Cardiology in the Young

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Coronary artery bypass grafting in children aged under 1 year: a report of three cases

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Abstract

We performed coronary artery bypass grafting with the internal thoracic artery in three infants. Grafts were patent in all cases. One patient was lost due to chronic heart failure. Coronary artery bypass grafting can be performed even in infancy, and early surgical intervention may be necessary when myocardial ischaemia is recognised.

Brief Report

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Coronary artery bypass grafting in children[1] has been successfully reported; however, there are only a few reports on infant cases.[2] Here, we report three infant cases of coronary artery bypass grafting.

Case 1

A 2-month-old female (3.3 kg), diagnosed with Taussig–Bing anomaly (Shaher 4) and coarctation of the aorta and who had undergone aortic arch repair and arterial switch operation without Lecompte manoeuvre at the age of 9 days, underwent right ventricle-to-pulmonary artery conduit placement for severe pulmonary stenosis after arterial switch. During dissection around the pulmonary artery, the right coronary artery was accidentally injured. Therefore, coronary artery bypass grafting on the right coronary artery was performed using the right internal thoracic artery with antegrade cardioplegic arrest. Aspirin and dipyridamole were administered for antiplatelet therapy. Cardiac catheter examination after 1 year and 7 months revealed the graft patent (Fig 1a) with normal cardiac function. The right ventricle-to-pulmonary artery conduit replacement was performed 2 years postoperatively under ventricular fibrillation because cardioplegic arrest could not be induced due to adhesion. 5 years postoperatively, she was asymptomatic without any signs of myocardial ischaemia.

Case 2

A male was diagnosed with transposition of the great arteries with an intramural course of the left main trunk (Shaher 5a) and had undergone arterial switch with Lecompte manoeuvre at the age of 11 days. During arterial switch, the left main trunk was injured, thus requiring ostial angioplasty using a fresh autologous pericardial patch. During an outpatient clinic 3 months postoperatively, his cardiac function was found to be reduced. Emergent cardiac catheter examination revealed obstruction at the left main trunk and sufficient calibre of the internal thoracic artery (Fig 1b, c). Although we expected to develop collateral arteries, cardiac function worsened. We performed coronary artery bypass grafting on the proximal site of the left anterior descending artery using the left internal thoracic artery at the age of 7 months (7.2 kg). Aspirin was administered for antiplatelet therapy. Two months postoperatively, cardiac catheter examination revealed the graft patent (Fig 1d). However, cardiac function did not recover and inotrope infusion had to be increased. He died because of chronic heart failure 3 months postoperatively.

Case 3

A male was diagnosed with situs inversus totalis and transposition of the great arteries (Shaher 2a) and had undergone arterial switch with Lecompte manoeuvre at the age of 7 days. Two months postoperatively, during a scheduled outpatient clinic, his cardiac function was found to be reduced. Emergent cardiac catheter examination revealed ostial stenosis of the left anterior descending artery. We performed ostial angioplasty of the left anterior descending artery using the innominate vein patch. His cardiac function recovered temporarily; however, 3 months later, it had reduced again due to re-stenosis. We performed coronary artery bypass grafting on the left anterior descending artery using the right internal thoracic artery at the age of 5 months (7.0 kg). Aspirin and ticlopidine were administered for antiplatelet therapy. One year postoperatively, cardiac catheter examination revealed the graft patent with recovered cardiac function

