

# Surgical strategy for tetralogy of Fallot with abnormal coronary arteries

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Coronary artery anomalies (CAA) are common in many congenital heart disease (1,2) and to know the origin and the course of coronary artery is essential for patients when underwent cardiac catheterization or surgery. In patients with transposition of great arteries the coronary artery course has a very high variability (2,3); also it may cross the superficial face of ventricular infundibulum in children with Tetralogy of Fallot (TOF) (4). In surgical, angiographic, and autopsy series, CAA have been reported in 2% to 14% of patients with TOF (2). Anomalies of the coronary arteries involving the anterior wall of the right ventricle are highly significant and these anomalies can get to many problems at operation (5,6).

There are some anomaly patterns as: origin of the left anterior descending coronary artery (LAD) from right coronary artery (RCA), RCA rising from left coronary artery (LCA), origin of RCA from left descending coronary artery, large conal artery rising from RCA, and only one RCA (7).

Today in most centers, the coronary anatomy is delineated by echocardiography. With a not certain echocardiographic diagnosis, the surgeon is alerted and will examine the proximal coronary arteries. Rarely in patients with TOF, heart catheterization is used as primary indication to study coronary pattern (8). In the last years, also increased the use of cardiac CT scan and MRI for the identification and exact delineation of anomalous coronary arteries in TOF (9).

The presence of an important artery crossing the infundibulum often in the past determined a postponement of primary repair with an initial palliation, usually using a systemic to pulmonary shunt (10).

In the presence of the pulmonary annulus hypoplasia and

coronary anomaly crossing the face of the infundibulum there are some surgical problems. Conversely, when the pulmonary annulus is of normal size these anomalies do not pose a problem because the infundibulum should not be cut. In the last situation, the surgeons can perform a transatrial-transpulmonary approach with the technical advantage to perform a repair though there is an anomaly coronary artery on the infundibulum, avoiding a more extensive and demolitive repair (7).

Already in 1998, Brizard *et al.* (7) after correction in 36 of 611 patients (5.9%), affirmed that an important coronary crossing the infundibulum in TOF can be corrected by the transatrial-transpulmonary approach frequently without many changes in technique. In fact, the results appeared similar to those of others patients with TOF and in conclusion the authors affirmed that the presence of coronary anomalies did not increase the risk after this surgical correction. After a few years, also Kalra *et al.* (9) completed follow-up without reoperation in 18 patients and affirmed that the transatrial-transpulmonary approach is a suitable option and there is no need for an extracardiac conduit. There is no uniformity because more authors said that the residual gradients may be better or do not get worse anyway, but most important is a continued follow-up that is suggested to discover an aggravation of residual gradients (9).

Commissurotomy is always performed in cases of valvular stenosis. When there is hypoplasia of the pulmonary annulus (less than 2 Z-score), must do an enlargement of right outflow tract by transannular patch cutting the annulus of valve, often extended to the pulmonary trunk. Some authors (11) in this situation prefer to avoid the transannular

patch implanting a valved graft, but reoperation for graft replacement is obviously programmed and this is the big limit that makes it the second choice. Even in this situation, Brizard *et al.* (7) privilege to use conservative techniques based on small infundibulotomy or parallel to the abnormal coronary or transatrial-transpulmonary approach. They showed a freedom from reoperation at 120 months of the 96.5%, similar between the two groups of patients, which differed only for coronary anomalies (7).

Also described is a double-barrel technique modified: the surgeon create a flap of anterior pulmonary wall sutured to the right ventriculotomy overlying coronary artery, then an anterior patch reconstruct a conduit and right ventricular outflow tract (RVOT) (12). In 1976 Bonchek (13) described the mobilization of the LAD on the infundibulum, then under the coronary artery created an infundibulectomy and patch enlargement. However, the last two techniques have some technical problem as: conduit compression, potential damage to the anomalous coronary artery and not a good enlargement with residual gradient on RVOT.

Furthermore there are many case reports with special situations and techniques described. For example Balkanay *et al.* (14) performed a right ventriculotomy parallel and distal to the anomaly LAD in a 7-year-old child: through the ventriculotomy the surgeon enlarged the pulmonary annulus with a pericardial patch. The patient was discharged without any problems. They avoided the damage of the coronary artery along its course through linear closure of the right ventriculotomy, and also conduit or valve use.

Recently, Ustunsoy *et al.* (15) presented the early period results of new technique that called "V-Plasty", developed to perform pulmonary valve enlargement and reconstruction in selected patients, without the use of a massive transannular patch. Some authors (16,17) use biomarkers as brain natriuretic peptide or Troponin I that may improve the risk prediction in pediatric cardiac surgery, supporting its routine use in this setting.

In summary, a delineation of coronary anatomy is very important for surgeons and the use of echocardiography can be the only one preoperative diagnostic study in patients with TOF. Rarely is necessary preoperative diagnostic cardiac catheterization to study coronary anatomy more accurately. Many different surgical techniques can be used for complete repair of TOF with coronary arteries crossing the anterior wall of the right ventricle. Transatrial-transpulmonary correction remains the most commonly technique used if possible; while can be avoided in the

majority of patients the placement of an extracardiac conduit with good clinical outcome and by the use of alternative surgical approaches.

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### Footnote

*Conflicts of Interest:* The authors have no conflicts of interests to declare.

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