Aortic Valve Replacement for Severe Aortic Stenosis and Concomitant Coronary Artery Bypass Graft: Assessing the Impact of Grafts Number

Mohamed Abdelshafy Azab*, Mostafa Abdelsattar Kotb, Karim Mohamed Elfakharany
Cardiothoracic Surgery Department, Faculty of Medicine, Zagazig University, Egypt
Corresponding author: Mohamed Abdelshafy Azab
E-mail: Mohamedabdelshafyazab89@gmail.com, Abdelshafyazzab@gmail.com
Conflict of interest: None declared
Funding: No funding sources

Abstract

Background: The impact of multivessel coronary artery bypass grafting on outcomes after combined aortic valve replacement and coronary artery bypass grafting (AVR-CABG) has not been sufficiently evaluated. It is well established that Patients diagnosed with aortic stenosis (AS) indicated for AVR usually also have coronary artery disease (CAD) requiring CABG. The impact of grafts number in case of combined AVR-CABG also has not been sufficiently evaluated. This study aimed to evaluate the impact of grafts number on outcome of concomitant AVR-CABG.

Methods: This prospective study enrolled patients who had operated AVR-CABG between February 2019 till January 2021 in the Cardio-Thoracic Surgery Department of Zagazig University Hospital using the traditional on-pump technique.

***Results*:** The study consisted of 50 AVR-CABG patients. Mean follow-up was 1 years. Preoperative clinical characteristics were well-matched between patients who received one (n 14), two (n 26), or multiple (n 10) bypass grafts. Operative mortality was 0%, 3.8 %, and 10 %, respectively. Patients in all groups shows significant improvement in New York Heart Association (NYHA) status ($p < 0.01$). Renal failure was significantly associated with multiple grafts patients. The number of coronary bypass grafts did not predict mortality.

***Conclusions*:** For patients undergoing AVR-CABG, the number of bypass grafts does not adversely affect survival.

Keywords: coronary artery disease , aortic valve replacement , aortic stenosis

Tob Regul Sci. ™ 2022;8(1): 2712-2721
DOI: doi.org/10.18001/TRS.8.1.202

Introduction:

For patients with combined severe AS and CAD, surgical AVR -CABG has become an accepted operation with good results. Although there are some conflicting results in other studies, most studies agree that performing AVR-CABG slightly improves survival, even in high-risk populations. Another studies also highlight the importance of complete revascularization during AVR-CABG. These factors are most likely responsible for the significant increase in number of bypass grafts with AVR-CABG [1].

Current guidelines recommend bypass of all significant stenoses at the time of AVR, with evidence level C; however, performing AVR-CABG is associated with elevated short- and long-term mortality [2]. This association may cause by increasing myocardial ischemic time or simply a marker for a high-risk patient profile. Identification this may lead to more clear diagnosis, therapy, and chronic disease management [3].

The important issue is taking long time to do more bypass grafts needed for complete revascularization will impact outcomes.

Incomplete revascularization is associated with greater postoperative left ventricular (LV) systolic dysfunction and reduced survival rates after surgery compared with patients who receive complete revascularization. For more than a decade, advanced techniques used in myocardial preservation have been associated with decreased overall operative mortality, and it has become standard practice to bypass all significant coronary artery stenosis when possible, in patients undergoing AVR [4].

The important factor is whether, or not, consuming the time to perform more bypass grafts to do a complete revascularization will impact outcomes. We hypothesize that completeness of revascularization and not just bypass grafts number is an important factor in successful outcomes after AVR-CABG.

Patients and Methods

Study design

A prospective study , carried out in Cardio-Thoracic Surgery Department , at our institution on 50 patients with severe AS with CAD indicated for AVR-CABG , patients classified into three groups according to the grafts number (one graft , two grafts , multiple grafts) in the period from February 2019 till January 2021. Patients who received three or four bypass grafts were combined into one group (multiple bypass grafts group)

After ethical committee approval, written consent obtained from all patients ,the risk and advantage of both valve replacement and CABG operation were explained to all patients

Inclusion criteria

- Adult patients with acquired severe AS.
- Patients with severe AS and CAD.

