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Concurrent Aortic Valve Replacement and Coronary Artery Bypass Grafting: Early Outcome and Predictors of Mortality

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ABSTRACT

Background: The most prevalent structural heart valve condition that affects the aging population is degenerative aortic stenosis (AS). Conflicting reports have been reported on the effect of concomitant coronary artery bypass grafting (CABG) and aortic valve replacement (AVR) in patients with AS.

Objective: At our medical center, we aimed to investigate outcomes of patients that occurred following AVR for AS conditions with and without CABG.

Patients and Methods: A prospective study was performed in the Cardiothoracic Surgery Department from February 2019 to January 2021. A total of 50 patients were enrolled in the study and were equally divided into two groups. Group A involved patients who had an isolated AVR (n = 25). At the same time, Group B included patients who underwent AVR in conjunction with CABG (n = 25). AVR and all bypass anastomoses were performed under intermittent antegrade cold blood cardioplegia. Furthermore, we compared demographic, preoperative, operative, and postoperative data within groups.

Results: Our finding revealed that the combination surgery patients were significantly older than the AVR patients (63.4 ± 8.7 vs. 57.7 ± 6.9 years; p = 0.014). The hospital mortality rate was similar in the combined procedure and AVR. The aortic cross-clamp time and cardiopulmonary bypass time were significantly longer in AVR + CABG compared to AVR patients (p < 0.0001). One-year postoperative improvements were reported in the NYHA class, with only one hospital mortality case among the two groups.

Conclusions: We concluded that with optimal myocardial protection, minimal cross-clamp, and cardiopulmonary bypass time, in addition to the ideal and precise technique, the combined result of CABG-AVR was comparable to that of isolated CABG or AVR.

Keywords: Coronary artery disease, Aortic valve replacement, Aortic stenosis, Outcome.

INTRODUCTION

Aortic stenosis and coronary atherosclerosis may cause myocardial ischemia and its consequences, including angina, myocardial infarction, and mortality independently [1].

Aortic valve replacement is the preferred procedure for patients with severe AS [2]. Surgical AVR lowers morbidity and mortality associated with AS and has been the operation of choice for adolescent, low to intermediate-risk patients, often defined by the society of thoracic surgeons predicted risk of mortality (STS-PROM) score of 8% or less [3].

Patients with AS frequently have significant coronary artery diseases (CAD) [4]. It has been demonstrated that the early and long-term survival rates of AVR patients with CAD are worse without CABG [5, 6]. Regarding AVR with CABG combined procedures, there were conflicting findings. Some studies have shown higher rates of early death [6-8], whereas others have found no significant differences with concurrent CABG [9-14].

As the average age of patients referred for CABG surgery increases, the prevalence of patients with coronary and valve disorders increases. If AS is severe or the patient exhibits symptoms, AVR in a single stage and CABG should be performed [15].

AVR-CABG is a viable surgical option for patients with combined valvular and CAD. Although there are some inconsistent conclusions in the literature, most authors agree that CABG with AVR significantly improves long-term survival, even in high-risk populations [16]. Calcified AS is commonly related to CAD, and coronary grafting is a mandatory requirement for AVR procedures [17]. CABG is the most frequent procedure associated with aortic valvular pathology correction. Despite the higher risk, AVR-CABG is the third most commonly performed procedure after isolated CABG and AVR [15].

In recent years, nonsurgical and surgical treatment options have expanded, as a reliable evaluation of the relative risks associated with each approach is needed. With advances in surgical procedures, myocardial protection, and perioperative treatment outcomes have improved, and the purpose of the present study was to provide information on the risks of AVR with and without CABG. Herein, we aimed to assess the early clinical outcomes and mortality risk factors of AVR-CABG patients in our institution.

PATIENTS AND METHODS

Study design and patient population

A prospective comparative study was conducted in the Department of Cardio-thoracic Surgery, Zagazig University from February 2019 to January 2021. A total of 62 adult patients of more than 40 years who had either significant acquired AS or severe AS and concomitant CAD patients were included. The final analysis of the study included 50 patients, who were equally categorized into two groups according to

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operation type: Group A included patients who had isolated AVR (n = 25) and Group B included patients who had AVR and CABG (n = 25).

