

ROENTGENOGRAPHIC FINDINGS IN BRONCHIOLITIS

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Background. Acute bronchiolitis is a very frequent respiratory infection in infancy characterized by obstructive respiratory distress with crepitations and wheezing. The diagnosis of bronchiolitis is complex because characteristic radiological patterns are combined with each other. The aim of this study is to reveal radiologic changes in patients with acute bronchiolitis.

Methods. One hundred and seventy-five children with bronchiolitis in their first wheezing episode were included in this study, who were admitted to the pediatric intensive care unit between 2000 and 2008. All patients underwent X-rays of the lungs in addition to other clinical and laboratory examinations.

Results. Our results show that radiological changes were present in all cases: hyperinflation of the lungs in 175 children (100%), perihilar linear density and peribronchial thickening in 121 children (69.14%), bilateral bronchopneumonia in 44 children (25.14%), lobar pneumonia in 26 children (14.85%) and atelectasis in 28 children (16%). Usually radiological changes appear in combined forms: pulmonary hyperinflation and pulmonary trauma signs in 121 children (69.14%), pulmonary hyperinflation with bronchopneumonia and atelectasis in 31 children (17.71%), pulmonary hyperinflation with lobar pneumonia and atelectasis in 23 children (13.14%).

Conclusions. We conclude that pulmonary hyperinflation and perihilar linear density are more evident when the auscultatory findings are poor. This fact has a practical value and is the main cause for the disappearance of alveolar consolidation. The differentiation between viral and bacterial bronchopneumonia as well as pneumonia and atelectasis is specially important. The radiological aspect gives us guidance for therapeutic follow up and treatment.

Descriptors: BRONCHIOLITIS, VIRAL; RESPIRATORY TRACT INFECTIONS; RADIOGRAPHY; CHILD

Acute bronchiolitis is a very frequent respiratory infection in infancy, and is characterized by obstructive respiratory distress with crepitations/rales and wheezing (1, 3, 9).

Bronchiolitis is caused by a respiratory syncytial virus (RSV) in 50-80% of patients, parainfluenza virus type 1,2,3 (1, 2, 3, 4, 9, 12), human metapneumovirus (hMPV) (14, 15), influenza virus A or B, rhinovirus, adenovirus, enterovirus or *My-*

coplasma pneumoniae (1, 7). The last affects the small caliber bronchi 37-300 µm in diameter and cause necrosis of the bronchial epithelium followed by infiltration of the bronchial tree with lymphocytes and other cells (1, 2, 3).

Wheezing is the most common symptom of bronchiolitis in children as a consequence of the inflammatory obstruction of the small respiratory airways, with a higher incidence in the first six months of life. The peak incidence is in winter and in the beginning of the spring (1, 2, 4, 8, 12). The disease commences as a mild infection of the upper respiratory airways, with nasal secretions and sneezing. After 1-2 days the children have a teasing cough, quarrel, dyspnoea, a temperature of 38-39°C, anorexia. In severe forms the clinical picture appears within some hours

with dyspnoea, cyanosis, wheezing, and a respiratory rate of 60-80/min (1, 3, 9, 10).

Radiological studies are of great importance in practice because they can help in diagnosis of this pathological entity, in differential diagnosis with other pulmonary pathologies, and in therapeutic orientation (5, 6). The diagnosis of bronchiolitis is complex because the characteristic radiological patterns are combined with each other. In literature for didactic purposes, radiological patterns are described separately but practically they are combined with each other, which makes correct diagnosis difficult.

In these conditions we undertook this study to observe the characteristic radiological alterations/changes in acute bronchiolitis in young children and to underline their practical importance.

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Figure 1. Pulmonar hyperinflation, perihilar linear density
Slika 1. Plućna hiperinflacija, perihilarni plućni infiltrat i naglašen plućni crtež



Figure 2. Perihilar linear density, intercostale herniation, left sided pneumonia
Slika 2. Perihilarno linearno pojačan plućni crtež, interkostalne hernijacije, lijevostrana pneumonija

Table 1. Radiological changes according the age of child
Tablica 1. Radiološke promjene na plućima, ovisno o djetetovoj dobi

	Patients < 6 months (number) Bolesnik < 6 mjeseci (broj)	Patients > 6 months (number) Bolesnik > 6 mjeseci (broj)
Pulmonary hyperinflation / Plućna hiperinflacija	117	58
Perihilar linear density and peribronchial thickening / Perihilarni plućni infiltrat i naglašen plućni crtež	62	59
Bronchopneumonia / Bronhopneumonija	34	10
Lobar pneumonia / Lobarna pneumonija	17	9
Atelectasis / Atektaza	16	12

PATIENTS AND METHODS

In this study we enrolled 175 children, hospitalized in the intensive care unit of the pneumo-allergology clinic in-patient ward of the paediatric department of the University Hospital Centre in Tirana between 2000 and 2008. The age of the children varied from 20-days to 24-months. The children included in this study had typical signs of bronchiolitis: acute infection of the lower respiratory tract associated with temperature or rhinitis with tachypnea, wheezing and increased respiratory effort. Only children with first episode of wheezing were included.

