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Brief communication - Cardiac general

# Simultaneous multi-vessel coronary artery bypass grafting, ischemic mitral regurgitation repair and descending aortic aneurysm replacement: analysis of technical points☆

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**Abstract**

The combination of coronary artery disease and its complications (ischemic mitral regurgitation etc.) with the aneurysm of the descending thoracic aorta is not a rare case. The single-stage correction of coronary/intracardiac/aortic lesions may be considered as a way of managing the combined patients. Simultaneous multi-vessel coronary artery bypass grafting, suture mitral annuloplasty and descending aortic aneurysm replacement with synthetic prosthesis is described. The operation was performed through the left thoracotomy with cardiopulmonary bypass established by the cannulation of the ascending aorta and of the right atrial appendage. Ventricular fibrillation and no clamping of the ascending aorta were used. The circulatory arrest was induced for the construction of the proximal anastomosis between the descending aorta and the synthetic prosthesis. No complications related to the operation were diagnosed for the 14-month follow-up. Several technical points seem optimal for the combined procedure: (1) Minimization of manipulations on the ascending aorta (using of pedicled left internal thoracic artery; construction of the proximal anastomoses with synthetic aortic prosthesis; unclamped ascending aorta). (2) Revascularization of all coronary areas and correction of intracardiac lesions through the left thoracotomy. Individual planning of the procedural technical points for every patient may provide a safe feasibility of the combined procedure.


*Keywords:* Coronary artery surgery; Descending aortic aneurysm; Simultaneous operation; Left anterolateral thoracotomy; Suture mitral annuloplasty

## 1. Introduction

The combination of the coronary artery disease (CAD), the ischemic mitral regurgitation (IMR) with the descending thoracic aortic aneurysm (DTAA) is not a rare case. Each of the concomitant lesions may affect the results of the isolated surgery of the others [1, 2]. The single-stage correction of coronary/intracardiac and aortic lesions may be considered as a way of managing the combined patients.

## 2. Materials and methods

A 57-year-old man was admitted in June 2006 with the proximal occlusion of the dominant circumflex coronary artery (Cx), 50% stenosis of the diagonal artery (DA), IMR 3+ (scale 1+ to 4+) and the dissecting degenerative DTAA (Fig. 1).

The operation was performed on 17 June 2006. The left anterolateral thoracotomy (LTT) through the fifth intercostal space with a little extension of the backward incision was made. Following the pericardial opening, diagonal, obtuse marginal and circumflex arteries were identified. The harvesting of LITA and autovenous grafts was done. The cardiopulmonary bypass (CPB) was established by ascending aortic and right atrial appendage cannulation. The ascending aorta was not clamped. The left atrium was incised at the base of the appendage along the entrance of the left inferior pulmonary veins into the left atrium. The mitral leaflets were slightly fibrotic. The semicircular suture annuloplasty (MASS) [3] was performed with a 2-0 running suture (Gore-Tex, CV-2) on caliber N28. After the atrial closure, LITA was anastomosed to DA, 'Y'-shaped autovein graft to obtuse marginal (OM) and Cx arteries (Video 1). CPB was stopped, and the aneurysmal sac was opened. The aneurysm showed double lumens with thrombosis of the false one. The intercostal arteries were obstructed with thrombotic masses which allowed not to reconstruct them. The proximal aortic anastomosis was created with a 26-mm prosthesis Gelweave™ (VASCUTEK) using the clamp-less technique. Then, prosthesis was cross-clamped and CBP was reinstituted. The circulatory arrest time was 17 min. After the distal aortic anastomosis construction, the proximal end of the 'Y'-shaped graft was anastomosed with the aortic prosthesis (Video 2). After rewarming, deairing under TEE control, the patient was

