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Abdumadjidov H. A *

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Research Article

Diagnostic and Surgical Treatment of Multi-Valve Heart Disease with Infective Endocarditis

Abdumadjidov H. A [1*]., Buranov H. J [1]., Saidkhanov B. A [2]., Isomitdinov B. Sh [2]

[1] Republican Specialized Scientific and practical medical Center of Surgery named after academician V.Vakhidov.

[2] Bukhara State medical institute after named Abu Ali ibn Sino.

***Corresponding Author:** Abdumadjidov H. A, Professor of the department of the Surgical disease and reanimation.

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Abstract

" Diagnostic and surgical treatment of multi-valve heart disease with infective endocarditis"

Objective: The aim of the study was to analyze our own experience of diagnosis, choice of tactics and execution of multi-valve surgical correction of heart defects in infective endocarditis (IE).

Methods: We retrospectively analyzed data and clinical results of 156 patients with infective endocarditis who underwent the cardiac surgery in our clinic. Among them, 85 were men (56.5%), and women - 71 (45.5%). Age of our patients ranged from 12 to 68 (mean 32.76 (1.6)) years. The patients were divided into 2 groups: group 1, 89 (57.4%) patients who underwent a complex of developed by the author's antibiotic therapy, surgical treatment and preventive measures and 2-group 67 (42.6%) patients who underwent the traditional surgical treatment scheme. We analyzed electrocardiography, chest X-Ray, transthoracic echocardiography, transesophageal echocardiography, cardiac catheterization and coronary angiography and blood culture analysis.

Results: Intraoperative treatment - preventive measures (TPM) were as follows; mechanical and chemical sanitation of the infected area of the heart; implantation of valves with antibacterial properties; hyperthermic perfusion; antimicrobial therapy, including anti-fungal agents. Application of the above measures reduced mortality in the study group to 5.1%, in the control group - 9.3%. In dynamics, mortality declined to 3.9% in the study group.

Conclusion: Our results of surgical treatment of multi-valve heart defects with infective endocarditis showed the efficacy of developed complex preoperative and intraoperative measures in surgical treatment of IE. This new treatment approach is associated with significant improvement of left ventricular function and low mortality rate.

Key words: multi-valve acquired heart diseases, complications of infective endocarditis

Objective

Infective endocarditis (IE) is common etiological factor in the development of multi-valve heart lesions and has a number of special features in the definition of diagnosis, surgical tactics and postoperative management [1; 2; 3; 4].

Infective endocarditis is a rare, life-threatening disease which may affect heart valves, mural endocardium and cause acute valvular insufficiency and systemic embolic events. It is caused by pathogenic or opportunistic microflora. In the setting of bacteraemia with a pathogenic organism, an infected vegetation may form as the end result of complex interactions between invading microorganisms and the host immune system. Vegetation is composed from fibrin overlay, blood clots, blood cells, damaged heart tissue and microorganisms. According to the last data, the incidence of the infective endocarditis in Russian Federation is about 2 - 6.5 cases to 100,000 population [1]. According to various authors, up to 18% of patients are adults aged from 20 to 50 years [3]. Unfortunately, attempts to treat IE through conservative treatment were unsuccessful. Nowadays, the effectiveness of surgical treatment over medical treatment is obviously clear. V.P. Polyakov reported that mortality rate in patients who got only conservative treatment was 50 - 90% [5]. R.A. Nishimura claimed that, good early and long-term results of surgical treatment of multi-valve infective endocarditis is clearly depend on the correct definition of surgical tactics. In time and prompt surgical decision will reduce mortality up to 11,2% [4, 10]. In this article, we would like to share and discuss own experiences in diagnostic strategies, management and correct choice of surgical tactics in the treatment of IE with multi-valve lesions.

Material and Methods.

Statistical analysis of the result was carried out using Microsoft Office Excel 2007 with Statistical Version 6.0 package. Continuous variables are presented as mean and standard error, and categorical data as percentages. Comparison of continuous variables between groups was performed using parametric Student's (t) test and Chi-square test was used for comparison of categorical variables. The degree of accuracy was determined at the level of significance $p<0.05$.

