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Typical findings for bronchiolitis in high resolution computed tomography

High resolution computed tomography is a diagnostic modality of choice in imaging of interstitial lung diseases. HRCT enables visualization of the pathological findings invisible on plain radiographs and their evaluation at the level of the pulmonary lobule.

The aim of the study was the evaluation of typical HRCT findings in patients with bronchiolitis, and the assessment of their usefulness in differential diagnosis.

MATERIAL AND METHODS

Material comprises a group of 17 patients with bronchiolitis, in which HRCT examination was performed. The scanning was performed from the lung apices to the level of the diaphragm. The thickness of the section was 2 mm, the intervals 10 mm. Scanning was performed at full inspiration with patients in a supine position. Additional expiratory sections were performed to reveal air-trapping. In the presence of the subpleural thickenings in dependent posterior lung areas additional sections were performed in a prone patient's position to differentiate dependent densities.

RESULTS

Thickening of the interlobular septa, peribronchovascular interstitium and bronchial walls form an increased reticular pattern, visible on HRCT images in eight patients. Dilatation of the bronchioles (bronchiolectases) with the thickening of the bronchial wall, resulting in a typical signet-ring sign and tram-line sign were seen in 13 patients (Fig. 1). Confluent small nodules were also seen in five patients, but there was no statistical significant correlation with the bronchiolitis (Fig. 2). The tree in bud pattern was seen in 13 patients (Fig. 3), the correlation was statistically significant ($p < 0.001$). Air--trappings were visible on expiratory sections in 14 patients, with significant correlation ($p = 0.01$). Mosaic perfusion was also seen in 10 patients as a result of regional differences in blood flow (Fig. 4). The correlation was statistically significant. Ground glass opacities where also seen in four patients, suggesting coexisting areas of interstitial pneumonia.

Fig. 1. Bronchiectasis. Dilated bronchus form tram-line sign (arrows). Parenchymal band and signet-ring sign also visible

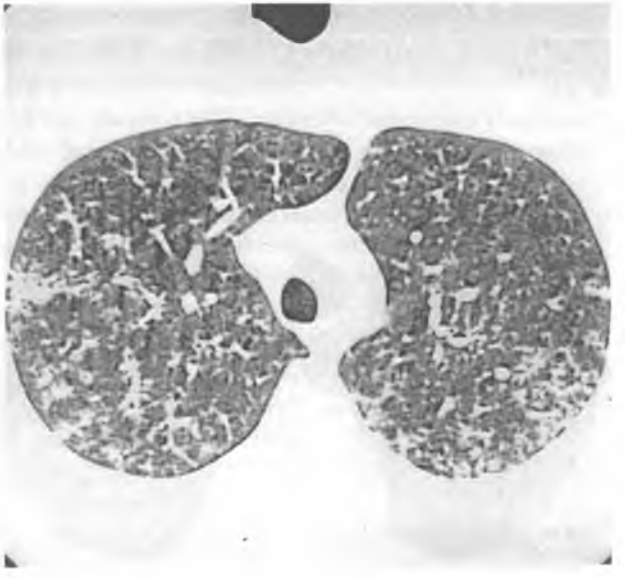

Fig. 2. Confluent nodules especially in subpleural posterior lung areas. Tree in bud and parenchymal bands also visible