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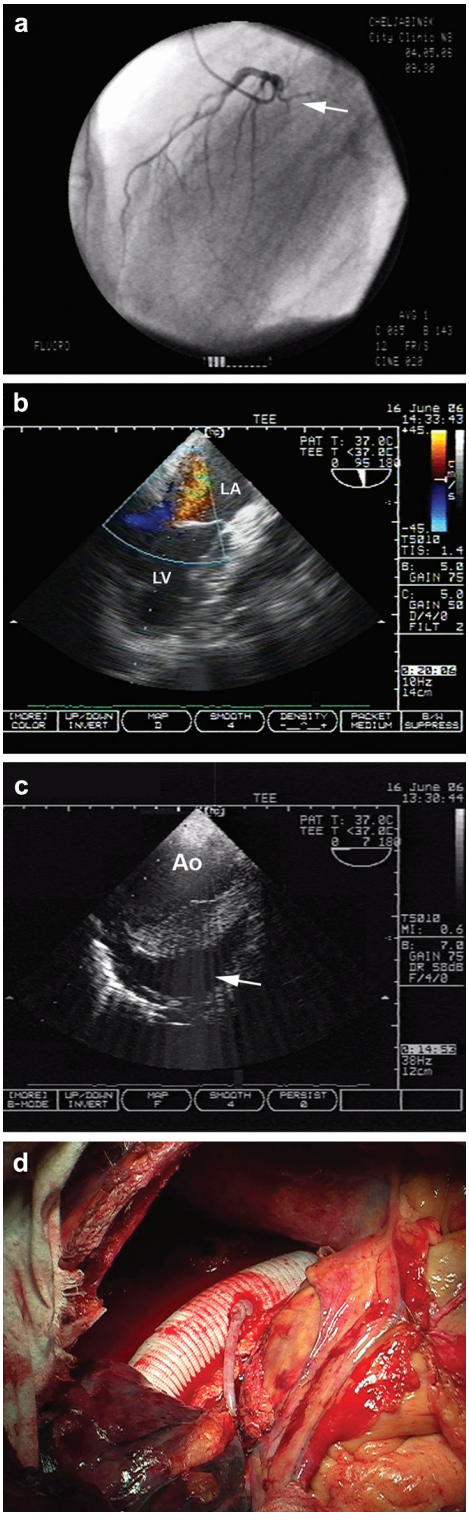
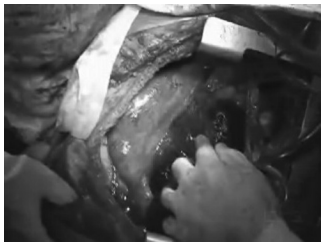



Fig. 1. (a) Left coronary angiogram showing no collaterals to the distal branches of the left circumflex artery resulting in the extensive posterior area free of coronary vessels. (b) TEE demonstrating the double lumen of the descending aorta (Ao) with the signs of thrombosis of the false lumen (arrow). (c) TEE showing the preoperative mitral regurgitation. LA, left atrium; LV, left ventricle. (d) The view of the prosthesis of the descending thoracic aorta with the proximal anastomosis with the auto-vein graft.


Video 1. Coronary and intracardiac stages of combined procedure: (i) LITA harvesting via LTT. (ii) Semicircular suture mitral annuloplasty (MASS procedure). (iii) Distal anastomoses to coronary arteries. LITA, the left internal thoracic artery; LTT, the left thoracotomy; MASS, the mural annulus shortening suture.



Video 2. (i) Aortic stage of combined procedure (construction of the proximal and distal aorticanastomoses). (ii) Construction of the proximal coronary anastomosis with synthetic prosthesis of the descending thoracic aorta.

weaned from CPB with moderate dopamine support. The CPB time amounted to 147 min.

## 3. Results

The postoperative course was complicated by rethoracotomy resulting from the diffuse bleeding and the superficial wound infection. No complications related to the combined operation were diagnosed for the 14-month follow-up period.

Several technical points seem optimal for the single-stage procedure through LTT:

- Minimization of manipulations on the ascending aorta:
  - using of pedicled LITA;
  - formation of the all proximal coronary anastomoses with synthetic aortic prosthesis;
  - unclamped ascending aorta;
- Revascularization of all coronary areas and correction of intracardiac lesions through LTT.

## 4. Discussion

The conventional management of CAD to DTAA combination includes performance of PTCA/CABG prior to the aortic surgery. However, PTCA is not capable of repair of the secondary CAD complications (IMR etc.). The aortic surgery preceded by CABG brings a risk of an aneurysmal rupture between operations because of activation of bioactive substances that directly affect the aneurysmal wall.