Inclusion criteria were: 1) Adult patients with severe AS. 2) Patients with severe AS and CAD.

Exclusion criteria were: 1) Patients who had previous open-heart surgeries. 2) Patients who required additional surgical procedures other than AVR and CABG.

Preoperative preparation

Although cardiovascular risk, morbidity, and mortality are expected to vary greatly between these two groups, we found it informative to make the comparison. Echocardiography and color preoperative coronary angiography were performed to all patients to examine valve dysfunction and pathology. With coronary stenosis, 50% stenosis in the left main artery and 75% occlusion or worse in other proximal major branches, the left anterior descending artery (LAD), left circumflex artery (LCX), or right coronary artery (RCA). All patients received a questionnaire to fill out that describes their health compared to the time before the operation, their quality of life, their use of anticoagulants, rehospitalization, and specific complications.

Operative intervention

Anesthetical, surgical, and perioperative management were administered following divisional protocols. Two cardiac surgeons with more than 10 years' experience performed nearly equal number of surgeries for the included patients in each group. There was fixed team of perfusionists, nurses and intensive care unit personnel for the patients included in our study. All surgeries were performed through median sternotomy with cardiopulmonary bypass (CPB) closed circuit and mild systemic hypothermia (32-34˚C). Cold blood cardioplegia was administered and appropriate myocardial protection was accomplished. Before valve surgery, distal anastomoses were performed in patients undergoing combination surgery. After valve surgery and removal of the aortic cross-clamp, proximal vein graft anastomoses were conducted.

Patient follow-up:

All patients were directed to a complete clinical evaluation. The transthoracic full detailed echocardiographic assessment was performed at hospital discharge, 3 months, 6 months and 1-year postoperative. Patients were followed up at our outpatient clinic. Examination of patients was done to check the postoperative course, NYHA classification, and the potential complications such as arrhythmia, stroke or readmission status among patients of the two studied groups. Postoperative survival and mortality rates were recorded.

Ethical Statement:

The Ethical Institutional Review Board at Zagazig University (IRB-ZU) approved the study. The registration number is (5635-8-10-2019). After explaining our research objectives, written informed consents were obtained from all study participants. This study was conducted in compliance with the code of ethics of the world medical association (Declaration of Helsinki) for human subjects.

Statistical analysis

Coding, entering and analyzing Microsoft Excel data from history, clinical exams, lab tests, and outcome measurements. Data were imported into SPSS version 25.0 for analysis. The Shapiro Walk test assessed normality. Chi-square (χ^2) and Fisher exact were employed to compare qualitative variables. Parametric data were expressed as mean ± SD and nonparametric data as median and range. Parametric and nonparametric variables were compared using the Independent T-test and the Mann-Whitney test. A P-value ≤ 0.05 was regarded as statistically significant &< 0.001 for highly significant two-tailed tests.

RESULTS

Demographic and preoperative characteristics

In this study, 50 adults with severe AS who had AVR with or without CABG were included and subdivided into two groups AVR, n = 25, and AVR + CABG, n = 25. Demographic and preoperative characteristics of the two groups showed that the mean age in the AVR + CABG group was significantly higher compared to AVR group (Table 1).

Table (1): Demographic data among the studied groups

Variable	AVR group N=25		AVR+ CABG group N=25		t-test	P-value
Age (years):						
• **Mean ± SD**	57.7 ± 6.9		63.4 ± 8.7		-2.6	**0.014**
• **Range**	48-72		47-76			**(S)**
Variable	**N**	**%**	**N**	**%**	**χ 2**	**P-value**
Sex:						
• **Male**	18	72	17	68		1
• **Female**	7	28	8	32	0.95	

Patients in both groups were also more likely to be males, with higher baseline morbidities, however no significant differences were observed between the groups in terms of previous hypertension, MI, hypercholesterolemia, DM, smoking, chronic pulmonary obstructive disease (CPOD) as well as PVD (Table 2).

