International Journal of Cardiology xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Severe ischemic cardiomyopathy with mechanical complications: Still a surgical disease

Antonio M. Calafiore [a,*], Angela L. Iaco [a], Hatim Kheirallah [a], Azmat A. Sheikh [a], Hussain Al Sayed [a], Mohammed El Rasheed [a], Ahmed Allam [b], Mohammed O. Awadi [c], Juan J. Alfonso [a], Ahmed A. Osman [d], Michele Di Mauro [e]

[a] Prince Sultan Cardiac Center, Riyadh, Saudi Arabia
[b] Ain Shams University, Egypt
[c] Benha University, Egypt
[d] Cairo University, Egypt
[e] L'Aquila University, L'Aquila, Italy

ARTICLE INFO

Article history:
Received 28 December 2016
Accepted 28 March 2017
Available online xxxx

Keywords:
Ischemic cardiomyopathy
Ischemic mitral regurgitation
Right ventricular dysfunction

ABSTRACT

Background: Surgical treatment of ischemic cardiomyopathy (ICM) with mechanical complications has been limited in favor of suboptimal treatments because of the perception of poor outcome.

Methods and results: From May 2009 till June 2014 115 patients with severe ICM (ejection fraction, EF, ≤25%) and mechanical complications were operated on. Median EF was 24% (19, 24), mean end-systolic volume index (ESVi) was 86 ± 27 ml/m^2 and all patients had an MR grade of 2 or more. The right ventricle (RV) was hypokinetic in 33 patients. All of them underwent mitral valve surgery. Left ventricular (LV) surgical remodeling was performed in 60 patients (52.2%) and tricuspid surgery in 58 (50.4%). In-hospital mortality was 4.3% (5 patients). Six-year freedom from death any cause and from death any cause and NYHA class III/IV were, respectively, 70.5 ± 4.9% and 66.4 ± 4.8%. Cox regression analysis showed that risk factors were lower EF (cutpoint ≤ 20%) and RV hypokinesia. Eighty-six patients had a follow up echocardiogram after a median of 31 (19, 51) months. EF increased by 60%, from 24 (19, 24) to 35 (27 ,46) ($p = 0.00$), and ESVi decreased by 32%, from 87 ± 29 to 59 ± 27 ml/m^2 ($p = 0.00$). SVi increased by 32%, from 23 ± 7 to 32 ± 12 ml/m^2. MR grade was ≥2 only in 6 patients (7%) and was not severe in any of them.

Conclusions: Surgery for severe ICM with MR can be performed with low surgical risk and good midterm survival. These findings have to be taken into account while abandoning a clear surgical indication in favor of suboptimal alternative therapies.

1. Introduction

Ischemic cardiomyopathy (ICM) following acute myocardial infarction (AMI) is the most frequent cause of heart failure. Ventricular remodeling frequently causes mitral regurgitation (MR) due to papillary muscles' displacement, which adds complexity to the presence of scars of different extent. Conventional surgery for ICM then includes myocardial revascularization and correction of mechanical complications, as mitral valve surgery and, when necessary, left ventricular surgical remodeling (LVSR). However, surgical possibilities to treat these complex patients are progressively reduced in favor of medical treatment, percutaneous mitral repair or LV assist devices as destination therapy. On the other side, results of medical treatment alone are poor [1], and the benefit of percutaneous mitral repair, if any, is controversial [2]. Destination therapy is not a solution widely available, mainly due to the high costs [3].

We report our results with conventional surgical treatment of severe ICM and mechanical complications. "Severe" identifies patients with ejection fraction (EF) of 25% or less. The primary objective of this study is to evaluate the surgical outcome and to determine whether assessment of risk factors can help to identify patients who can benefit more from surgical treatment.

2. Material and methods

All elective or urgent patients who underwent surgical treatment of severe ICM due to a previous AMI with mechanical complications in a single institution from May 2009 to June 2014 were included in this study. Mechanical complications are defined as the presence of functional MR and of dyskinetic or akinetic segmental areas of the LV cavity. Patients operated on as an emergency (on inotropic support and/or intra-aortic balloon

* Corresponding author at: Department of Adult Cardiac Surgery, Prince Sultan Cardiac Center, Riyadh, Saudi Arabia.
E-mail address: am.calafiore@gmail.com (A.M. Calafiore).

http://dx.doi.org/10.1016/j.ijcard.2017.03.133
0167-5273/

pump [IABP] and/or mechanical ventilation), were not included. Retrospective analysis of our database was approved by the institutional review board, which waived patient consent.