Another surgical option for combined CAD/DTAA is the single-stage correction of coronary/intracardiac and aortic lesions [4–8]. Inherent in single-stage procedure, a heavier bleeding and a longer operating time are conditioned by

Table 1
Published cases of combined CABG and replacement/repair of thoracic descending aortic aneurysm

| Author, year of publication | Number of the affected coronary vessels | Vessels undergoing revascularization | Coronary angiography |
|---|---|---|---|
| Takamoto S. et al., 1993 | 1 (LAD) | 1 (LAD) | Not presented |
| Yamanaka J. et al., 1995 | 1 (CX) | 1 (CX) | Not presented |
| Mukohara N. et al., 1996 | 1 (OM) | 1 (OM) | Not presented |
| Mihaljevic T. et al., 1999 | 1 (LAD) 1 (PDA) | 1 (LAD) 1 (PDA) | Not presented |
| Ohtani N. et al., 2000 | 3 (LAD, OM, ***RCA***) | 2 (LAD, OM) | Presented |
| Ener S. et al., 2001 | 3 (CX, ***LAD***, ***RCA***) | 1 [OM (CX)] | Presented |
| Nakamura Y. et al., 2001* | 2 (LAD, RCA) | 2 (LAD, RCA) | Not presented |

The mean number of the distal anastomoses per patient – 1.25
CABG, coronary artery bypass grafting; LAD, left anterior descending coronary artery; CX, circumflex coronary artery; OM, obtuse marginal coronary branch; PDA, posterior descending artery; RCA, right coronary artery.
***RCA***, ***LAD***, ***RCA***, the coronary arteries presented as narrowed but were not grafted.
*RCA was grafted via the upper mid-abdominal skin incision as a separate approach.

the different approaches to the cardiac structures and to the descending aorta [2].

The endovascular treatment of DTAA combined with CABG is the most common single-stage strategy. However, the aneurysm rupture, microembolization, paraplegia owing to absence of intercostal artery reconstruction, endoleaks, graft migration, left subclavian artery occlusion and aorto-esophageal fistulas were described as endovascular treatment complications [3]. The occlusive vascular disease of the iliofemoral arterial segment is a contraindication for stent-graft setting via the femoral approach [3].

Insertion of a stent-graft in the descending thoracic aorta through a small linear incision on the anterior wall of the aortic arch during coronary/intracardiac operation was described as a way of avoiding of the femoral approach [9]. However, this technique does not eliminate other probable complications of the endovascular treatment.

LTT may be regarded as the optimal approach for combined procedure, because it provides an excellent exposure of the distal segment of the aortic arch [4], the descending thoracic aorta, LITA, the left coronary branches, the left atrium, the mitral valve, the apex of the left ventricle and even of the ascending aorta and the right atrial appendage [1, 5–8].

The question is whether LTT is suitable for the complete myocardial revascularization. Although the analysis of the published articles concerning combined aortic/CABG surgery showed that the mean number of distal anastomoses per patient was only 1.25, and some authors had permitted incomplete revascularization in their cases (Table 1), we believe that all coronary territories are achievable through LTT.

For the reason of limited exposure and handling of ascending aorta via LTT, a new resource for the proximal coronary anastomotic sites should be considered. The synthetic prosthesis of the descending aorta is of special interest as a site for proximal anastomoses [6] due to easy approachability for surgical manipulations and the vast space for anastomotic constructions.

The patency rate of the vein grafts anastomosed from synthetic prosthesis to the native coronary arteries was shown to be similar to that of conventional CABG [10]. However, the length of the conduit should be sufficient for a smooth curving in order to avoid kinking when the left lung is inflated [1]. The excessive shunt material consumption in case of the multi-vessel CABG may occur. The use of the composite venous grafts helps in shunt material saving.

Repair/replacement of the mitral valve through LTT was common in the past era of the closed mitral comissurotomy in cases of failing procedures. The excellent exposure of the left ventricle apex and the opportunity of the apical ventricular venting allow safe deairing of the left heart chambers. To reduce the overall operation time, a less time consuming procedure – MASS [3] may be performed.

In our case, the complex procedure became feasible due to a favorable combination of the anatomical features of lesions. Individual planning of the procedural technical points for every patient may provide a safe feasibility of the combined procedure.

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