Kardiologia Polska 2018; 76, 3: 655–661; DOI: 10.5603/KP.2018.0005 ISSN 0022–9032

ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Clinical presentation, surgical management, and outcomes of patients treated for aortic stenosis and coronary artery disease. Does age matter?

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Abstract

Background: Aortic stenosis and coronary artery disease (CAD) sharing similar risk factors are associated with aging of the human population.

Aim: The purpose of this study was to examine whether age affects clinical presentation, intraoperative management, and outcomes of patients who undergo simultaneous operations of aortic valve replacement (AVR) and coronary artery bypass grafting (CABG).

Methods: The study involved 452 consecutive patients aged 64.8 ± 8.2 years (range 38–79 years), who underwent combined AVR and CABG between 2005 and 2015. They were divided into three groups: Y (young; below the first quartile; n = 114), M (middle-aged; 58–71 years; n = 225) and E (elderly; above the third quartile; n = 113). Pre- and intraoperative variables were analysed. The deaths that occurred in hospital and throughout follow-up were defined as cardiac- or non-cardiac-related. The probability of survival was calculated with the use of Kaplan-Meier curves.

Results: Coronary artery disease was more extensive in group E than in group Y ($p < 0.05$). Complete myocardial revascularisation was performed in 94.1%, 76.2%, and 62.8% in groups Y, M, and E, respectively ($p < 0.05$). In-hospital mortality was 2.0%, 5.3%, and 6.4%, in groups Y, M, and E, respectively. Early morbidity was significantly higher in group E than in groups M or Y. The 12- and 60-month freedom from cardiac-related death was higher in group Y (0.98 ± 0.02 and 0.94 ± 0.03) than in group E (0.93 ± 0.02 and 0.85 ± 0.03; $p = 0.023$, respectively). Left ventricular ejection fraction below 0.4 and incomplete revascularisation were associated with worse prognosis, particularly in group E.

Conclusions: Elderly patients undergoing combined procedures of AVR and CABG having more extensive CAD less often receive complete revascularisation, are at higher risk of early organ failure, and present markedly reduced rates of freedom from cardiac-related deaths throughout follow-up than younger subjects.

Key words: age, aortic valve replacement, aortocoronary bypass grafting, long-term outcome

Kardiol Pol 2018; 76, 3: 655–661

INTRODUCTION

Patients undergoing aortic valve replacement (AVR) for severe aortic stenosis (AS) not uncommonly have also coronary artery bypass grafting (CABG) procedures. Coronary artery disease (CAD) may be identified in as many as half of AVR patients [1]. These diseases share similar risk factors (arterial hypertension, hyperlipidaemia, diabetes) and are associated with the aging of the population [2, 3]. Chronic inflammation and repeated microinjuries promote atherosclerosis development [4]. On the other hand, an ultrastructural study of the stenotic aortic

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Received: 07.09.2017 **Accepted:** 18.12.2017 **Available as AoP:** 06.01.2018

valves harvested intraoperatively revealed remodelling associated with tissue damage followed by its repair as predisposing factors for AS onset and progression [5]. The 2014 American Heart Association/American College of Cardiology guidelines considered CABG at the time of AVR as reasonable (indication class IIa) for coronary stenosis exceeding 70% (significant lesions) [6].

Currently, the elderly constitute a large proportion of patients undergoing invasive cardiac surgical procedures [7]. Aging itself is considered as a risk factor for the onset and progression of many pathologies but also has a huge impact on in-hospital and late outcomes following surgical procedures [8, 9]. In a result, management of patients with significant AS and CAD selected for invasive and complex procedures, such as AVR and CABG, may differ between young and elderly individuals. In a series of clinical scenarios, surgeons and cardiologists, bearing in mind procedure-related risk, decide to disqualify elderly patients from surgery or to limit the extent of surgical intervention. There is no clear conclusion if the latter attitude should be recommended. However, it was shown recently that if combined CABG and AVR were not feasible, even percutaneous coronary intervention (PCI) or AVR alone still improved significantly long-term survival, as compared with medical treatment alone [10].