The retrospective material of our research is based on 196 patients who underwent surgery in our hospital from 2014 to 2019 yy for IE with multi-valve lesions. The age of our patients ranged from 12 to 71 (mean 32.76 ± 1.6) years, 105 were men (54.5%), and 91 were woman (45.5%), respectively. In diagnosis, we used the classification criteria of Durack D.T. (2004).

The patients were divided into 2 groups: group 1 consists of 112 (57.4%) patients who got preventive measures, antibacterial and surgical treatment. 2-nd group consists of 84 (42.6%) patients who underwent the traditional scheme of prevention and surgical treatment.

Taking in account the following features valve infective endocarditis (IE):

- High frequency of systemic embolism
- High mortality in the treatment of infective endocarditis (IE)
- The dilemma of the optimal operation period
- Imperfect system of prevention
- Aspects of the antimicrobial therapy

In order to solve these tasks, we developed own comprehensive measures for the prevention and treatment of IE:

1. The elimination of source of infection
2. Correction of hemodynamics.
3. Reliable fixation of the prosthesis
4. Prevention of relapse of IE

Clinical examinations. All patients are examined by standard protocol: general clinical tests, electrocardiography (ECG), chest X-ray, transthoracic echocardiography (TTE) was performed in 40.5% of patients; coronary angiography and heart catheterization was performed in 12.65% of patients; sampling of blood culture in 38.6% of patients, histology with light electron microscopy (SEM) in 47.5% of patients, respectively. Surgical treatment consisted of an "open" correction of affected valves, with performing complex measures to eliminate intracardiac source of infection and prevention of postoperative septic complications. All patients underwent surgery with cardiopulmonary bypass (CPB) and cardioplegia (CP).

Results and Discussion

The surgical treatment of multivalvular heart disease associated with infective endocarditis is still challenging. Application of updated by our department complex of medical, surgical and preventive measures aimed to improve the immediate and long-term results of our operations.

The etiology of infective endocarditis associated with valvular heart disease in our patients included rheumatic heart valve disease in 62% of patients, infective endocarditis – 16%, degenerative valvular disease – 13%, and congenital heart disease in 9% of patients, respectively. Interestingly, there were no patients with addiction and substance use.

Types of operations performed in our patients are provided in Table 1. The most commonly performed surgery was mitral valve replacement (MVR) plus aortic valve replacement (AVR) with tricuspid valve (TV) repair. Other types of operations included: mitral valve (MV) repair, aortic valve replacement (AVR), tricuspid valve open commissurotomy (OTC), tricuspid valve replacement (TVR) and mitral valve replacement (MVR). We also used left atrial thrombectomy of in combination with other types of surgery.

Name the Transactions	Number of	Percent
MVR+AVR with Pl TC	98	50%
TV repair, MV repair, AV repair	32	16.3%
MVR with TV repair and AV repair	26	13.3%
AVR with TV repair and AV repair	9	4.6%
MVR with TV repair	7	3.8%
MVR+AVR with OTC	5	2.5%
MVR, TVR, AVR	3	1.5%
MVR, TVR	3	1.5%
Other operations	13	6.6%

***** AV - aortic valve, AVR –aortic valve replacement, MV – mitral valve, MVR - mitral valve replacement, OTC - open tricuspid commissurotomy, TV – tricuspid valve, TVR - tricuspid valve replacement

Table 1: The types of operations performed in patients with multi-valve heart defects with infective endocarditis

Intraoperative treatment and preventative measures were as follows:

1. Mechanical and chemical sanitation of infected heart area
2. Use of antibiotic coated prosthetic heart valve sewing cuffs
3. Hyperthermic Perfusion
4. The antimicrobial therapy, including anti-fungal agents.

Use of specially produced artificial mechanical heart valves can prevent further development or activation of the infection. Antibiotic cuff impregnated in artificial prosthesis retains its activity for 2 weeks, which reduces the recurrence of IE [8]. In addition, we used hyperthermic perfusion in these patients, targeting micro- and macro-organisms, as following: keeping temperature within 38.5-39˚ C for 15-20 min after removal of aortic clamp. This, results in "impact on the macro-organism": restoring the patient immunobiological properties [7]; and "the impact on the micro-organism" - intensifying pathogen metabolism and enhancing effectiveness of antibiotics [6].

