

Detection of Pulmonary and Coronary Artery Anomalies in Tetralogy of Fallot using CT Angiography

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Abstract

Background: Tetralogy of Fallot (TOF) is the most common cyanotic congenital heart disease, multidetector CT (MDCT) has the highest spatial resolution, allowing a detailed assessment of small vessel anatomy. We aimed to demonstrate the MSCT role in delineation of the extracardiac vascular abnormalities, and detect the common and uncommon findings in TOF cases for proper pre-surgical evaluation. **Methods:** This observational study was conducted on 45 patients with TOF diagnosed by echocardiography (ECHO) who underwent cardiac CT-angiography. All subjects underwent chest X-ray, electrocardiogram, ECHO, cardiac MSCT. **Results:** CT examination revealed 3 cases of pulmonary atresia and 2 cases of absent left pulmonary artery were detected, 11% had left pulmonary artery ostial stenosis, 5% had right pulmonary artery ostial stenosis, 8% had abnormal aortic arch branching, , **Conclusions:** MDCT is a crucial for extra cardiac evaluation of TOF patients prior to surgical repair, identifying vascular abnormalities, additional VSDs and coronary anomalies.

Keywords: Pulmonary Artery Anomalies, Coronary Artery Anomalies, Tetralogy of Fallot, CT Angiography.

1. Introduction

Tetralogy of Fallot (TOF) is a complicated congenital heart disorder defined by four anatomical

abnormalities: ventricular septal defect, blockage of the right ventricular outflow tract, overriding aorta, and right ventricular hypertrophy [1]. This disorder accounts for a substantial

number of cyanotic congenital heart problems and necessitates rigorous examination and surgical treatment for best results [2].

Accurate pre-surgical examination is essential in instances with transposition of the great arteries because it permits a full evaluation of the amount and character of extracardiac vascular abnormalities [3]. These malformations, especially those affecting the pulmonary and coronary arteries, considerably affect the surgical strategy and prognosis following surgery. To this purpose, the development of imaging methods has been crucial in increasing diagnostic skills and patient care [4].

CT angiography (CTA) has emerged as a helpful tool for the evaluation of TOF patients among the many imaging modalities. CTA combines CT with angiography to provide three-dimensional, high-resolution pictures of the cardiovascular system. By applying intravenous contrast agents and quick acquisition methods, CTA enables the identification and characterization of pulmonary and coronary artery abnormalities in patients with TOF [5].

This research aims to highlight the relevance of multi-slice CT (MSCT) angiography in the identification of both frequent and unusual extracardiac vascular anomalies in patients of transient ischemic attack (TIA)

2. Methods

This was an observational hospital-based study conducted on 45

TOF patients who underwent cardiac CT-angiography at Pediatric Department, Faculty of Medicine, Benha University and National Heart Institute from the period of June 2019 to June 2021. The inclusion criteria for this study were pediatrics age group from day who were diagnosed as Fallot tetralogy by Echo. Exclusion criteria included undergoing previous cardiac surgery.

An informed consent was obtained from the parents before enrollment in the study. Benha Faculty of Medicine Research Ethics Committee permission was received.

All the enrolled subjects underwent various assessments and evaluations, including history taking, clinical examination, chest X-ray, electrocardiogram (ECG), echocardiography, multi-slice cardiac CT.

3. CT angiography

Each cardiac CT examination was done and analyzed by a consultant pediatric cardiologist. Using a 64-slice dual-source scanner (SOMATOM Definition; Siemens, Germany). CT scans were done on each of these individuals.

The scan was done from the brachiocephalic vascular to the upper abdomen. Contrast (ultravist 370) was administered via a peripheral intravenous catheter at a rate of 4 ml/sec (18-20 gauge). This was followed by a saline bolus. In spite of this, each cardiac CT procedure varies somewhat based on patient weight, concurrent lesions, and clinical questions addressed during the scan.

Objectives of CT examination:

Look for pulmonary valve morphology and pulmonary artery's confluence, caliber, and branches, evaluate RVOTO or fixed narrowing of the subpulmonary infundibulum, evaluate coronary artery anomalies.

