lung disease. [**Chin J Contemp Pediatr**, **2010**, **12** (**6**):**417 – 420**]

Key words: Pneumothorax; Mechanical ventilation; Respiratory distress syndrome; Mortality; Neonate

伊朗伊斯法罕新生儿重症监护中心新生儿气胸的发病因素、发生率和死亡率调查

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[**摘　要**] **目的**　该研究旨在调查伊朗伊斯法罕新生儿重症监护中心(NICU)住院新生儿气胸的发病因素、发生率和死亡率。**方法**　738 例入住 NICU 的新生儿中,43 例发生了气胸。回顾性分析气胸患儿的临床资料,包括胎龄、出生体重、Apgar 评分、出生方式、母亲年龄、产次、围产期窒息、出生时复苏、气胸发生部位、机械通气情况、肺表面活性物质治疗、肺部疾病等。**结果**　气胸患儿平均胎龄为 31 周,出生体重为 1 596 g。12 例(28%)患儿胎龄小于 28 周。28 例(65%)出生体重低于 1 500 g。共 43 例(5.8%)新生儿发生了气胸。97% 的气胸为单侧(n = 63),双侧气胸仅占 3%(n = 2)。呼吸窘迫综合征(40/43, 93%)和机械通气(37/43, 86%)是导致气胸发生的常见原因。共 28 例(65%)患儿死亡。死亡患儿与幸存患儿出生体重、胎龄及胸管留置时间差异有统计学意义。需要肺表面活性物质治疗的气胸患儿死亡率显著增加,与无需表面活性物质治疗的气胸患儿比较差异有统计学意义。**结论**　该研究中气胸的发生率与死亡率高于其他报道,其原因可能是该研究中新生儿出生体重和胎龄都较低。呼吸窘迫综合征和机械通气是导致新生儿气胸发生的常见原因。患儿胎龄越小,体重越低,肺部疾病越严重,死亡率则越高。

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[**关　键　词**]　气胸;机械通气;呼吸窘迫综合征;死亡率;新生儿

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Pneumothorax (PTX) might occur in critically ill ventilated neonates in spite of being treated with antenatal corticosteroids[1] and exogenous surfactants[2-3]. It's incidence is reported between 1 to 2 percent[4]. However the incidence of PTX varies with underlying lung diseases as well as with resuscitation and ventilation methods[5], moreover this incidence varies between units with similar population of infants[6]. Different mortality rates of PTX are reported in various studies. Although neonatal PTX is one of the few treatable causes of respiratory difficulty in the early days of life, yet the mortality rate remains unjustifiably high at approximately 20 to 38 percent[7-9]. In addition, PTX during respiratory distress is associated with an increased risk of intraventricular hemorrhage, chronic lung disease and death[10-11]. Most previous studies have been reported from industrialized countries, and limited information exists from developing countries.

This study aimed to determine the incidence and mortality of neonatal PTX and its predisposing factors in a referral neonatal intensive care unit (NICU) in order to consider the findings of this study for preventive measures and reducing the PTX mortality and morbidity in high risk newborns.

Methods

Patients and study design

We retrospectively reviewed the medical data of 43 newborns with documented PTX among 738 newborns who were hospitalized between November 2005 and December 2006 in the NICU of Shahid Beheshti Hospital, Affiliated to Isfahan University of Medical Sciences in Isfahan, Iran. The neonates' records were analyzed according to gestational age, birth weight, Apgar score, type of delivery, age of mother, parity, perinatal asphyxia, resuscitation at birth, side of PTX, mechanical ventilation, surfactant therapy, and underlying lung disorders [transient tachypnea of newborns (TTN), respiratory distress syndrome (RDS), pneumonia, meconium aspiration syndrome (MAS)] and accompanying disorders. Newborns with congenital anomalies were excluded from the study. The diagnosis of PTX was based on chest radiography. The usual treatment for PTX in this NICU, i. e. transthoracic needle aspiration or chest-tube placement, was documented.

Statistical analysis

Data were analyzed with SPSS 16 and MedCalc (Version 9. 2. 0. 1). Continuous variables were compared using the independent sample t test and differences between categorical variables were assessed using the chi-square or Fisher's exact tests. A P-values of <0.05 were considered as statistically significant.

