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Advantages of MDCT in Evaluating Pediatric Congenital Heart Disease

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Abstract

Objective: To investigate the clinical application value of multi-slice CT in congenital heart disease, retrospectively analyze the post-processing technology of multi-slice CT, the results of ultrasound diagnosis and postoperative results, and compare the diagnostic accuracy of the two diagnostic methods. **Results:** The diagnostic accuracy rates of MDCT and Echo for extracardiac structural deformities were 97.06% and 78.49%, respectively. The diagnostic accuracy of MDCT for extracardiac structural deformities was higher than that of Echo, and there was a statistical difference between the two (P<0.05). **Conclusion:** Multi-slice CT is superior to ultrasonography in the diagnosis of extracardiac malformations.

Keywords

Congenital Heart Disease, Enhocardiography, Multidetector-Rowcomputed Tomography

Congenital heart disease (CHD) is a congenital heart malformation caused by abnormal cardiovascular development in fetal period or the failure to close the channels that should be automatically closed after birth. The number of newly born children with congenital heart disease is 200,000 every year in our country. Among them, 50% are complex congenital heart disease (CCHD). Congenital heart disease is characterized by many malformations, complexity and complications. The natural fatality rate of children is extremely high. The natural fatality rate of children under 1 year old is about 50%. Therefore, early diagnosis and timely intervention or surgical correction are particularly important. In clinical practice, the most commonly used imaging examination methods for diagnosing congenital heart disease are echocardiography (TTE) and angiocardiography (CAG). With the increasing application of multi-slice spiral CT (MSCT) in the diagnosis of congenital heart disease, PiliphsiCT (256 slices) has been applied in the diagnosis of complex malformations of congenital heart disease in children, and the effect is satisfactory. With higher temporal resolution and density resolution, it can obtain more detailed images, which directly affects the surgical results [1]. Multiple studies have demonstrated that MDCT is an accurate method for evaluating pulmonary artery morphology [2]. In order to explore the diagnostic effect of 256-slice iCT in the diagnosis of complex malformations inside and outside the heart of children with congenital heart disease, this study selected 32 children with congenital heart disease diagnosed by surgery for analysis.

1. Clinical Data

1.1 Case Selection

A total of 32 patients with congenital heart disease confirmed by angiography in our hospital from October 2018 to October 2021 were selected, including 16 males and 16 females. Afterwards, echo checks were performed. Including atrial septal defect, ventricular septal defect, patent ductus arteriosus, abnormal pulmonary artery and other malformations.

1.2 Equipment Check

Using PiliphsiCT (256 slices); high pressure syringe; 22-24 gauge trocar AW4.4 post-processing workstation; using PhilipsIE33 color Doppler echocardiograph and broadband probe. The frequency is 3-7MHz.

1.3 MDCT Scanning Technology and Parameters

PiliphsiCT (256 layers) was used. Prospective ECG gated scanning was used. Before scanning, infants and patients who could not cooperate were sedated by oral administration of 0.5-0.7ml kg 10% chloral hydrate. PiliphsiCT (256 layers) scanning parameters: tube voltage and tube current adopt individualized scheme, tube voltage: 80-120Kv, tube current: 80-200 mAs, collimation detector: 128 ×0.625mm, reconstruction layer thickness: 0.9mm, reconstruction interval: 0.45mm, tube ball rotation time: 0.27s, scanning time: 2.5s. The contrast agent is iodine specific alcohol (350mg/ml), the dose is 2ml/kg, and the injection speed is 1.5-2.0ml/s. Scanning range: chest entrance to 5cm below the diaphragm.