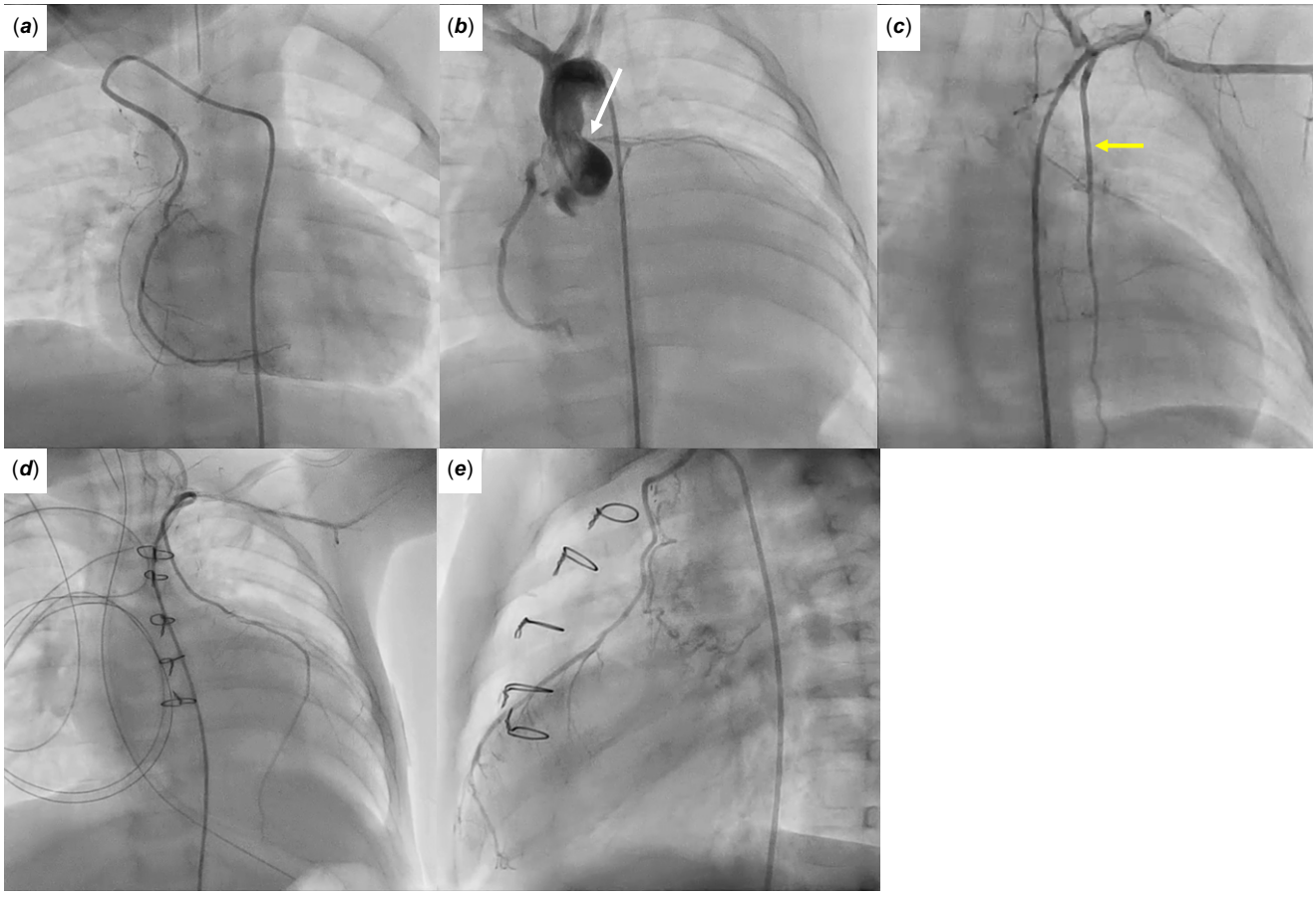

Figure 1. Angiography. (***a***) Post-operative angiography in case 1. (***b***) Pre-operative angiography in case 2. The white arrow indicates stenosis of the left main trunk. (***c***) Pre-operative angiography in case 2. The yellow arrow indicates the left internal thoracic artery. (***d***) Post-operative angiography in case 2. (***e***) Post-operative angiography from left lateral view in case 3.

(Fig 1e). One year and 6 months postoperatively, he was asymptomatic without any signs of myocardial ischaemia.

Discussion

Paediatric coronary artery bypass grafting is technically challenging, and it is difficult to decide whether it should be performed immediately or wait for the patients' somatic growth and development of the collateral arteries when coronary artery obstruction is recognised.

The small calibre of the vessels is the biggest issue with coronary artery bypass grafting in infancy. Mavroudis et al. reported[3] that 0.7 mm is the threshold value for small vessel anastomosis with proper magnification. For our three cases, cardiac examination revealed that internal thoracic artery calibre was 1.1, 1.5, and 1.0 mm, respectively. However, in case 3, calibre was approximately 0.8 mm intraoperatively, even though the transection was made relatively proximal to the artery. This is most likely due to an internal thoracic artery spasm. Effective length of the internal thoracic artery is a recurrent issue in infants, due to their small size; therefore, anastomosis has to be performed proximal to the coronary artery.

We performed coronary artery bypass grafting under antegrade cardioplegic arrest to anastomose small arteries. In case 2, retrograde cardioplegia was used concomitantly. Transection of the pulmonary artery was not necessary in cases 2 and 3 with Lecompte manoeuvre. Anastomosis of the arteries was performed with interrupted suture in case 1 and with running suture in cases 2 and 3 using 8-0 polypropylene. Shafarenko et al. reported[4] paediatric coronary artery bypass grafting using the microscope. However, because our team did not have enough experience with the microscope, we performed the operations using usual surgical loupes. Each operation was performed by a different surgeon. In cases 2 and 3, surgeries were performed by an adult coronary artery surgeon.

In case 2, we expected to develop the collateral arteries. In some cases of coronary artery obstruction after arterial switch, no evidence of myocardial ischaemia was recognised because of development of the collateral arteries.[5] On the contrary, Tanel et al. reported[6] that coronary artery obstruction may lead to catastrophic coronary events even in the asymptomatic patients. Kondo et al. reported[7] that cardiac denervation was one of the mechanisms for this asymptomaticity. Moreover, it is difficult to detect symptoms of myocardial ischaemia in infants. Therefore, routine electrocardiogram, echocardiogram, and blood examination including B-type natriuretic peptide should be performed. In our case, regardless of the development of the collateral arteries, cardiac function was reduced. The viability of the myocardium was lost probably because of the rapid progression of coronary artery obstruction and the late development of collateral arteries. Therefore, we considered early surgical intervention when coronary artery obstruction was recognised, regardless of the presence

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or absence of myocardial ischaemia. After arterial switch, we perform catheter examination 1 year postoperatively for routine follow-up. After revascularisation for coronary artery stenosis like these cases, we perform catheter examination 1–2 months postoperatively, before discharge, and 1 year postoperatively. Aspirin with or without other antiplatelets was administered in all cases.

In conclusion, coronary artery bypass grafting in infancy using the internal thoracic artery and its early and mid-term patency was feasible. However, if revascularisation is performed too late, cardiac function cannot be recovered, even if the operation is successful. Early surgical intervention may be necessary when coronary artery obstruction is recognised.

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Conflicts of interest. None.

Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national guidelines on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008, and has been approved by the institutional review board (Hyogo Prefectural Amagasaki General Medical Center, ID: 4-163).

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