In view of the above, the purpose of this study was to examine if the age of patients affects clinical presentation, intraoperative management, and outcomes following concomitant AVR for AS and CABG, on the base of a single cardiac surgical centre experience.

METHODS

Patients

The retrospective study involved 452 consecutive patients (320 males and 132 females) who underwent elective or urgent operations of simultaneous AVR for AS and CABG between 2005 and 2015. The following exclusion criteria such as necessity for other simultaneous cardiac surgical procedures (e g. mitral valve surgery, ascending aorta replacement) and emergent operations due to haemodynamic instability were applied.

Patients were divided retrospectively into three age groups: group Y (young; below the first quartile; at the age 57 or less; n = 114), group M (middle-aged; between 58 and 71 years old; n = 225), and group E (elderly; above the third quartile; 72 years and older at the time of surgery; n = 113).

Informed consent was obtained from each patient and the study protocol conforms to the ethical guidelines of the Declaration of Helsinki as reflected in a priori approval by the institution's Human Research Committee.

Preoperative period

Patients were selected for surgery on the basis of transthoracic echocardiography (TTE) (M+2D+Doppler) and coronary angiography. In echocardiography, parameters assessing both morphology and function of all cardiac valves and both ventricles were collected and analysed. Particular attention was paid to aortic valve and systolic left ventricular performance. In the coronary angiography the extent of CAD was evaluated on the basis of not only the number of vessels involved (left main, single-, double- and triple-vessel disease, respectively) but also using the SYNTAX (Synergy between PCI with Taxus and cardiac surgery) calculator. According to the latter, patients were classified as low (0–22 points), intermediate (23–32 points), and high SYNTAX (> 32 points) score subjects [11, 12].

Operation

All patients were operated from median sternotomy with the use of standard cardiopulmonary bypass (CPB). Cold cardioplegic arrest with intracoronary infusion of St. Thomas Hospital II solution and moderate systemic hypothermia were applied as protective measures. The sequence of operations was similar in all cases. First, during cardioplegic solution infusions, stenotic valves were removed, and then distal anastomoses of free grafts with 7-0 monofilament sutures were performed. Afterwards, the aortic mechanical or biological prostheses were implanted with the use of non-everting 2-0 Ti-Cron mattress sutures followed by revascularisation of the left anterior descending artery or its diagonal branch with left internal thoracic artery (ITA). Eventually, after aortotomy closure, the aortic clamp was released and proximal anastomoses of the free grafts were performed on the ascending aorta with 6-0 or 5-0 monofilament sutures.

We analysed intraoperative parameters such as type of aortic prosthesis, number and type of aortocoronary bypass grafts, completeness of myocardial revascularisation, CPB, and aortic cross-clamping (ACC, e.g. ischaemic) times. Complete revascularisation was defined if all diseased vessels potentially amenable to treatment (i.e. with diameter > 1.0 mm) were bypassed.

Postoperative period

Immediately after surgery patients were transferred to a postoperative intensive care unit where they were carefully monitored. On the following day, stable patients were transferred to a cardiac surgical unit.

Follow-up period

All patients were systematically followed-up in the outpatient clinic. Usually once a year TTE (M+2D+Doppler) was performed and the function of the valves as well as regional or global contractility were analysed. In cases of recurrent symptoms, particularly stenocardia, repeat coronary angiography followed by PCI, if applicable, were carried out. All deaths that occurred throughout the follow-up period were carefully analysed and then defined as cardiac- or non-cardiac-related.

