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Radiological features of round pneumonia in children: 10 years of experience

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ABSTRACT

Aim: Round pneumonia (RP) is a type of pneumonia that appears round on imaging studies and usually occurs in children. Although round pneumonia is a well-known clinical condition, few publications available in the literature describing the imaging findings and features of round pneumonia. The purpose of the review was to evaluate the chest radiographs, chest ultrasonography and CT findings associated findings of round pneumonia as compared to the published literature.

Material and Method: 65 children who were diagnosed with round pneumonia in our hospital between December 2010 and July 2020 were included in our study. Initial chest radiographs and CT scans were evaluated for lesion parameters: number, margin, opacity, size, location, and hilar LAP and air bronchogram accompaniment. Follow-up chest radiographs were evaluated for temporal variation (resolution or progression to lobar pneumonia). The findings of the patients who underwent chest ultrasonography were recorded.

Results: The mean age of the 65 children with round pneumonia included was 6.2 years and their ages ranged from 9 months to 16 years. Evaluation of chest radiographs showed one lesion in each of 63 children (96%, 63/65) and two lesions in two children (4%, 2/65). Lesion margins were sharp in 84% (55/65) and the mean diameter of lesions was 2,5 cm with a range of 1.5–9.5 cm. On the radiograph, the opacity of round pneumonia was low (60%, 39/65) and hilar lymphadenopathy was detected in 1 out of 5 patients (20%, 13/65). The location of the lesion tended to be posterior (51%, 33/65) and upper lobe (54%, 35/65). On chest ultrasonography, consalidation was seen in 8 patients, consalidation and pleural effusion were seen in 3 patients. CT images were available in 11 (17%) children. Pleural thickening or satellite lesions were not observed in any of the patients on tomography. Follow-up radiographs tended to show resolution in 95% (62/65) and progression to lobar pneumonia in 4.6% (3/65). 1 patient progressed to lobar pneumonia and died. 2 patients developed cavitary pneumonia.

Conclusion: Round pneumonia is a benign type of pneumonia that is mostly seen in children due to its physiopathology. Most patients with RP recover clinically and radiologically after antibiotic therapy. Although there are many diseases in the differential diagnosis, knowing the radiological features facilitates the diagnosis and prevents unnecessary diagnostic and imaging studies.

Keywords: Round pneumonia, children, radiology, chest radiography, computed tomography

INTRODUCTION

Round Pneumonia (RP) is a type of pneumonia that appears round on imaging studies and usually occurs in children (1). Chest radiography is the first imaging method that should be done to evaluate it diagnostically. Computed tomography (CT) is used in patients in whom the diagnosis is uncertain to exclude other diagnoses (2).

Although round pneumonia is a well-known clinical condition, few publications available in the literature describing the imaging findings and features of round pneumonia.

The purpose of the review was to evaluate the chest radiographs, chest ultrasonography (US) and CT findings associated findings of round pneumonia in 65 children as compared to the published literature.

MATERIAL AND METHOD

This retrospective study was performed in a territory children's hospital. The study was carried out with the permission of Dr. Sami Ulus Training and Research Hospital Clinical Research Ethics Committee (Date: 16.06.2021, Decision No: 2020-KAEK-141/205). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

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65 children who were diagnosed with round pneumonia in our hospital between December 2010 and July 2020 were included in our study. Children with other underlying medical diseases were not included in the study.

Demographic information (age and gender) and symptoms of the patients were recorded.

The diagnosis of round pneumonia and the efficacy of treatment were evaluated by chest radiography.

Thoracic ultrasonography was performed to determine the presence and amount of fluid in cases with pleural effusion on radiographs. Thoracic CT was performed in suspected cases to exclude a non-infectious pathology and other diseases that may seen a round opacity on the chest X-ray.

Initial chest radiographs and CT scans were evaluated for lesion parameters: number, margin, opacity, size, location, and hilar LAP and air bronchogram accompaniment.

Follow-up chest radiographs were evaluated for temporal variation (resolution or progression to lobar pneumonia). The time interval between the initial and follow-up radiographs was recorded.

