Usage of 64-slice CT in the diagnosis of congenital cardiovascular malformations

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Abstract: Objective To study the value of the 64-slice CT used in the diagnosis of congenital cardiovascular malformations. **Material and methods** the CT images of 59 patients with congenital cardiovascular malformations were analyzed using imaging reconstructive techniques which included the volume rendering (VR), multiply plane reformation (MPR), maximum intensity projection (MIP) and curved planar reformation (CPR). The results were compared with those of the surgery. There were two groups according to the type of cardiovascular malformation, one group included intracardiac malformation and another extracardiac malformation (included cardiovascular department and peripheral vascular malformation). **Results** 59 patients with congenital heart disease were all confirmed by the operation. In all of them, intracardiac malformations were 129 places , CT diagnosis correctly 114 places, misdiagnosis 15 places, diagnostic accuracy was 88.37% (114/129); Extracardiac malformation in 69 places, compared with surgical results, CT inspection correct diagnosis 67 places, missing 2 places, diagnostic accuracy was 97.10% (67/69). **Conclusion** 64-slice spiral CT can be used as an effective method for evaluation of congenital cardiovascular disease,especially for extracardiac malformation diagnosis .
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In recent years, multi-slice spiral CT (multi-detector spiral computed tomography, MDCT) especially 64 -slice or 64 -slice above the millisecond level streak widened cardiac CT clinical application, powerful post-processing software provides many reconstruction method, including multiple planar reformation (MPR), maximum intensity projection (MIP), curve planar reformation(CPR), volume rendering (VR), and so on. The many kinds of image reconstruction method can display complex cardiovascular anatomical structure stereoscopically, clearly. MDCT in the diagnosis of congenital cardiovascular disease (hereinafter referred to as congenital heart disease factors) at home and abroad reports only a few literatures [1, 2, 3]. This study was to analyze the value of the 64 -slice spiral CT used in the diagnosis of congenital heart disease in 59 patients and was compared with the result of the surgery.

Material and method

1. General material

Collect and analyze the CT results of the 59 patients who were diagnosed of congenital heart disease by surgery from April 2008 to April 2012, , the male 30 cases, female 29), mean age, 18.26 + / - 17.83 y (2 m - sixty y), average weight 34.51 + / - 22.52 kg (4 -76 kg), average height 1.31 + / - 0.37 m (0.52 - 1.78 m).

2. The examination method

All ECG-triggering angiography examination were performed using a 64-section CT scanner(GE light speed VCT scanner, workstations Aw4.4 Advantage version) during free breathing, without slowing down the heart rate by taking drugs. The contrast material was injected via peripheral veins in the head or back of the hand. The children less than 4 years old who did not cooperate after sleep were scanned. First was side positioning as scanning, the selection of aortic root level scanning, determining the optimal scanning delay time, the following acquisition parameters were used: frame rotation speed 0.35 s/r, 0.625 mm thick, the reorganization of the interval 0.625 mm, pitch 0.18 ~ 0.24:1, vision for 250 mm, matrix 512 * 512, tube voltage of 120 kV (children for 80 kV), tube current for 300 ~ 680 mA (children for 200 ~ 420 mA), ECG- controlled scan between 65% - 85%in R - R period adopt full mA, the other phase adopt the 20% of the full mA.

3. Image analysis

After the scanning, the original image were reconstructed by using a section thickness of 0.60mm.all image were transferred to the post-processing Workstation (GE Advantage Workstation 4.4), multiple planar reformation(MPR), maximum intensity projection(MIP) and curve planar reformation(CPR) were done by an experienced radiologists

4. Data processing

The results of surgical were utilized as the reference standard. The result of the 64 -slice spiral CT diagnosis was considered as correct when it is conform to the result of the surgical(the last diagnosis result by three experienced radiologists), and

discrepancy with surgical results or did not provide diagnosis are considered to be missing.

Result

1. The intracardiac malformation of surgical findings was confirmed by the diagnosis result of the 64 -slice spiral CT.

The intracardiac malformation in a total of 129 places of separate cardiovascular deformities was confirmed by surgical findings. The accuracy of the 64 -slice spiral CT in diagnosing separate cardiovascular deformities was 114. the misdiagnosis were 15, 5 places for atrial septum defect, 3 place for mitral valve variation and deformity, 4 in tricuspid variation and deformity, 3 place for a ventricular septal defect, and single atrium, three room heart, complete core intima cushion defect, single ventricle, double cavity in heart, left ventricular outflow tract stenosis and right ventricular outflow tract stenosis are diagnosed correctly (**table 1**, **figure 1-2**).

