

ORIGINAL ARTICLE

doi: 10.5455/medarh.2015.69.6-9

© 2015 Edin Omerbasic, Aida Hasanovic, Amir Omerbasic, Sanko Pandur
This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Med Arh. 2015 Feb; 69(1): 6-9
Received: December 15th 2014 | Accepted: February 05th 2015

Prognostic Value of Anatomical Dominance of Coronary Circulation in Patients with Surgical Myocardial Revascularization

Edin Omerbasic¹, Aida Hasanovic², Amir Omerbasic³, Sanko Pandur¹

¹Institute for Heart Disease, Cardiac Surgery Clinic, Clinical Center, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

²Department of Anatomy, Faculty of Medicine, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

³Policlinic „Atrijum“, Sarajevo, Bosnia and Herzegovina

Corresponding author: Edin Omerbasic, MD, Mr. Sci Med. Institute for Heart Disease, Cardiac Surgery Clinic, Clinical Center, University of Sarajevo, Bolnička 25, 71000 Sarajevo, Bosnia and Herzegovina. Phone:+38761710151, E-mail: doeedo@gmail.com

ABSTRACT

Introduction: This study evaluated the frequency of domination of the coronary arteries types in patients treated by surgical myocardial revascularization. The aim of the study was to determine whether the left coronary circulation dominance is a prognostic factor for poorer outcome in patients undergoing coronary artery bypass surgery. **Material and methods:** A total sample consisted of 100 patients with coronary artery disease that were treated with coronary artery bypass grafting at the Clinic for Cardiac Surgery, Clinical Center of the University of Sarajevo. To all patients on the basis of preoperative coronary angiography was determined the dominance of the coronary arteries. Patients included in the study were divided into two groups, with the left and right with coronary dominance. **Results:** Left coronary dominance in a sample of patients was present in 21/100 (21%), right in 69/100 (69%) and balanced in 10/100 (10%) cases. Female gender was significantly more frequent in patients with left coronary dominance and proved to be a stronger predictor of poorer outcome, especially in combination with left main stenosis of the left coronary artery and left coronary dominance. Inability of revascularization of the r. interventricularis posterior (RIVP) was statistically significantly higher in case of left dominance 9/21 (42.9%), compared to the right 16/79 (20.3%), $p=0.033$. Lethal outcome was more common in case of left dominance in relation to the right (9.4% vs 0.9%). The incidence of surgical complications, respiratory, neurological and renal complications was not significantly different between groups, while the length of hospital stay was significantly higher in the group of patients with left dominance, $p = 0.003$. **Conclusion:** Left coronary dominance is an important risk factor for patients undergoing surgical myocardial revascularization.

Key words: dominance of the coronary arteries, coronary angiography, surgical myocardial revascularization.

1. INTRODUCTION

Dominance of the coronary arteries is based on determining the scheme of the heart arterial vascularization, by which it is the dominant coronary artery which gives r. interventricularis posterior (RIVP) or posterior descending artery (PDA). Under this scheme, there are three main types of arterial vascularization of the heart: right, left and balanced coronary dominance. If the right coronary artery is reaching the place on the back of the heart where merge sulcus coronarius and the sulcus interventricularis posterior and creates r. interventricularis posterior, then the coronary circulation is classified as a right dominant. If this creates r. circumflexus (Cx) of the left coronary artery, then the coronary circulation is classified as a left dominant type. If r. circumflexus and the right coronary artery supplies equally the rear third of the interventricular septum, then the coronary circulation is classified as balanced dominant type. In the general population about 70% of the people have right dominant type, 20% left and 10% the balanced type of the heart arterial vascularization (1, 2, 3, 4).

Dominant vascularization of the ventricular septum, as a holder of the left ventricle strength, creates r. interventricularis anterior (left anterior descending artery-LAD) through 4-6 septal branches, rr. interventricularis septales, which are 70-80 mm long. Unlike them, septal branches that start from the PDA are long up to 15 mm. Septal branches that start from a PDA, however, are important because they serve as an important source of additional septum vascularization.

It is believed that the left coronary dominance is associated with a worse prognosis for patients with acute coronary syndrome and stable coronary artery disease (5, 6, 7, 8, 9).

