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Mesihović Dinarević, Senka

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MITRAL VALVE DISEASES
IN CHILDREN AND ADULTS



AKADEMIJA NAUKA I UMJETNOSTI BOSNE I HERCEGOVINE
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Senka Mesihović-Dinarević

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INTRODUCTION

The Committee for Cardiovascular Pathology of the Department of Medical Sciences of the Academy of Sciences and Arts of Bosnia and Herzegovina organized on the 29th of September, 2016 the International scientific symposium “Mitral valve diseases in children and adults”. The Committee has been included in world’s scientific assembly on celebrating World Heart Day as a part of World Heart Federation. Over past nine years, the Committee has organized the following Symposiums which resulted with the following publications of the Academy of Sciences and Arts of Bosnia and Herzegovina:

1. Symposium: “I work with heart”, ANUBiH, 2010.
2. International Symposium “Pulmonary Artery Hypertension”, ANUBiH, 2011, Book no: CXXXIX/39.
3. Symposium: “The Risk Factors for Development of Cardiovascular Diseases”, ANUBiH, 2011, Book no: CXLI/40.
4. Symposium: “Congenital Heart Defects”, ANUBiH, 2012, Book no: CL/42.
5. International Symposium: “Perspectives in Paediatric Cardiology” (Dubrovnik), ANUBiH, 2012, Book no: CLI/43.
6. Symposium: “Rhythm disturbances in children and adults”, ANUBiH, 2013.
7. International Symposium: “Acquired Heart Diseases”, ANUBiH, 2014, Book no: CLVIII/45.
8. International Scientific Symposium: “Fetal medicine: from Leonardo da Vinci up Today”, ANUBiH, 2015, Book no: CLIX/46.

The International Scientific Symposium: „Mitral valve diseases in children and adults“ has resulted with the book which is in front of us including the presentation/articles of distinguished experts in this medical area from Bosnia and Herzegovina and Europe (University Clinical Centre Ljubljana, Slovenia, and AKH Wien, Austria). Through this event the scientific and professional public in Bosnia and Herzegovina and wider, has been introduced with newest knowledge and experience in the field of adult and paediatric cardiology and cardio surgery. At this International Symposium which had excellent audience and has been intended for: physicians, family doctors, paediatricians, specialists of internal medicine, cardiologists, geneticists, cardiac surgeons, medical students and dentistry students, students of Faculty of health studies, pupils from secondary medical schools as well as all interested for medical

pathology, lectures ex cathedra were given by eminent lecturers as stated earlier including lectures from the Institute for Public Health of Canton Sarajevo and Institute for Public Health of the Federation of BiH. All articles have been reviewed by two independent domestic and foreign reviewers who add to the value of this publication,

It was an excellent Symposium on mitral valve (MV) with good systematic approach to MV diseases in children and adults performing excellent pictures of ECHO, TTE, TEE, CC and surgical techniques with newest update in invasive approach. One of the conclusions was to do prevention in the field of medicine for avoiding/controlling the risk factors in order to decrease the cardiovascular diseases in children and adults. It is a team work with primary care professionals, clinicians, public health practitioners, politics, media services, health institutions, education institutions, families, in mission towards decreasing cardiovascular diseases. We have tasks to do together. The vision of responsibility of health professionals now should adjust it to the present situation with the plan of multisystemic interdisciplinary approach and action.

Sarajevo, December, 2016.

Academician Senka Mesihović-Dinarević



MITRAL VALVE DISEASE IN CHILDREN AND ADULTS

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Abstract

Mitral valve / MV / is a functional complex that is based on the normal morphology, geometrical relations and function of all constituents. Its role is triple: 1. regulate blood flow to the LV during diastole with low pressure gradient, preventing the recurrence of systolic blood flow in LA, 2. contribute to the formation of LV outflow tract in systole and 3. its integrity is essential for maintenance of a normal size and geometry function of LV. The disease of heart valves, mitral and aortic caused by degenerative changes, is quite common in adults. In a young person, the more common causes are: inflammatory diseases, cardiomyopathy and ischemic heart disease. Using color Doppler echocardiography, the morphological valve changes and damage to its function can be diagnosed. The goal of treatment is: to reduce or eliminate symptoms of disease, to avoid damage to LV function or right ventricle, improving the quality of patient's life, prevention of complications and mortality reduction. Treatment options for valvular heart disease are: medical therapy, balloon valvuloplasty and surgical therapy: valve replacement or valve reconstruction. In children there are predominantly acquired valvular heart diseases of rheumatic etiology. Mitral stenosis is rare, more common is mitral regurgitation /MR/. Treatment of MR involves: SBE prophylaxis, afterload reducing agents, diuretics and digoxin. Surgical correction prefers reconstruction over MV replacement. Asymptomatic patients with MV prolapse do not require treatment, and symptomatic patients need beta blocker agents. Reconstructive surgery or MV replacement is indicated in rare patients with severe MR.