Table (2): Co-morbidities among the studied groups

Variable	AVR group N=25		AVR+ CABG group N=25		t-test	P-value
BMI:						
• **Mean ± SD**	28.7±3.6		29.1±5.3		-0.314	0.755
• **Range**	46-92		44-80			
Variable	**N**	**%**	**N**	**%**	**χ 2**	**P-value**
Hypertension:						
• **No**	11	44	4	16	4.7	0.062
• **Yes**	14	56	21	84		
Hypercholesterolemia:						
• **No**	9	36	5	20	1.6	0.345
• **Yes**	16	64	20	80		
DM:						
• **No**	15	60	9	36	2.9	0.156
• **Yes**	10	40	16	64		
History of MI:						
• **No**	25	100	22	88	fisher	0.235
• **Yes**	0	0	4	12		
COPD:						
• **No**	23	92	21	84	fisher	0.667
• **Yes**	2	8	4	16		
Smoking:						
• **No**	15	60	21	84	fisher	0.114
• **Yes**	10	40	4	16		
PVD:						
• **No**	22	88	23	92	fisher	1
• **Yes**	3	12	2	8		
AF:						
• **No**	23	92	21	84	fisher	0.667
• **Yes**	2	8	4	16		

Ejection fractions percentage (EF%) was greater in the isolated AVR group (54.8 ± 9.3 vs. 48 ± 12, respectively; $p = 0.033$), with a narrower mean aortic valve area m AVA (0.77 ± 0.11 vs 0.84 ± 0.11, respectively; $p = 0.043$) relative to combined AVR+CABG. On the contrary, no differences were reported between the studied groups in terms of m. AV Gradient ($p > 0.05$). Concerning operative and postoperative data**,** as expected, the times of aortic cross-clamping (XCT) and CPB were significantly higher among patients with AVR + CABG (125.3 ± 30.9 and 173.1 ± 43.1, respectively) than among subjects with isolated AVR subjects (45.8±7.1 and 67.8±6.1, respectively) ($p < 0.0001$) (Table 3).

Table (3): Preoperative and operative data among the studied groups

Variable	AVR group N=25	AVR+ CABG group N=25	t-test	P-value
EF (%):				
• **Mean ± SD**	54.8±9.3	48±12	2.2	**0.033**
• **Range**	35-70	20-70		**(S)**
m AVA:				
• **Mean ± SD**	0.77±0.11	0.84±0.11	-2.1	**0.043**
• **Range**	0.50-0.95	0.60-1		**(S)**
m. AV Gradient:				
• **Mean ± SD**	51.9±7.7	48.9±3.5	1.7	0.087
• **Range**	40-70	43-55		
Cross clamp time (min.):				
• **Mean ± SD**	45.8±7.1	125.3±30.9	-12.5	**0.000**
• **Range**	35-60	82-198		**(HS)**
Cardiopulmonary bypass time:				
• **Mean ± SD**	67.8±6.1	173.1±43.1	-12.1	**0.000**
• **Range**	55-78	112-270		**(HS)**

Regarding postoperative data, total hospital stays and postoperative bleeding were also significantly longer in combined AVR + CABG (8.2 ± 2.1 days and 682.8 ± 394.9 min, respectively $p<0.05$) compared to AVR (6.9 ± 1.6 days and 468.8 ± 154.1 min, respectively $p<0.05$). Whereas, no statistically significant difference was observed of either reopening for bleeding or surgical site infections (SSI) among the two studied groups ($P>0.05$). The duration of stay in the ICU (2.1 ± 0.44 days vs. 2.4 ± 0.65 days, respectively, $p = 0.079$) was the same between both groups. Postoperative complications such as congestive heart failure (CHF), stroke, pneumonia, renal failure, and in-hospital mortality did not show statistically significant differences between the two groups ($p > 0.05$). A case of hospital mortality was reported for both groups, with no statistical differences between the combined AVR + CABG group and the isolated AVR group (Table 4).

