ORIGINAL ARTICLE

# Coronary Anomalies in Pakistani Children with Tetralogy of Fallot

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## ABSTRACT

**Objective**: To determine coronary artery anomalies in tetralogy of Fallot in Pakistani children as seen on angiography.
**Study Design**: Case series.
**Place and Duration of Study**: The National Institute of Cardiovascular Diseases, Karachi, Pakistan from July 2006 to July 2007.
**Methodology**: Children under 15 years of age with echocardiographic diagnosis of tetralogy of Fallot were included in the study. All patients had pre-operative cardiac catheterization and angiography. Coronary arteries were studied with a non-selective aortic root angiogram in standard cranially tilted left anterior oblique view. The frequency of a normal and an anomalous coronary was determined.
**Results**: Of the 83 patients, 78% were male and had a mean age of 8.9 years. Their mean weight was 14.3 kilograms. Seventy six (91.6%) had a normal coronary anatomy while 7 (8.4%) patients had anomalous coronary arteries. Among the patients with coronary anomalies, the commonest was a single origin coronary artery in 04 (57.14%) cases. Three (42.86%) had an anomalous origin of left anterior descending artery from the right coronary artery.
**Conclusion**: Coronary artery anomalies were detected in 8.4% of the cases with tetralogy of Fallot. Single origin coronary artery anomaly was the commonest anomaly.

**Key words:** *Coronary anomaly. Angiography. Aortogram. Right coronary artery. Left coronary artery. Left anterior descending artery. Tetralogy of fallot. Single origin coronary artery.*

## INTRODUCTION

The prevalence of anomalous coronary artery in tetralogy of Fallot (TOF), has been reported as being up to 9%.[1-4] These anomalies are not always detectable intraoperatively, particularly when they are covered by epicardial fat, pericardial-epicardial adhesions or by overlying myocardium.[5] An unrecognized inadvertent division of such a vessel during incision for corrective surgery can lead to myocardial infarction or death.[6] Thus accurate pre-operative recognition of such an anomaly is essential to minimize postoperative complications. In such cases alternative surgical approaches may be planned beforehand. The alternative approaches are transatrial-transpulmonary approach or placement of a conduit from the right ventricle to the main pulmonary artery. Even corrective surgery may be deferred till 5-6 years of age.[6-8]

In adults CT coronary angiography and MRI has an established role in diagnosis of coronary artery anomalies. As young children have higher heart rates and are unable to hold the breath during examination, good quality CT is difficult to obtain. MRI has also a limited role for assessment of coronaries in children due to poor temporal resolution. It may require general anaesthesia as well.[9,10] There is also an increasing evidence of coronary assessment by echocardiography but this modality has a low sensitivity in various studies.[11,12] Thus angiography plays an important role in the evaluation of anomalous coronary arteries in TOF.[4,5,13]

This study was performed to determine coronary artery anomalies in patients with TOF.

## METHODOLOGY

The study was conducted from July 2006 to July 2007. Children under 15 years with echocardiographic diagnosis of TOF as suggested by Van Praagh *et al.*[14] were included in the study. All of them had pre-operative angiocardiography at the National Institute of Cardiovascular Diseases, Karachi. Informed consent was taken from parents prior to the procedure. The procedure was performed under local anaesthesia with 3% ligocaine. Sedation with oral chloral hydrate (50 milligram per kilogram body weight) was also given in children under 5 years. Cardiac catheterization was performed via the femoral route. Antegrade aortic root angiogram was performed by manipulating angiographic flow catheters (NIH or Berman angiographic side-hole catheters) across the ventricular septal defect (VSD). Cases in which the catheter could not be crossed into the ascending aorta via VSD, a retrograde route via the femoral artery was used with pigtail angiographic catheter. An angiogram was performed in standard angiographic left anterior oblique (LAO 45-60 degree) cranial (20-30 degree) view by injecting a large bolus of commercially available iodine containing contrast (0.75

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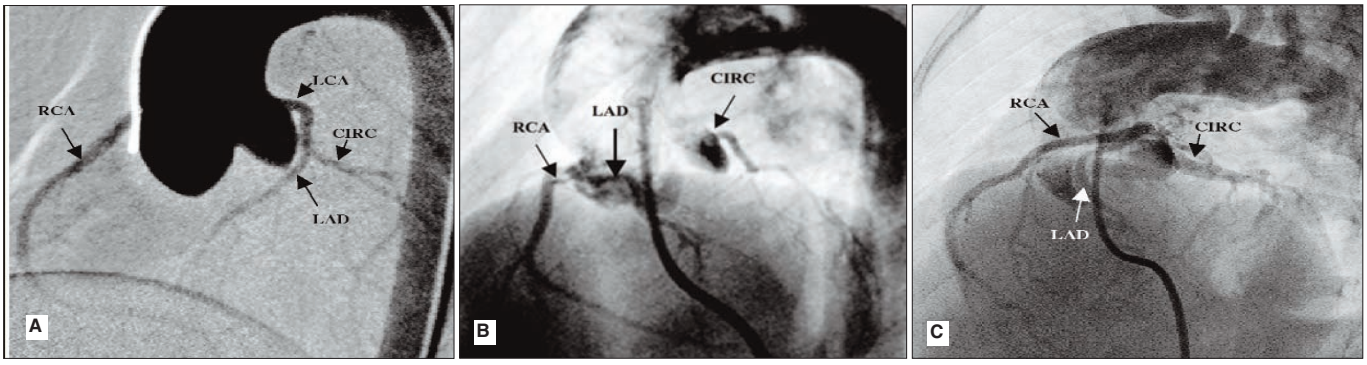


**Figure 1:** Aortogram in left anterior oblique (LAO) and cranial view. **(A)** normal coronary anatomy. **(B)** LAD arising from RCA. **(C)** single coronary artery from left sinus (RCA=right coronary artery; LCA=left coronary artery; CIRC=circumflex artery; LAD=left anterior descending artery).

to 1 ml/kg). Those patients with an unclear coronary course after standard angiogram, were subjected to an additional aortogram in LAO (10-15 degree) caudal (40-45 degree) (laid-back view). The angiograms were reviewed independently by two paediatric cardiologists.

