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European Journal of Cardio-Thoracic Surgery 62(2) (2022) 1–3
https://doi.org/10.1093/ejcts/ezac306 Advance Access publication 12 May 2022

CASE REPORT

Cite this article as: Squiccimarro E, Margari V, Paparella D. Bilateral mini-thoracotomy for combined minimally invasive direct coronary artery bypass and mitral valve repair. Eur J Cardiothorac Surg 2022; doi:10.1093/ejcts/ezac306.

Bilateral mini-thoracotomy for combined minimally invasive direct coronary artery bypass and mitral valve repair

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Received 28 January 2022; received in revised form 14 April 2022; accepted 5 May 2022

Abstract

Consistent evidence recognizes minimally invasive valve surgery as the top-tier surgical approach for heart valve pathology. Conversely, the overall adoption of minimally invasive coronary surgery remains low. Notwithstanding, excellent clinical outcomes have been recently reported, further consolidating a technique that addresses major concerns associated with the traditional approach for the most frequently performed cardiac operation, including sternal dehiscence (i.e sternal sparing) and stroke (i.e. no-touch aorta), but that also guarantees a reduced resort to blood transfusions, diminished pain and faster recovery. More to the point, the suitability of minimally invasive strategies for combined coronary and valve procedures remains debateable. Almost no reports of such combined procedures are available in literature and the very few published experiences appear scarce and heterogeneous about the surgical access (i.e. single versus bilateral mini-thoracotomy). However, bilateral mini-thoracotomy has been proposed as a feasible and safe strategy for different cardiac operations like surgical ablation and left ventricular assist device implantation, but also for isolated multivessel minimally invasive coronary surgery. Here, we describe the feasibility of combined minimally invasive mitral valve and coronary surgery performed through bilateral mini-thoracotomy and we report outcomes of our initial series of 3 cases.

Keywords: minimally invasive mitral valve repair • minimally invasive direct coronary artery bypass • minimally invasive cardiac surgery

CASE SERIES

In December 2021, 3 patients underwent combined minimally invasive mitral valve repair (MVr) and direct coronary artery bypass (MIDCAB). Patients' characteristics are shown in Table 1 as well as mitral and coronary imaging features, intraoperative and postoperative data.

A double-lumen endotracheal tube was used. Two inflatable bags were positioned bilaterally at the patients' scapula level for selective hemi-thorax elevation during MIDCAB (left) and MVr (right). Heparin was administered with a target activated clotting time of 420 s. Percutaneous cannulation of the right internal jugular vein was performed (Fig. 1A).

MIDCAB was accomplished via a 6-cm anterolateral left mini-thoracotomy at the fifth intercostal space (IS). The left internal thoracic artery (LITA) was harvested under direct vision proximally to the first rib and distally to 1 cm pre-bifurcation (i.e., satisfactory mobilization) resorting to a retractor (ThoraTrak^{TM}, Medtronic, USA). A mini-pericardiectomy allowed the off-pump distal anastomoses on the left anterior descending artery (LAD) by using a transthoracic epicardial stabilizer (Octopus^{TM} Nuvo, Medtronic, USA), and an adequately sized intracoronary shunt. Routine intraoperative transit time flowmetry was performed.

A 3-cm right groyne incision exposed the femoral vessels which underwent transesophageal echocardiography (TEE)-guided cannulation (Seldinger). Totally endoscopic MVr was accomplished via a 6-cm right anterolateral mini-thoracotomy above the nipple, at the fourth IS. A soft-tissue retractor was adopted, and trocars were placed at the fourth and sixth IS for 3D thoracoscopy (TIPCAM1^{TM}, Karl Storz, Germany) and CO_2 insufflation. After right-to-left switching of selective ventilation and hemi-thorax elevation, the chest was safely entered allowing a pericardiectomy 2–3 cm above the phrenic nerve. An aortic needle was placed through the working incision for cardioplegia delivery and aortic venting. Normothermic cardiopulmonary bypass was established. Aortic cross-clamp was achieved via a Chitwood clamp placed through the second IS at the anterior right axillary line, antegrade blood-crystalloid 'St. Thomas I' cardioplegia was administered. The LITA-LAD graft was temporarily occluded (i.e. via left thoracotomy) throughout cardioplegia administration. All patients underwent ring annuloplasty, 2 patients received a quadrangular resection of the posterior leaflet and 1 patient underwent concomitant monopolar ablation and double-layer linear left atrial appendage closure from within the atrium, performed via the right mini-thoracotomy.

Routine computerized tomography (CT) angiography was performed before hospital discharge to ascertain the LIMA-LAD

Table 1: Pre-, intra- and postoperative data

Preoperative data			
Patients		3	
Age (years), mean ± SD		60 ± 4	
Male, *n* (%)		3 (100%)	
LVEF (%), mean ± SD		55 ± 0	
eGFR <85 ml/min (%)		0 (0%)	
EuroSCORE II (%), mean ± SD		1.6 ± 1.4	
	Patient 1	Patient 2	Patient 3
BMI (kg/m^2)	30.45	24.12	26.84
Previous PCI	Yes	No	No
Persistent atrial fibrillation	Yes	No	No
Mitral pathology			
Carpentier's classification	Type I	Type II	Type II
Mitral regurgitation	Severe	Severe	Severe
Annular dilatation	Yes	No	No
Posterior leaflet prolapse	No	Yes	Yes
Chordal rupture	No	Yes	Yes
LAD			
Stenosis >75%	Yes	Yes	Yes
LAD segment	Proximal	Mid	Mid
FFR	0.72	0.68	0.72
Operative time (min)			
LITA harvest	18	22	25
Distal anastomosis	25	27	23
CPB	118	102	105
Cross-clamp	82	74	78
Total operative time	247	220	230
Postoperative results			
Intensive care unit stay (h)	24	24	48
Mechanical ventilation (h)	6	4	5
Postoperative stay (days)	8	6	7
VAS (1st postoperative day)	1–3	1–3	1–3
Tn-I (ng/ml)	11	9	6
CK-MB (ng/ml)	32	28	24
TIA/stroke	–	–	–
Postoperative atrial fibrillation	–	–	–
Surgical re-exploration	–	–	–
Groyne complications	–	–	–
Transfusions	0	0	1