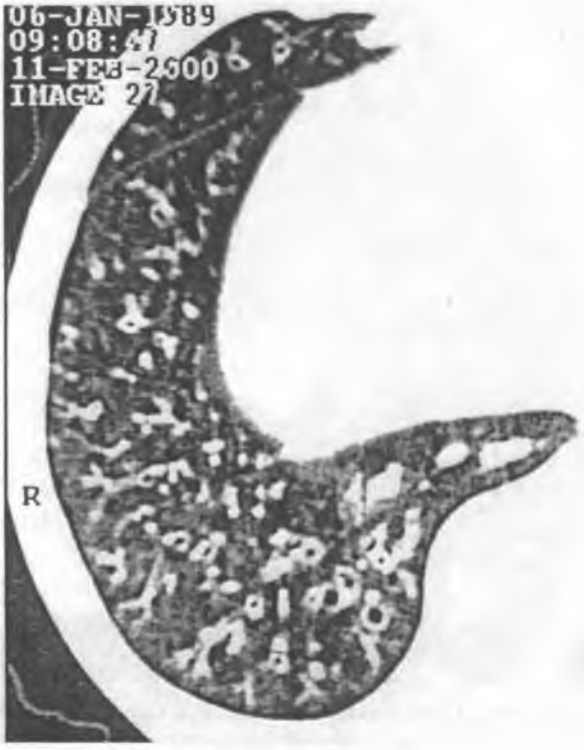

Fig. 3. Bronchioles filled with puss, mucus, granulomas or inflammatory cells give tree in bud appearance. Small bronchiectases form the signet-ring sign

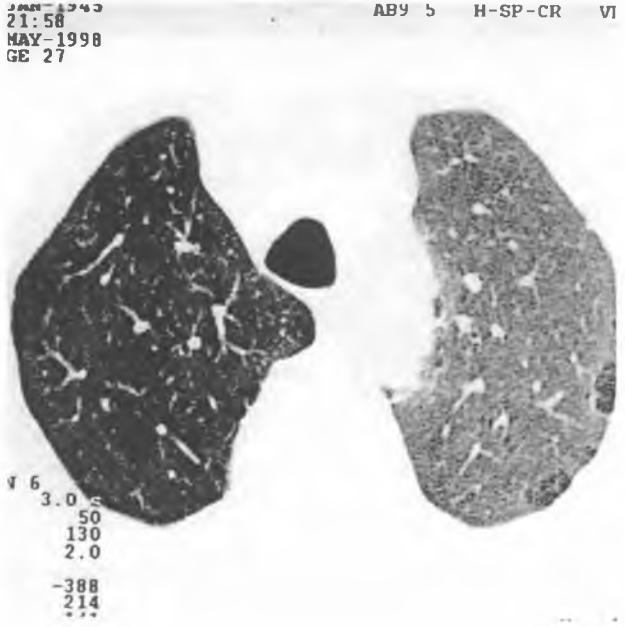

Fig. 4. Mosaic perfusion in patient with bronchiolitis. The diameters of vessels in relative dense areas are larger than in areas of decreased density

DISCUSSION

Normal branches of the bronchi, without cartilages within the walls are called bronchioles. In healthy people bronchioles are invisible within distal 1–2 cm from the surface of the pleura (4).

Diseases of the bronchioles cause the bronchiolar wall thickening and dilatation of bronchiolar lumen. The bronchioles are filled with puss, mucus, granulomas or inflammatory cells. Filling of the bronchioles results in the presence of the linear or branching centrilobular structures. They are irregular, characterized by lack of tapering and bulbous dilatations at the tops of branches, unlike the normal centrilobular vessels. These findings in HRCT are called the tree in bud (4).

An indirect sign of bronchiolitis may also be seen, such as subsegmental atelectasis, and air--trapping.

Bronchiolitis may be caused by multiple pathogenic factors similar to causes of bronchiectases. They include infections, inhalation irritating dusts, immunologic deficiency, smoking (4, 11).

Airway infections result in small centrilobular nodules and the tree in bud pattern.

The lung density is partially dependent on the amount of the blood in the lung parenchyma. In HRCT heterogeneous lung density may result from local differences in blood flow in diseases of airway or vessels. Because this phenomenon is often patchy distributed, it was called mosaic perfusion (2).

Areas of relative lower lung density in HRCT may have different sizes and relate to nodules, segments, lobes or lung. In almost all cases the diseases that result in decreasing of the local blood flow cause the mosaic perfusion. The differences in density between normal and pathologic lung areas are intensifying by compensatory increased perfusion in normal or relative normal lung areas (10).