Table 1: the surgical results and 64-slice spiral CT diagnoses about intracardiac malformations

type	Surgical results （place）	Diagnosis of 64-slice spiral CT	
		correct	misdiagnosis
atrial septal defect	53	48	5
single atrium	4	4	0
cor triatriatum	2	2	0
mitral valve variants and deformity	5	2	3
tricuspid valve variants and deformity	9	5	4
Completely endocardial cushion defect	6	6	0
ventricular septal defect	34	31	3
single ventricle	3	3	0
Double-chambered right ventricle	4	4	0
Left ventricular outflow tract malformations	2	2	0
right ventricular outflow tract malformations	7	7	0
total	129	114	15

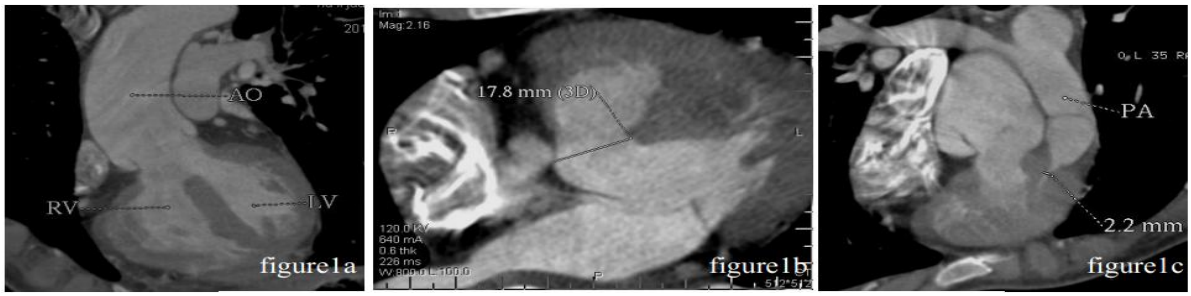

Figure 1: female,36 years old, tetralogy of Fallot

Figure 2:female,15 years old,pulmonary atresia,ventricular septal defect,patent ductus arteriosus

2 Extracardiac malformations of the surgical results confirmed by 64-slice spiral CT diagnosis

The extracardiac malformations in a total of 69 places were confirmed by surgical findings. The accurate diagnosis of the 64 -slice spiral CT were 67 places, two places were missed , respectively coronary artery fistula and pulmonary atresia, double outlet of left ventricle, double outlet of right ventricle, Interrupted aortic arch, coronary artery anomaly, patent ductus arteriosus, Major aorto pulmonary collateral arteries , common artery dry mouth, pulmonary artery stenosis, anomalous systemic venous return, transposition of the great arteries etc lesions were all diagnosed correctly (**table 2**, **figure 3-4**).

Table 2: the surgical results and 64-slice spiral CT diagnoses about extracardiac **malformations**

type	Surgical results （place）	Diagnosis of 64 row spiral CT	
		correct	misdiagnosis
double outlet of left ventricle	1	1	0
double outlet of right ventricle	5	5	0
Interrupted aortic arch	6	6	0
The origin of coronary artery malformation	3	3	0
coronary artery fistula	5	4	1
patent ductus arteriosus	12	12	0
aortopulmonary septal defect	4	4	0
Common arterial trunk	5	5	0
pulmonary atresia	2	1	1
Pulmonary stenosis	4	4	0
Anomalous pulmonary venous drainage	15	15	0
transposition of the great arteries	7	7	0
total	69	67	2

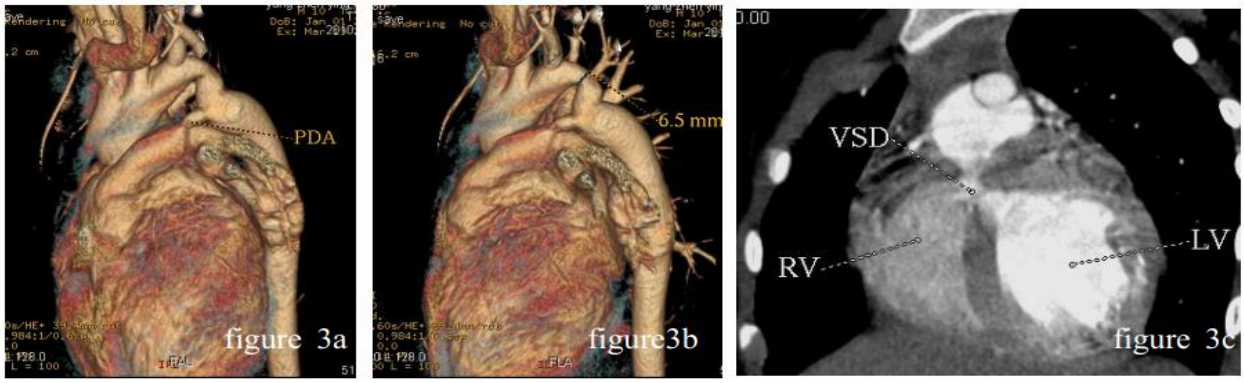

Figure 3: male, 10 years old,aortic coarctation, patent ductus arteriosus, ventricular septal defect