Chest X-ray and thoracic CT of the patients were evaluated simultaneously with consensus by a radiologist with 20 years of pediatric radiology experience and a board-certified pediatric radiologist with 3 years of experience in pediatric radiology. Thorax ultrasonography was initially interpreted in a clinical setting during patient admission by radiologist. The findings of the patients who underwent chest ultrasonography were recorded.

RESULTS

The mean age of the 65 children with round pneumonia included was 6.2 years and their ages ranged from 9 months to 16 years. Our patient population consisted of 28 females (43%) and 37 males (57%). The most common symptoms were fever (83%) and cough (64%).

Typical imaging findings are demonstrated in **Figure 1.**

Evaluation of chest radiographs showed one lesion in each of 63 children (96%, 63/65) and two lesions in two children (4%, 2/65).

Lesion margins were sharp in 84% (55/65) and ill-defined in 15% (10/65). The mean age of children with round pneumonia with a sharp margin was 4.9 years (range 10 months to 12 years) and of those with an indistinct margin 6.4 years (range 15 months to 16 years).

The mean diameter of lesions was 2,5 cm with a range of 1.5–9.5 cm. On the radiograph, the opacity of round pneumonia was low in most of the patients (39/65, %60).

Hilar lymphadenopathy was detected in 1 out of 5 patients (13/65%, 20%).

In most of the patients (37/65, 57%), no air bronchogram was seen in round pneumonia on the radiograph.

Most of the patients had two-view chest radiographs (47/65, 72%). All round pneumonic infiltrations were visible on the lateral chest radiograph. On lateral chest radiographs, the lesions were seen to be located in the anterior portion (n=13), middle portion (n=1), and posterior portion (n=33).

Specific lobar locations were left lower lobe (14), right lower lobe (11), right upper lobe (27), left upper lobe (8), right middle lobe (1), and lingula (4). In summary, the location of the lesion tended to be posterior (%,51, 33/65) and upper lobe (%54,35/65) (**Figure 2**).

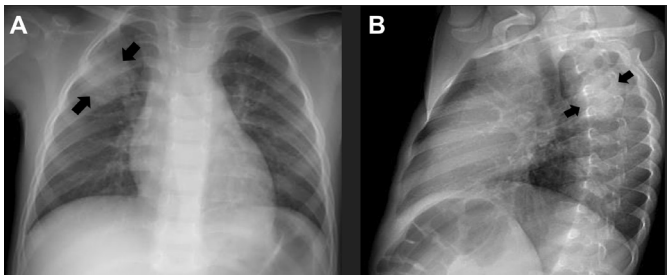

Figure 2. A 3-year-old boy with fever. Posterioranterior (A) and lateral chest radiographs (B) show well-defined, 4-cm round pneumonia in the right upper-lobe (arrows).