In patients with left coronary dominance, the left ventricle is almost completely vascularized by the LAD and Cx. In addition, the possibility of creating collaterals may be lower in patients with left coronary dominance. Since there is no RIVP that starts from the right coronary artery (RCA), there is no possibility of creating collaterals from the right coronary system in cases when the left coronary system suffers from severe stenosis (10, 11, 12, 13, 14).

This study evaluates the short-term outcome after surgical myocardial revascularization in relation to anatomical dominance of the coronary circulation.

2. MATERIAL AND METHODS

We analyzed medical records of 100 patients, aged between 40 and 70 years, with isolated coronary artery disease who were selected randomly, and surgically treated by coronary artery bypass grafting (CABG) at the Clinic of Cardiac Surgery, Clinical Center of the University of Sarajevo in the period from January 2012–January 2013.

All patients underwent coronary angiography as part of standard preoperative preparation in the same institution. On the basis of angiography was determined distribution of coronary artery disease by segments, the guides of the American Heart Association (AHA), and the type of coronary circulation dominance.

Indications for surgery were determined by the council of cardiac surgeons and cardiologists. Patients came to surgery based on waiting list while priority for surgery was determined by surgeon on the basis of preoperative condition. We estimated demographic data, medical history, clinical form of coronary artery disease, and preoperative Left Ventricular Ejection Fraction (LVEF) according to Simpson on the basis of transthoracic echocardiography (TTE). Based on the data from the surgery reports, was determined the number and type of grafts used during myocardial revascularization, as well as data on arteries where grafting was not possible. Also was recorded perioperative and postoperative clinical course of patients, length of hospital stay after surgery and postoperative complications were observed in the first 30 days after surgery. We analyzed data obtained by postoperative ultrasound examination of the heart in order to monitor the kinetics of left ventricle and values of the LVEF, as well as the value of cardiac biomarkers (troponin C–TnC and Creatine Kinase MB (CKMB)).

Statistical analysis

Statistical analysis of the results was performed using χ^2 test. For comparison of variables was used parametric test (Student's test). When the distribution of continuous variables was unsymmetrical, for showing average value and the measures of dispersion were used median and interquartile range, and for their comparison nonparametric tests (Mann–Whitney test). For the statistical analysis of data obtained was used SPSS Statistics ver. 17

3. RESULTS

Analysis of 100 patients coronary angiograms who were surgically treated in our institution, showed the left coronary dominance type was present in 21/100 (21%) of patients, mixed type with 10/100 (10%) patients, while the

Variable	Right coronary dominance (n=79)	Left coronary dominance (n = 21)	Sig.
Age \pm SD	59 \pm 6.1	59 \pm 7.5	0.88
Female gender	17 (22)	10 (48)	0.017
Unstable angina pectoris	52 (65.8)	16 (76.2)	0.365
Preoperative myocardial infarction	63 (79.7)	15 (71.5)	0.413
LVEF \geq 50%	32 (40.5)	7 (33.3)	0.82
LVEF 35-50 %	24 (30.4)	11 (52.4)	0.12
LVEF < 35%	23 (29.1)	3 (14.3)	0.11
LM stenosis	15 (19)	5 (23.8)	0.623
Single vessel coronary disease	5 (6)	1 (5)	0.78
Two vessel coronary disease	27 (34)	8 (38)	0.78
Three vessel coronary disease	47 (59)	12 (57)	0.55
Surgery urgency	24 (30.4)	8 (38.1)	0.501

Table 1. Adjusted preoperative patient characteristics

Variable	Right coronary dominance (n=79)	Left coronary dominance (n = 21)	Sig.
Perioperative myocardial infarction	17 (21.5)	4 (19)	0.805
MACCE	14 (17.7)	4 (19)	0.888
Lethal outcome	1 (1.3)	2 (9.5)	0.11
Minor complications	42 (53.2)	8 (38.1)	0.035
Postoperative rhythm disorder	33 (41.8)	7 (33.3)	0.241
LVEF \geq 50%	19 (24.1)	6 (8.6)	0.09
LVEF 35-50 %	36 (45.6)	10 (47.6)	0.82
LVEF < 35%	24 (30.4)	5 (23.8)	0.45
TnC	3.18 \pm 3.5	1.72 \pm 1.3	0.501
CK-MB	49.2 \pm 32.64	41.2 \pm 48.2	0.656
Length of hospitalization	9.4 \pm 1.1	11.1 \pm 3	0.003

Table 2. Adjusted postoperative data

largest number 69/100 patients (69%) had the right type of coronary dominance (Figure 1 and Figure 2).