Key words: mitral, valve, disease

Mitral valve /MV/, located between the left atrium /LA/ and left ventricle /LV/, is a functional complex that is based on the normal morphology, geometrical relations and function of all constituents: the left atrium, the mitral annulus, the mitral leaflets, the subvalvular apparatus (tendinous chords and papillary muscles) and left ventricle. Its role is triple: 1. regulate blood flow towards the LV during diastole at low pressure gradient, while preventing systolic backflow in LA, 2. contribute to the formation of LV outflow tract during systole and 3. its integrity is essential to maintain normal size, geometry and function of LV. Normal mitral valve function depends on perfect function and complex interaction between various structures. The broader concept of “mitral valve complex” – mitral annulus, mitral leaflets, chordae tendineae, papillary muscles, left ventricular wall, left atrium – allows a better characterization of both normal and abnormal valvular function. It is important to recognize that the leaflets of the mitral valve constitute only a portion of the mitral valve apparatus and that diseases resulting in mitral dysfunction are often caused by abnormalities in the overall apparatus rather than in the actual leaflets (1).

During the phase of contraction, the mitral valve closes so that all the blood is ejected into the aorta. When mitral valve is diseased, valve can be stenotic, or not closing properly during blood ejection, which is then insufficient, and is called: mitral regurgitation. Early mitral regurgitation consists of: increased LV end diastolic pressure, increased LV contractility via increased preload, decreased or stable afterload due to filling of LA, preserved / hyperdynamic LV systolic function. Chronic compensate regurgitation has: dilatation of LV with hypertrophy, dilated LA with normal pressure, normal to hyperdynamic LV function. Chronic decompensated regurgitation is characterized by enlarged LV chamber and decline of LV function. Mitral stenosis used to be the main cause of mitral valve disease due to untreated streptococcal infections of the throat. Today, given the widespread use of antibiotics, mitral stenosis is increasingly rare, and is present in economically depressed areas (2). Insufficiency of the mitral valve - mitral regurgitation is now the most common form of mitral disease. It is mostly due to mitral valve prolapse generated on the basis of degenerative process in the mitral valve leading to elongation and cracking of tendinous chords that control valve movement. In mitral regurgitation, the valve does not close during the blood ejection phase, so only the portion of the blood goes into the aorta, and a portion is returned back into the left atrium and towards the lungs. Over time this leads to the heart load, and deterioration of the heart muscle, accompanied by fatigue,

suffocation and rhythm disorders. Mitral regurgitation may also occur with coronary artery disease and myocardial infarction. Infarction of left ventricular inferior wall usually leads to the so-called: ischemic mitral regurgitation.

Heart valve disease is quite common in adults (3-5). The most common diseases are of aortic and mitral valve, rarely tricuspid and pulmonary valve. The valve diseases include narrowing or stenosis and insufficiency or incomplete closure of the valve. In elderly patients, valvular heart disease is usually caused by degenerative changes, but in younger persons inflammatory bowel disease, cardiomyopathy, and ischemic heart disease are more common causes. A multiple simultaneous disease of the heart valves could be diagnosed in some patients. The most common symptoms that patients have are: dyspnoea or shortness of breath, feeling of increased heart rate or palpitations, intolerance to physical effort and faster fatigue, fainting, chest pain, and swelling of legs. A diagnosis of valvular heart disease is based on patient's history, clinical examination and diagnostic procedures including: electrocardiogram, X-ray of lungs and heart, transthoracic and transesophageal echocardiography, cardiac catheterization and coronary angiography, stress test - exercise test, magnetic resonance imaging and computerized tomography. The mitral valve was the first of the four cardiac valves to be evaluated by echocardiography (6-9). This was due to the relatively high prevalence of rheumatic heart disease and the relatively large excursion of the mitral valve leaflets, which made them easier targets for early M mode techniques. Using Doppler echocardiography and Color echocardiography, valvular morphological changes and their function damage can be diagnosed. This diagnostic method is used to estimate the severity of heart valves disease. Real-time-3 dimensional echocardiography of MV allows easy identification of different anatomical segments of MV including both commissures (10). The "en face" view of MV can be constructed and refers to exposure to the MV from the atrial perspective, similar to the surgeons view during MV surgery.