In this study were excluded children who had used bronchodilators before being hospitalized and those with chronic pulmonary disease, congenital anomalies of the heart, cystic fibrosis or bronchopulmonary dysplasia. Anamnestic data were taken from parents. All of the children un-

derwent radiological examination (chest X ray) in an antero-posterior position with calm aspiration and lateral position. The first radiographs were performed on the first day of their hospitalization in a standing position, while control radiographs were done after a week. In all cases in this study radiological changes were analysed as follows:

1. Pulmonary hyperinflation
2. Hilar density and peribronchial thickening
3. Small multiple pulmonary opacities/consolidations
4. Opacities/consolidations: alveolar, segmental, subsegmental and lobar

These changes were compared with their age and the severity of clinical signs.

RESULTS

Table 1 shows radiological changes according to the age of child. As may be no-

ticed in Table 1, in children younger than 6-months changes of pulmonary hyperinflation and perihilar linear density are predominant. In most cases the radiological signs were combined: 121 or 69.14% of children were found to have pulmonary hyperinflation and peribronchial thickening signs and bronchopneumonia, in 26 or 14.85% of patients pulmonary hyperinflation was found with lobar pneumonia and atelectasis, in 28 or 16% of patients pulmonary hyperinflation with bronchopneumonia and atelectasis were found. Pulmonary hyperinflation is expressed with an increased volume of lungs, augmentation of pulmonary radiolucency and widening of the intercostal spaces, flattening of the diaphragm. The heart takes up a vertical position. The peribronchial thickening-signs seems to be higher in the parahilar and infrahilar regions. Small multiple opacities are localised in the basal parahilar regions. Alveolar, subsegmental, segmental, and lobar opacities are localised more frequently in the upper right lobe.

A comparison of radiographic alterations and respiratory alterations showed the following: in all patients with polypnea pulmonary hyperinflation was found (when chest X ray was performed at this stage) while clinically the auscultatory findings were poor, in 83 or 47.42% of patients control radiographs that were performed at soon afterwards, pulmonary hyperinflation was decreased or was concealed, and pulmonary trauma was exaggerated with small multiple opacities in the parahilar region. In none of the patients pleural effusion was found.



Figure 3. Hyperinflation interstitial, perihilar linear and bronchovascular density, subsegmental and lobar zones of bronchopneumonia and atelectasia
Slika 3. Intersticijska hiperinflacija, perihilarno linearno pojačan plućni crtež, bronhovaskularna konsolidacija



Figure 4. Pulmonary hyperinflation interstitial and marginal, perihilar linear density and intercostal pulmonary herniation
Slika 4. Plućna hiperinflacija, intersticijska i marginalna, perihilarni linearni infiltrati i interkostalna hernijacija dijela pluća

DISCUSSION

According to our, dominant and characteristic signs of bronchiolitis are pulmonary hyperinflation with hilar density and exaggeration of pulmonary trauma. In literature the presence of normal radiographical findings is found in 10-20% of patients, maybe due to the early respiratory symptomatology of the disease (5, 6). The authors do not pinpoint this moment exactly, so it is to be taken into consideration when chest X rays for bronchiolitis are being performed.

In 17 patients hyperinflation of lungs was very evident, causing mild prolapse of the lungs between the intercostal spaces, known as intercostal herniation of the lungs. When pulmonary hyperinflation is expressed radiographic-auscultatory discordance is found.

In a child with a poor auscultation pattern, the radiological expression is hyperinflation. When after 24-48 hours of treatment the respiratory difficulty improves, on auscultation rales are heard, while hyperinflation is decreased on the X-ray, but there is hilar enlargement/density and exaggerated signs of pulmonary trauma with small multiple opacities. This radiographic aspect is interpreted wrongly as aggravation of the child's condition, which is not practically true. In literature there is discussion that the radiographic aspect may be valuable for differential diagnosis between bronchopneumonia with a different aetiology. The appearance of small nodular opacities in the periphery of the lung is more pathognomonic for bron-

chopneumonia of bacterial aetiology. We support this idea because small multiple opacities were found in bronchiolitis in the para-hilar and para-mediastinal regions in our patients. The manifestation of these small multiple peripheral opacities in bronchiolitis should be considered as a sign of bacterial infection (5).

