ALGORITHMS FOR FORMAL STRATIFICATION OF PATIENTS WITH ISCHEMIC MITRAL REGURGITATION

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ABSTRACT

INTRODUCTION: There is a significant percentage of Bulgarians suffering from ischemic heart disease (IHD) and its complications, such as ischemic mitral regurgitation (IMR). It plays an important role in Bulgarian society. Surgical treatment of this pathological conditions could have positive impact on life expectancy and the medical quality of life of patients.

AIM: The purpose of the study is to establish a reproducible algorithm to advise the appropriate surgical treatment of patients with IHD and significant, but not severe IMR based on their condition.

MATERIALS AND METHODS: The study is based on the data collected prospectively at the Department of Cardiac Surgery, St. Marina University Hospital in Varna, Bulgaria. IHD and significant IMR (i.e. more than mild 1+, but less than severe 4+ degree) were diagnosed in 186 patients. Applying inclusion and exclusion criteria, 140 patients with pure secondary IMR remained in the study group. The data was analyzed in a retrospective fashion. We discussed two possible treatment strategies: coronary artery bypass grafting + mitral valve repair (CABG+MVRep) and isolated revascularization (CABG only). To obtain comparable data for those treatment strategies, we needed a formal stratification of the patients, allowing comparison between the groups.

RESULTS: Creating formal algorithms we are able to divide the patients into comparable Group A (CABG+MVRep) and Group B (CABG only), and surgical strategy is based on characteristics of the individual pathology of every patient.

DISCUSSION: Despite data from small randomized and non-randomized trials, to date there is no clear agreement and strategy regarding concomitant mitral valve repair with CABG during the first-time operation.

CONCLUSION: Formal stratification with the algorithms created and applied gave us the opportunity for reliable comparison of relatively different patients, and to draw conclusion for the practice. This approach should be applied in such small non-randomized trials to achieve better understanding of the problem of secondary IMR.

Keywords: *ischemic heart disease, ischemic mitral regurgitation, stratification algorithms*

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Received: November 4, 2018
Accepted: December 7, 2018

INTRODUCTION

Investigating the outcomes of surgical treatment and the accompanying diagnostic procedures is basic to the development of smarter diagnostic and therapeutic modalities to a disease. With regard to a very specific disease with a relatively few patients, no data for large groups of patients can be collected and summarized in a single institution, i.e. there is no way to carry out the classical design model for target and control group. Another aspect of difficulty is professional and ethical standards, which should not allow the use of treatment considered to be less effective to be applied to patients for the sake of research. Having in mind the above, randomization of patients for mitral valve repair performed as a concomitant procedure with surgical revascularization: coronary artery bypass grafting + mitral valve repair (CABG+MVRep) or with CABG only, is hardly achievable. Different models are needed to provide reliable and trustworthy information about the outcomes of this treatment. An applicable model may be the *formal stratification of patients* included in a study by P. Panayotov from 2013 (1) on advanced methods for diagnosis and surgical treatment of significant chronic ischemic mitral regurgitation.

AIM

In our daily practice we need reproducible criteria for surgical treatment of patients with ischemic heart disease (IHD) complicated by significant ischemic mitral regurgitation (IMR) (2,3). The decision-making process of the Heart Team for the volume of the surgical procedure – CABG+MVRep or CABG only should be guided by the data obtained at the hospital and based on the institutional experience and results of the treatment of such patients (4).

MATERIALS AND METHODS

The study was conducted on patients of the Department of Cardiac Surgery at St. Marina University Hospital - Varna, Bulgaria, who underwent surgical treatment of IHD. Significant IMR was diagnosed in 186, of whom 37 patients experienced substantial concomitant pathology and were excluded from the study. Seven patients of the remaining 149 patients were excluded from the target groups due to acute, not chronic, IMR in 4, and structural change of the mitral valve apparatus (which is different from chronic IMR) in 3 of them. Mitral valve ring calcification in two other patients made grounds for them to be excluded from the study. Thereby, there were 140 patients subject of the study and it was based on a sample of these patients. We can formalize the inclusion and exclusion criteria as follows:

In the study patients were divided into two main groups:

- Group A: patients with combined cardiac surgery – revascularization by CABG+ MVRep;
- Group B – patients with isolated revascularization (CABG only).

Significant chronic ischemic mitral regurgitation (5) refers to:

- Low - grade to moderate IMR, also known as 1st to 2nd grade;
- Moderate IMR including 2nd grade and 2nd to 3rd grade;
- Moderate to severe IMR, often referred to as 3rd grade.

The term significant IMR emphasizes on the fact that each of the IMR degrees, according to research data, impacts functional classification, patients' quality of life and long-term survival (6).