Exclusion criteria:

- Previous open cardiac surgery.
- Any additional procedures rather than AVR and CABG

Preoperative trans-thoracic echocardiography was done to detect the severity of AS , morphology of aortic valve , presence of other valve pathology and ejection fraction (EF). Also preoperative coronary angiography was performed in all cases to determine the presence of CAD. All patients had significant CAD and received AVR-CABG. To conclude the surgical indication, patients were discussed in a multidisciplinary heart team meeting. Inserting an intra-aortic balloon pump (IABP) was the only additional procedure accepted in this study.

Surgical technique

All surgical procedures were carried out via a midline sternotomy by cardiothoracic surgeons at our institution. AVR was performed employing the usual techniques of cardiopulmonary bypass (CPB). Myocardial protection strategies included blood antegrade cardioplegia with mild hypothermia. Distal coronary anastomoses were performed first, followed by AVR, closure of aortotomy and, finally, the proximal coronary anastomoses were done. Selection of the aortic valve prosthesis was based on the patient's age, expected survival, and the surgeon's preference. Intraoperative transesophageal echocardiography was used in almost all cases.

Patient Follow-up

All patients was studied after 3 , 6 and 12 months by telephone and by following the patients at our institution Out -patient clinic to examine post-operative NYHA and to check for any complications such as arrythmia , readmission and stroke and also to detect the one year mortality.

Statistical Analysis

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 25.0) (Statistical Package for the Social Sciences) software for analysis.

Results

Over two years study period at our center 14 patients received one bypass graft with *mean* ± *SD* age (60.4±8.5) , 26 patients received two grafts with *mean* ± *SD* (60.7± 9.1) and 10 patients received three grafts with *mean* ± *SD* (60.2± 6.1). The severity of CAD, as measured by the mean number of stenosed vessels, significantly increased with the number of bypass grafts that patients received.

Mean cross-clamp time increased significantly as the number of bypass grafts increased. Left anterior descending artery (LAD) were anastomosed to internal mammary artery (LIMA) in all patient and also there was no statistically significant association between number of grafts and (bleeding, reopening for bleeding and surgical site infection (SSI))($p> 0.05$). Our study also concluded that there was highly statistically significant association between number of graft and renal failure (p< 0.01), but there was no statistically significant association between number of graft and congestive heart failure (CHF) , stroke, pneumonia and in hospital mortality (p> 0.05).

The number of coronary artery bypass grafts performed did not correlate with survival in the present study.

Through 3, 6 months and one year follow up there were marked improvement in NYHA in both groups , while there was no significant difference between both groups as regard readmission , arrythmia , CHF and stroke.

Table 1: Demographic data among the studied groups:

Variable	One graft N=14		Two grafts N=26		Multiple grafts N=10		F	P-value
Age (years): *Mean ± SD* *Range*	60.4±8.5 47-75		60.7± 9.1 47-76		60.2± 6.1 50-70		0.013	0.987
Variable	**N**	**%**	**N**	**%**	**N**	**%**	**χ 2**	**P-value**
Sex: *Male* *Female*	9 5	64.3 35.7	20 6	76.9 23.1	6 4	60 40	1.3	0.525

Data is shown as number (percentage) or mean ± standard deviation.
Chi-square (χ 2), and anova (f) tests were used.
Bold values are statistically significant at p<0.05. S: Significant

This table shows that there was no statistically significant association between number of graft and age & sex (p> 0.05).

Table 2: Co-morbidities among the studied groups:

Variable	One graft N=14		Two grafts N=26		Multiple grafts N=10		f	P-value
BMI: *Mean ± SD* *Range*	28.98±3.5 23.4-36.7		29.5±4.9 20.9-42		27.4±4.9 20.3-33.6		0.742	0.482
Variable	**N**	**%**	**N**	**%**	**N**	**%**	**χ 2**	**P-value**
Hypertension: *No* *Yes*	4 10	28.6 71.4	9 17	34.6 65.4	2 8	20 80	0.754	0.686