Figure 4: female, 36years old,complete anomalous pulmonary venous drainage(supracardiac type), atrial septal defect

Discussion

Congenital heart disease is to point to all patients who have more than one pathophysiological change or several cardiovascular malformations concurrently [4, 5]. According to the related literature, it is about 29% of the congenital heart disease baby birth lively, congenital heart disease is the leading cause of infant death and serious complications, and is the most important reason brings great burden to the society and family, therefore early accurate anatomical diagnosis before the preoperative in the treatment of congenital heart disease and its prognosis is very important. At present more think two-dimensional ultrasound, cardiovascular imaging evaluation is the most accurate method to congenital heart disease, but the technology is limitation and its clinical application is limited. So far, MDCT with scanning speed improved and the image quality improvement and post-processing software development is used increasingly in the diagnosis of congenital heart disease in the field of clinical, but at present the literature about 64-slice spiral CT in the diagnosis of congenital heart disease is still less reported.

1. The value of 64-slice spiral CT in the diagnosis of intracardiac malformation

At present, it is so many research report about MDCT, especially 64-slice spiral CT used in clinical, many scholars have studied the value and method of MDCT used in the diagnosis of congenital heart disease[6,7]. The MDCT improve the accuracy of diagnosing the congenital heart disease by development hardware and post-processing software obviously. For The 129 intracardiac malformations, the CT examination give the correct diagnosis of 114 , and misdiagnosis of 15 , include of 5 place of the atrial septum defect , 3 place of mitral valve variation and deformity, 4 places of tricuspid variation and deformity , 3 place of ventricular septal defect . The accuracy of MDCT diagnosis is 88.37%, lower than the results (97.69%)of Duan Yan-hua [8] , the possible reasons maybe that the research has not further study the congenital heart disease type , furthermore this research used the dual-source CT prospective scanning mode, 5 places of interatrial septum are so small that the CT misdiagnosed them, and one place of three hole room misdiagnosed to double hole room of reduction. for the contrast medium concentration in the superior vena cava is too high and the defect itself is too small, so 3 other place are misdiagnosed. The mitral valve and tricuspid valve lesions are missing due to other intracardiac malformation combined and valve lesions show itself not clearly, 1 case of the 3 ventricle septal defect missed due to the defect itself small and combined with other abnormalities, 1 case missed the smaller ventricle septal defect of the 2 places, 1 case show the lesion not clearly due to the heartbeat artifact which results from the patients not using the ECG-controlled scanning mode, for the other intracardiac malformations, the 64 -slice spiral CT are all make an accurate diagnosis, the research indicate that the accuracy of CT used in exam the congenital heart disease has certain differential with the surgical results although 64 -slice spiral CT for complex intracardiac anomalies diagnosis accuracy has been greatly improved. The reason is mainly for the small defect deformity, valve disease with reduction, additionally, the dosage and injection way of the contrast, whether or not adopting the ECG-controlled scanning mode are also the main elements which affect the diagnosis of the 64 -slice spiral CT.

2. The value of the 64 -slice spiral CT used in the diagnosis for extracardiac **malformation**

Due to MDCT has realized the isotropic scanning; it has completely changed the condition that the CT image only can be observed in cross-section. Which lay a solid foundation for all-round display each part of the heart anatomy, the powerful post-processing software make equal quality of reconstructed image and original cross-sectional image completely, which can make the MDCT display complex cardiovascular anatomical structure of extracardiac malformation excellently[9,10]. In this study, there were 69 places of extracardiac malformation, the 64 -slice spiral CT made right diagnosis of 67 places, missing two places. 1 place was coronary artery right ventricular fistula, the misdiagnosis due to there was a very small right ventricular fistula of the left coronary artery which abnormally originated from the pulmonary artery, another 1 was the pulmonary atresia, the patient did not adopt the ECG-controlled scanning technology, then it was misdiagnosed as pulmonary stenosis because of larger artifact of pulmonary valve. According to the report [5], the accuracy of 64 -slice spiral CT diagnosed the extracardiac malformation was 97.10% (67/69) which was similar to our result (97.4%). The results further show that 64 -slice spiral CT can well display the position , shape of cardiovascular connection part and large vascular space position and can also show congenital heart disease combined with the coronary artery origination malformation clearly which was helpful to the correct diagnosis of coronary artery lesions.

To sum up, 64 -slice spiral CT can be used as an effective method for evaluation of the congenital heart disease, especially for extracardiac malformation diagnosis.

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