2.1. Echocardiographic evaluation

All echocardiographic measurements were obtained following American Society of Echocardiography (ASE) and European Association of Echocardiographists' (EAE) guidelines [4,5]. Severity of MR and TR was graded in a scale from 1 to 3 (1, mild; 2, moderate; 3, severe). The presence of left ventricular diastolic dysfunction (LVDD) was assessed based on the EAS/ASE recommendations [6] and patients with a ratio E/e′ ≥15 were considered to have severe LVDD. Basal right ventricular (RV) dimension was recorded at end-diastole, along with tricuspid annular plane systolic excursion (TAPSE) and/or tissue Doppler imaging. The RV was defined as dilated if basal end-diastolic diameter was >42 mm and hypokinetic if TAPSE was <16 mm and/or S′ velocity was <10 cm/s [7] at tissue Doppler imaging. RV dilatation or hypokinesia were included in the analysis as a binary variable. RV systolic pressures were estimated using continuous-wave Doppler data and the simplified Bernoulli equation (4 × [peak TR velocity]) with 10 mm Hg added for the estimated right atrial pressure. The value obtained was considered the systolic pulmonary artery pressure. Pulmonary hypertension (PH), defined as a systolic RV pressure above 55 mm Hg [8], was included in the analysis as a binary, and not as a continuous, variable, as some patients had no TR.

2.2. Surgical indications and techniques

All patients were candidates for MV surgery as all of them had moderate or severe MR. A coaptation depth (CD) of ≤10 mm was the limit for MVr. If CD was >10 mm, the anatomy was not considered suitable for repair, and a prosthesis was inserted (MVR) with the preservation of the leaflets and subvalvular apparatus. MVr was achieved by inserting a 40-mm or 50-mm band (Sorin Biomedica, Saluggia, Italy) from trigone to trigone. The LV was surgically remodeled if there were localized dyskinetic or akinetic areas, the exclusion of which could contribute to a decrease in the filling pressure and to an improvement in the efficiency of the cardiac pump. Different techniques were used in case of anteroseptal localization [9], all aimed at reducing the volume maintaining a conical shape. Linear septoexclusion, already described by our group [10], joins the borders of the anterior and the septal scars with interrupted 2/0 U sutures. It is addressed mainly to large hearts (end diastolic volume index, EDVi, >120 ml/m^2). Septal reshaping uses, instead of a direct suture, an oval patch [11] and is addressed mainly to hearts with an EDVi <120 ml/m^2. The septoapical Dor procedure was used only in case of scars that involved the distal portion of the septum, of the anterior wall and of the apex. In case of lateral or inferior scars, an incision was made from the apex to the base of the heart, and the scarred area was excluded by internal plication with interrupted 2/0 Ethibond U sutures. TR was always corrected when ≥2 or, if mild, if the systolic dimension of the annulus was >24 mm [12].

2.3. Follow-up

All patients were clinically followed up in our outpatient clinic 3, 6, and 12 months after surgery, and at yearly intervals thereafter. The most recent information was obtained by calling the patient or the referring cardiologists. If the patients were living in places difficult to access or left the country, the last information was included in the analysis. Follow-up ended on April 2016 and was 100% complete. Median follow-up of survivors was 55 (37, 74) months.

