Pulmonary sequestration: Diagnosis with multidetector computed tomography

Pulmoner sekestrasyon: Çok kesitli bilgisayarlı tomografi ile tanı

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Abstract
Pulmonary sequestration is an uncommon disease with non-functioning pulmonary tissue and anomalous systemic blood supply. The diagnosis depends on identification of abnormal systemic vessels. Arteriography, CT, MR and Doppler ultrasound can been used for diagnosis. MDCT is fast, allows high-resolution volumetric imaging that can be obtained during a single breath-hold and single-phase contrast injection. Moreover, volumetric helical imaging allows three-dimensional reconstruction of data, which is useful in the demonstration and characterization of the lesions and also showing vascular structures. Herein, a case of pulmonary sequestration diagnosed by MDCT is reported.

Key Words: **Bronchopulmonary sequestration; Computed tomography**

Özet
Pulmoner sekestrasyon anormal sistemik kan dolaşımı olan, fonksiyon göstermeyen akciğer dokusundan oluşan nadir konjenital hastalıktır. Tanısı, anormal sistemik damarların gösterilmesi ile konur. Bu damarların gösterilmesinde arteriyografi, BT, MR ve Doppler ultrasonografi kullanılmaktadır. Multidedektör BT ile tek faz kontrast enjeksiyonu ve tek nefes tutulumu ile hızlı,yüksek çözünürlüklü, volümetrik görüntüler elde edilebilir. Ayrıca volümetrik helikal görüntüleme ile çekim sonrasında üç boyutlu rekonstrüksiyon yapılarak lezyonların ve vasküler yapıların karekterizasyonu ve görüntülenmesi sağlanır. Bu yazımızda multidedektör BT ile tanısı konulan pulmoner sekestrasyon olgusu gözden geçirilmiştir.

Anahtar Kelimeler: **Bilgisayarlı tomografi; Bronkopulmoner sekestrasyon.**

Introduction

Pulmonary sequestration (PS) is a rare congenital disorder lacking a normal connection with the tracheobronchial tree and pulmonary arteries. It has an anomalous systemic blood supply. Angiography is the gold standard for identifying the systemic feeding artery and venous drainage in PS. Non-invasive imaging techniques, including CT angiography, Doppler ultrasound and Magnetic Resonance Angiography (MRA), can also demonstrate the systemic feeding artery and venous drainage (1-11). The use of Doppler ultrasonography is generally limited to pre- and post-natal evaluation of sequestration. MR is able to show the origin and course of both the aberrant systemic artery and the venous drainage, but the imaging time is long and the parenchymal changes cannot be evaluated. Multidetector CT (MDCT) is fast and the images can be obtained with a single breath hold. When performed with an appropriate technique this is an effective imaging method for evaluating parenchymal changes, feeding artery and draning vein, which is important for diagnosis, and for surgery planning (2, 3, 12).

In this study, the demonstration of systemic vascular supply and venous drainage of an intralobar pulmonary sequestration (ILS) by using MDCT is reported.

Case report

A 38-year-old, non-smoker women, initially presented 3 months previously with a non-productive cough and fever. On chest radiography, paracardiac infiltration on the right lower zone (Picture 1) was detected. A detailed history revealed recurrent pneumonias since adolescence. Although she was treated empirically with antibiotics, her symptoms were not completely resolved. Pulmonary sequstration was suggested and CT examination was performed with a MDCT (Lightspeed 16, GE Medical Systems, Milwaukee, Wis, USA). Non-ionic contrast medium (100 ml, iodine 350 mg/ml) was administered at a rate of 3.5 ml/s via the antecubital vein. The bolus track system with a density of 100 HU in the descending aorta was used to initiate scanning in order to optimise contrast in the systemic arterial phase. Three-dimensional (3D) reconstruction was performed on a workstation using a volume rendering and maximum intensity projection (MIP) program. On axial images a non-homogeneous mass with air-bronchograms involving the posterior basal segment of the right lower lobe and a feeding artery originating from the descending aorta was observed (Picture 2a -2b). The venous drainage could not be tracked. The use of MIP images made tracking possible. MDCT angiography (Picture 3) showed a feeding artery arising from the descending thoracic aorta and venous drainage to the pulmonary veins at their full length, and with these findings the diagnosis of ILS was established. During surgery an infected ILS was detected.

Discussion

Pulmonary sequestration is a non-functioning pulmonary tissue with an anomalous systemic blood supply. Classically two forms, ILS and extralobar sequestration (ELS), have been described to date. Although both types are supplied with blood from the aorta or its branches, the venous return of ILS is usually via the pulmonary veins, while ELS generally have systemic venous drainage. Intralobar sequestrations are located within the visceral pleura and surrounded by normal lung. Extralobar sequestrations have a separate pleural covering. Both ILS and ELS characteristically involve the lower lobes of the lungs. Intralobar pulmonary sequestration accounts for 75% of all sequestrations and has a predilection for the posterior basal segment of the lower lobes (1-6). In about two thirds of the cases reported, the first symptoms occur after the age of 10 years and are usually secondary to a superimposed infection. Productive cough, fever, hemoptysis, recurrent pneumonia and chest pain are typical presenting complaints (4-6). Recurrent pneumonia in a characteristic location should raise the suspicion of PS. The case presented in this study had a history of recurrent pneumonias and the consolidation was located in the right lower lobe, therefore suspicion of sequestration had arisen.

CT scan is useful in non-invasive evaluation of PS and reveals the characteristic features of the lesion more clearly. On CT a homogeneous or heterogeneous consolidation, cavitation or cystic mass with fluid or only air or air-fluid levels may be seen. The lesion is surrounded by emphysematous changes (air-trapping) produced by collateral air drift. Pseudotumor appearance with spiculations may also occur (4, 5).