After clinical examination and diagnostic procedures, a decision is made on the choice of therapy (10, 11). The goal of treatment of diseases of the heart valves is to: reduce or eliminate symptoms of the disease, avoid damage to the functions of the left and right ventricle, improve the quality of patient's life, prevent complications and reduce mortality. Treatment options for valvular heart disease are: medical therapy, balloon valvuloplasty and surgical valve replacement therapy or surgical therapy for valve reconstruction. Following drugs are recommended: vasodilators, beta-blockers, ACE-inhibitors and for some groups of patients anticoagulant therapy (12). Balloon

valvuloplasty and percutaneous mitral commissurotomy are the way of treating mitral stenosis. Through peripheral artery, a catheter with a balloon is introduced and positioned to the place of narrowing of the mitral valve, then, by increasing the pressure and expanding the balloon, the stenotic area of the mitral valve is expanded (13). One of the possibilities of surgical treatment of valvular heart disease is valve repair which lately brings more benefits than the insertion of an artificial valve. By reconstructing the valve, the pathological changes in the mitral ring, or tricuspid valve, then the valve leaflets, the chordes tendineas or papillary muscles, can be corrected. Another option is surgical treatment for an artificial valve insertion which may be: mechanical, biological or homograft with the treatment of associated diseases such as coronary heart disease. Following insertion of the mechanical valve, patient should take lifelong anticoagulant therapy with regular control of coagulation parameters to determine the optimal dose of the drug. After the reconstruction of the valve or biological valve installation or bio prosthesis, such therapy is required in the first three months after surgery, while maintaining the target value (INR 2.5).

Acquired valvular diseases in children are mostly of rheumatic etiology. Involvement of MV occurs in $\frac{3}{4}$ and of aorta in $\frac{1}{4}$ of all cases of rheumatic heart disease. Stenosis and regurgitation of the same valve usually occur together. Mitral stenosis /MS/ is rare in children, because MS requires a period of 5-10 years from initial attack to develop. MS is the most common valvular disease in adult rheumatic population. Maintenance of dental hygiene with SBE prophylaxis is essential. In the case of atrial fibrillation development, anticoagulants are necessary with digoxin and quinidine as well. Balloon valvuloplasty was initially tried as an alternative to the closed commissurotomy – the results were comparable. MR is the most common valvular disease in children with rheumatic heart disease (14-16). Treatment includes SBE prophylaxis, afterload reducing agents, diuretics and in the case of atrial fibrillation (rare in children), digoxin. Surgical treatment prefers correction of the mitral valve rather than replacement due to lower mortality and the fact that anticoagulants are not necessary. Its use is necessary in case of the prosthetic valve. Mitral Valve Prolapse (MVP) occurs in 5% of children, in 50% of cases it is idiopathic (17). MVP is observed in primary form of autosomal dominant inheritance, and congestive heart failure occurs in 30% of cases. Thick and redundant mitral valve leaflets due to myxomatous degeneration bulge into mitral annulus. The posterior leaflet is more commonly and more severely affected than the anterior leaflet. Almost all patients with Marfan syndrome have MVP;

it may occur with diseases of connective tissue disorders. Asymptomatic patients do not require treatment or activity restriction. SBE prophylaxis is recommended in patients with MR or thickened mitral valve. Symptomatic patients (palpitations, dizziness, syncope) or those with arrhythmias, are subjected to 24-hour Holter ECG and/or stress test. Propranolol or other beta blocker is the drug of choice in patients with arrhythmias or chest pain. Reconstructive surgery or MV replacement is indicated in few patients with severe MR.

