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INFLUENCE OF RISK FACTORS ON FREQUENCY AND PROGNOSIS OF NEONATAL PNEUMOTHORAX, FIVE-YEAR EXPERIENCE

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Penetration of air from the lungs into the space between the parietal and visceral pleura occurs in the neonatal population, and is potentially a very serious problem with the frequency 1-2%. It occurs idiopatically, though may be secondary, mostly in the field of the lung pathology or previous trauma of the lung parenchyma. The aim of the study was to assess the morbidity and mortality among hospitalized neonates with the clinical presentation of pneumothorax.

Retrospective analysis involved 16 neonates hospitalized during a 5-year period in the Pediatric Surgery Clinic in Niš. We analyzed the gestational age, body mass, existence of previous lung pathology, Apgar score and treatment.

Neonatal pneumothorax was more common in boys (m:f=2,2:1), in patients with Apgar score below 3, prematured babies and patients with previous lung disease. Treatment was surgical in all patients, and involved thoracotomy (in 75% of patients), while in the remaining 25% thoracocentesis was performed. Mortality reached 30% and was recorded in the population of patients at risk with low Apgar score, in premature babies, and in patients with previous lung disorders.

Any child with signs of ARDS must be carefully examined by neonatologist and pediatric surgeon. If pneumothorax is timely diagnosed, even in a group of children with increased risk, treatment is effective. *Acta Medica Medianae 2010;49(2):5-8.*

Key words: *pneumothorax, neonatus, risk factors*

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Introduction

Pneumothorax is the accumulation of air in the space between the parietal and visceral pleura, and is potentially a very serious problem, especially if it occurs in the neonatal population. Little is known that the incidence of pneumothorax is 1-2%, even in the neonatal population (1), and that the same usually occurs as asymptomatic (in over 98% of cases). Frequently, it occurs in preterm babies, and even with 5-7% in infants whose body weight is below 1500 grams (2,3). Also, its frequency is increased in the macrosomic babies (more than 5000 g), and is mainly a result of distocia (4).

The first inspiratory effort in the infant produces transpulmonary pressure higher than 100 cm of water column and opens the lungs that were collapsed intra utero. After the first few breaths, this pressure is normalized and the lungs takeover its function. If this transpulmonary pressure remains elevated for a long time, it leads to alveolar rupture and consecutive pneumothorax. This type of pneumothorax is known as spontaneous (primary, idiopathic). The risk of developing a secondary pneumothorax is higher in patients with ARDS, meconium aspiration, pulmonary hypoplasia, as well as in reanimated neonates (5,6).

Diagnosis is based on anamnestic data, clinical examination, local findings, gas analysis (hypoxia and respiratory acidosis) and chest radiography. In unclear cases, findings can be supplemented with CT and ultrasound.

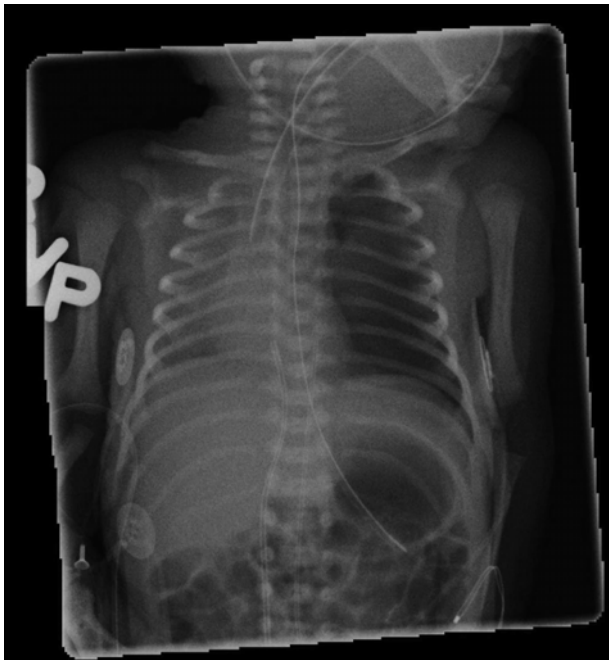

Figure 1: Radiological images of neonatal pneumothorax (left)

Chest radiography revealed: translumination in the area affected by pneumothorax, collapsed lung, trachea and mediastinum have moved to contralateral side, the extended intercostal space on the affected side, hemidiaphragm dome is lower and deep sulcus sign (Figure 1).

Therapeutic approach should be adapted to each child and it depends on: gestational age of infant, birth weight, condition of the patient, tolerance of drugs and surgical procedures, and personal affinity and experience of a surgeon. General attitude is that the infant with asymptomatic pneumothorax, with no previous lung pathology, does not require treatment (7-10). In all other cases, thoracic drainage is recommended: thoracocentesis (in mild form, to evacuate the air from the pleura with a needle) or thoracostomy (in severe cases, to evacuate the air, by placing the thoracal drain in the pleural space) (11).