Results

Incidence of PTX

During the aforementioned period, 738 newborns were admitted into the Shahid Beheshti NICU. PTX occurred in 43 of them (5.8%, 95% *CI*: 4.11%-7.49%). In total, 65 episodes of PTX occurred in 43 newborns. Sixty-three episodes of PTX (97%) were unilateral [26 (40%) left side, 37 (57%) right side] and 2 (3%) were bilateral. Overall, 28 out of the 43 neonates with documented PTX died (65%). Of the 28 neonates, 15 died of RDS, 5 of PTX, 4 of positive blood culture sepsis, 2 of intraventricular hemorrhage and 2 of pulmonary hemorrhage.

Predisposing factors

Among the neonates with PTX, 37(86%) were premature. Twelve (28%) neonates had a gestational age of less than 28 weeks. Thirty-eight of 43 neonates with PTX (88%) had low birth weight: 28 (65%) below 1 500 g, 9 (21%) below 1 000 g (700-1 000 g). Their mean gestational age and birth weight were 31 weeks and 1 596 g, respectively. Twenty-five (58%) were male and 18 (42%) were female. Seventeen boys and 11 girls died. There was no significant difference for the mortality between sexes.

In general, 9 (75%) out of 12 babies who were from first gravid mothers and 19 (61%) out of 31 babies who were from higher gravid mothers died. Although the prevalence of PTX was lower (28%) in the first gravid group than that (72%) in the higher gravid, there was no significant difference in the mortality rate among various parities.

Overall, 21(62%) of 34 neonates who were delivered by cesarean section and 7 (78%) of 9 neonates who were delivered by normal vaginal delivery died. There was no significant difference in the mortality according to the type of delivery. Mean gestational age, birth weight, first and the fifth minute Apgar score, ventilation duration, time interval between ventilation need and birth time, time of first and second PTX occurrence and the mean chest tube duration were compared between the dead and surviving neonates. The results are demonstrated in Table 1. Birth weight ($P=0.002$), gestational age ($P=0.001$) and chest tube duration ($P=0.019$) were significantly different between dead and surviving infants.

Table 1 Comparison of some variables in dead and surviving neonates ($\bar{x} \pm s$)

	Surviving neonates ($n=15$)	Dead neonates ($n=28$)	Total
Gestational age (week)	33.8 ± 2.3	29.5 ± 1.2[a]	31.0 ± 1.3
1st min Apgar score	6.7 ± 1.3	5.6 ± 0.9	6.0 ± 0.7
5th min Apgar score	8.2 ± 0.9	7.3 ± 0.6	7.6 ± 0.47
Birth weight (g)	2 022 ± 436	1 367 ± 202[a]	1 596 ± 214
Ventilation duration (day)	7.8 ± 4.8	6.8 ± 2.4	7.1 ± 2.2
Time interval between ventilation need and birth time (day)	0.70 ± 0.6	0.76 ± 0.45	0.74 ± 0.35
Occurrence of first PTX (day)	3.5 ± 1.5	3.0 ± 0.8	3.3 ± 0.6
Occurrence of second PTX (day)	7.8 ± 6.9	7.6 ± 3.3	7.7 ± 2.7
Mothers'age (year)	28.2 ± 3.3	25.5 ± 1.7	26.5 ± 1.6
Chest tube duration (day)	5.4 ± 2.4	10.5 ± 3.8[b]	7.9 ± 3.1

Compared with the surviving neonates, a: $P<0.01$; b: $P<0.05$

Predisposing factors of PTX are shown in Table 2. RDS (40/43, 93%) and mechanical ventilation (37/43, 86%) were the most common predisposing factors of PTX. Accompanying disorders are presented in Table 3.