Statistical analysis:

Using version 23.0 of the statistical program for social sciences, data were analyzed (SPSS Inc., Chicago, Illinois, USA). The data's normality was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The quantitative data were given as mean, standard deviation, and ranges for variables with parametric (normal) distributions, and median and interquartile range for variables with non-normal distributions (non-parametric data). Similarly, qualitative characteristics were quantified and given as percentages.

4. Results

Table 1 reveals the baseline characteristics distribution among study group.

Table (1) Baseline characteristics distribution among study group (n=45)

	Baseline characteristics	Total (n=80)
Age (months)	Range	0.7-144
	Mean±SD	25.29±27.90
Sex	Female	21 (46.6%)
	Male	24 (53.3%)
Weight (kg)	Range	2.9-29
	Mean±SD	9.8±3.64
Length (cm)	Range	47-131
	Mean±SD	80.07±17.32
SA	Range	0.19-1.02
	Mean±SD	0.45±0.16
Time of diagnosis (months) by Echo	Range	0.2-24
	Mean±SD	2.8±4.06
O2 saturation	Range	65-93
	Mean±SD	77±7.9

Data is presented as mean ± SD and range, SA:

5. Discussion

TOF is one of the most prevalent cyanotic congenital heart abnormalities. It accounts for 10% of all congenital cardiac disease in children.

Imaging plays a crucial role in CHD diagnosis. It describes anatomy and physiology, aids in refining management, assesses the outcomes of therapies, and aids in determining prognosis. However, no one imaging modality currently accessible performs these functions for all individuals and disorders [6].

Our study included 45 patients. Twenty four were boys (53.3%), and 21 were girls (46.6%). The age of patients ranged between 20 days and 12 years, with the mean of 25.29 months. and the mean time of diagnosis was 2.8 months, O2 saturation range was 65-93% while the mean O2 saturation 77%.

The analyzed cases were categorized based on their findings into different subtypes of Tetralogy of Fallot (TOF). These subtypes included classic TOF, TOF with pulmonary stenosis (TOF/PS), TOF with pulmonary atresia (PA/VSD) variant, TOF with complete atrioventricular canal (TOF/CAVC) variant, and TOF absent pulmonary valve variant. In a separate study by Elreweny et al., a similar classification was employed for the examined cases, including classic TOF, TOF with pulmonary stenosis (TOF/PS), TOF with pulmonary atresia (PA/VSD) variant, TOF with complete atrioventricular canal (TOF/CAVC) variant, TOF with double outlet right ventricle (TOF/DORV) variant, and TOF absent pulmonary valve variant [7].

In addition, Siraj et al. discovered in their research that 31 (96.9%) patients had MPA

stenosis and 3 (3.1%) patients had MPA atresia [8].

But percentage of atretic pulmonary valve was higher in Elrewny et al, 2019 when they stated that Atretic valve found in 18 patients (36%).

TOF absent pulmonary valve variant was detected in 5% of patients by MDCT.

This was consistent with the findings of Drogalis et al., who said that Tetralogy of Fallot (TOF) with missing pulmonary valve (PV) is a severe congenital cardiac condition observed in only 3% to 6% of TOF individuals [9]. While Elrewny et al. [7] found no cases of TOF absent pulmonary valve variant in their study.

Another variant of fallot was detected in our study, 5% were diagnosed as Fallot with absent pulmonary valve.

It agreed with Drogalis et al., who said that a missing pulmonary valve is an uncommon and severe variation found in only 3% to 6% of TOF patients. Our research agreed with Drogalis et al. [9].

Regarding right pulmonary artery abnormalities MDCT revealed ostial stenosis in 5% of patients.

In contrast to our study **Sheikh et al, 2014** found that Stenosis of RPA was less common (0.9%) in their study [10].

Regarding left pulmonary artery (LPA) abnormalities MDCT revealed ostial stenosis in 11% of cases.

Sheikh et al, 2014 found in their study that isolated LPA stenosis was detected in 10.4% of cases. This is comparable to the reported incidence of 3% and 10% from Asia and Europe respectively [10].

6. Conclusion

Prior to surgical repair, MDCT is essential for extracardiac assessment of TOF patients. It offers supplemental information to echocardiography about anomalies of the pulmonary arteries, coronary arteries, and tracheobronchial tree.

MDCT plays a vital role in the identification of additional VSDs. CT has been used to detect coronary abnormalities.

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