Scientific letters

Implementation and clinical impact of a robotic heart surgery program

Implementación e impacto clínico de un programa de cirugía cardiaca robótica

To the Editor,

Since robotic cardiac surgery was first performed at the end of the 1990s,[1,2] the technique has gradually become more widespread. It has even been adopted by some leading centers in the United States as the approach of choice for mitral valve surgery. Although its adoption has been slower in Europe, both the case volume and the number of centers performing robotic surgery appear to have increased significantly in recent years.[3]

The objective of the present study was to report the outcomes of the first 120 patients who underwent robotic cardiac surgery in our hospital (from December 2019 to July 2022). The study was approved by the ethics committee of our center (HCB/2021/0248). The committee waived the need for informed consent from individual patients.

A single team of 2 surgeons (1 at the robot control console and 1 at the operating table) conducted all of the interventions with the DaVinci Xi platform (Intuitive Surgical, United States). Overall, 82% of the operations comprised mitral valve surgery (n = 98), and the most frequent procedure was mitral valve repair (n = 86) (figure 1A). The other procedures were atrial septal defect closure (n = 9), concomitant tricuspid surgery (n = 2), robotic dissection of the internal mammary artery to revascularize the anterior descending artery without cardiopulmonary bypass (CPB) (n = 7) (figure 1B), tumor excision (n = 3), and aortic valve replacement (n = 3). The characteristics of the cohort are shown in Table 1.

In the total cohort, the median [interquartile range] total surgery time was 225 [195-255] minutes while the median CPB and myocardial ischemia times were 105 [89-135] and 74 [61-93] minutes, respectively. All surgery times progressively decreased (figure) from program initiation, as follows (Q1 vs Q4): CPB time, 136 vs 98 minutes (P = .003); ischemia time, 92 vs 70 minutes (P = .009), and total surgery time, 240 vs 211 minutes (P = .02) (figure 1C).

Most patients (58%) were extubated in the operating room (median mechanical ventilation time of patients extubated in the operating room, 7 [5-13] hours). The median lengths of stay in the