Data management and statistical analysis

To check normality of continuous variables the Shapiro-Wilk W was performed. When the values were normally distributed, they were presented as means ± standard deviations, then analysis of variance (ANOVA) followed by the Tukey's test were employed. SYNTAX scores were expressed as medians (25^{th} and 75^{th} percentiles), and categorical data as numbers (n) and percentages (%). All of the aforementioned variables were compared with non-parametric Kruskal-Wallis ANOVA test followed by multiple comparisons of mean ranks. Survival analyses were performed with the use of Kaplan-Meier, and probability of survival rates were presented as the respective curves. The curves were compared with the use of the Gehan's Wilcoxon test. A p value < 0.05 was considered statistically significant. All statistical analyses were performed using Statistica 10.0 for Windows (StatSoft, Inc., Tulsa, OK, USA).

RESULTS

Primary clinical presentation

In the majority of group Y patients (n = 94; 82.5%), symptomatic CAD was the first clinical manifestation of any cardiac pathology. It included acute coronary syndrome (ACS; n = 69; 60.5%) or stable angina (n = 25; 22.0%). Eleven (9.5%) individuals had known about aortic valve disease (or at least some pathology) for many years prior to surgery. The remainders suffered from heart failure, and after detailed examinations AS and CAD were diagnosed.

In group M, CAD was the primary diagnosis and predominant pathology in approximately 50% of patients (n = 109; 48.4%). However, among them stable CAD was the most prevalent (156/225; 69.3%). Otherwise in group E, patients with symptomatic significant AS accounted for the majority (n = 68; 60.2%) and during qualification to surgery CAD was also detected. In this group, as few as 10% (n = 11; 8.8%) of patients had ACS as the first clinical presentation.

Findings in preoperative examinations

Coronary angiography. The severity of CAD that required surgical revascularisation during AVR differed significantly between the studied groups, particularly the youngest (group Y) and the other subjects (Table 1). In group Y, the majority of patients had less severe forms of CAD defined as one- or two-vessel disease (n = 96; 84.2%). In groups M and E they still accounted for more than 50% of cases, although markedly less than in group Y. On the other hand, patients with three-vessel disease or significant stenosis in the left main stem accounted for about 15% in group Y but was at least twice more likely in group E ($p < 0.05$ group Y vs. group M or group E; Table 1). Similarly, the extent of coronary disease calculated according to the SYNTAX score differed significantly between groups (Table 1, Fig. 1). Median score was the lowest for group Y and the highest for group E patients.

Transthoracic echocardiography (M+2D+Doppler). Mean left ventricular ejection fraction (LVEF) was the lowest in group Y (0.49 ± 0.12) and the highest in group E (group Y < group M < group E) (Table 1). It corresponded with the percentage of subjects with significantly impaired left ventricular systolic performance (i.e. LVEF < 0.4). They comprised one third of individuals in group Y and below 10% in group E (group Y > group M > group E). At the same time, the left ventricular end-diastolic dimension was also the largest among group Y (5.4 ± 1.2) and systematically decreased with the ageing of patients (group Y > group M > group E). Mean peak systolic aortic transvalvular gradient was the lowest in group Y and the highest in group E. Moreover, a rate of individuals with moderately elevated peak transvalvular pressure gradient (< 60 mmHg) was the highest in group Y (27.2%) and the lowest in group E (18.6%). It resulted from either depressed preoperative LVEF or moderate AS. The first scenario was predominant in group Y and the second one in groups M and Y.

The detailed findings in the preoperative coronary and TTE (M+2D+Doppler) are displayed in Table 1.

Surgical management

Operations were carried out electively in the majority of cases in all groups. However, differences between them were found (Table 2). In the youngest patients (group Y), stenotic valves were replaced by mechanical prostheses exclusively, whereas in group E the vast majority of cases (n = 109; 96.5%) received pericardial bioprostheses.

Complete myocardial revascularisation was performed in 107 (94.1%) patients in group Y, 171 (76.0%) in group M, and 71 (62.8%) in group E, respectively ($p < 0.05$). Target coronary arteries vessels were not bypassed either due to their small diameter (less than 1.0 mm) or severe atherosclerosis that enabled graft implantation.