BMI: body mass index; CK-MB: creatine kinase isoenzyme MB; CPB: cardiopulmonary bypass; eGFR: estimated glomerular filtration rate; FFR: fractional flow reserve; LAD: left anterior descending artery; LITA: left internal thoracic artery; LVEF: left ventricular ejection fraction; PCI: percutaneous coronary intervention; SD: standard deviation; TIA: transitory ischaemic attack; Tn-I: troponin I; VAS: visual analogue pain scale.

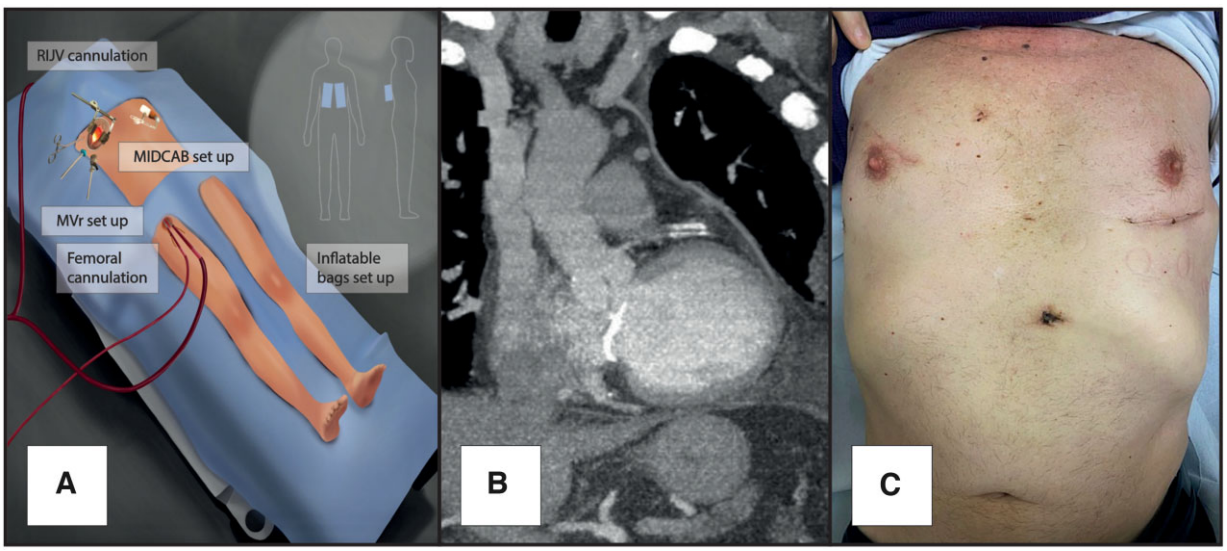

Figure 1: (**A**) Surgical set-up (bilateral mini thoracotomies, cannulation sites and inflatable bags positioning). (**B**) Postoperative CT scan (also showing a closed stent at the left anterior descending artery level). (**C**) Healing wounds.

patency (Fig. 1B). All patients were discharged home healthy, and with healing surgical wounds. Our institutional 30-day follow-up confirmed satisfactory surgical results and all patients reported an excellent quality of life (Fig. 1C).

DISCUSSION

Recent data demonstrate an increased share of minimally invasive mitral surgery, to an extent that some highly specialized centres embraced this surgical innovation until it turned standard practice [1, 2]. Conversely, MIDCAB is scarcely adopted, although excellent short- and midterm results have been reported [3]. It is evident by itself that combined minimally invasive operations are exceptional procedures characterized by inherent technical issues that can be overcome just by dedication and consistency. Indeed, only 6 cases of combined MIDCAB (LITA-LAD) and MVr performed through a bilateral mini-thoracotomy have been published worldwide [4].

Our experience demonstrates solid surgical results with satisfactory surgical times, favourable outcome, early mechanical ventilation discontinuation and discharge from intensive care unit.

The alternatives for these patients, discussed by the Heart Team, would have been a standard operation in full sternotomy or a hybrid procedure with a minimally invasive MVr followed by percutaneous revascularization. Both the options are less appealing than the chosen one: the first for the greater invasiveness, the second for the lesser long-term effectiveness. Our preliminary data prompt us to further investigate on both safety and efficacy of the technique. We recognize that the approach hereby described can only be accomplished if both single techniques are routinely performed. However, our experience shows that minimally invasiveness can be pursued even when multifactorial pathology is encountered.

Finally, single minimally invasive surgery is safe and reliable and provides excellent outcomes with reduced pain and faster recovery [1–3]. It should be indeed embraced and regarded as the benchmark to compare and to work in conjunction with transcatheter techniques, ensuring higher acceptance among patients without weakened long-term results.

Conflict of interest: none declared.

Reviewer information

European Journal of Cardio-Thoracic Surgery thanks Nikolaos Bonaros and the other, anonymous reviewer(s) for their contribution to the peer review process of this article.

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