Transapical aortic valve implantation and minimally invasive off-pump bypass surgery

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Abstract

Transcatheter aortic valve implantation (TAVI) has gained increasing popularity for high-risk patients with symptomatic aortic valve stenosis. A concomitant coronary artery disease leads to a complicated management and an increased perioperative risk. This case report describes the successful total arterial coronary revascularization of the left anterior descending and the left marginal branch of the circumflex artery utilizing the left internal mammary artery (LIMA) and left radial artery in off-pump technique in combination with the transapical transcatheter aortic valve implantation via minimally invasive anterolateral access in the fifth intercostal space.

Keywords: Aortic valve, replacement • Coronary artery bypass graft • Heart valve, transapical • Minimally invasive surgery • Off-pump surgery

CASE REPORT

An 83-year old man was admitted to our hospital with increasing dyspnoea, currently according to NYHA IV (New York Heart Association class IV). Although the patient denied an angina pectoris (CCS 0—Canadian Cardiovascular Society Angina Classification), the ECG findings as well as the paraclinical exams identified an ischaemic cardiac event. Echocardiography revealed the progression of a previously known moderate aortic stenosis with a current aortic orifice area of 0.5 cm² without aortic regurgitation and ΔPmean 44 mmHg, and hypertrophic left ventricle with a preserved systolic LV-function (LVEF = 66%). Additionally, the patient had mild mitral and tricuspid valve regurgitation. Selective coronary angiography demonstrated severe two- vessel coronary artery disease (CAD) with significant stenosis of the left anterior descending artery and the left circumflex artery. Comorbidities included extracardiac arteriopathy with previous thrombendarterectomy of the left carotid artery, severe asymptomatic calcification of the aorta as well as the iliac and femoral arteries, pulmonary hypertension and deforming spondylosis of the thoracic spine. Additionally, the patient just recovered from a recently performed gastrectomy. The preoperative risk calculation (EuroSCORE I = 36.86%, EuroSCORE II = 5.52% and Society of Thoracic Surgeons-score = 11.24%) verified the clinically anticipated elevated perioperative risk.

Due to the complex nature of coronary stenosis, surgical revascularization was favoured. Based on the experiences with total arterial coronary revascularization via anterolateral mini-thoracotomy in our department, the interdisciplinary board (TAVI-Team) proposed the option of a combined minimally invasive coronary artery off-pump revascularization (MIC-OPCAB) with a simultaneous transcatheter aortic valve implantation (TAVI).

The procedure was performed in a hybrid operating theatre equipped with fluoroscopy (Siemens Artis Zeego; Siemens, Munich, Germany), endoscopic tower (Vasoview® 6 Endoscopic Vessel Harvesting System, Maquet, Inc., Wayne, NJ, USA) and transoesophageal echocardiography (TOE) (GE Vivid; GE Healthcare Ltd, Buckinghamshire, UK) in general anesthesia and double-lung intubation.

After preoperative testing of the palmar arch (negative Allen’s test), the left radial artery was harvested endoscopically (Vasoview® 6, Maquet, Inc., Wayne, NJ, USA). Simultaneously, an anterolateral minithoracotomy via the fifth intercostal space was performed. The left internal mammary artery (LIMA) was harvested under direct visualization in skeletonized fashion. After systematic heparinization, the free radial artery graft was anastomosed end-to-side to the in situ LIMA (Fig. 1). Utilizing a conventional off-pump stabilizer (Octopus® Evolution, Medtronic, Minneapolis, MN, USA) and intra-coronary shunts (1.5 mm, Medtronic), we initially bypassed the radialis graft to the LAD artery. After re-exposure, the radialis graft was anastomosed to the marginal branch. Both intraoperative results were validated by ultrasonic flow measurements (VeriQ, Medistim Deutschland GmbH, Deisenhofen, Germany).

After successful coronary revascularization, the same incision was used for the standardized transapical TAVI procedure [1]. The apex of the heart was exposed and two transmural purse-strings were placed protected by Teflon pledgets. The necessitated pacemaker was implanted epicardially and the transapical TAVI
A procedure with precise deployment of a 26 mm Edwards Sapien XT prosthesis (Edwards Lifesciences, Irvine, CA, USA) was performed uneventfully. Subsequent TOE and angiography showed only a trace aortic regurgitation. The technical setting was used additionally for validation of both grafts with encouraging run-off (Fig. 2). The total operation time (skin-to-skin time) lasted 290 min.

The patient was extubated in the operating theatre and transferred to the intensive care unit in stable haemodynamic status. The patient was discharged from the ICU 2 days after initial surgery and no adverse events occurred during hospital stay. The initial follow-up echocardiography 50 days after the procedure revealed a transvalvular gradient of $\Delta P_{\text{mean}} = 11$ mmHg. The patient presented with a clinically improved NYHA-classification and is alive (NYHA I) 17 months after his operation.

**DISCUSSION**

TAVI-candidates with accompanying CAD may benefit from preoperative percutaneous coronary intervention (PCI). For patients with complex coronary stenoses, therapeutical alternatives are rare. For these patients the combination of surgical off-pump coronary revascularization and transapical TAVI procedure can avoid extracorporeal circulation as well as complete sternotomy. Such combinations consisting of minimally invasive single-artery bypass and TAVI have been described previously [2].

The revascularization of patients with two or even three vessel disease via an anterolateral mini-thoracotomy has been published before [3]. In consequence of our experiences in treating multi-vessel disease via both mini-thoracotomy and transcatheter valve implantations, we combined those procedures successfully.

In conclusion, the described procedure enlarges the therapeutical options for complex high-risk patients with aortic stenosis and severe CAD that would benefit from surgical treatment.

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**REFERENCES**

