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Original Article

Incidence and risk factors of pneumothorax in premature low birth weight infants under mechanical ventilation

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ABSTRACT

Objective: pulmonary air-leakage especially pneumothorax (ptx), is a severe complication in neonates. The aim of this study was to assess the predisposing factors and frequency of ptx among the low birth weight (LBW) premature infants, under mechanical ventilation.

Methods: This cross sectional study was performed in 121 LBW intubated premature infants at neonatal intensive care unit of a children hospital in Rasht, Iran during 18 months. Birth weight, gestational age(GA), sex, mode of delivery, initial diagnosis, respirator settings, history of surfactant therapy or ptx, 5th minute apgar score were recorded in neonates with or without ptx. Univariate and multivariate regression analysis were done.

Finding: A total of 42 (34.7%) of infants developed ptx. Mean GA of neonates with ptx (case group) was 30±2.42 W and in neonates without ptx (control group) was 30.17±2.95 W. Mean birth weight in case and control groups were 1330 ± 386gr and 1482 ± 507gr respectively. In case group 69% and in control group 50% were delivered by cesarean section. 54.8% of cases and 53.2% of control group were male. No mentioned items reached statistical significance. Respiratory distress syndrome was the most common lung pathology in both groups. The rate of ptx was higher in cases with low apgar score at 5th minute (P=0.006). Surfactant therapy decreased the incidence of ptx (P=0.023). After multivariate logistic regression analysis only low apgar score at 5th minute significantly increased the risk of ptx.

Conclusion: The incidence of ptx in this study was slightly higher than other reports and this may be due to assessment of only LBW premature intubated neonates. After multivariate logistic regression analysis only low apgar score at 5th minute increased the risk of ptx significantly.

Keywords: Apgar score, Neonate, Pneumothorax, Pulmonary Surfactant.

Introduction

Pneumothorax (ptx) is a frequently encountered surgical problem requiring urgent intervention in neonatal intensive care unit (NICU) (1). Ptx is more frequently observed in neonates (1-2%) than in older children (1.2-28.100.000) (2). The rate can increase up to 30% in neonates who have concurrent underlying lung disease or who require mechanical ventilation(3) and the incidence varies between units with similar populations of infants.(4)

Ptx during respiratory distress is associated with an increased risk of intraventricular hemorrhage, chronic lung disease and death (4, 5). Therefore it is important to consider its predisposing factors and clinical findings.(1)

There are few reports identifying the risk factors of neonatal ptx.(6)

The objective of this study was to assess risk factors and incidence of ptx in low birth weight (LBW) premature neonates who were under mechanical ventilation.

Material and Method

This retrospective cross sectional study was performed on all intubated LBW premature neonates at NICU of 17 shahrivar teaching children hospital of Rasht, Iran from April 2010 to Oct 2011. Newborns with ptx were compared to those without ptx. Data collected from all neonates included: sex, birth weight, gestational age (GA), mode of delivery, Apgar score at 5th minute, initial clinical diagnosis, Surfactant therapy, occurrence of ptx, peak inspiratory pressure (PIP) and positive end expiratory pressure (PEEP) at the onset of ptx.

Diagnosis of ptx was always confirmed by chest X-ray. All of the neonates were under baby

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log 8000 pluse-drager ventilator on SIMV mode. The neonates with ptx before intubation or with malposition of tracheal tube were excluded from study. All statistical calculations were done using computer programs SPSS V.15 for Microsoft. Univariate analysis and multivariate logistic regression backward stepwise analysis were considered. Comparing categorical data were assessed using chi square test. P value less than 0.05 was considered statistically significant. This study was approved by the institutional review board at Guilan University of Medical Sciences.

Results

During the specified period, 121 LBW preterm infants were under mechanical ventilation in the NICU. Among them 42 (34.7%) neonates (23male, 19female) were diagnosed with ptx (case group) and 79 (65.3%) neonates (42 male, 37female) had not ptx (control group). Median GA and birth weight of case group were 30 ± 2.42 w and 1330 ± 386 gr respectively. Mean pip and peep at time of occurrence of ptx was 17.18 ± 2.90 (max 25) cmh2o and 3.4 ± 0.56 (max5) cmh2o respectively. In case group 29 (69%) neonates and in control group 50 (63.3%) neonates were born by cesarean section (C.S). Mean Apgar score at 5th minute in case and control group were in this manner 6.45 ± 1.5 and 7.39 ± 1.89 (P=0.06). Surfactant replacement therapy was done in 21 (50%) of case group and 56 (70.9%) of control group (P=0.023). data are outlined in table 1.

The most common underlying cause of mechanical ventilation was respiratory distress syndrome (RDS) in both groups (table2).