The patients in both groups had similar preoperative characteristics and preoperative risks which can be seen in Table 1. When comparing preoperative data significant differences between the groups of patients with left and right coronary dominance was not found.

During the surgery is compared the completeness of revascularization. There were no statistically significant differences if we look at the total revascularization of blood vessels. However, comparing the number RIVP which was non-graftable, between the right and left coronary dominance (20.3%: 42.9%) there was a statistically significant difference ($p = 0.033$).

After the surgery was monitored short-term outcome of these patients compared to the studied groups (Table 2). By comparing the observed postoperative parameters, perioperative myocardial infarction, Major Adverse Cardiovascular and Cerebrovascular Event-MACCE and postoperative rhythm was not revealed statistically significant difference, according to the Chi-square test. Minor complications demonstrated a statistically significant difference when compared, $p = 0.035$. Comparing lethal outcome in relation to the studied groups by the Fisher exact test has been demonstrated, however insignificant difference of $p = 0.11$ but it is evident that the fatal outcome was

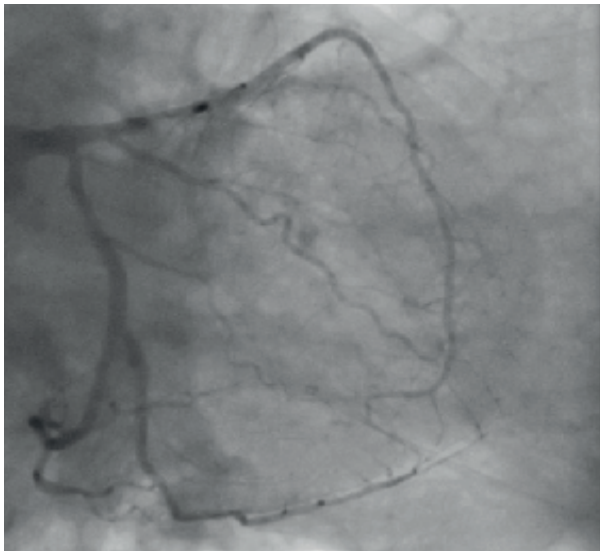


Figure 1. Coronary angiogram of a patient with left coronary dominance

higher in the group with left dominance in relation to the right (9.5%: 1.3%). This can probably be explained by the small number of parameters in the table for comparison. Also, binary logistic regression analysis of lethal outcome and type of domination returned the predictive value for greater mortality in the group with left dominance than in the group with right coronary dominance. In our study, 2/3 patients who enter the group of 30 day mortality had LM stenosis. One patient was with left and the one with the right coronary dominance.



Figure 2. Coronary angiogram of a patient with right coronary dominance

4. DISCUSSION

Relative frequency of coronary artery dominance published in the literature varies. Schlesinger MJ (5) found that right type of vascularization is present in 48% of cases, left in 18% of cases, while the balanced type was observed in 34% of cases. Angiographic analysis by Hasanovic et al. (1) found the right type of coronary artery domination in 71.42% of the cases, left in 10% and balanced in 18.57% of cases. By studying the types of arterial vascularization of the heart by dissection method Hadziselimovic H (2)

found the right type of coronary dominance in 63% of the cases, left in 10-15%, and the balanced type in 24% cases. Similar results reached Ortale JR et al. (6) in their research noticing the right type in 62.5% of cases, left in 12.5%, and balanced in 25% of cases. Vasheghani-Farahani et al. (7) the right type of coronary artery domination have noted in 84.2% of cases, left in 10.9% of cases and balanced in 4.8% of cases.