In the case of segmental and lobular pneumonia, we cannot exclude the coexistence of a superinfection, although literature data that this can also be manifestation of infection with viruses such as RSV, parainfluenza A, adenoviruses, etc. According to our data that correspond with the literature, these opacities appear more frequently in children under 6 months of age.

The immunological immaturity of infants explains the absence of secretion of local IgA. So that in infants, infection in the upper respiratory airways can be passed on to the lower airways after 1-2 days (11).

Infants have no possibility to re-ventilate collaterally through the alveoli as long as the bronchioli are obstructed. This anatomic specificity explains the frequency of *peripheral atelectasis* in acute bronchiolitis (2).

Often, the differentiation between atelectasis and pneumonia is difficult when they are segmental and subsegmental moreover, if are both associated with pulmonary hyperinflation (5, 13). In these cases a rapid change within 1-2 days of these opacities indicates atelectasis.

The radiological pattern gave us better orientation for treatment. In the cases of

bronchiolar syndrome, hydration of patient is performed with 80-100 mL/kg liquids. However, in patients with alveolar syndrome, hydration is performed with 60 mL/kg liquids and in some with additional diuretic, since in alveolar syndrome there is an increase in anti-diuretic hormone levels. According to our view, use of corticosteroids is of no value. On the basis of our data we are of the opinion that manifestation of pleural effusion is a sign of bacterial superinfection and rarely a cardiac complication.

Based on this study, the above radiographic features are characteristic for bronchiolitis. Their combination helps us make a quick diagnosis and finally to find adequate treatment without other examinations. Also the dynamics of X-rays is valuable to predict the severity of the disease and can serve for treatment. Manifestation of alveolar syndrome in the course of the disease suggests need for intensive therapy.

As a conclusion we can say that radiographic changes are present in all of patients with bronchiolitis.

They appear as a pulmonary hyperinflation, hilar density/enlargement and exaggeration of pulmonary trauma, small multiple opacities that can be alveolar, subsegmental, segmental, lobar or atelectasis.

These changes vary according to the age and in most cases they are combined with each other. Over the age of 6 months small multiple pulmonary opacities are predominant while under this age pulmonary hyperinflation and alveolar opacities prevail.

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RADIOLOŠKI NALAZI U DJECE S BRONHIOLITISOM

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Uvod. Akutni bronhiolitis je vrlo česta infekcija dišnog sustava u dojenčaćko doba. Očituje se epizodama opstruktivnog respiratornog distresa praćenog piskanjem i teškim disanjem. Dijagnoza bronhiolitisa je kompleksna, jer se karakteristični radiološki obrasci mogu preklapati. Cilj ovog rada je otkriti radiološke promjene u bolesnika s akutnim bronhiolitisom.

Metode. U istraživanje smo uključili 175-ero djece s bronhiolitisom u prvoj epizodi teškog disanja, primljeno na liječenje u pedijatrijsku jedinicu intenzivnog liječenja u razdoblju od 2000. do 2008. godine. U svih je bolesnika, uz ostala klinička i laboratorijska ispitivanja, učinjen i rengenogram pluća.

Rezultati. Rezultati pokazuju da su radiološke promjene prisutne u svih bolesnika, i to: hiperinflacija pluća u 175-ero djece (100%), perihilarni linearni infiltrati i naglašen plućni crtež u 121-og djeteta (69,14%), bilateralna bronhopneumonija u 44-ero djece (25,14%), lobarna upala pluća u 26-ero djece (14,85%) i atelektaza u 28-ero djece (16%). Često je istovremeno prisutna kombinacija više radioloških promjena: plućna hiperinflacija i naglašen plućni crtež u 121-og djeteta (69,14%), plućna hiperinflacija s bronhopneumonijom i atelektazom u 31-og djeteta (17,71%), plućna hiperinflacija s lobarnom pneumonijom i atelektazom u 23-je djece (13,14%).

Zaključci. Zaključujemo da što su plućna hiperinflacija i perihilarni linearni infiltrati vidljiviji, to je auskultatorni nalaz nad plućima manje jasan. Ova činjenica ima i praktičnu vrijednost i glavni je uzrok za nestanak alveolarne konsolidacije. Razlikovanje virusne i bakterijske bronhopneumonije uz pomoć rengenkih snimki, kao i pneumonije i atelektaza ima posebno značenje. Radiološki aspekt daje nam smjernice za praćenje i liječenje bolesnika.

Deskriptori: BRONHIOLITIS, VIRUSNI, INFEKCIJE RESPIRATORNOG SUSTAVA; RADIOGRAFIJA; DIJETE

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