Table (4): Postoperative data and complications among the studied groups

Variable	**AVR group N=25**		**AVR+ CABG group (N=25)**		**t-test**	**P-value**
Bleeding:						
• **Mean ± SD**	468.8±154.1		682.8±394.9		-2.5	**0.015**
• **Range**	250-760		250-1960		(MW)	**(S)**
Variable	**N**	**%**	**N**	**%**	**χ 2**	**P-value**
lim to lad:			2			
• **No**	0	0	23	8	---	----
• **Yes**	0	0		92		
reopening:						
• **No**	25	100	22	88	fisher	0.235
• **Yes**	0	0	3	12		
SSI:						
• **No**	23	92	22	88	fisher	1
• **Yes**	2	8	3	12		
Total hospital stay:						
• **Mean ± SD**	6.9±1.6		8.2±2.1		-02.4	**0.022**
• **Range**	5-12		6-14			**(S)**
ICU stay:						
• **Mean ± SD**	2.1±0.44		2.4±0.65		-1.8	0.079
• **Range**	2-4		2-4			
Chf:						
• **No**	22	88	23	92	fisher	1
• **Yes**	3	12	2	8		
Stroke:						
• **No**	24	96	23	92	fisher	1
• **Yes**	1	4	2	8		
Pneumonia:						
• **No**	25	100	24	96	fisher	1
• **Yes**	0	0	1	4		
Renal failure:						
• **No**	23	92	21	84	fisher	0.667
• **Yes**	2	8	4	16		
In-hospital mortality:						
• **No**	24	96	24	96	----	1
• **Yes**	1	4	1	4		

Postoperative follow-up, there was a significant postoperative decrease in the III / IV classes, indicating NYHA improvements within both groups (Table 5) ($p < 0.001$). On the contrary, there were no significant differences in readmission, arrhythmia, CHF, and stroke. There was one death reported in each group throughout the one-year follow-up, with non-statistically significant operative deaths among the studied groups (Table 6).

Table (5): Preoperative & postoperative NYHA classes among AVR and AVR-CABG groups

Variable In AVR	Preoperative		3 m post-operative		6 m post-operative		1-year post-operative		χ 2	P-value
	N	%	N	%	N	%	N	%		
NYHA:										
• **I**	4	16	21	87.5	23	95.8	23	95.8		
• **II**	18	72	2	8.3	0	0	0	0	13.2	**0.000**
• **III**	2	8	1	4.2	1	4.2	1	4.2		**(HS)**
• **IV**	1	4	0	0	0	0	0	0		
Variable In AVR-CABG	**Preoperative**		**3m post-operative**		**6 m post-operative**		**1-year post-operative**		**χ 2**	**P-value**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**		
NYHA:										
• **I**	2	8	14	58.3	20	83.3	21	87.5		
• **II**	13	52	9	37.5	3	12.5	1	4.2	47.3	**0.000**
• **III**	9	36	1	4.2	1	4.2	1	4.2		**(HS)**
• **IV**	1	4	0	0	0	0	1	4.2		

Table (6): 1-year postoperative data among the studied groups

Variable	AS Group N=24		AS+ CABG group N=24		χ 2	P-value
	N	%	N	%		
NYHA:						
• **I**	23	95.8	21	87.5		
• **II**	0	0	1	4.2	2.1	0.554
• **III**	1	4.2	1	4.2		
• **IV**	0	0	1	4.2		
Arrhythmia:						
• **No**	24	100	23	95.8		
• **Yes**	0	0	1	4.2	fisher	1
Readmission:						
• **No**	23	95.8	22	91.7	fisher	1
• **Yes**	1	4.2	2	8.3		
Stroke:						
• **No**	24	100	23	95.8		
• **Yes**	0	0	1	4.2	fisher	1
Mortality:						
• **No**	23	95.8	23	95.8	-----	1
• **Yes**	1	4.2	1	4.2		

DISCUSSION

Severe calcified AS is usually associated with CAD and CABG is a procedure required during AVR. CABG is the most common procedure performed during AVR in case of severe AS. However, because of the increased risk, AVR-CABG is the third procedure performed most frequently after isolated AVR and CABG [18]. CABG and aortic valve surgeries play an important role in cardiac surgery worldwide. CAD is found in around 50% of patients undergoing AVR and, if left without intervention, may inversely affect early and late postoperative outcomes. The old AHA/ACC guidelines considered that CABG was revealed (class I) for CAD >70% stenosis in AVR and reasonable (class IIa) among patients with CAD 50% - 70% stenosis [6].

