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Case Report Open Access

Usefulness and Limitations of Multidetector Computed Tomography Angiography for Visualization of Thoracic Aberrant Arteries in Neonates

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Abstract

We describe two neonatal patients where the final diagnosis differed in whom multidetector computed tomography (MDCT) angiography could clearly visualize the intrathoracic aberrant artery. The first case was a infant with a right intrathoracic tumor detected by fetal sonography. MDCT was performed 13 days after birth at a weight of 3492 g. An aberrant arteries arising from the Th10-high aorta toward the right lower lobe was detected. A right lower lobectomy was performed in the diagnosis of pulmonary sequestration. The latter was an infant born at 28 weeks of gestation. MDCT was performed to investigate an abnormal right upper lobar shadow 92 days after birth at a weight of 2906 g. An aberrant arteries arising from the Th5-high aorta toward the right upper lobe was detected. We determined the artery considered aberrant was an inflammatory dilated bronchial artery by conventional angiography. MDCT could visualize ultra-fine aberrant arteries in neonates. However, it cannot explore the artery peripherally or evaluate the area controlled by the artery. Conventional angiography should be performed in cases without a branch defect of the bronchus or pulmonary artery, and in those cases with an aberrant artery arising from Th5-Th6-high thoracic aorta, which cannot be distinguished from the bronchial artery.

Keywords: Pulmonary sequestration; Multidetector computed tomography; Aberrant artery; Bronchial artery; Neonate

Introduction

Diagnosis of pulmonary sequestration where the aberrant artery has been detected by contrast computed tomography (CT) [1-3] or magnetic resonance angiography (MRA) [1,4-6] instead of by conventional angiography is becoming more common. However, the aberrant artery is difficult to visualize in neonates because of the fineness of the artery and neighboring respiratory and cardiac motion. In recent years, multidetector CT (MDCT) angiography, which has high spatial resolution and high scanning speed, has become clinically available [7]. Here, we report the use of 64-row MDCT angiography to clearly visualize the intrathoracic aberrant artery of two neonates. The usefulness and limitations of this imaging technique in neonatal pulmonary sequestration are discussed.

MDCT angiography was performed using LightSpeed VCT (GE Healthcare, Waukesha, WI, USA) with a 64-row detector. Scan parameters were tube voltage of 120 kV, automatic tube current, and slice thickness of 3.75 mm. Under mild sedation with chloral hydrate at a dose of 75 mg/kg, non-ionic iodinated contrast with a volume of 3 mL/kg body weight was injected over a period of 20 s. Scanning was initiated immediately after contrast injection.

Case Presentation

Case 1

A 3-day-old male infant with a right intrathoracic tumor detected by fetal sonography presented with no respiratory distress. Multidetector computed tomography (MDCT) angiography was performed 13 days after birth, at a weight of 3492 g. An aberrant artery measuring 4.5 mm in diameter arising from the Th10-high thoracic aorta toward the lower lobe of the right lung was detected (Figure 1). A right lower lobectomy was performed 4 months after birth in the diagnosis of pulmonary sequestration, and the post-operative course was satisfactory.

Case 2

A female infant born at 28 weeks gestation, weighing 1364 g, was affected by recurrent pneumonia. An abnormal right upper lobar shadow was consistently observed on chest radiography. MDCT was performed 92 days after birth, at a weight of 2906 g. An aberrant artery measuring 3.0 mm in diameter arising from the Th5-high thoracic aorta toward the right upper lobe of the lung was detected (Figure 2). Because pulmonary sequestration in the right upper lobe is rare, conventional angiography was performed to enhance preoperative evaluation. A peripheral artery was distributed throughout the right lobe of the lung, and the entire right lobar parenchyma was visualized by aberrant arteriography (Figure 3). Pulmonary arteriography showed no defect of the pulmonary arterial branch. Blood pressure and oxygen partial pressure in the pulmonary artery and vein had no differences bilaterally. It was determined that the artery considered aberrant was an inflamed and dilated bronchial artery. She has been well for 5 years without any symptoms.

Figure 1: MDCT angiography (3D rendering) shows the aberrant artery (arrow) arising from the Th10-high thoracic aorta toward the lower lobe of the right lung (Case 1).

Figure 2: MDCT angiography (3D rendering) shows the aberrant artery (arrow) arising from the Th5-high thoracic aorta toward the right hilar area (Case 2).