Hypercholesterolemia:								
No	5	35.7	6	23.1	3	30	0.746	0.689
Yes	9	64.3	20	76.9	7	70		
DM:								
No	6	42.9	13	50	5	50	0.206	0.902
Yes	8	57.1	13	50	5	50		
History of MI:								
No	13	92.9	24	92.3	10	100	0.803	0.669
Yes	1	7.1	2	7.7	0	0		
COPD:								
No	12	85.7	24	92.3	8	80	1.1	0.568
Yes	2	14.3	2	7.7	2	20		
Smoking:								
No	10	71.4	19	73.1	7	70	0.037	0.982
Yes	4	28.6	7	26.9	3	30		
PVD:								
No	12	85.7	24	92.3	9	90	0.440	0.883
Yes	2	14.3	2	7.7	1	10		
AF:								
No	11	78.6	23	88.5	10	100	2.5	0.280
Yes	3	21.4	3	11.5	0	0		

This table shows that there was no statistically significant association between number of graft and BMI & co-morbidities (p> 0.05).

Table3: Data among the studied groups:

Variable	One graft N=14	Two grafts N=26	Multiple grafts N=10	f	P-value
EF (%):					
Mean ± SD	54.5±10.7	50.3±11.3	49.8±12.3	0.743	0.481
Range	30-70	20-70	30-70		
m AVA:					
Mean ± SD	0.83±0.09	0.79±0.12	0.79±0.14	0.603	0.552
Range	0.7-1	0.5-1	0.6-1		

m. AV Gradient: ***Mean ± SD*** ***Range***	49.2±4.9 40-58	50.9±7.3 40-70	50.8±4.4 45-60	0.359	0.700
Cross clamp time (x c t): ***Mean ± SD*** ***Range***	67.9±40.2 35-172	82.7±38.5 38-148	105.1±66.9 35-198	1.2	**0.048** **(S)**
Cardiopulmonary bypass time: ***Mean ± SD*** ***Range***	107.9±48.1 58-213	116.2±51.2 60-199	149.2±92.7 55-270	1.5	0.306

HS: Highly significant

This table shows that there was statistically significant association between number of graft and Cross clamp time (p< 0.05), but there was no statistically significant association between number of graft and EF, m AVA, m. AV Gradient, & Cardiopulmonary bypass time (p> 0.05).

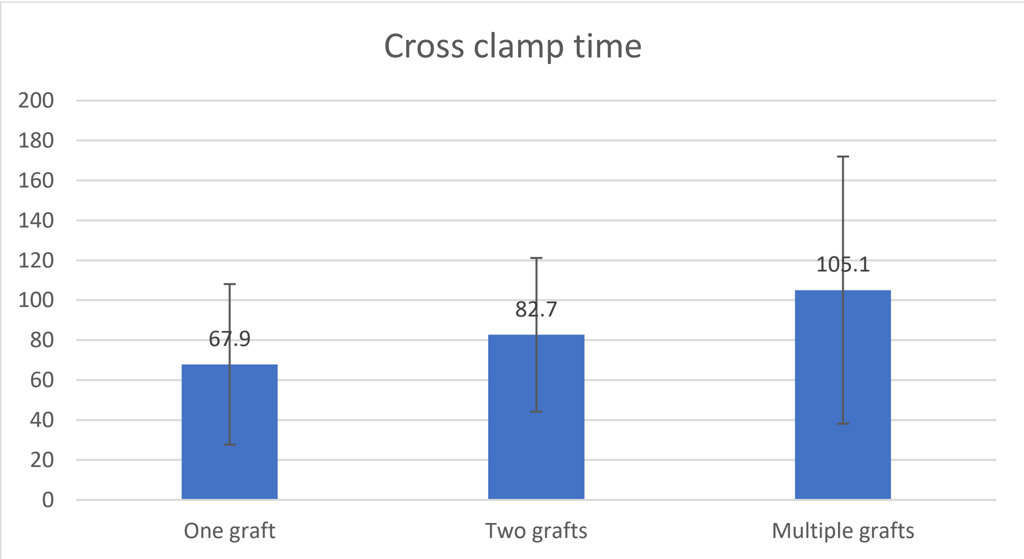

Fig1: cross clamp time among the studied group.

