

Surgical Treatment of Coronary Malperfusion with Acute Type A Aortic Dissection

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Coronary malperfusion associated with aortic dissection is relatively rare, which has been reported at 5.7%–11.3%,^[1] but when it occurs, it is fatal to the patient. Despite improved therapeutic techniques for aortic dissection over the years, surgical treatment for the uncommon condition of aortic dissection with coronary malperfusion is still premature. Prompt coronary revascularization and concomitant surgical repair of the aorta are essential for dealing with this problem. To date, the surgical management for this condition relies on various techniques, which include coronary artery bypass grafting (CABG) and repair coronary vessels.^[1,2] However, the optimal surgical strategy for coronary revascularization is still debated. In this study, we reviewed our experience with aortic dissection involving the coronary artery in 36 patients, which evolved over a 14-year period, aiming to provide alternative options in the face of this scenario.

CLINICAL DATA

From January 1999 to December 2013, totally, 371 consecutive patients with type A aortic dissection underwent surgery at Department of Cardiothoracic Surgery, Shanghai Hospital, The Second Military Medical College, China. Among them, 36 patients (36/371, 10%; 25 men and 11 women; mean age: 49.7 ± 13.5 years) suffered coronary malperfusion due to dissection of coronary ostia, they had electrocardiographic signs of myocardial ischemia (including new ST-segment elevation more than 0.1 mV and/or Q waves). None of these patients had a history of coronary artery disease which was evaluated by epicardial palpitation in surgery. Preoperative coronary angiography was not performed. Electrocardiogram changes and wall motion abnormalities on preoperative echocardiography revealed preoperative myocardial infarction in seven (7/36, 19%) patients. Preoperative

echocardiography showed that all the patients had aortic regurgitation, and six (6/36, 17%) patients had mitral regurgitation because of papillary muscle dysfunction. Mean preoperative left ventricular ejection fraction was 41% (range from 27% to 53%). The data were retrospectively collected from the database for the Division of Cardiothoracic Surgery, which was approved by the Institutional Review Board of Shanghai Hospital.

According to the Neri's definition of coronary malperfusion in aortic dissection,^[2] we differentiated among three types of lesions based upon operative findings: type A ($n = 23$), ostial dissection is defined as a disruption of the inner layer limited to the area of the coronary ostium without disrupting coronary vessel; type B ($n = 8$), dissection with a coronary false channel; and type C ($n = 5$), circumferential detachment with an inner cylinder intussusception.

All patients underwent an urgent operation. The aortic root should be replaced, if the condition involving any of these pathologies; Marfan syndrome, aortic valve pathology, intimal tear in sinus, root aneurysm (>4.5 cm), and known connective tissue disorders. Otherwise, the procedure of aortic valve-sparing was performed. The ascending aorta was replaced with trunk of a 4-branch prosthetic graft (Boston Scientific Inc., Boston, Massachusetts, USA). The technique of revascularization depended on the type and extent of the lesion. For type A coronary malperfusion, the coronary

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ostium was repaired with a continuous 6-0 over-and-over suture conjoining the dissected arterial layers, leaving the ostium in continuity with the aortic wall or directly anastomosing the ostial button to the tube graft. In the case of type B coronary artery dissection, the coronary artery was transected in a nondiseased zone, and short graft was performed with saphenous vein or polytetrafluoroethylene artificial graft (Gore-Tex, W.L.Gore&Associates, Inc., Flagstaff, Arizona, USA) by a continuous 7-0 polypropylene suture [Figure 1]; in the case of type C coronary artery dissection, the proximal coronary artery was ligated, then CABG was performed using saphenous vein graft [Table 1].

Hospital mortality was 14% (5/36), which was higher than the mortality without coronary malperfusion (26/335, 8%). The early deaths were due to multiorgan failure ($n = 2$), low cardiac output syndrome and heart failure ($n = 1$), renal failure ($n = 1$), and infection ($n = 1$). Five patients suffered prolonged heart failure and required long hospitalization but was discharged from the hospital with recovery. Postoperative hemorrhage necessitating reoperation developed in two patients. Moreover, one patient suffered acute renal failure requiring temporary hemodialysis. Transient neurologic

dysfunction was observed in six patients and was discharged without any neurologic deficit.

DISCUSSION

Coronary malperfusion associated with aortic dissection is relatively rare.^[1] Our study demonstrated the incidence of coronary malperfusion pathology was 9% of the general acute type A aortic dissection, which was similar to the previous reports.^[1,2] Although the angiography is the gold standard to evaluate the coronary anatomy and to discriminate acute coronary artery disease caused by ostial involvement from chronic coronary artery disease, the role of this examination is still controversial when the aortic dissection is concomitant suspected. Therefore, we did not perform preoperative coronary angiography. In the absence of coronary angiography, electrocardiogram and echocardiography maintain their importance in the evaluation of malperfused myocardium. We observed that the diagnose result of electrocardiogram reflecting the location of preoperative Q waves during coronary malperfusion paralleled with the sign of wall motion abnormalities which was clearly indicated by echocardiography.