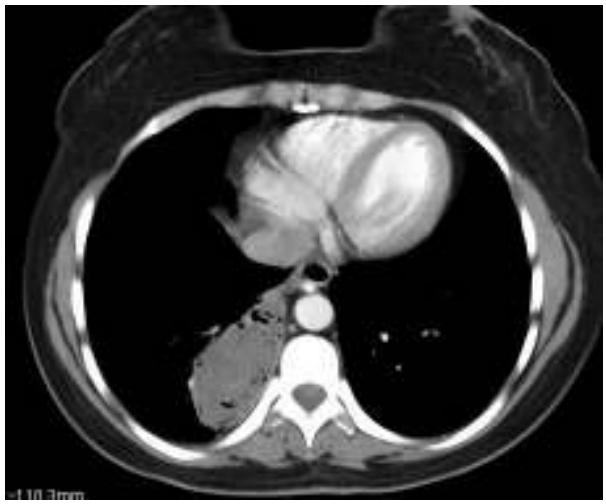
The aberrant feeding vessels cannot always be demonstrated by conventional CT. Ikezoe et al. reported that the aberrant systemic artery was not visible in one third of cases (8). But helical CT scan demonstrates the anomalous vessel in up to 80 % of cases (6). Since helical CT offers faster scanning, multiplanar and CT angiographic display, and retrospective data reconstructions with narrow intervals, it can facilitate the display of the aberrant artery, which may be as small as 1mm. Furthermore, helical CT allows simultaneous evaluation of the associated lung

parenchyma and airway abnormalities, and the vessel can be traced to the PS (2). In the case presented the feeding artery was seen on axial images.

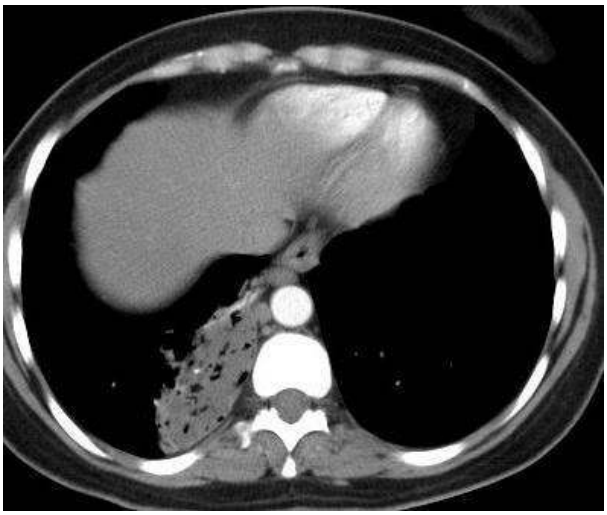
The draining vein of PS is oriented in the z-axis, therefore some investigators concluded that the venous drainage could not be demonstrated with CT (7, 9). However, with helical CT, especially MDCT, demonstrating the venous drainage is possible (1, 2). 3D volume-rendered display gives the opportunity to rotate the image in any orientation in real time, which is helpful for tracing the venous drainage and showing its relationship with pulmonary veins (2). Demonstrating the venous drainage is important for the differentiation of ILS and ELS and for planning surgery. Excision of a lobe or segment is generally necessary for ILS, whereas for ELS only excision of the sequestration is needed (1, 2). In the case presented axial images showed the feeding artery although the venous drainage was not seen. With MIP and 3D images the arterial and venous drainage of the lesion in their full length were traced, and thus the relation between the draining vein and pulmonary veins could be demonstrated. Conventional angiography is considered to be the gold standard for the diagnosis of PS but it is invasive, requires high radiation dose and the lung parenchyma cannot be evaluated (2). Therefore, noninvasive techniques including CT, MRI and USG are used for the diagnosis of PS. MRI shows the precise anatomic localization of the sequestration, origin and course of both the aberrant systemic artery and the venous drainage. With the use of breath-hold contrast enhanced MR angiography, the aberrant artery can be shown without flow or respiratory artefacts. This requires relatively long imaging time and it can not accurately evaluate lung parenchyma (4, 5, 10). Sonography requires a favorable acoustic window and its use is ideally suited for evaluating the chest prenatally and postnatally (1, 2, 5, 11). MDCT is superior to other techniques, because it is fast, volumetric imaging can be performed in one breath hold and one contrast injection. Motion and respiratory artefacts are reduced. Its spatial resolution is high. As a result, it is suitable for evaluating vascular structures and lung parenchyma (2, 6). One disadvantage of MDCT is radiation exposure. However, the arteries and veins can be shown with single contrast injection, which is critical for reducing the radiation dose. In pediatric patients, low exposure factors can be used.

In conclusion, MDCT images obtained with an appropriate technique provide the opportunity for simultaneous imaging of anomalous vessels and parenchymal lesions in a single examination, and thereby allow accurate diagnosis and surgical planning. Therefore, we assume that MDCT should be the procedure of choice in the diagnosis and assessment of pulmonary sequestration.

Picture 1: On PA chest radiography a paracardiac infiltration is seen on the right.



Picture 2a



Picture 2b

Picture 2a - 2b: On contrast-enhanced axial images a non-homogeneous mass with air bronchograms involving the posterior basal segment of the right lower lobe and a feeding artery originating from the descending aorta is seen.

Picture 3: MDCT angiography shows a feeding artery arising from the descending thoracic aorta and venous drainage to the pulmonary veins at their full length.

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