The number of implanted aortocoronary grafts did not differ significantly between studied subgroups. All patients with pathology that involved left anterior descending artery territory received ITA grafts irrespective of group. ITA was used in 82 (71.9%), 170 (75.6%), and 85 (75.2%) patients, respectively, in groups Y, M, and E (p = NS). However, ACC and CPB times were markedly longer in group E than in the remainders (Table 2).

In-hospital mortality and morbidity

Twenty-one patients died during in-hospital stay (early mortality 4.9%): two in group Y (1.7%), 11 in group M (4.9%), and eight in group E (7.0%). The predominant reason in all groups was postcardiotomy low cardiac output syndrome (two, eight, and six, respectively in groups Y, M, and E), followed by respiratory failure (two in group M and one in group E), massive stroke (one in group M), and sepsis (one in group E).

Table 1. Selected preoperative angiographic and echocardiographic parameters

Variables[1]	Group Y (n = 114)	Group M (n = 225)	Group E (n = 113)
Coronary angiography			
One-vessel disease	60 (52.6%)	88 (39.1%)	42 (37.2%)
Two-vessel disease	36 (31.6%)	62 (27.6%)	26 (23.0%)
Three-vessel disease	9 (7.9%)	41 (18.2%)	23 (20.4%)
Left main disease	9 (7.9%)	34 (15.1%)	22 (19.4%)
Severe CAD[2]	18 (15.8%)	75 (33.3%)#	45 (39.8%)*
SYNTAX score	20 (14, 28)	24 (18, 32)#	30 (22, 37)**&
Low SYNTAX	65 (57.0%)	76 (33.8%)#	30 (26.6%)*
Intermediate SYNTAX	34 (29.8%)	71 (31.5%)	32 (28.3%)
High SYNTAX	15 (13.2%)	78 (34.7%)#	51 (45.1%)*
Echocardiography (M+2D+Doppler)			
LVEDd [mm]	5.4 ± 1.2	4.5 ± 0.9#	4.4 ± 0.7*
LVESd [mm]	3.9 ± 1.3	3.3 ± 1.1	3.0 ± 0.8*
LVPWd [mm]	1.3 ± 0.3	1.4 ± 0.3	1.4 ± 0.2
IVSd [mm]	1.5 ± 0.3	1.6 ± 0.4	1.6 ± 0.3
LAd [mm]	4.1 ± 0.6	4.1 ± 0.8	4.0 ± 0.5
RVd [mm]	3.0 ± 0.4	2.9 ± 0.5	2.8 ± 0.6
LVEF [%]	0.49 ± 0.12	0.55 ± 0.14	0.59 ± 0.13*
LVEF ≤ 0.40	38 (33.3%)	43 (19.1%)#	11 (9.7%)**
Regional LV contractility disturbances	78 (68.4%)	86 (38.2%)#	18 (15.9%)**&
PPG [mmHg]	74.4 ± 15.2	79.4 ± 26.1	86.4 ± 18.0
PPG < 60 mmHg	31 (27.2%)	54 (24.0%)	21 (18.6%)
LVEF ≤ 0.40 and PPG < 60 mmHg	18 (15.83%/58.14%)	14 (6.2%/26.0%)	3 (2.6%/14.2%)

[1]Categorical variables are presented as the numbers (percentage) and continuous variables as the means ± standard deviation or as medians (25th, 75th percentile); [2]Defined as three vessels and/or left main stem disease; [3]Percentage vs. whole group; [4]Percentage vs. patients with PPG < 60 mmHg in a given subgroup; *p < 0.05 group E vs. Y, **p < 0.001 group E vs. Y, #p < 0.05 group M vs. Y, &p < 0.05 group E vs. M; CAD — coronary artery disease; IVSd — diastolic ventricular septum thickness; LAd — left atrial dimension; LV — left ventricular; LVEDd — LV end-diastolic dimension; LVEF — LV ejection fraction; LVESd — LV end-systolic dimension; LVPWd — diastolic LV posterior wall dimension; PPG — peak systolic pressure gradient; RVd — diastolic right ventricular dimension