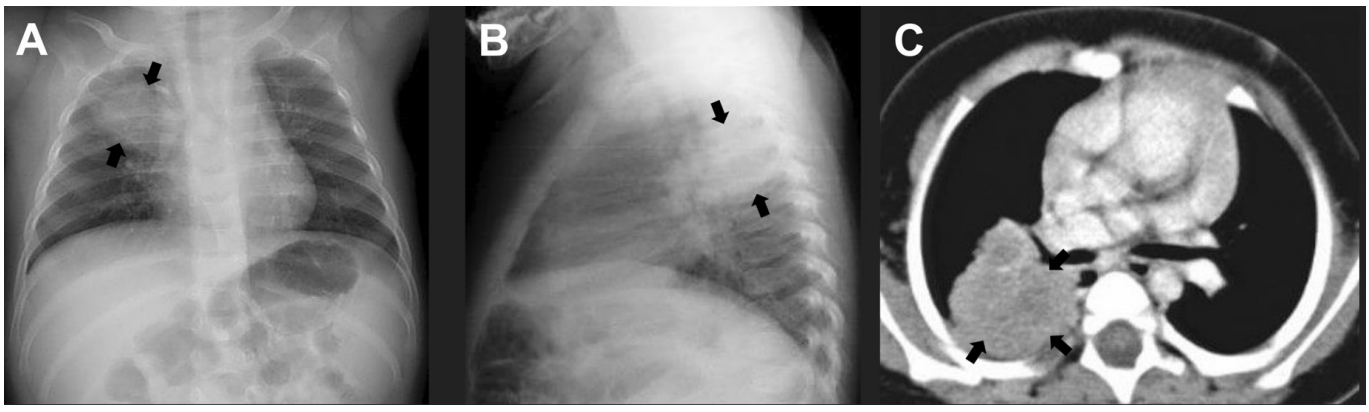

Figure 1. A 10-month-old boy with fever and cough. Posterioranterior **(A)** and lateral **(B)** chest radiographs with chest CT (mediastinal window) **(C)** show a well-defined round pneumonia (arrows) in the right upper lobe posterior segment.

Thorax ultrasonography was performed in 11 patients. Consolidation was observed in 8 of them. Consolidation with pleural effusion was seen in 3 of them.

CT images were available in 11 (17%) children. Pleural thickening or satellite lesions were not observed in any of the patients on tomography.

Follow-up chest radiographs were obtained in 49 (75%) children. Follow-up radiographs tended to show resolution in 95% (62/65) and progression to lobar pneumonia in 4.6% (3/65) (**Figure 3**). The mean time interval between initial and follow-up radiography was 15 days with a range of 4 to 45 days.

1 patient progressed to lobar pneumonia and died. 2 patients developed cavitary pneumonia.

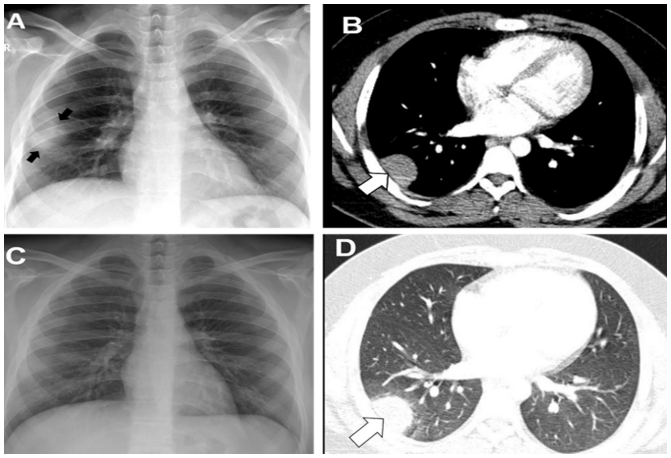

Figure 3. A round pneumonia lesion in a 16-year-old boy. İnitial posterioranterior chest radiography (A) and chest CT images (B. mediastinal window, D. lung window) show round foci of opacity (arrows) in the right upper lobe. C. Chest radiograph obtained 4 weeks later reveals resolution.

DISCUSSION

Round Pneumonia (RP) has been recognized since the 1970s as a clinical entity (1). Round pneumonia is commonly manifested in children younger than 8 years of age who have underdeveloped pathways of collateral ventilation (pores of Kohn, channels of Lambert), more closely apposed connective tissue septae and smaller alveoli compared to older children and adults (2,3). In the literature, the mean age of occurrence of round pneumonia is between 3.3 and 5 years (4,5). In our study, most of our patients (65%) were younger than 8 years old and the mean age of the patients was 6.2.

As shown in other studies, round pneumonia was seen as a solitary lesion in 96% of the cases in our study (6,7). The presence of a solitary lesion is considered a useful finding in the diagnosis of round pneumonia. Due to the poor development of collateral ventilation pathways and confinement of inflamation in adults and adolescents, more than one round lesion may be observed together (8). The ages of the children with round pneumonia, whom we saw in more than one focus in our study, were between 12 and 15 years.

Hilar lymphadenopathy may sometimes accompany round pneumonia on imaging (10). However, in the presence of hilar lymphadenopathy, causes such as tuberculosis, abscess, and fungal infections should be considered in the differential diagnosis (11). In our study, hilar lymphadenopathy was observed in 13 (20%) of our patients. While the differential diagnosis of most of these patients was made clinically, CT was performed in 3 of them.

