Case report - Congenital

Thermal coronary angiography in pediatric coronary artery bypass grafting

Takashi Miyamoto,*, Kagami Miyaji, Kuniyoshi Ohara, Tadashi Tashiro

Department of Cardiovascular Surgery, Kitasato University School of Medicine, 1-15-1 Kitasato, Sagamihara, Kanagawa, 225-8555, Japan

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Abstract

A 2-year-old boy was referred to our institution for treatment of coronary artery obstruction after an arterial switch operation (ASO). We performed a pediatric coronary artery bypass graft (CABG) with skeletonized left internal thoracic artery (LITA). The patient was 88 cm tall and weighed 11 kg. The left anterior descending (LAD) coronary artery was also identified about 1 mm in diameter. Anastomotic failure of imposed stricture was detected with an infrared camera (IRIS-V, VERITAS, Tokyo, Japan). In the situation of CABG, thermal coronary angiography (TCA) is very useful to reveal satisfactory blood flow into the left coronary system during this procedure.

Keywords: TCA; Pediatric CABG; LITA-LAD bypass

1. Introduction

The success of the arterial switch operation (ASO) depends on the quality of the transfer of the coronary arteries. The coronary obstruction after ASO is one of the most risky complications of such a procedure with an occurrence that remains significant. We report a case in which a pediatric coronary artery bypass grafting (CABG) by left internal thoracic artery (LITA) graft to the left anterior descending coronary artery (LAD) was successfully used in a patient with proximal left main coronary artery obstruction. In the situation of CABG, thermal coronary angiography (TCA) is very useful to reveal satisfactory blood flow into the left coronary system during this procedure.

2. Case report

A 2-year-old boy was referred to our institution for treatment of coronary artery obstruction after ASO. ASO was performed when the patient was five days of age and 1.5 kg of body weight. We underwent a successful ASO with Lecompte modification by the Paciffico method and VSD direct closure prior to Rashkind procedure.

The patient was discharged one month later. Angiography at one year postoperatively revealed a total obstruction of the left main coronary artery plus collateral vessels which had grown from the right coronary artery into the territory of the LAD.

In February 2006, we performed pediatric CABG with skeletonized LITA. The patient was 88 cm tall and weighed 11 kg. After redo-sternotomy was done, the LITA was dissected free and found to have a diameter of 1 mm. The LAD was also identified to be approximately 1 mm in diameter. Cardiopulmonary bypass (CPB) was instituted with a single right atrial cannula, and the patient was cooled to a nasopharyngeal temperature of 32 °C. After clamping the aorta and administration of crystalloid cold cardioplegia through the aortic root, the LITA was anastomosed end-to-side to the proximal part of the LAD using an 8-0 monofilament running suture. However, anastomotic failure of imposed stricture was detected with an infrared camera (IRIS-V, VERITAS, Tokyo, Japan) (Video 1). Then, we decided to revise the anastomosis subsequently. The anastomosis was revised and resulted in excellent flow in the LAD (Video 2). Weaning from CPB was uneventful after rewarming, the chest was closed and the patient was returned to the ICU in sinus rhythm receiving 5 μg kg⁻¹ min⁻¹ of dopamine. He was discharged on the 11th postoperative day because echocardiography revealed good left ventricle (LV) function. Angiography at one month postoperatively revealed a patent LITA and showed good blood flow into the left coronary system. Thallium scintigraphy was performed three months postoperatively, and showed only a small perfusion defect in the middle portion of the LV anterior wall.