Microorganisms	Frequency allocation,%
Gram (-) negative bacillus	8,8
Gram (+) positive bacillus	2,5
Staphylococcus aureus	7
Pseudomonas aeruginosa	6,3
St.epidermidis	5
Candida spp.	5
Klebsiella pneumoniae in total	4 38,6

Table 2: *Microbiological examination*

Laboratory and microbiological tests are of particular importance to guide antibioticotherapy. Table 2 shows the results of microbiological tests, where in contrast to literature data: in 5% of all patients, we identified fungal lesions of the heart valves - Candida spp. The blood culture was positive in 39.1% of patients, in 8.8% of the cases we detected multidrug-resistant Gram-negative flora, in 7% - Staphylococus aureus, and in 6.3% of cases - Pseudomonas aeruginosa. In remaining 60.9% of patients, the blood culture was negative due to wide-spectrum antibiotic therapy used on pre-hospital state. According to above-mentioned results, we used antifungal therapy in addition to antibiotics.

Echocardiography had a particular importance in adequate definition and choice of surgical tactics for our patients. Transthoracic 2-dimensional and Doppler echocardiography data in addition to the clinical criteria were the basis of indications for surgical correction of multi-valvular defects with IE, preoperative echocardiography data are presented in Table 3. Surgical tactics of the operation were identified taking in account the peculiarities of defect anatomy, disease complications, and presence of comorbidities. At intraoperative stage TEE was carried out aiming at refining the tactics of surgical correction and evaluation of the adequacy of the operation.

Options LV	group I	group II	Overall	Meaning *P1-2*
	M±m	M±m	M±m	
EDD (ml)	5,88±0,15	6,16±0,18	6,01±0,12	>0,05
EDV (ml)	181,8±9,81	194,55±13,4	187,3±8,01	>0,05
ESD (ml)	3,88±0,12	7,05±1,65	5,3±0,76	<0,05
ESV (ml)	83,64±12,1	81,86±6,82	82,8±7,44	>0,05
SV (ml)	111,24±5,9	116,45±7,5	113,5±4,69	>0,05
EF **(%)**	63,21±1,96	60,3±1,19	61,83±1,23	<0,05

*LV–left ventricle, EDD – end-diastolic dimension, EDV – end-diastolic volume, ESD – end –systolic dimension, ESV – end systolic volume, SV-stroke volume, EF-ejection fraction

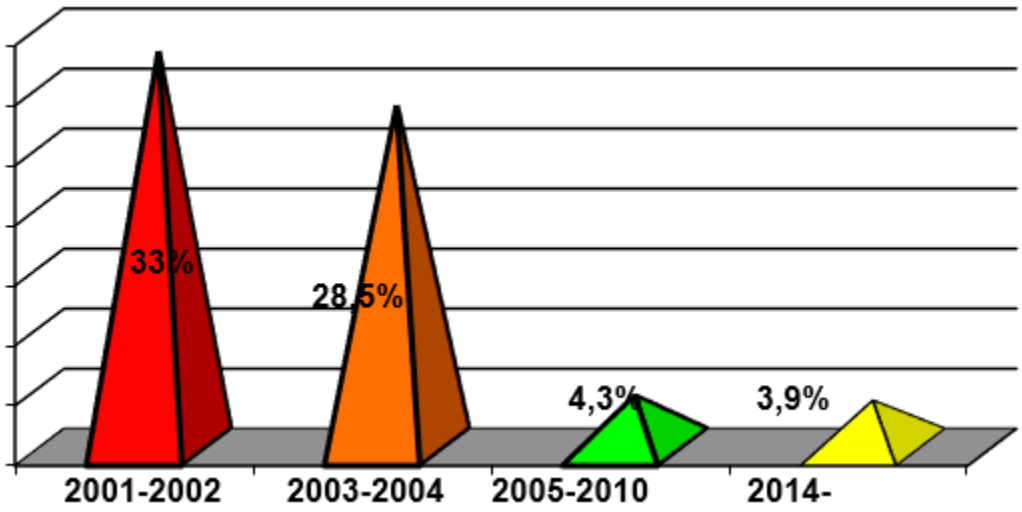
Table 3: Clinical characteristics of patients according to the TT echocardiography preoperatively

Indication for surgical treatment in our patients, in most cases, was progressive heart failure. At the same time, we are sure that lower inflammatory activity may be achieved using a complex of medical and antibiotic therapy. The combination of the preoperative preparation, using the updated therapeutic and preventive measures, subsequently, was the basis to decrease mortality in the short and long periods of observation.