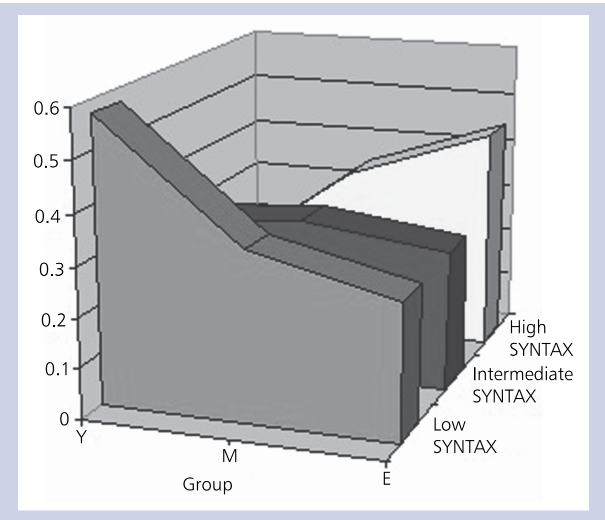

Figure 1. Severity of coronary artery disease in three age groups. In group Y more than 50% of patients had low SYNTAX score whereas in group E less than 20%

Table 2. Selected intraoperative data

Variables[1]	Group Y (n = 114)	Group M (n = 225)	Group E (n = 113)
Elective surgery	80 (70.2%)	180 (80.0%)	98 (86.7%)*
Urgent[2] surgery	34 (29.8%)	45 (20.0%)	15 (13.3%)*
Mechanical valves	114 (100%)	176 (78.2%)	4 (3.5%)**
Bioprostheses	0 (0%)	49 (21.8%)	109 (96.5%)**
One ACBG	65 (57.0%)	114 (50.7%)	67 (59.3%)
Two ACBGs	42 (36.8%)	87 (38.7%)	35 (31.0%)
Three ACBGs	7 (6.1%)	24 (10.7%)	11 (9.7%)
CPB time [min]	87.1 ± 17.1	94.2 ± 25.5	104.1 ± 21.6*
ACC time [min]	69.3 ± 15.1	74.8 ± 21.2	81.8 ± 14.6*

[1]Categorical variables are presented as the number (percentage) and continuous variables as the mean ± standard deviation; [2]Defined if patients had to stay in hospital prior to surgery; *p < 0.05 group E vs. Y and M, **p < 0.001 group E vs. Y and M; ACBG — aortocoronary bypass graft; ACC — aortic cross clamping; CBP — cardiopulmonary bypass

Table 3. Early morbidity[1]

Complications[2]	Group Y (n = 114)	Group M (n = 225)	Group E (n = 113)
Organ adverse events:			
Perioperative MI[3]	4 (3.5%)	10 (4.4%)	7 (6.2%)
Atrial fibrillation	25 (21.9%)	54 (24.0%)	37 (32.7%)
Respiratory insufficiency[4]	2 (1.8%)	6 (2.7%)	10 (8.0%)*
Acute renal injury[5]	7 (6.1%)	18 (8.0%)	18 (14.1%)*
Neurological events[6]	0 (0%)	3 (1.3%)	5 (4.4%)
Surgical complications:			
Haemorrhage[7]	2 (1.8%)	5 (2.2%)	3 (3.7%)
Surgical site infection[8]	1 (0.9%)	2 (0.9%)	1 (0.9%)

[1]Only serious adverse events are listed; [2]Categorical variables are presented as the numbers (percentage); [3]Defined if significantly elevated (at least 10 times) myocardial necrosis parameters (troponin I and MB isoenzyme of creatine kinase) were accompanied by electrocardiography changes and new disturbances in regional myocardial contractility; [4]If mechanical ventilation was longer than 24 h or repeat endotracheal intubation was necessary; [5]If creatinine concentration exceeded by at least 50% its preoperative value; [6]Confines only stroke confirmed in computed tomography; [7]If required reoperation; [8]Only deep wound infections that involved structures below sternum; *p < 0.05 group E vs. other groups; MI — myocardial infarction