The results of our analysis of 100 patients coronary angiograms who were surgically treated by coronary artery bypass grafting (CABG) at the Clinic of Cardiac Surgery, Clinical Center of the University of Sarajevo, showed that 69% had right coronary dominance, 21% the left coronary dominance and 10% of patients balanced type. In our study, patients with right dominance and balanced form are placed in the same group since it was shown that these patients have similar prognoses. A similar classification of the types of coronary dominance provided Veltman CE et al. (3) and Goldberg et al. (4).

In the study by Ozturk et al (8) which studied the frequency of different types of dominance is determined that the frequency of left dominance in females was 8.3%, 3.7% with balanced and 88% with the right coronary dominance. Female gender is an independent predictor of morbidity and mortality after cardiac surgery and is included in most of the scores used for risk calculation (9, 10, 11, 12, 13). Numerous studies have shown that women have a higher mortality than men in case of coronary bypass and female gender represents an additional risk for coronary artery bypass surgery. Analyzing the STS (Society of Thoracic Surgeons) national database led to the conclusion that the mortality of women is 3.54% and men 2.15%.

The results of our study showed a significant difference in gender distribution among the groups of $p = 0.017$. The distribution of females in the group with right coronary dominance was 22%, and in the group with left coronary dominance 48% of patients were female.

Surgical outcome was associated with parameters that are specific to female gender, such as smaller size of the coronary arteries, less available grafts and the inability to use the full capacity of left internal mammary artery (LIMA) (14,15). Clinical manifestations of coronary artery disease of our patients were: stable angina, unstable angina and preoperative acute myocardial infarction. In the group of patients with right coronary dominance type the unstable angina pectoris had 65.8% of patients and 76.2% in the group with left dominance. The rest of the patients had symptoms of stable angina pectoris.

Preoperative myocardial infarction had 79.7% of patients in the first group with the right type of coronary dominance and 71.5% in the group with left coronary type of domination. There was no statistically significant difference, $p = 0.413$.

Analysis of left main coronary artery stenosis showed that the first group of patients with right coronary dominance LM stenosis had 19% of patients and 23.8% of patients in the group with left dominance. There was no statistically significant difference between the groups, $p = 0.623$. In our study, 2/3 patients who enter the group of 30 day mortality had LM stenosis. One patient was with left and the one with the right coronary dominance.

The presence of stenosis of left main coronary artery is considered a factor that increases mortality after coronary surgery. Excluding patients with acute myocardial infarction, revision surgery the 30-day mortality in one study was 1.3% (16). In cases of severe LMCA stenosis predicted mortality increases up to 3 times (17).

In CASS study (18) the highest surgical mortality occurred among patients with LM stenosis with 90% or more. Patients with left dominance had surgical mortality 4 times higher than those with right coronary dominance. In contrast, patients with LM stenosis of 50-75% had lower mortality regardless of the left or right coronary dominance.

The study Oswald BR et al. (19) examining whether incomplete vascularization after CABG in patients up to 70 years affects the early outcome after surgery. In this study, the percentage of incomplete revascularization was 10.7%. It is proved that incomplete revascularization affects early outcome after CABG surgery and that is an independent risk factor for mortality.

In our study the overall percentage of incomplete revascularization was 39%. In case of the right coronary revascularization the percentage was 36.7% and 47.6% in case of the left. Although there are differences, after comparisons, they were not statistically significant, $p = 0.362$. However if we compare incomplete revascularization of RIVP, with right coronary dominance percentage of incomplete RIVP revascularization was 20.3% and 42.9% among patients with the left coronary dominance. Here is, after comparison, determined significant difference of $p = 0.033$ among compared groups.

Lethal outcome in our study was more common in case of left dominance in relation to the right. The incidence of surgical complications, respiratory, neurological and renal complications was not significantly different between groups, while the length of hospitalization was significantly higher in the group of patients with left dominance $p = 0.003$.

5. CONCLUSIONS

Coronary artery dominance type is a very important factor, because the manifestations and outcome of the coronary artery disease are different in relation to which the coronary arteries are affected and which type of arterial vascularization is present.

Although the right type of vascularization is more frequent, patients with left coronary dominance have a higher possibility for poorer outcomes after coronary artery bypass surgery, and can expect less possibility of revascularization, particularly in RIVP, as well as a longer post-operative stay. Additional risks are female gender and LM stenosis.