Discussion

over 18 months, 42 (34.7%) of ventilated LBW preterm infants, developed ptx. The incidence of ptx has a wide range, varying from 1% to 30 %(3). Malek et al and Abdellatif et al found ptx in 26% and 25.7% of mechanically ventilated infants respectively (5,2). They studied both term and preterm neonates. Lim et al reported an incidence of 1.3% in term and preterm neonates with or without mechanical ventilation (7). Difference in the rate of ptx might be attributed to different assessed groups. Since ptx is more common in preterm and LBW infants, our finding was slightly higher than other mentioned ranges. Our data indicated that ptx was more common in male and some other investigations have agreed with this finding (2, 5,7). Ngerncham et al found the male sex as one of the risk factors for ptx during the first day of life(6).In the current study C.S was more common is case group with no statistical significant. Benterud et al reported that C.S was significantly associated with more frequent need for mechanical ventilation had development of ptx in preterm infants. They studied 2694 cases (8). Infants with GA < 32w in case group had higher rate of ptx than infants with same GA in control group (P=0.817). Also cases with birth weight < 1500gr had higher rate of ptx than infants with same weight in control group (P=0.241). Abdellatif et al reported the highest incidence of ptx in infants with GA < 32W (47.5%) and infants with birth weight < 1500 gr (42.37%), but they did not have any control group and 89.83% of their cases were under mechanical ventilation.(2)

RDS was the most common cause of mechanical ventilation and this finding is similar to some other studies (2, 5 and 9).

The mean pip and peep at the onset of ptx were 17.18 and 3.4 cmH2o respectively which were relatively not high settings but might be on individual basis not the optimum setting at that time for the lung physiology. These amounts were lower than reports of Abdellatif et al (pip: 18.61 ± 4.88 and peep: 4.39 ± 0.67 cmH2o) (2) and Malek et al (PIP: 22.7 and PEEP: 4.2 cmH2o) (5). Esme et al suggested that neonatal ptx developed because of underlying lung pathology rather than being a complication of mechanical ventilation (1). By contrast a previous study mentioned that ptx in LBW infants is associated with factors present on day of ptx and not initial severity of lung disease. Vigorous control of ventilation can decreases the risk of ptx, including optimizing peep and minimizing pip (10). Also Vellank et al decreased the incidence of ptx in VLBW infants by increasing vigilance and real time monitoring of tidal volume (VT) and pip. High VT (>6cc.kg) was noted around the time of occurrence of ptx (11). One limitation in our study was use of pressure-limited ventilator and no monitoring of VT. Another limitation was lack of comparison of respirator settings with ventilated neonates without ptx, but this was done because of the wide variation of ventilator setting for each patient during the mechanical ventilation and comparison was not done with the highest pip and peep because some of ptx occurred after starting to wean the setup rather than at maximal setting.

In the present study low Apgar score at 5th minute after birth was a significant risk factor for ptx, so effective resuscitation may reduce the risk of ptx. Mean Apgar score was 6.45 at 5th minute in case group, which is higher than 6.2in Esma et al investigation. They didn't have any control group

for ptx and suggested low Apgar score as a significant risk factors for death (1). Also Weinberger et al found that low Apgar score was associated with increased neonatal morbidity (including ptx) in preterm newborns. Antenatal maternal history and pregnancy complications were not clearly associated with low Apgar scores. Therefore they suggested that Apgar score was a useful tool in assessing neonatal short-term prognosis.(12)

Surfactant replacement therapy significantly reduced the risk of ptx (P=0.023). Malek et al reported the same finding (5). Meberg et al found lower risk of ptx after surfactant therapy (P>0.05) .(13)

After multivariate logistic regression analysis only low Apgar score at 5th minute significantly increased the risk of ptx (table3). This difference between two types of analysis may be due to low sample size or relationship of other factors with each other. More studies with larger sample Size is recommended.

Conclusion

the incidence of ptx was slightly higher than the range mentioned in other unit due to observation of only intubated LBW preterm infants.

Our findings indicate that low Apgar score at 5th minute, significantly increases the risk of ptx and surfactant therapy can decreases it.

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Table1. The factors in successful and unsuccessful INSURE

Parameter	Case n. (%)	Control n. (%)	P. value
Male .Female	23.19 (54.8-45.2%)	42.37 (53.2 - 46.85%)	0.867
Birth weight			
< 1500gr	29(69%)	45 (46.9%)	0.241
1500-2500 gr	13 (31%)	34 (43.1%)	
Mean	1330 ± 386gr	1482 ± 507gr	0.069
Gestational age			
< 32 w	34 (81%)	61 (77.2%)	0.817
32-37 w	8 (19%)	18 (22.8%)	
Mean	30 ± 2.42w	30.17 ± 2.95w	0.739
Mode of delivery			
Vaginal	13 (31%)	29 (36.7%)	0.554
Cesarean section	29 (69%)	50 (63.3%)	
Mean of5th minute Apgar	6.45 ±1.5	7.39±1.89	0.006
Surfactant therapy			
Yes	21 (50%)	56 (70.9%)	0.023
No	21(50%)	23 (29.1%)	
Total	42 (34.7%)	79 (65.3%)	

Table2. Accompanying Disorders in case and control groups

	Case n. (%)	Control n. (%)
Respiratory distress syndrome	26 (61.9%)	57 (72.2%)
Pneumonia & Sepsis	12 (28.6%)	16 (20.3%)
Asphyxia	2(4.8%)	6 (7.6%)
Diaphragmatic hernia	1(2.4%)	-
Tracheoesophageal fistula (post operation)	1(2.4%)	-

Table3. Comparison of significant factors in case and control groups in multivariate logistic regression backward stepwise (wald)

variable	B	S.E	wald	df	sig	Exp(B)	95% C.I for Exp	
							lower	upper
Surfactant therapy	-.353	.205	2.971	1	.085	.702	.47	1.05
5th Apgar score	.254	.114	4.969	1	.026	1.29	1.03	1.61
Constant	-.506	.942	.288	1	.591	.603		