2.4. Statistical analysis

Categorical variables are expressed as counts and percentages. Continuous variables are expressed, if normally distributed, as mean ± standard deviation, if non-normally distributed, as median with the 25th and 75th percentiles. Comparison between groups was performed using unpaired 2-tailed t-test for normally distributed continuous variables, Mann-Whitney U test for non-normally distributed continuous variables, and Pearson's chi-square test (or Fisher's exact test) for categorical variables. Pre- and postoperative data of each group were compared by paired t-test for normally distributed variables or Wilkinson test for non-normally distributed variables. Repeated categorical variables were compared by the McNemar test if nominal, and the Friedman test if ordinal. Stepwise logistic regression analysis was performed to evaluate independent risk factors for in-hospital mortality. The overall model fit and the Hosmer–Lemeshow test were used to evaluate model predictivity. Survival was evaluated by the Kaplan–Meier method. Results of the Cox proportional hazards regression model were reported as the instantaneous relative risk (hazard ratio, HR), 95% confidence intervals (CI), and p-value. All the variables reported in Table 1 were included into the multivariate analyses. Definition of the variables, when not indicated, follows the definition reported in the EuroSCOREII model [8]. Optimal cut-offs were determined by receiver operating characteristic (ROC) curve analysis. The area under the curve (AUC) with corresponding 95% CI and p-values were reported. Multivariable model was validated in 1000 bootstrap samples. For all tests, a p-value <0.05 was considered significant. The SPSS software (SPSS Inc., Chicago, IL, USA) was used.

Table 1
Clinical and echocardiographic preoperative data and surgical characteristics.

Variable (n = 115)	
Age (y)	60 ± 11
F gender	14 (12.2)
Obesity	21 (18.3)
ESII	8 (5.4, 11.9)
NYHA class	
I	9 (7.8)
II	21 (18.3)
III	73 (63.5)
IV	12 (10.4)
III/IV	85 (73.9)
Angina	71 (61.7)
Recent AMI	34 (29.6)
DM	76 (66.1)
On insulin	27 (23.5)
CrCl	81 ± 30
<50 ml/min	18 (15.7)
High hs-cTnT	35 (30.4)
High bil (>22 μmol/l)	11 (9.6)
No SR	5 (4.3)
EF (%)	24 (19, 24)
EDD (mm)	62 ± 8
ESD (mm)	51 ± 8
EDVi (ml/m^2)	109 ± 31
ESVi (ml/m^2)	86 ± 27
SVi (ml/m^2)	23 ± 7
SI	0.69 ± 0.08
sPAP (mm Hg)	45 (30, 60)
PH (>55 mm Hg)	42 (36.5)
LVDD	73 (63.5)
RV dim (mm)	41 ± 8
RV hypo	33 (28.7)
RV dil	43 (37.4)
MR grade	
2	69 (60)
3	46 (40)
TR grade (0–4)	
0	30 (26.1)
1	46 (40)
2	31 (27)
3	8 (7)
CABG	108 (93.9)
MV repair	76 (77.1)
MVR	39 (33.9)
LVSR	60 (52.2)
SR	41 (68.3)
LSE	9 (15)
SA Dor	6 (10)
lat wall	2 (3.3)
inf wall	2 (3.3)
TV repair	58 (50.4)
CPB time (min)	143 ± 32
XCl time (min)	113 ± 27

Values are expressed as mean ± SD, median (95% confidence interval) or counts (%).
Legend. y, years; F, female; ESII, EuroSCORE II; NYHA, New York Heart Association; AMI, acute myocardial infarction; DM, diabetes mellitus; CrCl, creatinine clearance; hs-cTnT, high sensitivity cardiac troponin T; bil, bilirubin; SR, sinus rhythm; EF, ejection fraction; EDD, end-diastolic diameter; ESD, end-systolic diameter; EDVi, end-diastolic volume index; ESVi, end-systolic volume index; SVi, stroke volume index; SI, sphericity index; sPAP, systolic pulmonary artery pressure; PH, pulmonary hypertension; LVDD, left ventricular diastolic dysfunction; RV, right ventricle; dim, dimension; hypo, hypokinesia; dil, dilatation; MR, mitral regurgitation; TR, tricuspid regurgitation; CABG, coronary artery bypass grafting; MV, mitral valve; MVR, mitral valve replacement; LVSR, left ventricular surgical remodeling; SR, septal reshaping; LSE, linear septoexclusion; SA, septoapical; lat, lateral; inf, inferior; TV, tricuspid valve; CPB, cardiopulmonary bypass; XCl, cross clamping.

Please cite this article as: A.M. Calafiore, et al., Severe ischemic cardiomyopathy with mechanical complications: Still a surgical disease, Int J Cardiol (2017), http://dx.doi.org/10.1016/j.ijcard.2017.03.133