Aims

The aim was to present the clinical manifestations and importance of early diagnosis, to determinate the optimal time for treatment in order to prevent all possible complications that can lead to the occurrence of pneumothorax.

Patients and methods

In the period 1.1.2005-31.12.2009, 16 patients with neonatal pneumothorax were hospitalized and treated in the Pediatric Surgery Clinic in Niš. In all patients, biochemical analyses, Astrup and chest radiograph (the Institute for Radiology, Clinical Center Niš) were done. We analyzed gestational age of infants, sex distribution of pneumothorax, Apgar scores, birth weight, the presence of primary lung disease, pneumothorax representation of the affected side, type of thoracic drainage, and degree of mortality.

Results

In the time interval 1.1.2005.-31.12.2009, 16 infants were hospitalized at the Clinic for Pediatric Surgery, CC Niš. Sex predomination was more reported in boys, and in ratio (m:f=2,2:1). The diagnosis was established on the basis of anamnestic data, clinical examination, local findings, gas analysis (hypoxia and respiratory acidosis) and chest radiography. In all cases, the clinical presentation is characterized by: progressive respiratory distress syndrome, dyspnea, tachipnea, and retraction of the wall chest.

75% of patients were infants with birth weight less than 2700 grams, while in one case neonatal pneumothorax was directly associated with birth trauma caused by macrosomic birth weight (TM = 6000 grams). In 75% of patients pneumotorax was localized to the right side, 6.25% were bilateral, and in the remaining 18.75% of patients it was localized on the left side. 68.75% of the patients were preterm babies born before the 37th gestational week, while the remaining 31.25% were full-term babies.

In accordance with our expectations, Apgar score was low in the population of patients with neonatal pneumothorax. In our study, in 13 (81.25%) patients, it was below 3, and the treatment of these patients had a fatal outcome in 30.8% In the remaining patients Apgar values were above 3, but less than 5. Accordingly, prognosis of these babies was better as well. The existence of previous pulmonary pathology was confirmed in more than 75% of the neonates, and was usually associated with meconial aspiration (in 6 patients), pneumonia (in 5 patients) or birth trauma (in one case).

All patients were treated surgically, with thoracostomy. Thoracic drain was placed in 11 patients in the projection of the front axillary line, while the remaining 5 were placed through the

Table 1: Analysis of risk factors affecting the development of neonatal pneumothorax

	Total	cured	died	P
APGAR score				p<0,05
below 3*	13(81,25%)	9(69,2%)	4(30,8%)	
above 3	3(18,75%)	3(100%)	0(0%)	
Gestational age				p<0,05
above 36 GN	5(31,25%)	4 (80%)	1(20%)	
below 36 GN*	11(68,75%)	8(72,72%)	3(37,28%)	
Strana				p<0,01
desno*	12(75%)	9(75%)	3(25%)	
levo	3(18,75%)	3(100%)	0%	
obostrano	1(6,25%)	0%	1(100%)	
Body mass				p<0,05
>2700gr	12(75%)	11(91,66%)	1(8,34%)	
<2700gr*	4(25%)	1(25%)	3(75%)	
Primary pulmonary disease				p<0,01
present*	12(75%)	8(66,67%)	4 (33,33%)	
Idiopathic pneumothorax□	4(25%)	4(100%)	0%	

medial axillary line, through the fifth or sixth intercostal space. The thoracic drain was removed after the confirmation of reexpansion of the lungs, which was proven by serial medial axillary line, through the fifth or sixth intercostal space. The thoracic drain was removed after the confirmation of reexpansion of the lungs, which was proven by serial radiographies and constant monitoring of patients. Complications were not reported. Mortality rate was 25% and was recorded in the population of patients with low Apgar score, and in premature patients with previous pulmonary pathology (Table 1).

Discussion

Penetration of air from the lungs or the external environment into the space between the parietal and visceral pleura that occurs in the neonatal population is potentially a very dangerous problem, which is characterized by high rates of morbidity and mortality. The incidence of neonatal pneumothorax is almost 1-2% (1), and may start even with the first breath. In 2% of newborn children, their lungs are not fully expanded during the initial breaths, which increases pressure in the lungs, that can cause alveolar rupture as the most fragile part of the lung parenchyma (especially in premature babies). That causes the penetra-tion of the air along the direction of interalveolar septas to the pleural space. Literature data indicate that this type of pneumothorax is two times more common in the population of boys (2-4) and in group of premature babies (1,5). The increased incidence in the group with lower gestational age is caused by immaturity of the lung parenchyma, due to the lack of surfactant and high surface tension, and that causes "air capture "with the first breath in these alveoli, which results in their rupture.