The inclusion criteria are:

1. Patients with IHD diagnosed with the use of coronary angiography (interventional or computer-assisted) and having indications for surgical revascularization (CABG);

2. Evidence for left ventricular ischemia in the area of posteromedial and/or anterolateral papillary muscle with electrocardiography data for postero-inferior and/or anterior and lateral myocardial infarction data from coronary angiography – pathology of the epicardial arteries supplying the left ventricular dysfunction area, segmental or diffuse hypokinesia to akinesia/dyskinesia signs in transthoracic echocardiography (7,8);

3. No less than 7 days after the onset of acute myocardial infarction;

4. Echocardiographic assessment of the mitral valve (MV) morphology and function establishing significant IMR (see below) with no morphological changes in the MV apparatus (i.e. secondary IMR) (9) (Table 1);

5. Age between 18 and 80 years;

Table. 1. Diagnostic criteria for the evaluation of the degree of IMR by angiography and echocardiography according to ACC/AHA Guidelines for Management of Patients with Valvular Heart Diseases

Evaluation of the degree of mitral regurgitation according to ACC/AHA Guidelines for Management of Patients with Valvular Heart Disease			
	Mild	Moderate	Severe
Qualitative Assessment			
Angiography*	1 +	2 +	3 – 4 +
Color Doppler – regurgitant jet	Small central jet< 4 cm^2 or < 20% LA surface	More than mild, but no signs of severe MR	Central reg. jet > 40% LA surface; every reg. jet reaching to LA roof
VC with (cm)	< 0.30	0.30 – 0.69	≥ 0.70
Quantitative Assessment			
RV (mL)	< 30	30 – 59	≥ 60
RF (%)	< 30	30 – 49	≥ 50
RA (cm^2)	< 0.20	0.20 – 0.39	≥ 0.40
Additional Criteria			
LA size			Increased
LV size			Increased

(Angiography – left ventriculography during heart catheterization; LA – left atrium; VC – vena contracta; RV – regurgitant volume; RF – regurgitant fraction; RA – regurgitant area)

6. Subjectively assessed life expectancy of over 3 years (10,11).

The exclusion criteria are:

1. Patients with acute IMR due to rupture of papillary muscle or chordae;
2. High-grade chronic IMR (4+ grade) - there is a consensus for surgical correction of such regurgitation grade (performing MVRep) concomitantly with a CABG procedure;
3. Low-level chronic IMR (1+ grade) with no recommendations for MV intervention;
4. Patients with IHD and degenerative or other primary changes in the MV apparatus morphology exhibiting regurgitation;
5. Previous cardiac surgery;
6. Contraindications for cardiac surgery;
7. Less than 3 years of life expectancy.

Categorization of each patient in the study was performed in five steps using the developed algorithm for stratification of patients, presented below.

Algorithm 1 for selection of surgical treatment in patients with IHD complicated by significant IMR:

1. In a severely impaired general medical condition, the patient should receive less complicated surgical approach, aiming to improve cardiac condition by revascularization without the additional risk of a combined surgery. So, for these patients classification in Group B is beyond doubt. Hence, the following primary criteria for inclusion in Group B and exclusion from Group A can be defined:

- Impaired general medical condition with concomitant diseases (pulmonary diseases, peripheral vascular disease, cerebrovascular disease), especially in the elderly;
- Subjectively assessed life expectancy of less than 4 years;
- Severe left ventricular dysfunction with ejection fraction < 25% and with pronounced symptoms of heart failure;

- Relative contraindications for cardiopulmonary bypass during surgery or indications for a less invasive surgical intervention such as off-pump coronary artery bypass (OPCAB).

With any of the primary criteria in place, the patient is categorized as Group B and the algorithm ends.

2. After establishing that the patient is not in a highly deteriorated medical condition, the significance of MV regurgitation is evaluated. If it is highly significant, Group A categorization is undisputable because deprivation of MVRep will be associated with poor prognosis. Then secondary criteria for inclusion in Group A and exclusion from Group B can be defined:

- IMR 3rd grade;
- IMR 2nd to 3rd grade with RV (regurgitation volume) > 30 mL;
- MR 2nd to 3rd grade with RV < 30 mL but with a vena contracta (VC) at least 7 mm.

With any of the secondary criteria in check, the patient is categorized as Group A and the algorithm ends.

3. Hitherto, it has been established that the patient is neither in a greatly deteriorated medical condition, nor the MV regurgitation is highly significant. If MV regurgitation is mild and less significant, then Group B categorization is undoubted because the MV plasty would unnecessarily increase surgical risk without significantly benefitting patient's postoperative condition. Considering the above, the presence of IMR of 1st to 2nd grade can be treated as a tertiary criterion for inclusion in Group B and exclusion from Group A.

When the tertiary criterion is met the patient is categorized as Group B and the algorithm ends.

4. Hitherto, it has been established that both surgical treatments are applicable as the patient is not in a highly deteriorated medical condition and has a moderate MV regurgitation. Categorization is carried out by scrutinizing a set of parameters checking if the latter constitute typical clinical pictures for Groups A and B as described below.

A typical Group A clinical picture includes: 2nd to 3rd grade IMR, regurgitant volume between 20 and 30 mL, VC between 4 and 7 mm, tenting area between 1.5 and 2.5 cm^2, tenting height between 10 and 20 mm, coaptation line between 1 and 4 mm, presence of tethering, subjectively assessed life expectancy of more than 5 years.