CABG and AVR combination signifies the technical complexity of the procedure and impacts the outcomes. The most common reason for coronary revascularization is to improve patient complaints when other treatments have failed. Life-threatening complications (death, MI, recurrent angina) are reduced by surgical revascularization more than by the other therapy lines [6]. When indicated, combined AVR-CABG, a single session is comparatively harmless, with satisfactory results and non-significant complications [16]. Therefore, we aimed to study and assess the early outcomes and predictors of mortality in patients undergoing AVR + CABG.

If AS is severe in symptomatic patients, it is generally agreed that AVR should be performed simultaneously with CABG. In this study, 50 patients were involved with severe AS. Subjects were subdivided into two groups AVR, n = 25, and AVR + CABG, n = 25. The patients with the combined procedure were significantly older than the patients who underwent isolated AVR (63.4 ± 8.7 vs. 57.7 ± 6.9 years respectively; p < 0.01). Similarly, **Benyoussef *et al.*** [19] reported that the mean age of combined AVR+CABG patients was older (64.9 ± 9.2) than of patients who underwent isolated valvular surgery (44.4 ± 13.1) (p = 0.0001). Unlike our findings, **Takagi *et al.*** [20] reported that the mean age was similar in the AVR and AVR+CABG groups at 87.9 vs 86.7 years, respectively (p = 0.2331). The AVR+CABG group exhibited significantly higher female frequency sex, dyslipidemia, and renal dysfunction than the AVR group.

Regarding preoperative complications, there were no significant differences between the 2 groups. However, the iAVR group had higher EF% (54.8 ± 9.3 vs. 48 ± 12, respectively; p = 0.033), narrower m. AVA (0.77 ± 0.11 vs. 0.84 ± 0.11, respectively; p =0.043) relative to combined AVR+CABG. In **Formica *et al.*** [21] the study revealed that the iAVR group exhibited higher EF% (56.7% vs. 54%, respectively; p = 0.028) and higher aortic peak gradients relative to combined procedures, but showed no differences in m. AVA between the two groups. Furthermore, previous studies indicated that a low EF increased the risk of undergoing AVR-CABG [1, 8, 22].

AVR + CABG have a longer CPB time and X-Clamp duration than iAVR subjects with statistical differences. Other investigations documented similar discrepancies [19, 21, 23]. Longer CPB is associated with a higher incidence of brain, kidney, and coagulation damage, and a longer X-Clamp increases the chance of myocardial injury; therefore, these factors always cause concern. Our findings were validated by those of **Benyoussef *et al.*** [19] who found that the CPB time, XCT, mechanical respiratory support time and ICU stay of patients who received AVR + CABG were longer than those of patients who underwent AVR .

Regarding intraoperative complications, there was statistical significance for amount of bleeding in AVR-CABG patients compared to AVR patients. **Alfaqe and Al-Yakoob** [24] reported that common postoperative complications that occurred in combined AVR+CABG and isolated AVR, indicating prolonged hospital stay, bleeding, and arrhythmia, where the results of the two investigated groups were comparable.

In our study, the operative mortality rate was 4% for both groups. This rate is in line with [1, 22, 23, 25, 26-28] (3.4–6.5%). Furthermore, **Thalji *et al.*** [6] reported that combining AVR with CABG did not affect operational mortality rates (AVR with CABG, 2.9% vs. isolated AVR, 3.0%; P = 0.90). Overall operative mortality in **Gunay *et al.*** [10] among AVR-CABG was 10%, whereas **Ahmed *et al.*** [16] reported a mortality rate of 14%. According to the National Cardiac Database of the Society of Thoracic Surgeons, the operative mortality rate for patients receiving AVR-CABG is 4.5%, which is much higher than that for isolated AVR (3%) [29]. So, our findings indicated that CABG could be performed concurrently with AVR without increasing operative mortality.