Table4: Post-operative data among the studied groups:

Variable	One graft N=14	Two grafts N=26	Multiple grafts N=10	f	P-value
Total hospital stay: ***Mean ± SD*** ***Range***	7.4±1.3 5-10	7.3±1.9 5-14	8.5±2.4 5-14	1.5	0.245

ICU stay: *Mean ± SD* *Range*	2.1±0.36 2-3		2.3±0.62 2-4		2.3±0.67 2-4		0.409	0.667
Variable	N	%	N	%	N	%	χ 2	P-value
CHF: *No* *Yes*	 14 0	 100 0	 21 5	 80.8 19.2	 10 0	 100 0	5.1	0.077
Stroke: *No* *Yes*	 14 0	 100 0	 24 2	 92.3 7.7	 9 1	 90 10	1.3	0.520
Pneumonia: *No* *Yes*	 13 1	 92.9 7.1	 26 0	 100 0	 10 0	 100 0	2.6	0.269
Renal failure: *No* *Yes*	 13 1	 92.9 7.1	 26 0	 100 0	 5 5	 50 50	17.5	**0.000*** (HS)
In hospital mortality: *No* *Yes*	 14 0	 100 0	 25 1	 96.2 3.8	 9 1	 90 10	1.5	0.467

This table shows that there was highly statistically significant association between number of graft and renal failure (p< 0.01), but there was no statistically significant association between number of graft and CHF , stroke, pneumonia and in hospital mortality (p> 0.05).

Table5: 1-year post-operative data among the studied groups:

Variable	One graft N=14		Two grafts N=25		Multiple grafts N=9		χ 2	P-value
	N	%	N	%	N	%		
NYHA: *0* *I* *II*	 5 9 0	 35.7 64.3 0	 9 13 2	 36 52 8	 6 3 0	 66.7 33.3 0	5.4	0.490

III	0	0	1	4	0	0		
Arrythmia: *No* *Yes*	 14 0	 100 0	 24 1	 97 4	 9 0	 100 0	 0.94	 0.625
Readmission: *No* *Yes*	 14 0	 100 0	 23 2	 92 8	 9 0	 100 0	 1.9	 0.383
Stroke: *No* *Yes*	 13 1	 92.9 7.1	 25 0	 100 0	 9 0	 100 0	 1.7	 0.428
Mortality: *No* *Yes*	 14 0	 100 0	 23 2	 92 8	 9 0	 100 0	 1.9	 0.383

This table shows that at 1- year follow up; there was no statistically significant association between number of graft and NYHA, arrythmia, readmission and stroke (p> 0.05).

Discussion

Severe calcific AS is usually associated with CAD and CABG is an obligatory procedure during surgical AVR . The most common operation done during the surgical treatment of AS is CABG . Despite the increasing risk, AVR-CABG is the 3rd most accomplished technique behind isolated CABG and AVR[5].

CAD is identified in about 50% of patients undergoing AVR , and if left without revascularization will negatively impact on postoperative outcomes. Reports of the American Heart Association/American College of Cardiology (AHA/ACC) guidelines considered CABG indicated (class I) for CAD >70% stenosis at AVR , and reasonable (class IIa) in patients with CAD 50%-70% stenosis (level of evidence: C)[6].

Recently updated recommendations have reclassified CABG at time of AVR for>70%stenosis from a class I to a class IIa indication, whereas altogether deemphasizing the role of coronary revascularization in those with 50%to 70%stenosis [7].

CABG and Aortic valve operations occupy an important part in cardiac surgery in different cardiac centers all over the world. Concomitant AVR-CABG make the operation more difficult and influences early and late outcomes. The leading indication for coronary revascularization is to improve symptoms not responding to maximum non-surgical treatment . Surgical revascularization decreases the rate of life threatening events (death, myocardial infarction (MI), angina recurrence) more than other forms of treatment modalities [6]. When indicated, a single session, concomitant CABG with aortic valve surgery is comparatively useful with satisfactory outcomes . [8].

Recent randomized trials in patients with stable CAD have not demonstrated an advantage for surgical revascularization over medical management in minimizing risk of MI or death, except in patients with triple-vessel CAD. Considered alongside the revised guidelines for treatment of aortic valve disease, this may lead to the proposal that patients with less extensive and/or less severe CAD may be best served by conservative coronary management without surgical intervention at AVR[9].