The mosaic perfusion is most often seen in the airway diseases, with local air-trapping or decreased lung ventilation of the lung parenchyma. The areas of decreased ventilation are less perfused because of the reflex vasoconstriction or permanent reduction in the pulmonary vascular bed.

In mosaic perfusion the lung vessels in areas of decreased density often appear smaller than vessels in relative dense lung areas. That reflects the differences in the regional blood flow and may be helpful in distinguishing mosaic perfusion from ground glass opacities. In ground glass opacities the diameter of vessels is the same in all lung (10).

Inhomogeneous lung disease in HRCT may result from ground glass opacities, mosaic perfusion and air-trapping. The differentiation of mosaic perfusion and ground glass opacities is based on analyzing the diameters of the vessels in areas of decreased and increased lung density.

Ground glass opacities are called areas of increased lung densities without obscuring underlying vessels. If the vessels are obscured the term consolidation is used (2, 5, 8, 9).

Small bronchiectases and bronchiolectases are often seen in bronchiolitis. The main feature of the bronchiolitis is an increase of the bronchiolar diameter that is larger than the adjacent pulmonary artery. That result in a signet-ring sign, a very typical HRCT finding of bronchiectasis. Lack of tapering of bronchus lying in the plane of the scan results in tram-line appearance. And the third element in diagnosing bronchiectasis in HRCT is visibility of the bronchi within 1 cm from the pleural surface (3, 6, 7).

Diseases of the airways may cause prominence of the branching centrilobular structures, resulting in increased reticulation on HRCT images. Visibility of the centrilobular bronchiole without interstitial densities suggests airways diseases (1).

CONCLUSIONS

The tree in bud is a typical sign seen on HRCT sections in patients with bronchiolitis, resulting from filling the small centrilobular bronchioles with puss, mucus, granulomas or inflammatory cells. Material filling the bronchioles causes their obstruction resulting in the presence of air-trapping, visible on expiratory sections. Thickening of the bronchiolar walls and dilatation of the small bronchioles are also very often seen. Ground glass opacities and small nodules can also be seen in some patients with bronchiolitis.

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SUMMARY

High resolution computed tomography is a diagnostic modality of choice in imaging of interstitial lung diseases. HRCT enables visualization of the pathological findings invisible on plain radiographs and their evaluation at the level of the pulmonary lobule. The aim of the study was evaluation of typical HRCT findings in patients with bronchiolitis, and assessment of their usefulness in differential diagnosis. Tree in bud is a typical sign seen on HRCT sections in patients with bronchiolitis, resulting from filling the small centrilobular bronchioles with puss, mucus, granulomas or inflammatory cells. Material filling the bronchioles causes their obstruction resulting in the presence of air-trapping, visible on expiratory sections. Thickening of the bronchiolar walls and dilatation of the small bronchioles is also very often seen. Ground glass opacities and small nodules are also seen in some patients with bronchiolitis.

Najczęstsze zmiany w tomografii komputerowej wysokiej rozdzielczości w zapaleniu oskrzelików

Tomografia komputerowa wysokiej rozdzielczości jest metodą diagnostyczną z wyboru w diagnostyce obrazowej śródmiąższowych chorób płuc. TKWR umożliwia uwidocznienie zmian patologicznych niewidocznych na zwykłych radiogramach i ich ocenę na poziomie zrazika płucnego. Celem badania jest ocena typowych zmian w TKWR w zapaleniu oskrzelików oraz ich przydatności w diagnostyce różnicowej. Obrazy drzew w pąkach są typowym objawem w TKWR u pacjentów z zapaleniem oskrzelików, co jest spowodowane wypełnieniem małych środkowozrazikowych oskrzelików ropą, śluzem, ziarniną czy komórkami zapalnymi. Materiał wypełniający oskrzeliki powoduje ich obturację, będąc przyczyną obecności pułapek powietrznych, widocznych na przekrojach wydechowych. Pogrubienie ściany oskrzeli i ich poszerzenie jest często widoczne. Zacienienia szkła mlecznego i małe guzki są również widoczne u niektórych pacjentów z zapaleniem oskrzelików.