Neonatal pneumothorax is more common in babies with the existence of previous lung pathology (disease of hyaline membranes, meconial aspiration and pulmonary infection) that causes the development of pneumothorax, especially in the group of premature babies. Mortality was proportionally lower in the case of idiopathic pneumothorax and full-term newborn babies (5).

Cystic adenomatous malformation of the lungs and lung cysts may be misdiagnosed as pneumothorax, and their drainage and placing in the bottle with negative pressure can have fatal consequences (6).

Treatment can be conservative and surgical. It is believed that conservative therapy is possible only in clinical and hemodynamically stable patients, in cases where less than 25% of the lung parenchyma are collapsed. 1,25% of the volume of the air trapped in the pleural space is absorbed for 24h. We conclude that for the spontaneous resorption of air from the pleura few days are needed. The therapy involves the administration of 100% oxygen, careful aspiration of airways, antibiotics, continuous monitoring and serial chest radiographs till complete lung reexpansion. One should be particularly cautious about the administration of 100% oxygenin in preterm babies, because of retrolental fibroplasia.

In cases where more than 25% of the lungs are collapsed or the child's condition is unstable, we advise the removal of air from the pleural space through the thoracic wall. A growing number of authors prefers performing thoracostomy rather than of thoracocentesis to provide better suction of air from the pleural space, and spontaneous closure of the place through which air has penetrated (7). Cornel is placed at the level of the anterior or middle axillary line in the fourth or fifth intercostal space, and then in the bottle with negative pressure. Open thoracotomy with minimal incision through the chest wall is rarely applied in cases with no reexpansion of the lungs even after 7 days of drainage, or for the treatment of other lung diseases (bulas).

The factors indicating a more frequent occurrence of pneumothorax, also confirmed by literature data, are male sex, lower birth weight (8), prematurity (9), vacuum extraction, previous lung disease, low Apgar score, and ventilation in the immediate perinatal period (10). Our analysis of factors suggests that there is a statistically significant difference in the occurrence of pneumothorax on the right side in patients with previous pulmonary pathology ($p<0,01$), as well as in infants with Apgar score below 3, GN under 36 weeks and TM and under 2700 grams ($p<0,05$). The factors conditioned by mother are low standard lifestyle and uncontrolled pregnancy.

Any child with signs of ARDS must be carefully evaluated by the neonatologist and pediatric surgeon (11). Treatment is effective, even in a group of children with high risk, if the disease is recognized in adequate timely fashion (12).

Conclusion

We conclude that mortality in spontaneous pneumothorax is more common in the population of the boys, premature babies, patients on mechanical ventilation and those with primary pulmonary pathology, and all of these patients should be kept on continuous monitoring.

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UTICAJ FAKTORA RIZIKA NA UČESTALOST I PROGNOZU NEONATALNOG PNEUMOTORAKSA, NAŠE PETOGODIŠNJE ISKUSTVO

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Prodor vazduha iz pluća u prostor između parijetalne i visceralne pleure javlja se i u neonatalnoj populaciji i predstavlja potencijalno vrlo opasan problem sa učestalošću koja iznosi 1-2%. Javlja se idioptaski, mada može biti i sekundarni, najčešće na terenu prethodne plućne patologije ili traume plućnog parenhima.

Cilj studije bio je evaluacija morbiditeta i mortaliteta među neonatusima koji su hospitalizovani pod kliničkom slikom pneumotoraksa.

Retrospektivna analiza obuhvata 16 neonatusa koji su hospitalizovani u petogodišnjem periodu na Klinici za dečju hirurgiju KC Niš. Analizirana je gestaciona starost, telesna masa, postojanje prethodne plućne patologije, Apgar skor i način lečenja.

Neonatalni pneumotoraks češći je kod dečaka (m:ž=2,2:1), kod bolesnika sa Apgar skorom ispod 3, kod prematurusa i bolesnika sa prethodnom plućnom bolešću. Lečenje je bilo hirurško kod svih bolesnika i podrazumevalo je torakostomiju (kod 75% bolesnika), dok je kod preostalih 25% rađena torakocenteza. Mortalitet je iznosio 30% i zabeležen je u populaciji rizičnih bolesnika sa malim Apgar skorom, kod prematurusa i bolesnika sa prethodnom plućnom patologijom.

Svako dete sa znacima ARDS mora biti pažljivo sagledano od strane neonatologa i dečjeg hirurga. Ukoliko se na vreme prepozna pneumotoraks, čak i u grupi dece sa povećanim rizikom, lečenje je efikasno. Acta *Medica Medianae 2010; 49(2):5-8.*

Ključne reči: *pneumotoraks, neonatus, faktori rizika*