1.4 Image Post-Processing Method and Image Analysis

The disease is diagnosed on the basis of cross-sectional image information, and the scanning data is transmitted to AW4.4 post-processing workstation to reconstruct image information. The reconstruction technology includes multiplanar reconstruction (MPR), curved surface reconstruction (CRP), volume rendering (VRT), maximum density projection (MIP), minimum density projection (mIP), etc. Different anatomical sites were displayed by different reconstruction techniques. The MDCT image data information is post-processed by an imaging physician, and the image analysis is performed by two radiologists without knowing the results of cardiac surgery. If there is any objection, a diagnosis agreement is reached through consultation. The diagnosis of Echo was made by two physicians who performed ultrasound diagnosis of congenital heart disease. The diagnostic results of two kinds of imaging were compared and analyzed. The number of confirmed, misdiagnosed and missed diagnosis of internal and external cardiac structural malformations were compared with the surgical results respectively, and the diagnostic accuracy of MDCT and Echo for complex congenital heart disease was compared.

1.5 Statistical Methods

SPSS11.5 software analysis data package was used for statistical analysis of the data. The diagnostic accuracy of MDCT and Echo were compared and analyzed, and the enumeration data were subjected to chi-square test. $P<0.05$ indicated that the difference was statistically significant.

2. Results

MDCT and Echo were performed in all 32 patients. The results of surgical exploration showed that there were 87 intra- and extra-cardiac malformations, of which 51 were abnormal in extra-cardiac structures, including pulmonary artery development, that is, 26 pulmonary artery stenosis at different levels. Abnormal blood supply of various collateral vessels, namely 11 PDA, 6 direct body-pulmonary collateral vessels, 6 bronchial artery collateral vessels, and 2 intercostal artery collateral vessels. There were 36 intracardiac structural abnormalities, including 3 atrial septal defects, 1 patent foramen ovale, and 32 ventricular septal defects. Figures 1 and 2 show the number of surgically confirmed, MDCT and Echo diagnoses, misdiagnoses, and missed diagnoses of intracardiac and extracardiac structural malformations in 32 patients.

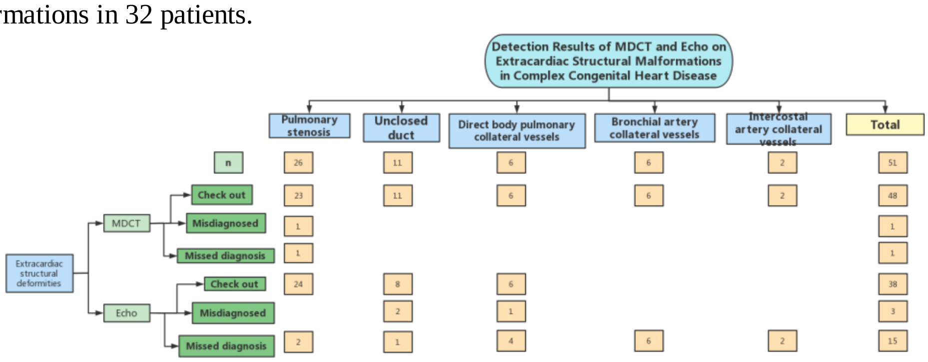

Figure 1.

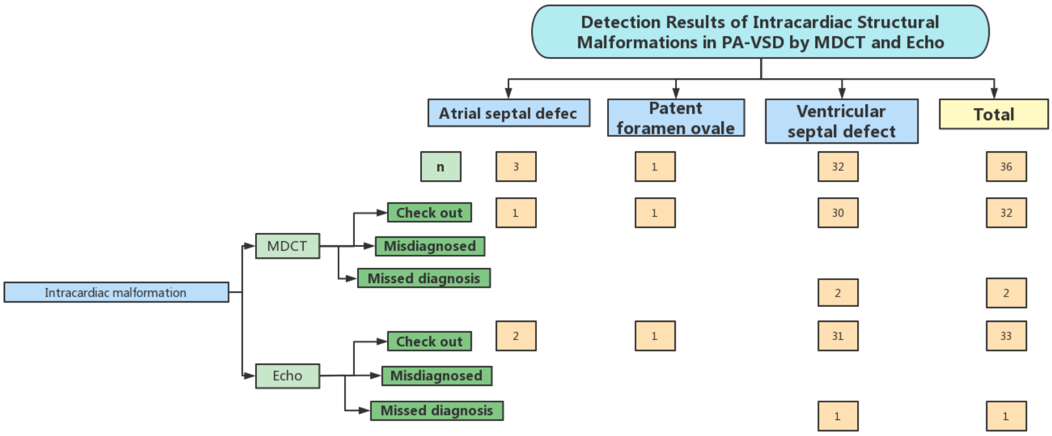

Figure 2.