Table 2 Predisposing factors of neonatal PTX ($n=43$)

Predisposing factors	Case number	Percent (% *CI*)
MAS	1	2 (0-6.8)
Pneumonia	1	2 (0-6.8)
TTN	2	5 (0-11)
Mechanical ventilation	37	86(75.6-96.4)
RDS	40	93(85.4-100)

Table 3 Accompanying disorders in neonates with PTX ($n=43$)

Accompanying disorders	Case number	Percent (% *CI*)
Pneumopericardium	1	2 (0-6.8)
Hypoglycemia	1	2 (0-6.8)
Chronic lung disease	2	5 (0-11)
Intraventricular hemorrhage	2	5 (0-11)
Asphyxia	4	9 (0.6-18)
Patent ductus arteriousus	7	16 (5.3-27.3)
Septicemia	8	19 (7-30.9)
Premature rupture of membranes	9	21(8.7-34.2)

Thirteen neonates required resuscitation at birth and 9 (69%) of them died. In the other 30 neonates who did not require resuscitation, 19 (63%) died. There was no significant difference for the mortality according to resuscitation at birth.

In 43 neonates, 11 (26%) did not require surfactant therapy due to mild distress. Three (27%) out of the 11 neonates died. Seventeen (77%) of 22 neonates who received single dose of surfactant died, and 8 (80%) of 10 neonates who received two doses of surfactant died. The mortality rate was significantly higher in those neonates who received surfactant therapy than that in those who did not receive it ($P=0.007$). However, there was no significant difference in the mortality rate in neonates receiving different number of doses of surfactant.

Sixteen (43%) of the neonates whose PTX occurred in the right side and 10 (38%) whose PTX was in the left side died. There was no significant difference in the mortality rate according to the side of PTX.

Discussion

PTX causes significant mortality and morbidity among neonates. The development of PTX with ensuing hypoxia and hypercapnia is a potentially life-threatening event. The incidence of PTX in our NICU was 5.8% and 65.1% of the PTX neonates died. The incidence of PTX in other studies is reported 1%-2%[4] and the mortality rates varied from 20% to 38%[7-9]. Bahatia et al[12] reported that 17% of newborns with aspiration of blood, meconium or mucus, RDS and vigorous resuscitation after delivery had a high incidence of PTX. Newborns requiring assisted ventilation especially with high positive inspiratory pressure or continuous positive end expiratory pressure experience PTX more frequently. About 8.7 % to 14% of ventilated neonates are reported to develop at least one episode of PTX[6,13-14]. Other risk factors include RDS, pneumonia, emphysema, pulmonary hypoplasia, urinary tract anomalies, and neuromuscular disease[15]. In this study, the underlying cause of PTX could be identified in 40 (93%) infants whereas PTX was idiopathic in 3 infants (7%). RDS was documented in 40 (93%) neonates in this study and 37 (86%) needed mechanical ventilation, whereas Esme et al[9] reported RDS as the major cause of PTX in 21% of infants and mechanical ventilation accounted just 9% of the causes of PTX. Furthermore, in that study, the mean gestational age was 35 weeks and the mean birth weight was 2 648 g, while in this study, the mean gestational age was 31 weeks and the mean birth weight was 1 596 g. Therefore the higher incidence and mortality of PTX in this study could be the result of lower gestational ages and birth weights of the neonates studied.

The Apgar score at the 5th minute was reported an important parameter in evaluation of the newborn[9]. However it was not significantly different in infants in this study who either died or survived.

One study reported that multiple doses of surfactant

to infants with worsening respiratory insufficiency led to improved clinical outcomes and appeared to be the most effective treatment policy[16]. In this study, there was no significant difference in the mortality rate in neonates receiving different number of doses of surfactant. The mortality rate was significantly higher in those neonates who required surfactant therapy than that in those who did not require it. It implies that the more severe underlying primary lung disease can increase mortality. The most common accompanying disorders in this study were premature rupture of membrane (PROM) (21%), sepsis (19%) and patent ductus arteriosus (16%). In the study of Esme et al[9], PROM (7%), intrventricular hemorrhage (7%) and sepsis (4%) were reported as the most common accompanying disorders.

This study showed prematurity, low birth weight, RDS, and mechanical ventilation were common predisposing factors in the frequency of neonatal PTX, and the mortality increased with lower birth weight, lower gestational age and more severe underlying primary lung disease. The incidence and mortality of PTX in this study were higher than some other reports and this might be attributed to lower birth weight and gestational age.

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