Several studies reported on the treatment of coronary dissection with stent implantation, both into the right coronary artery and left main coronary trunk.^[3,4] This procedure generating a prompt and adequate myocardial blood flow and thereby can prevent extensive myocardial damage. However, it is not always a straightforward procedure in patients with aortic dissection because of the presence of intimal flaps. Therefore, the surgical operation is considered to be the optimal strategy. Neri *et al.*^[1] preferred repairing of dissected coronary arteries over CABG and described various local repair techniques. They mentioned the advantages of local repair including anatomic reconstruction of the coronary artery ostia and avoidance of complete graft-dependent perfusion of large areas of the myocardium, as well as the preservation of antegrade flow in

Table 1: Clinical characteristics of patients and operative details

Variables	Values
Age (years, mean \pm SD)	49.7 \pm 13.5
Male	25 (69)
Hypertension	31 (86)
Preoperative myocardial infarction	7 (19)
Stroke	1 (3)
Resuscitation	1 (3)
Aortic regurgitation	36 (100)
Mild to moderate	13 (36)
Severe	23 (64)
Mitral regurgitation	6 (17)
Cardiac tamponade	7 (19)
Atrial arrhythmias	19 (53)
Ventricular arrhythmias	3 (8)
Anterolateral ischemia	12 (33)
Inferior ischemia	20 (56)
Anterolateral Q waves	2 (6)
Inferior Q waves	5 (14)
Operative details	
Cardiopulmonary bypass time (min, mean \pm SD)	191.7 \pm 35.4
Cross-clamp time (min, mean \pm SD)	114.5 \pm 29.6
Circulatory arrest time (min, mean \pm SD)	28.6 \pm 10.7
Proximal procedure	
Valve-sparing technique	6 (17)
Composite graft	30 (83)
Procedure of coronary revascularization	
Local repair	23 (64)
Short graft	8 (22)
Coronary artery bypass grafting	5 (14)
Concomitant procedure	
Mitral valve repair	4 (11)

Values are presented as n (%) or mean \pm standard deviation (SD).

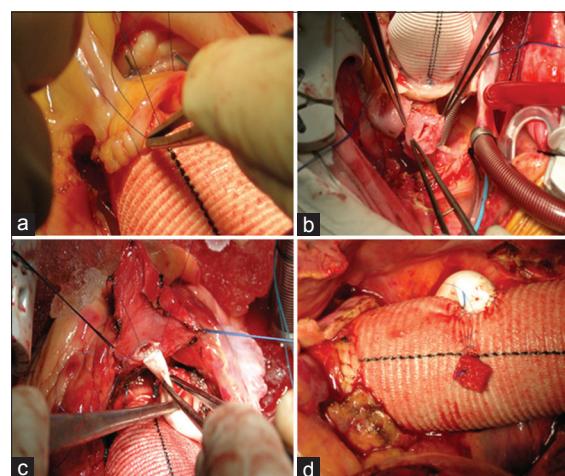


Figure 1: The surgical procedures for type A and type B coronary malperfusion patients. (a) Direct reimplantation was performed for type A coronary malperfusion; in type B coronary dissection. (b) The coronary artery was transected in a nondiseased zone. (c and d) Short graft was performed with Gore-Tex graft (diameter: 6 mm) by a continuous 7-0 polypropylene suture.

the coronary trees thus avoiding the risk of competitive flow and coronary re-dissection. However, mobilization and repair of acutely dissected coronary arteries are potentially dangerous and problematic. Therefore, others reported that CABG was preferable to local repair because the procedure was simple and less invasive.^[2,5] In our study, the different techniques were dependent on the type and extent of the coronary artery lesion. At type A coronary artery dissection, for avoiding a permanent need for anticoagulation and potential adverse of the vein grafts, local repair was performed with a continuous suture conjoining the dissected artery layers, leaving the ostium in continuity with the aortic wall. At type B coronary dissection, for the avoidance of complete graft-dependent perfusion of large areas of the myocardium, the coronary artery was transected in a nondiseased zone, and short graft was performed with saphenous vein or polytetrafluoroethylene artificial graft. At type C coronary dissection, the CABG procedure was performed in order to simplify the operation process. The results showed that the outcomes of primary procedure were acceptable.

In summary, acute type A aortic dissection with coronary involvement is associated with high mortality rate; accurate diagnosis and early operation are the key factors in the management of these patients. The operative techniques for coronary malperfusion depend on the type of coronary lesion.

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Conflicts of interest

There are no conflicts of interest.

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