Data was collected on a pre-tested questionnaire. Computer software SPSS version 13 was used for data entry and analysis. Frequency and percentages were calculated by univariate analysis.

## RESULTS

There were a total of 83 TOF patients who underwent angiocardiography. Their age ranged from 2 to 15 years with a mean of 8.9 years. The mean weight was 15 kilograms. There were 61 males (73.5%).

The origin and course of the coronary arteries were defined in all 83 patients.

Seventy six (91.6%) had a normal coronary anatomy (Figure 1A) while 7 patients (8.4%) had anomalous coronary arteries. Among the patients with coronary anomalies, the commonest was a single origin coronary artery occurring among 4 patients (Figure 1C) from left coronary sinus, (Figures 2A and 2B) from right coronary sinus). Three had an anomalous origin of the left anterior descending artery from the right coronary artery (Figure 1B). The course of surgical importance relative to right ventricular out flow tract (RVOT) was clarified by using an additional aortogram in a laid-back view as shown in Figure 2B. All of the anomalies had their anomalous course across RVOT.

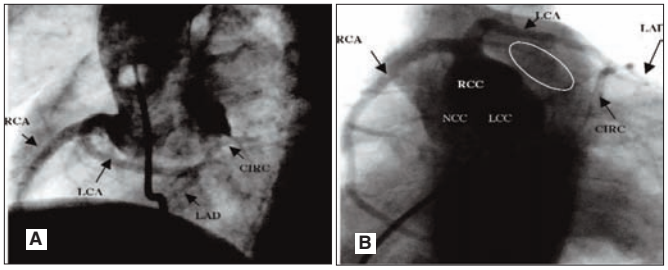


**Figure 2:** Single coronary artery from right coronary cusp. **(A)** LAO cranial view. **(B)** same patient in Laid back view showing the clarification of the course of LCA across crossing RVOT represented by the oval area. (RCA=right coronary artery; LCA=left coronary artery; CIRC=circumflex artery; LAD=left anterior descending artery; RCC=right coronary cusp; LCC=left coronary cusp; NCC=non-coronary cusp.

## DISCUSSION

Accurate pre-operative recognition of coronary artery anomaly is essential to minimize postoperative complications in patients with TOF. Injury to an anomalous coronary during right vetriculotomy incision for corrective surgery may lead to myocardial infarction or death.[6] Such vessels should be delineated before the surgery as they may not be seen intraoperatively due to the presence of epicardial fat.[5] Alternative surgical approaches are also to be adopted in such cases.

Angiographic evaluation is the gold standard for coronary evaluation in TOF. In this study, left anterior oblique with cranial angulation was used routinely. This is the recommended angiographic view in literature for coronary angiography in TOF.[13,16] As there is counter clockwise rotation of the aorta in TOF, the right and left coronary sinuses are in a direct anterior-posterior position. This rotation causes overlapping of RCA and LCA in an anteroposterior aortogram. So an aortogram in left lateral view was taken to separate their origins. In most cases we found this angiographic view sufficient for coronary assessment.

Those cases with an unclear coronary course were subjected to another aortogram in the laid back view. Laid backs had been used by O'Sullivan *et al.* in their study as well.[17] This view is particularly useful in cases with single origin coronary arteries to clarify the presence of branch coronary arteries across the RVOT. Such branch coronaries are at the risk of division during ventri-culotomy incision. Other coronary anomalies which do not cross the RVOT are not surgically important. The authors found the laid back view to be very useful in identification of all surgically important coronary anomalies, allowing pre-planned alternative surgical approaches to be adopted.

In this study, a non-selective aortic root angiogram was used for coronary assessment. This has been most commonly used in the paediatric population. However, selective coronary angiography is the preferred technique in some centres due to clear delineation of the origin of coronary arteries.

In this study, 8.4% of the patients had anomalous coronaries. Various angiographic studies by Fellows *et al.*,[9] Hekmat *et al.*,[1] Gupta *et al.*,[2] Dabizzi *et al.*,[3] and Farsani *et al.*,[15] had also reported almost the same incidence of coronary anomalies in TOF. This shows that coronary anomalies are present in a significant number of patients with TOF. This signifies the importance of pre-operative coronary assessment to decrease the operative morbidity and mortality.

The commonest coronary anomaly reported in various studies by Gupta *et al.*,[2] Dabizzi *et al.*,[3] Humes *et al.*,[6] Ruzmetov *et al.*,[7] and Li *et al.*[16] is the anomalous origin of LAD from RCA. The anomalous LAD always courses across the RVOT and, so an additional aortogram is not required in such cases. We did not use additional aortograms in such cases as well.

In this study, a single origin coronary artery was found as the commonest coronary anomaly in TOF, followed by an anomalous LAD from RCA. Such type of distribution had been reported previously by two studies from Iran by Hekmat *et al.* and Farsani *et al.*[1,15] Further studies on a larger population may further support this distribution.

## CONCLUSION

The present study showed that coronary artery anomalies were found in a number of patients with TOF. Pre-operative non-selective coronary angiography delineated such anomalies in 8.4%. Single origin coronary anomaly was the commonest anomaly in this study.

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