Anomalous left coronary artery from the pulmonary artery: creating an autogenous arterial conduit for aortic implantation

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Abstract
Anomalous origin of the left coronary artery from the pulmonary artery requires surgical correction. A surgical technique is presented. Two infants underwent re-implantation of their anomalous left coronary arteries by creating a tunnel using autogenous aortic and pulmonary arterial walls. The advantage of this technique is that the new left coronary artery lies in the horizontal plane and in an anatomically correct axis running in the groove behind the pulmonary artery. It also provides a tension free endothelialized autogenous arterial walls with normal growth anticipated. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction
Anomalous left coronary artery arising from the pulmonary artery (ALCAPA) is a rare condition with an incidence of 1 in 30,000–300,000 [1]. The anomaly, if uncorrected, is frequently fatal with a mortality of 90% by 1 year of age [2]. These patients present with symptoms and signs of myocardial ischaemia — as angina and or congestive heart failure in early infancy or as mitral regurgitation in older children. The anomalous left coronary artery (LCA) ostium may be located almost anywhere on the main pulmonary artery or branch pulmonary artery.

The creation of a two-coronary system eliminates the steal phenomenon and restores physiological antegrade flow to the ischaemic left ventricular myocardium. Neches successfully performed direct re-implantation of the anomalous LCA to the aorta from the pulmonary artery in 1974 [3]. Left coronary mobilization with direct implantation into the aorta can be achieved in most patients with low early mortality and excellent long-term outcomes. However, in some, the distance between the orifice of the anomalous LCA and the aorta is excessive and transfer of the anomalous LCA without tension is not possible.

We describe a technique to lengthen the anomalous LCA by creating a tunnel using autogenous aortic and pulmonary arterial walls.

2. Clinical history
Two infants presented with features of ischaemic cardiomyopathy secondary to ALCAPA and were referred for surgical correction.

2.1. Case 1
A 4-month-old boy was evaluated for cough and wheeze. Chest X-ray showed an enlarged cardiac silhouette. Echocardiogram revealed a dilated left ventricle with 13% fraction shortening (FS), a grade III mitral regurgitation and an anomalous LCA arising from the lateral aspect of the posterior-facing sinus of the main pulmonary artery.

2.2. Case 2
A 3-month-old boy was successfully resuscitated following a cardiac arrest secondary to ischaemic heart failure. Chest X-ray showed a left lower lobe pneumonia. Electrocardiogram (ECG) showed sinus rhythm with lateral T-wave inversion, left axis deviation and pathological Q-waves in lead AVL and poor R-wave progression. Echocardiogram demonstrated an anomalous origin of the LCA from the left lateral wall of the main pulmonary artery and poor left ventricular function with FS of 11%.
3. Operative technique

The heart was approached through a median sternotomy. Cardiopulmonary bypass was established via single venous cannulation and ascending aortic return. On commencement of bypass, both pulmonary arteries were snared to facilitate antegrade LCA flow. The patient was cooled to moderate hypothermia (25°C). Myocardial protection was achieved with cold antegrade blood cardioplegia via the aortic root and main pulmonary artery (to provide antegrade perfusion of the ALCAPA). The pulmonary artery was opened and the anomalous LCA ostium identified which was arising from the lateral aspect of the posterior-facing sinus. Despite significant mobilization, critical tension on the anomalous LCA persisted as the distance between it and the aorta was much greater than anticipated.

The aorta was opened and an area was identified in the left coronary sinus to provide a potential site for anastomosis. A flap was cut in the posterior wall of the aorta and swung forwards to form the anterior wall of the new left main stem. Similarly, a flap of the posterior pulmonary arterial wall formed the posterior wall (Fig. 1); thus creating an extended left main stem channel to the aorta (Fig. 2). The aorta was closed end-to-end to complete the suture line. The posterior wall of the pulmonary artery was patched with bovine pericardium and end-to-end closure of the pulmonary artery was undertaken. Both infants made uneventful recoveries.

4. Discussion

The ALCAPA may not reach the aorta despite extensive mobilization. Various options have been suggested to overcome this problem. Early attempts included simply ligating the anomalous artery, or using a vein graft from the aorta to the left anterior descending artery [4], or using the left subclavian artery to create a two-arterial system [5]. Takeuchi, in 1979, introduced the novel method of creating a tunnel from within the mean pulmonary artery (MPA) to connect to the ostium of the anomalous LCA to the aorta via an aortopulmonary window using the pulmonary artery wall [6].

Katsumata described a technique using the native arterial walls to create an extension of the LCA in the vertical plane [7]. Imoto [8] and van son [9] describe using the aortic and pulmonary wall to create the extension of the LCA in the horizontal plane. Imoto’s technique has the neo-LCA lying anterior to the great vessels, while van son’s technique needed rotation of the posteriorly lying proximal LCA for anastomosis.

The advantage of our method is that it is in the horizontal plane and in an anatomically correct axis, and the neo-artery runs in the anatomical groove behind the pulmonary artery. At the 12-month follow-up with Doppler-echo, both patients showed patent neo-LCA and significant improvement in their left ventricular function with FS improving to 41 and 37%, respectively and with normal ECGs. Angiography of the neo-LCA is planned at 2 years follow-up.

In conclusion, this technique provides tension free endothelialized autogenous arterial flaps for the transfer of ALCAPA to the aorta when the anomalous LCA ostium is at
a distance from the aorta. Native tissue is used, minimizing the risk of thrombosis, while normal arterial growth is anticipated.

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References