Conducted trial highlights the importance of determining the dominance of the coronary arteries before coronary artery bypass surgery. On this basis we will be able to plan different or additional strategies in order to have even better outcomes after these surgeries.

CONFLICT OF INTEREST: NONE DECLARED.

REFERENCES

1. Hasanović A, Aščić-Buturović B. Angiographic evaluation of the dominance patterns of coronary circulation. *HealthMED*. 2012; 6(6): 2229-2233.
2. Hadžiselimović H. *Krvni sudovi srca*. Jugoslavenska medicinska naklada Zagreb, 1981.
3. Veltman CE, De Graaf FR, Schuijf JD. et al. Prognostic value of coronary vessel dominance in relation to significant coronary artery disease determined with non-invasive computed tomography coronary angiography. *Eur Heart J*. 2012 Jun; 33(11): 1367-1377.
4. Goldberg A, Southern DA, Galbraith PD. et al. Coronary dominance and prognosis of patients with acute coronary syndrome. *Am Heart J*. 2007; 154: 1116-1122.
5. Schlesinger MJ. Relation of anatomic pattern to pathologic conditions of the coronary arteries. *Arch Pathol*. 1940; 30: 403-415.
6. Ortale JR, Keiralla LC, Sacilotto L. The posterior ventricular branches of the coronary arteries in the human heart. *Arq Bras Cardiol*. 2004; 82(5): 468-472.
7. Vasheghani-Farahani A, Kassaian SE, Yaminisharif A. et al. The association between coronary arterial dominance and extent of coronary artery disease in angiography and paraclinical studies. *Clin Anat*. 2008; 21: 519-523.
8. Ozturk E, Duran C, Sonmez G. et al. Arterial supply of the posterior interventricular sulcus: a CT coronary angiographic study. *Surg Radiol Anat*. 2011 Jan; 33 (1): 27-34.
9. Abramov D, Tamariz MG, Sever JY. et al. The influence of gender on the outcome of coronary artery bypass surgery. *Ann Thorac Surg*. 2000; 70: 800-805.
10. Edwards FH, Carey JS, Grover FL. et al. Impact of gender on coronary bypass operative mortality. *Ann Thorac Surg*. 1998; 66: 125-131.
11. Aldea GS, Gaudiani JM, Shapira OM. et al. Effect of gender on postoperative outcomes and hospital stays after coronary artery bypass grafting. *Ann Thorac Surg*. 1999; 67: 1097-1103.
12. Guru V, Fremes SE, Austin PC. et al. Gender differences in outcomes after hospital discharge from coronary artery bypass grafting. *Circulation*. 2006; 113: 507-516.
13. Tarakji A, Prasad S, Chedrawy E. et al. Gender disparity in CABG outcomes: an independent risk factor or not, women are at a disadvantage. *Thorac Cardiovasc Surg*. 2009; 57: 202-203.
14. Sharoni EKA, Medalion B, Stamler A. et al. Is gender an independent risk factor for coronary bypass grafting? *Thorac Cardiovasc Surg*. 2009; 57: 204-208.
15. Blankstein RWR, Arnsdorf M, Jones B. et al. Female gender is an independent predictor of operative mortality after coronary artery bypass graft surgery; contemporary analysis of 31 Midwestern hospitals. *Circulation*. 2005; 112: 1323-1327.
16. Cremer J, Shoneich F, Lutter G. et al. Pariooperative mortality in coronary bypass surgery for stable left main coronary artery stenosis. *Thorac Cardiovasc Surg*. 2007; 55-69.
17. Jonsson A, Hammar N, Liska J. High mortality after coronary bypass surgery in patients with high-grade left main stenosis. *Scan Cardiovascular journal*. 2006; 40(3): 179-185.
18. Kennedy JW, Kaiser GC, Fisher LD. Clinical and angiographic predictors of operative mortality from the collaborative study CASS. *Circulation*. 1981; 63: 793-802.
19. Osswald BR, Tochtermann U, Schweiger P. et al. Does the completeness of revascularization contribute to an improved early survival in patients up to 70 years of age? *The Thoracic and cardiovascular surgeon*. 2001; 49(6): 373-377.