Previous studies revealed a significant improvement in NYHA classes for combined AVR and AVR + CABG procedures through follow-up [8, 30], which is similar to our finding regarding isolated AVR and combined AVR+CABG, which indicated a notable decrease in NYHA Class II/ III during the preoperative period and a one year follow-up period (p<0.001).

CONCLUSIONS

In patients indicated for surgical AVR with underlying > 50% CAD, concomitant CABG, when technically feasible, does not affect early postoperative outcomes. Additionally, concomitant AVR-CABG does not increase major adverse cerebral or cardiovascular events for 1-year postoperative follow-up. However, both studied groups showed a marked improvement in postoperative symptoms and NYHA. Therefore, performing AVR-CABG in a single session, when indicated, is safe with accepted early outcomes.

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REFERENCES

1. **Cho W, Yoo D, Kim J *et al.* (2011):** Aortic Valve Replacement for Aortic Stenosis and Concomitant Coronary Artery Bypass: Long-term Outcomes and Predictors of Mortality. Korean J Thorac Cardiovasc Surg., 44 (2): 131-6.
2. **Nishimura R, Otto C, Bonow R *et al.* (2014): 2**014 AHA/ACC Guideline for the Management of Patients with Valvular Heart Disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation, 129 (23): 2440-92.
3. **Foroutan F, Guyatt G, O'Brien K *et al.* (2016):** Prognosis after surgical replacement with a bioprosthetic aortic valve in patients with severe symptomatic aortic stenosis: systematic review of observational studies. BMJ., 354: i5065. doi: https://doi.org/10.1136/bmj.i5065
4. **Sakakura R, Asai T, Suzuki T *et al.* (2019):** Outcomes after aortic valve replacement for aortic valve stenosis, with or without concomitant coronary artery bypass grafting. General Thoracic and Cardiovascular Surgery, 67 (6): 510-517.
5. **Mullany C, Elveback L, Frye R *et al.* (1987):** Coronary artery disease and its management: influence on survival in patients undergoing aortic valve replacement. J Am Coll Cardiol., 10 (1): 66-72.