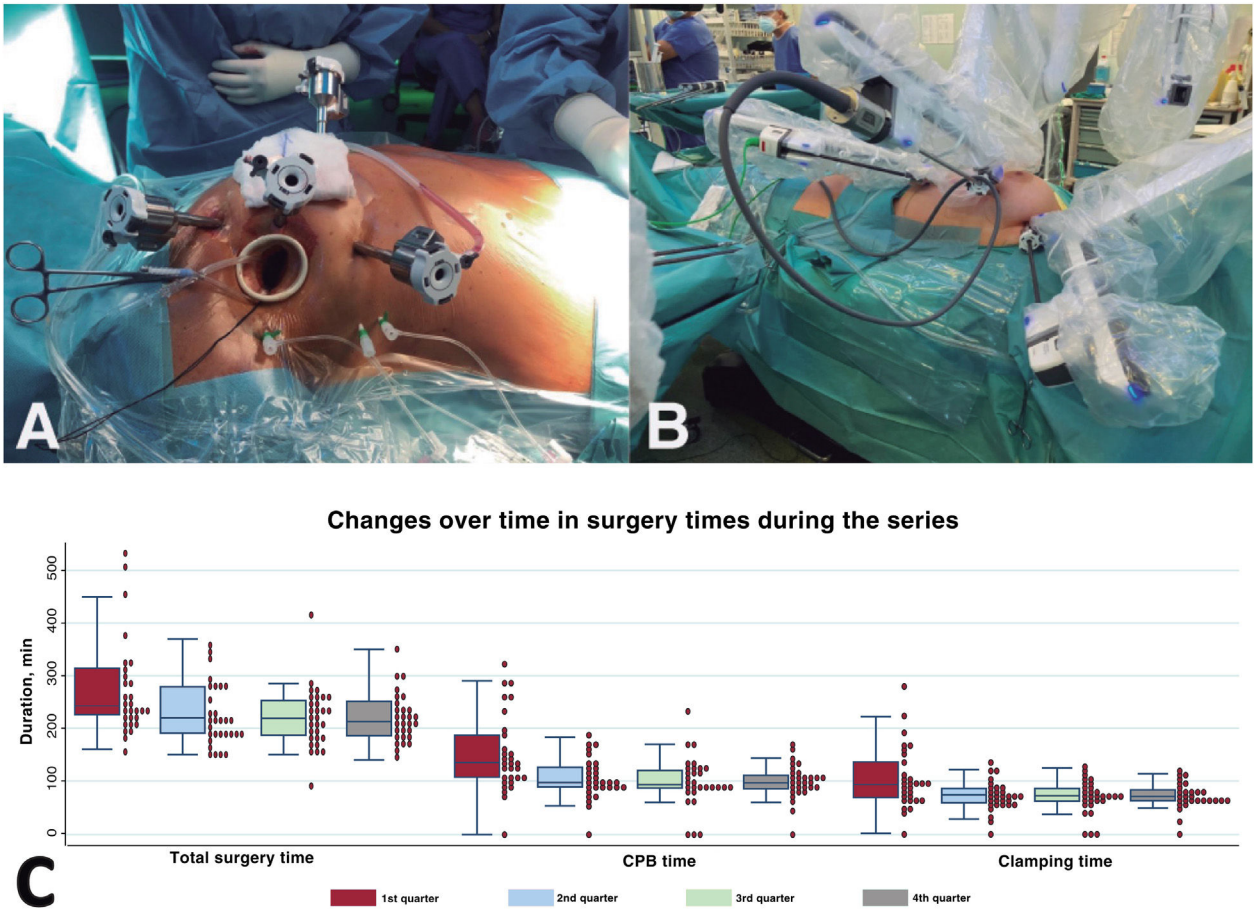

Figure 1. A: placement of the 4 robotic trocars and of the working port in the patient's right hemithorax, an arrangement used for intracavitary surgery. B: the 3 trocars placed in the left hemithorax to dissect the left internal mammary artery in coronary surgery patients. C: reduction in all surgery times (cardiopulmonary bypass [CPB], ischemia, and total surgery time), by quartile.

Table 1
Description of the population and outcomes.

Baseline characteristics	Total robotic cohort (n = 120)	Degenerative mitral valve robotic cohort (n = 78)	Degenerative mitral valve video-assisted cohort (n = 197)	*P*
Age, y	58 ± 15	59 ± 14	59.87 ± 12.7	.47
Male sex	62%	73%	67.7%	.41
Height, cm	168 ± 15	171 ± 9	169.7 ± 9.2	.24
Weight, kg	74 ± 19	75 ± 15	73.2 ± 13.6	.26
Hypertension	29%	33%	40%	.29
Dyslipidemia	25%	21%	26.4%	.31
Diabetes mellitus	9%	10%	4.5%	.07
Cerebrovascular disease	5%	3%	4.5%	.44
Chronic kidney disease	6%	6%	2.5%	.12
Creatinine, mg/dL	0.95 ± 0.3	0.99 ± 0.3	0.95 ± 0.32	.49
Ejection fraction, %	60 ± 8	61 ± 7	61 ± 6.5	.92
NYHA class > III-IV	26.5%	25%	26.4%	.89
EuroSCORE 2, %	1.5 [0.7-1.7]	0.9 [0.6-1.6]	1.03 [0.69-1.88]	.09
Localization of the mitral valve prolapse				
Anterior	—	9%	18	.96
Posterior		65%	124	.70
Both flaps		26%	56	.37
Intraoperative data				
CPB time, min	105 [89-135]	112 [92-140]	118 [94-146]	.60
Ischemia time, min	74 [61-93]	77 [67-100]	89 [69-115]	.05
Total surgery time, min	225 [195-255]	225 [197-259]	[b]	
Use of neochords	N/A	64%	46.7%	.009
Resection	N/A			
None		64%	54%	.19
Triangular		33%	35%	.85
Sliding plasty		3%	11%	.02
Annuloplasty		96%	100%	.02
Postoperative outcomes				
Mechanical ventilation, h	7 [5-13]	7 [4-21]	7 [5-13]	.50
Extubation in operating room	60%	59%	61%	.76
Extubation > 24 h	12 (10)	7	10	
Length of stay				
Intensive care unit	1 [1-2]	1 [1-2]	1 [1-2]	.29
Hospital	4 [4-6]	4 [4-6]	7 [6-10]	< .001
Complications				
Vascular	1 (0.8)	1 (1)	4 (2)	.67
Stroke	0	0	1 (0.5)	1
Renal failure[a]	2 (1.6)	2 (2.6)	5 (2.5)	.99
Permanent pacemaker	0	0	5 (2.5)	.32
Atrial fibrillation	23 (19)	17 (22.1)	45 (22.8)	.85
Transfusion	24 (20)	16 (20.5)	37 (18.8)	.74
Reoperation due to bleeding	6 (5)	4 (5)	14 (7.1)	.55
Aortic reclamping	9 (7.5)	7 (10)	17 (8.6)[b]	
Respiratory	14 (12)	8 (10)	1 (0.5)	.67
Coronary lesion	1 (0.8)	1 (1)		.49

CPB, cardiopulmonary bypass; NYHA, New York Heart Association functional class.
[a] Society of Thoracic Surgery criteria.
[b] Data not available.
Unless otherwise indicated, data are expressed as No. (%), mean ± standard deviation, or median [interquartile range].

intensive care unit and in the hospital were 1 [1-2] and 4 [4-6] days, respectively. As seen with the surgery times, the length of hospital stay significantly decreased with experience (from Q1 to Q4): from 5 days to 4 days ($P < .001$). All times were comparable to those of a video-assisted mitral valve surgery cohort, except the clamping time, which was lower in the robotic surgery group.

The rate of repair in patients with mitral regurgitation was 100% (with slight or minor mitral regurgitation at discharge in 98.8%). All

patients were discharged to home and none required reintervention during follow-up. Median postoperative length of hospital stay was much shorter in the robotic surgery group than in the video-assisted surgery group (4 vs 7 days, $P < .001$).