The number of coronary artery bypass grafts performed did not correlate with survival, In fact, those patients who received three grafts or more showed a small trend towards increased survival On multivariable analysis, the impact of the number of grafts did not reach statistical significance (p = 0.6) [10].

We evaluated patients undergoing surgical AVR with and without CABG, all of whom had diagnoses of coexistent AS and CAD at index surgery. We sought to determine the survival effect of the decision to perform concomitant CABG at the time of AVR, in contemporary practice and in patients with various distributions and severities of CAD, testing the null hypothesis that the addition of CABG is prognostically neutral.

Conclusions

In patients indicated for surgical AVR with underlying >50% CAD, concomitant CABG when technically feasible does not affect early postoperative outcomes. patients with combined AVR-CABG were more older , more difficult procedure , longer CPB ,longer cross clamp time , prolonged ICU stay and total hospital stay but without affection on hospital or post operative one year mortality. Also doing AVR-CABG does not increase major adverse cerebral or cardiovascular events during one year postoperative follow up however both studied groups show marked improvement in post operative symptoms and NYHA. When indicated, single session, combined CABG and valve surgery is relatively safe with acceptable early outcome and complications, and also the number of bypass grafts does not adversely affect survival .

References:

1. Hanayama N, Fazel S, Goldman BS, Mitoff PR, Sever J, Fremes SE. Contemporary trends in aortic valve surgery: a single centre 10-year clinical experience. J Card Surg 2004; 19:552– 8.

2-Kobayashi KJ, Williams JA, Nwakanma LU, Weiss ES, Gott VL, Baumgartner WA, et al. EuroSCORE predicts short- and mid-term mortality in combined aortic valve replacement and coronary artery bypass patients. J Card Surg. 2009; 24:637–643. [PubMed: 20078709]

3-Mattila S, Harjula A, Jarvinen A, Kyllonen KE, Tala P. Combined valve replacement and myocardial revascularization. Factors influencing early and late results. Scand J Thorac Cardiovasc Surg. 1984; 18:49–52. [PubMed: 6609428

4-Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ ACC guideline for the management of patients with valvular heart disease: A report of the American college of cardiology/American heart association task force on practice guidelines. J Am Coll Cardiol 2014 Jun 10;63(22):e57–185.

5-Frye RL, August P, Brooks MM, Hardison RM, Kelsey SF, MacGregor JM, et al. A randomized trial of therapies for type 2 diabetes and coronary artery disease. N Engl J Med. 2009;360:2503-15.

6-Nassir M. Thalji, Rakesh M. Suri, Richard C. Daly, Kevin L. Greason, Joseph A. Dearani, John M. Stulak, Lyle D. Joyce, Harold M. Burkhart, Alberto Pochettino, Zhuo Li ,Robert L. Hartzell V. Schaff. The prognostic impact of concomitant coronary artery bypass grafting during aortic valve surgery: Implications forrevascularization in the transcatheter era:The Journal of Thoracic and Cardiovascular Surgery 2015 c Volume 149, Number 2

7-Vicchio M, De Feo M, Giordano S, Provenzano R, Cotrufo M, Nappi G. Coronary artery bypass grafting associated to aortic valve replacement in the elderly: survival and quality of life. J Cardiothorac Surg 2012;7(1):13.

8-Ahmed OF, Al Kaabi LS, Kakamad FH, Mohammed SH, Salih RQ. Early outcome of combined coronary artery bypass grafting and valve surgery. J. Cardiothorac. Vasc. Surg. 2018;5(1):1e5.

9-Nishimura RA, Otto CM, Bonow RO, Carabello BA, Erwin JP, Guyton RA, et al. 2014 AHA/ACC Guideline for the Management of Patients with Valvular Heart Disease. J Am Coll Cardiol. 2014;63:1-234.

10- Alsoufi B, Karamlou T, Slater M, Shen I, Ungerleider R, Ravichandran P :Results of Concomitant Aortic Valve Replacement and Coronary Artery Bypass Grafting in the VA Population J Heart Valve Dis 2006 Vol. 15. No. 1.