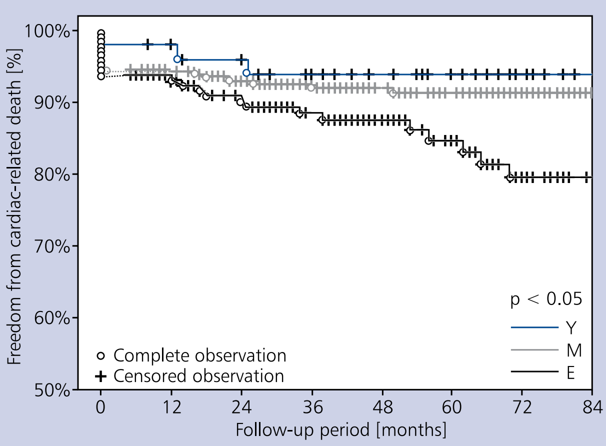

Figure 2. Freedom from cardiac-related death (Kaplan-Meier)

It should be highlighted that the aforementioned reasons led to multi-organ failure and eventually to death.

The morbidity rate was markedly higher in group E than in the other groups ($p < 0.05$). As the incidence of surgical complications did not differ between groups, the higher overall morbidity resulted from more frequent organ adverse events in group E, particularly respiratory and renal failure (Table 3).

Long-term follow-up

Fatal cardiac adverse events in the long-term follow-up significantly reduced the survival rate in group E as compared to group Y ($p = 0.023$). The 12-, 24-, and 60-month freedom from cardiac-related death was: 0.98 ± 0.02, 0.96 ± 0.03, and 0.94 ± 0.03 in the group Y patients; 0.95 ± 0.01, 0.93 ± 0.02, and 0.91 ± 0.02 in the group M patients; and 0.93 ± 0.02, 0.90 ± 0.02, and 0.85 ± 0.03 in the group E patients, respectively (Fig. 2).

Preoperative impaired left ventricular function defined as LVEF below 0.4 was associated with poor long-term survival, and its impact was the most pronounced in group E. Sixty-month freedom from cardiac-related death was significantly higher for patients with relatively well preserved preoperative systolic performance of the left ventricle (LVEF > 0.4) not only in group E (0.87 ± 0.02 vs. 0.29 ± 0.02; $p < 0.001$) but also in group M (0.92 ± 0.02 vs. 0.66 ± 0.07; $p = 0.001$) (Fig. 3A). It was not observed among the group Y subjects.

Moreover, the freedom from cardiac-related death during the follow-up period was significantly higher for complete revascularisation cases in both group M and group E patients. Sixty-month probability of survival without fatal cardiac events was 0.95 ± 0.02 and 0.84 ± 0.04 in group M ($p = 0.010$) and 0.88 ± 0.03 and 0.79 ± 0.04 in group E ($p = 0.046$), for patients with complete and incomplete surgical revascularisation, respectively (Fig. 3B). As incomplete myocardial revascularisation took place only in three of the group Y subjects, such analysis was not carried out for the youngest.

During the follow-up period repeat PCIs had to be carried out in five (4.5% of in-hospital stay survivors), 12 (5.6%), and eight (7.6%) patients, respectively, in groups Y, M, and E (p = NS). However, in groups Y and M, they predominantly involved treated surgically arteries (80% in group Y and 66.7% in group M) while in group E, PCIs were more frequent (62.5%) on the arteries that had not been revascularised during primary CABG. Nobody required cardiac surgical re-interventions throughout post-discharge follow-up.