Air bronchograms in round pneumonia on radiographs are more common in adults than in children (9,12). While the presence of air bronchogram in children suggests infection, it is absolutely necessary to make a differential diagnosis with lung cancer in adults (13). We detected air bronchogram in 37 (57%) of the patients.

In our study, the sizes of the round pneumonia lesions ranged from 1.5 to 9,5 cm and the mean diameter was 2.5 cm. These values are similar to previously reported dimensions of round pneumonia in childeren (4,14).

In our series round pneumonia lesion margins were sharp in 84% and ill-defined in 26% of the children. The mean age of children with a sharp margin (4.9 years) was less than the age of those with an indistinct margin (6.4 years). Our findings are similar to other studies (4,14). The lesion margin has been reported to be typically sharp in children.The sharp lesion margin in younger children may be associated with the underdeveloped pores of Kohn and the absence of canals of Lambert. Round pneumonia is seen less often and has ill-defined margins in children older than 8 years and in adults, who have fully developed collateral ventilation (10,14).

On radiographs, lesion opacity was found to be lower than lobar pneumonia in most of the patients (39/65, 60%). This is an important finding and fits with the pathophysiology of round pneumonia.

In studies on round pneumonia reported that the lesions tend to settle in the posterior and lower lobes. The reason for this is gravity and hypothesized that it is associated with the supine sleep position (14). However, in our study, the rates of posterior (51%) and upper lobe (54%) lesions were almost equal. This may be because the mean age of the patients in our study was higher than in other studies. As the age gets younger, sleeping on the back and the effect of gravity may increase.

Ultrasound is an easy-to-use and radiation-free imaging modality that helps evaluate the location and structure of the area of increased on chest radiography (15). We also performed chest ultrasound before CT in patients

who had round opacities with unclear borders or round opacities that we thought might be a mass on the X-ray. We performed the controls of our patients, in whom we detected consolidation and effusion, again by ultrasonography. We saw that the consolidated areas regressed sonographically before the radiography.

Chest tomography is not routinely recommended in patients with suspected RP due to unnecessary radiation exposure. We performed CT for our patients whose clinical picture was not compatible with pneumonia and whose round opacity did not improve after appropriate antibiotic treatment (16).

In previous studies, it has been reported that round pneumonia mostly improves clinically and radiographically with antibiotic therapy in both pediatric and adult patients, and rarely progresses to lobar pneumonia (4,17). In our study, a resolution of 95% (62/65) was observed in follow-up radiographs, which was consistent with the literature. Only 3 (5%) patients progressed to lobar pneumonia.

In our study, the microbiological agent causing round pneumonia was not determined, and only the radiological features of round pneumonia were described. In the literature, it has been mentioned that the etiology of round pneumonia is almost always bacterial and Streptococcus pneumoniae is the most common cause (8). On the determination of the causative microbiological agent together with the radiological features of round pneumonia studies will be helpful in determining which organism has progressed to lobar pneumonia.

Various diseases in the pediatric age group may present as intrathoracic round opacity on chest X-ray (8). Differential diagnoses of pediatric round pneumonia include fungal infection, lung abscess, tuberculosis, pulmonary malformations (sequestration, congenital cystic adenomatoid malformation and bronchogenic cyst), neoplasms (lymphoma, neuroblastoma, and chest wall tumors), and diaphragmatic hernia (8,11). Round pneumonia in children is likely to represent a benign process. Because neoplastic diseases are more common in adults and RP causes less than 1% of coin lesions in the lung (14,19). It is unlikely to be mistaken, especially with the typical clinical and radiographic appearance of round pneumonia in children. In our cases, other etiologies were not considered in the differential diagnosis because of the typical clinical and radiological findings and the regression of the findings after antibiotic treatment.

CONCLUSION

Round pneumonia is a benign type of pneumonia that is mostly seen in children due to its physiopathology. Most patients with RP recover clinically and radiologically after antibiotic therapy. Although there are many diseases in the differential diagnosis, knowing the radiological features facilitates the diagnosis and prevents unnecessary diagnostic and imaging studies.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Dr. Sami Ulus Training and Research Hospital Clinical Research Ethics Committee (Date: 16.06.2021, Decision No: 2020-KAEK-141/205).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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