The detection results of intracardiac and extracardiac structural deformities were examined by MDCT and Echo (see Figures 1-2). A total of 51 extracardiac structural abnormalities were detected by surgical exploration. MDCT missed 2 misdiagnoses (diagnostic accuracy rate was 97.06%). Echo There were 18 missed diagnoses (diagnostic accuracy rate 78.49%), and the difference in diagnostic accuracy between the two was statistically significant (X2 = 20.036 P < 0.005). There were 36 intracardiac structural malformations, 2 of which were missed by MDCT (diagnostic accuracy rate of 94.12%) and 1 by Echo (diagnostic accuracy rate, 98.53%), and there was no significant difference in the diagnostic accuracy between the two (X2 =1.869 P >0.05).

3. Discussion

Congenital heart disease is the abnormal local anatomical structure or hemodynamics caused by the formation of the heart and great blood vessels in the fetal period. For complex malformations of congenital heart disease in children, the heart is often manifested as vascular disease, and at the same time, there are cardiac chambers and blood vessels missing or abnormal connections, such as tetralogy of Fallot, pulmonary atresia, transposition of the great arteries, single ventricle malformation, etc. It is easy to cause hypoxia in children, which seriously threatens the life and quality of life of children. At present, cardiovascular angiography (CAG) is the clinically recognized "gold standard" for the diagnosis of complex congenital heart malformations in children. Compared with other diagnostic methods, this diagnostic method has many advantages. It is an invasive examination method with high risk, high cost and complex operation. Moreover, this examination method requires multiple injection of contrast agent and is limited by the location of the deformity during examination, resulting in a high rate of clinical misdiagnosis or missed diagnosis. In recent years, with the rapid development of medical technology in China, CT has been applied in the diagnosis of complex congenital heart malformations, and the effect is ideal. In this study, the diagnostic accuracy of 256 slice iCT for extracardiac malformations was 97.06%, higher than that of echocardiography (78.49%, P<0.05). 256 slice iCT low dose technology has many advantages over contrast-enhanced ultrasound diagnostic methods. Conventional single slice CT has a relatively long projection time and a large amount of radiation to patients. It is difficult to avoid artifacts caused by respiratory movement of children during diagnosis. However, the application of 256-slice iCT low-dose technology can effectively reduce the radiation dose and obtain the need for low-dose scanning of any part. The scanning speed of this diagnostic method is relatively fast. The automatic trigger enhancement method is used for scanning, and 45% of the R-R period is selected when triggering, which avoids image artifacts caused by the rapid heartbeat of children. At the same time, the 256 - storeyiCT low-dose technology USES double gun after elbow vein during the diagnosis to high pressure syringe injection of contrast medium and vascular preset method is used to determine the scan delay time, not only can clearly show the lesion of the heart, but also can clearly display coronary artery variation and smaller collateral circulation, collateral circulation show more clearly before surgery, It is more conducive to the formulation of surgical programs. It is an imaging method suitable for complex malformations of children with congenital heart disease, and can accurately and non-invasculativelydisplay the complex state of pulmonary blood supply [3-5]. Thus, the diagnostic effect of 256-layer iCT technology in children with complex congenital heart malformations can be seen. At the same time, 256-layer iCT technology can significantly improve the temporal resolution and spatial resolution, and can get rid of the influence of heart rate, showing good application value in coronary heart disease screening, post-coronary stent review, myocardial bridge diagnosis and other aspects.

To sum up, compared with echocardiography, 256 slice iCT has an ideal diagnostic effect for children with complex congenital heart malformations, which can improve the diagnostic accuracy of extracardiac malformations before surgery, and is worth popularizing.

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