Indications for surgery	Number	percent
Progressive heart failure	120	(61,3%)
The ineffectiveness of antibiotic therapy	25	(12,7%)
floating vegetation	17	(8,7%)
Embolism	21	(10,7%)
abscess	13	(6,6%)
Total operated	196	(100%)

Table 4: Indications for the implementation of multi-valve defect surgery with infective endocarditis

Analysis of the nearest results of our operations in the two groups showed mortality rate of 5.1% in the first group, and 9.3% in the second group. Thus, the overall hospital mortality was 6.9%. With the development of diagnostic criteria for multi-valve defect with IE, choosing the right surgical technique and the use of therapeutic and preventive measures developed in the department, we managed to reduce the rate of hospital mortality and improve cardiac function. We observed in a 3-year follow-up period reduction of cardiac chambers and volumes size (Table 5) and significant reduction of hospital mortality, as compared with previous years (from 33% in 2000-2002 to 3.9% in 2014-2019 periods) (Diagram №1).



Dynamics echocardiographic parameters (p<0,05)

Diagram :1 Dynamics of hospital mortality data

Echocardiographic data	**The periods of observation**		
I-group	Before surgery	At discharge	3 years later
EDD (ml)	5,88±0,15	5,03±0,13	4,65±0,16
EDV (ml)	181,8±9,81	133,63±8,12	105,4±7,43
ESD (ml)	3,88±0,12	3,67±0,11	3,3±0,21
ESV (ml)	83,64±12,12	67,58±6,56	45,4±5,76
SV (ml)	111,24±5,97	65,8±2,97	60,01±3,32
EF **(%)**	63,21±1,96	51,05±1,48	61,45±2,5
P II-group		<0,03	
EDD (ml)	6,16±0,18	5,34±0,17	5,14±0,15
EDV (ml)	194,5±13,39	147,13±11,21	125,71±8,07
ESD (ml)	5,25±1,01	5,1±1,22	3,3±0,21
ESV (ml)	81,86±6,82	73,16±7,05	47,93±5,91
SV (ml)	116,45±7,55	73,63±4,95	77,6±6,06
EF **(%)**	60,0±1,19	52,34±1,57	58,36±3,16
P	<0,05		

Table 5: Follow-up echocardiography data

***LV** – left ventricle,
EDD – end-diastolic dimension,
EDV – end-diastolic volume
ESD – end –systolic dimension
ESV – end –systolic volume
SV – stroke volume
EF – ejection fraction

Our study has certain limitations as being retrospective in design and relatively small numbers of patients. Further prospective studies need to be undertaken to clarify the usefulness of our approach of treatment of IE associated with multi-valvular heart defects.

Conclusion

Our results of surgical treatment of multi-valve heart defects with IE showed the efficacy of updated complex preoperative and intraoperative measures in surgical treatment of IE. Morphological studies found that during the formation of microbial vegetation, in 41.7% cases there was a mixed infection with addition of fungal microflora. So, it demonstrates the feasibility of the combined use of antibiotics and antifungal drugs in the complex treatment of IE. The combination of therapeutic and preventive measures and surgical treatment of IE is an effective method, and has allowed us to reduce hospital mortality from 9.3% to 5.1%, respectively. On the basis of our data the following conclusions:

1. In patients with multi-valve heart disease associated with IE, in order to verify diagnosis and chose of optimal surgical management, we strongly recommend use of transesophageal echocardiography.
2. Regardless of the type of the pathogen of endocarditis, treatment protocol for patients with IE should include antifungal therapy.
4. In order to achieve good early and long-term results, in postoperative period patients need to continue a course of antibacterial and antifungal therapy.
5. Patients who underwent open-heart surgery due to IE has a high risk of prosthetic endocarditis (if they do not follow our instructions).

This updated treatment approach is associated with significant improvement of left ventricular function and low mortality rate as compared to other methods.

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