Despite representing the initial experience, which includes the entire learning curve, our results are satisfactory and in line with those of series published by highly experienced centers[4–6] and with our own results for video-assisted mitral valve surgery. We believe that the learning curve was minimized by the extensive previous experience of the entire team with video-assisted surgery, which permitted a very high level of safety and quality from the outset, as shown by the absence of conversions to sternotomy, the superb rate of mitral valve repair, and the low incidence of postoperative complications.

In conclusion, robotic cardiac surgery in selected patients enables the performance of a wide variety of cardiac surgical interventions with excellent results and short postoperative hospital stay. Robotic surgery is currently the least invasive surgical option but involves a highly complex technique with a steep learning curve that can be minimized by extensive prior experience with video-assisted surgery.

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AUTHORS' CONTRIBUTIONS

E. Sandoval: manuscript drafting and editing of tables and figure. A. Muro: data collection and final revision of the manuscript. R. Navarro: final revision of the manuscript. A. García-Álvarez: final revision of the manuscript. M. Castellà: final revision of the manuscript. D. Pereda: conceptualization, figure editing, critical revision, and final revision of the manuscript.

CONFLICTS OF INTEREST

None of the authors have a conflict of interest to declare in relation to this study.

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REFERENCES

1. Carpentier A, Loulmet D, Aupècle B, et al. Computer assisted open heart surgery. First case operated on with success. *C R Acad Sci III.* 1998;321:437–442.
2. Mohr FW, Falk V, Diegeler A, Autschback R. Computer-enhanced coronary artery bypass surgery. *J Thorac Cardiovasc Surg.* 1999;117:1212–1214.
3. Cerny S, Oosterlinck W, Onan B, et al. Robotic Cardiac Surgery in Europe: Status 2020. *Front Cardiovasc Med.* 2021;8:827515.
4. Ascaso M, Sandoval E, Quintana E, Vidal B, Castella M, Pereda D. Early and mid-term outcomes of mitral repair due to leaflet prolapse in a national referral center. *Rev Esp Cardiol.* 2021;74:462–476.
5. Mihaljevic T, Koprivanac M, Kelava M, et al. Value of robotically assisted surgery for mitral valve disease. *JAMA Surg.* 2014;149:679–686.
6. Suri RM, Taggarse A, Burkhart HM, et al. Robotic mitral valve repair for simple and complex degenerative disease. Midterm clinical and echocardiographic quality outcomes. *Circulation.* 2015;132:1961–1968.

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Percutaneous transcatheter mitral valve repair: combining devices for challenging anatomies

Reparación percutánea de la válvula mitral: combinación de dispositivos para anatomías difíciles

To the Editor,

Percutaneous heart valve interventions have emerged as an alternative in patients at high or prohibitive risk for surgery. Mitral transcatheter edge-to-edge repair (M-TEER) is currently a well-established treatment for functional mitral regurgitation (MR)[1,2] and can also be considered a valid option in degenerative or acute MR for patients at high risk. M-TEER has, however, procedural limitations[3] in complex anatomies, and no other specific reparative options are currently available. There have been some reports of the use of vascular plugs in combination with M-TEER for challenging anatomies,[4] but the use of Amplatzer Vascular Plug III (AVP III) (Abbott, United States) has been less described. AVP III is specifically designed for paravalvular leak closure but, because of its asymmetrical shape with a thick neck, it is also appropriate for treating localized residual MR jets after M-TEER.[5] We describe our experience of combined treatment with M-TEER and AVP III for challenging mitral anatomies.

Patients treated in our center with M-TEER were retrospectively reviewed to identify those needing a combined therapy with occluders. Patients signed the consented inform for the intervention and all reported data were anonymized.

Since 2012, 242 patients have been treated at our center with M-TEER (MitraClip [Abbott, United States] or PASCAL [Edwards Lifesciences, United States]). Throughout this period, 5 patients required implantation of an additional plug after M-TEER. In addition, although other options are available to treat recurrent MR after edge-to-edge therapy, such as the ELASTA-Clip, we chose this technique because of the presence of a localized MR and the lesser invasiveness of the plug implantation.

The clinical and procedural characteristics of the 5 patients are described in table 1. All of the patients had severe symptomatic MR at the moment of the plug implantation. The patients also had challenging anatomies for M-TEER: *a)* ischemic MR due to papillary muscle rupture with prolapse of the posterior leaflet initially treated with 2 MitraClip NT; *b)* mixed etiology MR with P1 and anterior commissure prolapse with severe calcification at that level; *c)* degenerative MR with a wide prolapse of the anterior leaflet (A2-A3); *d)* combined etiology MR with dilated cardiomyopathy and A2 prolapse with chordal rupture treated with 2 MitaClip NT, new heart failure onset (5.5 years later) due to new A3 prolapse with chordal rupture and interclip MR; *e)* myxomatous degeneration of the mitral valve with prolapse of the posterior leaflet due to chordal rupture.