DISCUSSION

Our study has shown that young and elderly patients undergoing combined AVR and CABG are different with respect to clinical manifestation, intraoperative management, and outcomes. In younger individuals, the preoperative course was more dynamic. In our group, ACS was the first diagnosis in the vast majority of younger patients but only in one tenth of the elderly population. Previously it was shown that among individuals aged 50 years and below CAD was the most frequent cause of sudden cardiac death, in many cases as a result of ACS [13]. Additionally, a higher percentage of young subjects required urgent surgical intervention compared to the elderly.

We were not surprised that the elderly had more severe and extensive CAD as assessed by applying the SYNTAX calculator or on the basis of the number of involved ves-

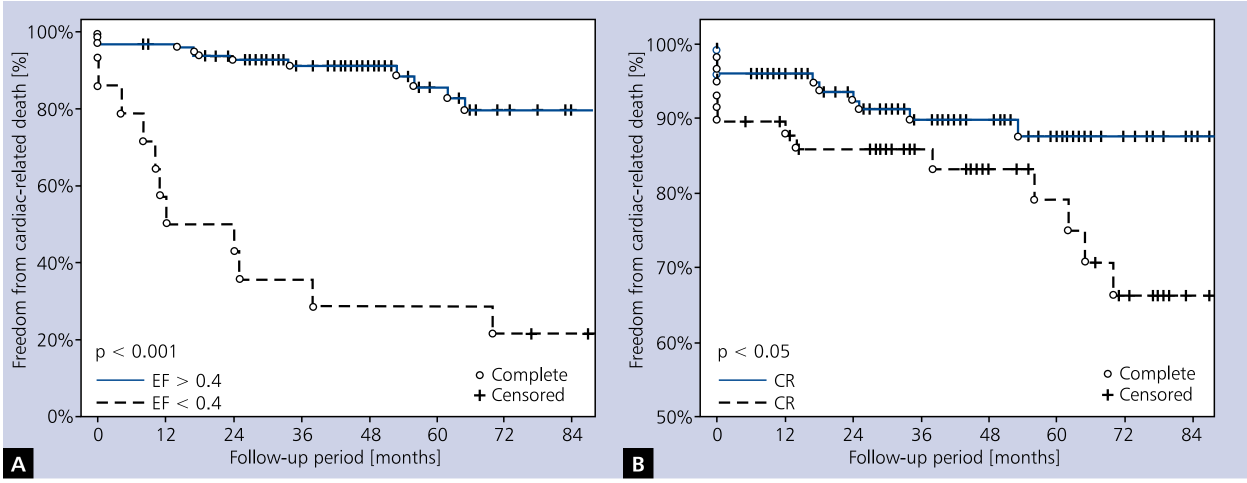

Figure 3. Association between low ejection fraction (EF) (A), incomplete surgical revascularisation (CR) (B) and freedom from cardiac-related death in the elderly (group E)

sels. Although CAD, a particular form of atherosclerosis, is inherently associated with aging of the circulatory system, this process is observed even in younger patients [13]. Atherosclerosis is attributed not only to chronic vascular injury but also to permanent vessel wall inflammation. It was also suggested that aging-related deficit of progenitor cells responsible for repair and rejuvenation of the arteries might also contribute to atherosclerosis onset and progression [14]. Although CAD was more diffuse in group E subjects, systolic left ventricular performance was better preserved than in the younger individuals (group Y). In the latter group, LVEF equal or below 0.4 was four times more prevalent than in group E and occurred at least twice as often as in middle-aged subjects (group M). Additionally, regional disturbances in myocardial contractility were noted more often in younger than in older patients. Thus, at least in group Y patients, the predominant reason for impaired left ventricular systolic performance was probably CAD rather than decompensated aortic valve disease.