A typical Group B clinical picture includes: 2nd grade IMR, regurgitant volume between 10 and 20 mL, VC between 3 and 4 mm, tenting area between 0.8 and 1.5 cm^2, tenting height between 6 and 10 mm, coaptation line between 3 and 5 mm, absence of tethering.

If a patient's preoperative clinical picture matches one of the two typical pictures for Groups A and B then the patient is referred to the respective Group and the algorithm ends.

5. Hitherto, it has been established that the patient is not in a highly impaired medical condition, there is a moderate MV regurgitation and the patient's preoperative clinical picture does not match either of the two pictures typical for Groups A and B. Once again, the two types of surgical intervention are applicable. The cardiovascular team then expertly assesses which of the two typical pictures for Groups A and B is more relevant to the patient. If the echocardiographic criteria for MR evaluation and left ventricular remodelling are highly controversial, the final decision on the volume of surgery could be based on stress echocardiography, aimed to show how the dynamic characteristics of MR are changed. The patient's general condition and eventually concomitant diseases are to be taken into consideration. If the "stress test" does not provoke an IMR increase and with an expected higher surgical risk without significant benefit from MV plasty, then isolated revascularization on- or off-pump (OPCAB), (i.e. Group B categorization), is preferred. If IMR increases during the "stress test" and a better effect of the MV repair is expected at an acceptable, relatively low surgical risk, the patient is categorized as Group A. The latter group includes patients of active age as well, thus seeking the best possible restoration of work capacity and physical activity.

The algorithm is schematically presented on Figure 1.

RESULTS

Within this study, 71 patients have undergone combined cardiac surgery – CABG + MVR, and were referred as Group A. The remaining 69 patients participating in the study had isolated revascularize-

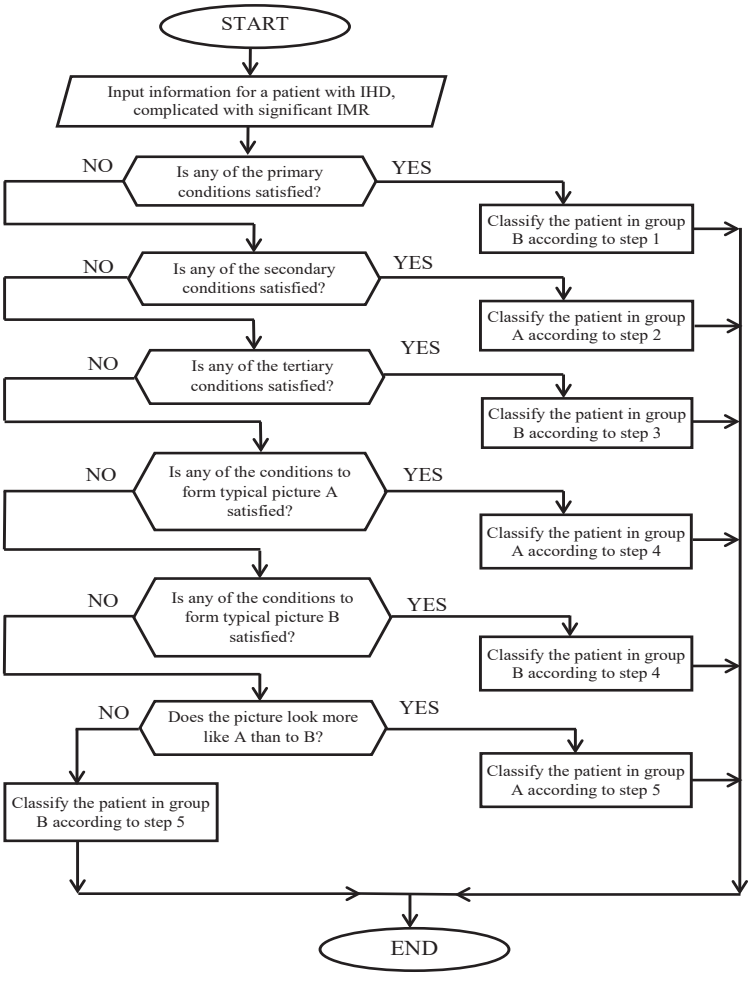

Figure 1. Scheme of the algorithm for classification of patients into groups A and B

tion, as these patients were classified into Group B (CABG).

The result of our approach is a formal differentiation to give the idea of how typical patients in Groups A and B are, on one hand, and on the other, it creates possibility of a unified approach based on formalized data. These are distinct prerequisites for creating a comparison algorithm for patients who underwent different surgical interventions. Depending on Heart Team's expert assessment the patient is classified into the relevant Group and the algorithm ends.

DISCUSSION

When processing data for patients with similar diseases but with different clinical manifestations, correct comparison between the groups identified according to the selected surgical method is not feasible. This requires a modality of solely informational comparison whereas conclusions for optimal treatment should be made. Based on the above and in further detail, algorithms for stratification of patients can be developed and introduced into daily practice. The breakdown in subgroups in close juxtaposition with one another is informative enough to produce such algorithms.

CONCLUSION

Patients' stratification benefits addressing heterogeneous pathology requiring specific therapeutic approaches by specific algorithms.

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