6. **Thalji N, Suri R, Daly R *et al.* (2015):** The prognostic impact of concomitant coronary artery bypass grafting during aortic valve surgery: Implications for revascularization in the transcatheter era. The Journal of Thoracic and Cardiovascular Surgery, 149 (2): 451-460.e2.
7. **Edwards F, Peterson E, Coombs L *et al.* (2001):** Prediction of operative mortality after valve replacement surgery. J Am Coll Cardiol., 37 (3): 885-92.
8. **Kobayashi K, Williams J, Nwakanma L *et al.* (2007):** Aortic valve replacement and concomitant coronary artery bypass: assessing the impact of multiple grafts. Ann Thorac Surg., 83 (3): 969-78.
9. **Kvidal P, Bergström R, Hörte L *et al.* (2000):** Observed and relative survival after aortic valve replacement. J Am Coll Cardiol., 35 (3): 747-56.
10. **Gunay R, Sensoz Y, Kayacioglu I *et al.* (2009):** Is the aortic valve pathology type different for early and late mortality in concomitant aortic valve replacement and coronary artery bypass surgery? Interact Cardiovasc Thorac Surg., 9 (4): 630-634.
11. **Dell'Amore A, Aquino T, Pagliaro M *et al.* (2012):** Aortic valve replacement with and without combined coronary bypass grafts in very elderly patients: early and long-term results. Eur J Cardiothorac Surg., 41 (3): 491-8.
12. **de Waard G, Jansen E, de Mulder M *et al.* (2012):** Long-term outcomes of isolated aortic valve replacement and concomitant AVR and coronary artery bypass grafting. Neth Heart J., 20 (3): 110-7.
13. **Abel N, Rogal G, Burns P *et al.* (2013):** Aortic valve replacement with and without coronary artery bypass graft surgery in octogenarians: is it safe and feasible? Cardiology, 124 (3): 163-73.
14. **Beach J, Mihaljevic T, Svensson L *et al.* (2013):** Blackstone, Coronary Artery Disease and Outcomes of Aortic Valve Replacement for Severe Aortic Stenosis. Journal of the American College of Cardiology, 61 (8): 837-848.
15. **Ahmed O, Kakamad F, Al-Neaimy S *et al.* (2019):** Outcome of combined coronary artery bypass grafting and aortic valve replacement; a case series. International Journal of Surgery Open, 21: 48-51.
16. **Ahmed O, Kaabi L, Kakamad F *et al.* (2018):** Early outcome of combined coronary artery bypass grafting and valve surgery. Edorium J Cardiothorac Vasc Surg., 5: 1-5.
17. **Vicchio M, Feo M, Giordano S *et al.* (2012):** Coronary artery bypass grafting associated to aortic valve replacement in the elderly: survival and quality of life. Journal of Cardiothoracic Surgery, 7 (1): 13-16.
18. **Frye R, August P, Brooks M *et al.* (2009):** A randomized trial of therapies for type 2 diabetes and coronary artery disease. N Engl J Med., 360 (24): 2503-15.
19. **Benyoussef H, Makani S, Benzha M *et al.* (2019):** Does Additional Coronary Artery Bypass Grafting Increase Hospital Mortality of Patients Requiring Valve Surgery? World J Cardiovasc Surg., 9 (10): 143-154.
20. **Takagi K, Arinaga K, Takaseya T *et al.* (2020):** Aortic valve replacement with or without concomitant coronary artery bypass grafting in very elderly patients aged 85 years and older. Heart and Vessels, 35 (10): 1409-1418.
21. **Formica F, Mariani S, D'Alessandro S *et al.* (2020):** Does additional coronary artery bypass grafting to aortic valve replacement in elderly patients affect the early and long-term outcome? Heart and Vessels, 35 (4): 487-501.
22. **Shahian D, O'Brien S, Filardo G *et al.* (2009):** The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 3--valve plus coronary artery bypass grafting surgery. Ann Thorac Surg., 88 (1): 43-62.
23. **Pereira J, Balaban K, Lauer M *et al.* (2005):** Aortic valve replacement in patients with mild or moderate aortic stenosis and coronary bypass surgery. Am J Med., 118 (7): 735-42.
24. **Alfaqe M, Al-Yakoob Z (2020):** Coronary Artery Bypass Grafting With Additional Procedures. Journal of Cardiovascular Disease Research, 11 (3): 19-25.
25. **Richardson JV, Kouchouko NT, Wright JO *et al.* (1979):** Combined aortic valve replacement and myocardial revascularization: results in 220 patients. Circulation, 59 (1): 75-81.
26. **Kirklin J, Kouchoukos N (1981):** Aortic valve replacement without myocardial revascularization. Circulation, 63 (2): 252-3.
27. **Miller D, Stinson E, Oyer P *et al.* (1979):** Shumway, Surgical implications and results of combined aortic valve replacement and myocardial revascularization. Am J Cardiol., 43 (3): 494-501.
28. **Mihaljevic T, Nowicki E, Rajeswaran J *et al.* (2008):** Cosgrove, Survival after valve replacement for aortic stenosis: implications for decision making. J Thorac Cardiovasc Surg., 135 (6): 1270-8.
29. **D'Agostino R, Jacobs J, Badhwar V *et al.* (2016):** The society of thoracic surgeons adult cardiac surgery database: 2016 update on outcomes and quality. The Annals of Thoracic Surgery, 101 (1): 24-32.
30. **Lytle B, Cosgrove D, Gill C *et al.* (1988):** Aortic valve replacement combined with myocardial revascularization. Late results and determinants of risk for 471 in-hospital survivors. J Thorac Cardiovasc Surg., 95 (3): 402-14.