A comparison of complex CABG and AVR patients, even in a single cardiac surgical centre, of different ages may be difficult. The elderly, considered as high-risk patients, are usually treated by the most experienced cardiac surgeons. That is also the case in our centre. In our series, in spite of the aforementioned fact, implantation of a comparative number of aortocoronary bypasses lasted longer (i.e. ACC and CPB times) in group E than Y. Thus, it cannot be excluded that the operations in the elderly were more difficult and technically demanding. The diffuse and more distal atherosclerosis of the coronary arteries observed more frequently in group E could also have impact on prolonged ACC and CPB times.

Early mortality of 4.9% after AVR combined with CABG is comparable with the previous reports [9, 15]. It is increased as much as twice in high-risk patients defined if the Society of Thoracic Surgeon (STS) score is > 10% and/or European System for Cardiac Operative Risk Evaluation (EuroSCORE) > 15% [16]. An increased early mortality among the elderly has also been stressed [17]. This negative impact may be amplified by impaired LVEF in the preoperative echocardiography [18]. We also confirmed that mortality in group E (7%) was more than three times higher than in group Y. Thus, in the future, elderly patients requiring AVR and CABG should be considered as the main target of less-invasive, percutaneous treatment strategies.

The importance of complete myocardial revascularisation (CR) has been studied several times. The vast majority of studies that involved isolated CABG or PCI individuals stressed a favourable impact of CR on overall and free of cardiac event survival, but not all reports were consistent [19]. It could result from the various definitions of CR employed by the authors. Up to now, many definitions of CR have been applied in clinical reports [20]. CR may be guided by angiographic parameters assessed in coronary angiography (anatomic CR) or myocardial ischaemic burden using myocardial perfusion imaging (functional CR) [20]. In the former at least two approaches have been proposed. In the unconditional one, all stenotic coronary arteries are revascularised, irrespective of their size, quality, and territory supplied. In the conditional one, all stenotic vessels greater than a defined diameter are revascularised [21]. For example, in the ARTS study all lesions with a > 50% diameter in a segment with a reference diameter of ≥ 1.50 mm were scored as potentially amenable to treatment. The conditional definition of CR was applied in our study (see surgical management subsection). We found incomplete revascularisation more often in group E. It was probably the consequence of more diffuse and distal atherosclerosis in this group than in the younger patients. Moreover, surgeons from the other centres do not perform CR in the elderly not only due to poor quality and unacceptable diameter of the recipient coronary artery but also due to their striving for abbreviation of intraoperative myocardial ischaemia (i.e ACC time). In our centre, we always tried to bypass all diseased arteries irrespective of ischaemic time.

It was shown in our study that CR is important for freedom from cardiac-related death in patients undergoing combined procedures including AVR for calcific AS. We confirmed a previous study in which the authors concluded that revascularisation should have been as complete as possible for severe coronary stenoses coexisting with significant AS [22]. It must be stressed that chronic AS leading to marked left ventricular hypertrophy quite often makes myocardial perfusion insufficient, even through normal coronary arteries. Severe CAD, particularly if not all diseased vessels are revascularised, may result not only in suboptimal intraoperative myocardial protection but may also inhibit proper postoperative recovery of myocardium.

Limitations of the study

We are aware of some study limitations. The main disadvantage is the retrospective design of the analysis. Outcomes after combined cardiac surgical procedures are operator-dependent. As the study was retrospective, patients were treated by many surgeons with different skills and experience. Moreover, we examined all consecutive patients undergoing combined procedures of AVR and CABG. It resulted in unequal representation in the groups; group M (n = 225) was two-fold larger than the others.

CONCLUSIONS

Elderly patients undergoing combined procedures of AVR and CABG having more extensive CAD less often receive CR, are at higher risk of early organ failure, and present markedly reduced rates of freedom from cardiac-related deaths during follow-up.

Conflict of interest: *none declared*

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Cite this article as: Perek B, Casadei V, Puślecki M, et al. Clinical presentation, surgical management, and outcomes of patients treated for aortic stenosis and coronary artery disease. Does age matter? Kardiol Pol. 2018; 76(3): 655–661, doi: 10.5603/KP.2018.0005.