3. Discussion

Coronary ischemic complications at the time of coronary obstruction after ASO have been successfully treated by proximal pericardial patch coronary arterioplasty and pediatric CABG with saphenous vein, LITA, or left subclavian artery graft [1]. A major problem with performing pediatric
CABG for coronary artery obstruction after ASO is complicated coronary anastomosis and their considerable growth postoperatively because the arteries may be too small to be grafted safely. It is very important to carefully select the type of revascularization procedure, which should be performed in each case. We found in the literature approximately 20 patients in which the authors preferred to undergo CABG using one of the internal thoracic arteries [2] and with proximal left arterioplasty [3]. In our report, we decided to perform the pediatric CABG using the LITA, becoming longer as the body surface area increases and the anastomotic orifice grows. Intraoperative evaluation of the performed region and the patency of graft is a guarantee for the success of the CABG procedure. Thermal imaging created by infrared technology provides real-time and easy-to-interpret coronary angiographies as well as graft flow measurements. The temperature difference generated between the myocardium and the coronary arteries by injecting either cold or warm cardioplegic solution by the patient’s own blood running through an internal thoracic artery graft creates angiographic images. When the temperature of the coronary artery is lower than the myocardium, it shows black images; the other way round giving a whiter image. At the present time, TCA is a useful method for intraoperative control of graft patency [4]. Technical failure of the anastomosis, as well as distal native coronary artery disease can be recognized by this method. As TCA imaging technology has developed, not only the problems of misinterpretation of non-restrictive anastomotic strictures or distal coronary artery disease have been overcome but also the flow rates of these distal arteries can now be obtained intraoperatively. Perioperative evaluation of anastomotic patency is especially considered in the pediatric CABG because of the small anastomosis <1 mm. In our case, it helps for the surgeon to decide to revise or replace by TCA. We consider TCA is a secure, non-invasive, reasonable method to guarantee the quality of the myocardial revascularization intraoperatively.

In conclusion, pediatric CABG (LITA to LAD bypass) is a good reconstructive procedure in the coronary obstruction after ASO. TCA is a very useful method to demonstrate the patency of graft intraoperatively.

References


EComment: Intra-operative diagnostics of surgical stenoses of coronary arteries

Authors: Leo A. Bockeria, Bakoulev Scientific Center for Cardiovascular Surgery, Rublevskoe Shosse 135, Moscow 121552, Russia; Arslan S. Karamatov, Tatyana G. Le, Tatyana M. Venglinskaya
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The guarantee for the success of the coronary artery bypass grafting (CABG) both in pediatric and adult practice is a good anastomotic patency. According to the literature, the coronary bypass patency can be established intra-operatively by the following diagnostic methods: standard X-ray angiography, intra-operative imaging system (SPY) using laser fluorescent angiography and thermal coronary angiography. The last one was applied by the authors of the publication [1]. We congratulate the authors on the successful intra-operative detection of anastomotic stricture of left internal thoracic artery and the left anterior descending coronary artery which helped to remove one of the risky complications in proper time. For the first time Intra-operative Imaging System (SPY) using laser fluorescent angiography [2, 3] was applied in the Bakoulev Centre of Cardiovascular Surgery in December, 2006 [4].

Intra-operative laser fluorescent-dye graft angiography with the use of IC Green (indocyamine green dye) provides an excellent real-time imaging of coronary arteries and shunts with speed of 30 shots per second. According to the data, the dye was entered into the central vein, cardiopulmonary bypass apparatus or directly in coronary artery shunts [5, 6].

At this moment the experience of investigation of this method of Intraoperative angiography in our Centre includes 11 patients. In 8 cases, laser fluorescent angiography was used after correction of a congenital heart disease in children at from the age of 7 days up to 3 months: In 3 patients after correction of anomalous left coronary artery from the pulmonary artery and in 5 patients with complete transposition of the great arteries after arterial switch operation. In the other 3 cases, the method was used for evaluation of coronary bypass patency of adults with coronary heart disease (CHD). According to the analysis of all cases the received intra-operative angiograms had precise and accurate images of coronary arteries and shunts; myocardial perfusion defects were not revealed. From our point of view, the most optimal place of introduction of dye at laser fluorescent angiography is the right auricle.

Thus, introduction in clinical practice of intra-operative diagnostic methods of stenoses of coronary arteries (thermal angiography, laser fluorescent angiography) opens new opportunities for early diagnostics of complications and improvements of the results after surgical operations.

References

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