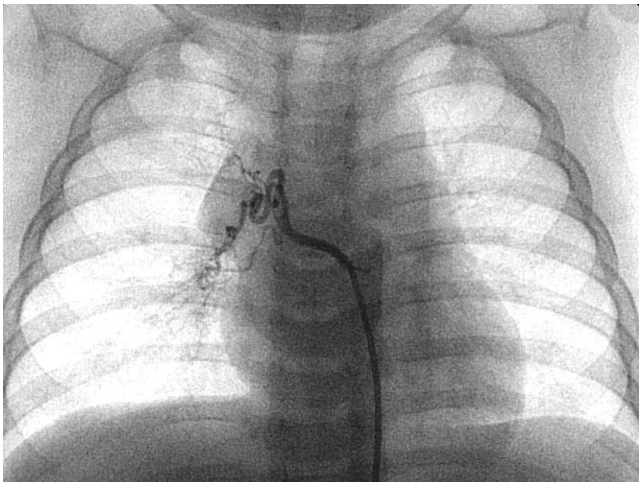

Figure 3: Conventional angiography revealing that the aberrant artery feeds the whole right lobe (Case 2).

Discussion

In pulmonary sequestration, identification of the aberrant artery from the systemic circulation to the sequestered lung is crucial. To visualize the aberrant artery, many authors have reported various imaging techniques, including conventional angiography, helical CT, and magnetic resonance imaging. Although single-detector helical CT scan image the aberrant artery for a shorter scanning duration, it has been difficult to visualize with sufficient resolution to aid diagnosis in neonatal cases due to the fineness of the target artery and respiratory and cardiac motion occurring in its vicinity. Deguchi et al. reported a case of intralobar pulmonary sequestration in an 11-month-old infant whose aberrant artery was visualized by contrast-enhanced MRA after CT failed to reveal the anomalous artery [4]. MRA has the potential to be an efficient and noninvasive imaging modality, but it requires a long imaging time and deep sedation, which are very stressful for a neonate.

Sixty-four-row MDCT, which was first applied in a clinical setting in 2004, can visualize even restless vessels such as the cardiac coronary artery [8] because of its high spatial resolution and high scanning speed. The usefulness of MDCT for visualization of the aberrant artery in pulmonary sequestration has been demonstrated in infants and school-age children [2,3,7]. In the present cases, MDCT was used to visualize ultra-fine aberrant arteries (as small as 3.0 mm in diameter) in neonates weighing as little as 2900 g without deep sedation.

Most extra-lobar sequestrations are located between the lower lobe of the lung and the diaphragm (63% of cases), and intra-lobar sequestration almost always (98% of cases) affects the medial and posterior basal segments of the lower lobes of the lung. The arterial supply to extra-lobar sequestrations comes mainly from the descending thoracic aorta (40% of cases) and abdominal aorta (30% of cases), and intra-lobar sequestration arises from the descending thoracic (73% of cases) and abdominal aorta (20% of cases) [9,10]. On the other hand, the fine bronchial artery arises from the Th5-Th6-high descending thoracic aorta, runs along the posterior wall of the bronchus from the hilum of the lung, and perfuses the pulmonary parenchyma [11]. It has been noted that this artery grows in response to pulmonary inflammation or defective circulation of the pulmonary

artery [12]. When an aberrant artery arises from the Th5-Th6-high thoracic aorta (as in Case 2 in this report), it is necessary to determine whether that artery is an aberrant artery of pulmonary sequestration or a bronchial artery dilated due to inflammation. In such cases, those diagnoses are difficult to distinguish because the etiology of the sequestration itself is unclear. Several hypotheses have been suggested, including the vascular traction theory proposed by Pryce [13], the accessory lung bud theory proposed by Eppinger et al. [14], and the theory of acquired pathology following infection proposed by Gebauer et al. [15].

Surgical resection of the involved lung is standard therapy in cases of pulmonary sequestration. Resection then allows evaluation of the area controlled by the artery considered aberrant. Additionally, blood pressure gradients and oxygen tension in the right and left pulmonary artery and vein and the presence or absence of anatomical bronchial anomalies can aid in diagnosing the source of the aberrant artery. MDCT can clearly visualize the origin of the aberrant artery in the aorta but cannot trace the artery peripherally. Thus, one limitation of MDCT is that it cannot distinguish the area supplied by the aberrant artery. The abnormal artery in Case 2 was first diagnosed by MDCT as an aberrant artery of pulmonary sequestration in the right upper lobe, as visualization of the right pulmonary parenchyma revealed an inflamed and dilated bronchial artery.

Conclusion

MDCT angiography has the potential to become a first-line clinical examination for the diagnosis of pulmonary sequestration across all age groups, including low-birthweight infants. However, in cases with an aberrant artery arising from the Th5-Th6-high thoracic aorta (which cannot be distinguished from the bronchial artery by CT), conventional angiography should be performed. Courses of treatment should be decided in a comprehensive manner through evaluation of the area controlled by the artery, the blood pressure gradient and oxygen partial pressure in the pulmonary artery and vein, and the presence or absence of anatomical bronchial anomalies.

Conflict of Interest

The authors declare that they have no conflict of interest.

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