Although valvular heart disease (VHD) is infrequent in industrialized countries in relation to coronary artery disease, heart failure, or hypertension, guidelines are important in this area because the VHD are frequent, and often require interventions (18-20). The decision on intervention is complex because the VHD is often seen in the elderly age, resulting in a higher frequency of comorbidity, which contributes to increased risk of interventions. Another important aspect of contemporary VHD is the growing number of previously treated patients who are presented with further problems. In contrast, rheumatic valve disease remains a major public health problem in developed countries, where it affects mostly the younger population. When compared with other heart diseases, there are few studies in the field of VHD and randomized clinical trials are particularly rare. A large number of guidelines are issued in recent years by the European Society of Cardiology as well as by other societies and organizations. Because of their impact on clinical practice, quality criteria have been established to develop guidelines so that all decisions would be clear to the user. The relationship between clinical research, developing the guidelines and their implementation in clinical practice, can be complete only if surveys and registries confirm that daily practice is keeping in line with what is recommended in the guidelines. Such surveys and registries also make possible the calculation of impact of the implementation of recommendations on patient's outcome. The guidelines, however, do not cover the individual responsibility of health professionals to make the appropriate decision in the case of an individual patient, in consultation with that patient, and – where appropriate and necessary – with the person who takes care of the patient. It is also the responsibility of health professionals to uphold the rules and regulations applicable to drugs and devices at the time of prescribing. The objectives of the evaluation of patients with VHD is to diagnose, quantify and assess the mechanisms of VHD, as well as its consequences. Consistency between the results of diagnostic tests and clinical findings should be checked at every stage of the decision-making process (20-22). It would be ideal if the decisions are made by the “Heart team”, with special

expertise in the field of VHD, which includes: cardiologists, cardiac surgeons, imaging specialists, anesthesiologists and, if necessary, general praxis physicians, geriatric specialists, or intensive care specialist. If decision has to be made in paediatric patient, then the Heart Team consists of: paediatrician, paediatric cardiologists, imaging radiologists, intensivists, cardiac paediatric surgeons, anesthesiologists, psychologists, social workers and nutritionists. This approach, in the “Heart Team”, is particularly advisable in the management of high-risk patients, and it is important also for other subgroups, such as asymptomatic patients, where assessment of the possibility of reconstructing the valve is very important in decision making. Finally, indications for intervention – and what type of intervention should be chosen – is mainly based on the comparative assessment of spontaneous prognosis and results of intervention according to the characteristics of VHD and associated comorbidity.

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BOLESTI MITRALNOG ZALISKA KOD DJECE I ODRASLIH

Sažetak

Mitralni zalistak (MV) je funkcionalni kompleks koji se temelji na normalnoj morfologiji, geometrijskim odnosima i funkcioniranju svih konstituenata. Njegova uloga je trostruka: 1. reguliše protok krvi u LV tijekom dijastole s niskim gradijentom pritiska, sprečavajući ponavljanje sistoličkog protoka krvi u LA, 2. doprinosi formiranju odlivnog trakta LV u sistoli i 3. njegov integritet je od suštinskog značaja za održavanje normalne veličine i geometrijske funkcije LV. Bolesti srčanih zalistaka, mitralne i aortne, uzrokovane degenerativnim promjenama, uobičajene su kod odraslih. Kod mladih osoba, češći uzročnici su: upalne bolesti, kardiomiopatija i ishemijske bolesti srca. Korištenjem kolor dopler ehokardiografije mogu se dijagnosticirati morfološke promjene zaliska i oštećenja njegove funkcije. Cilj liječenja je: smanjiti ili eliminirati simptome bolesti, izbjeći oštećenja funkcije LV ili desne komore, poboljšati kvalitetu života bolesnika, spriječiti komplikacije i smanjiti stopu smrtnosti. Mogućnosti za liječenje bolesti srčanih zalistaka su: medicinska terapija, balonska valvuloplastika i kirurške terapije: zamjena zaliska ili rekonstrukcija zaliska. Kod djece nalazimo pretežno stečena oboljenja srčanih zalistaka reumatske etiologije. Mitralna stenoza je rijetka, dok je češća mitralna regurgitacija (MR). Tretman MR-a uključuje: SBE profilaksu, agense za smanjenje afterloada, diuretike i digoksin. Kod hirurških korekcija preferira se rekonstrukcija u odnosu na zamjenu MV-a. Asimptomatski bolesnici s MV prolapsom ne zahtijevaju liječenje, dok pacijenti s izraženim simptomima trebaju beta blokatore. Rekonstruktivna hirurgija ili zamjena MV-a se koriste kod rijetkih bolesnika s teškom MR.

Ključne riječi: mitralni, zalistak, oboljenje

MITRAL VALVE PATHOLOGY: CHALLENGES AND SOLUTIONS – A SHORT OVERVIEW

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Abstract

Mitral valve prolapse (MVP) is the most common valve disease (prevalence of 2 to 3%). Although MVP is generally regarded as a benign condition, complications such as mitral regurgitation, atrial fibrillation, congestive heart failure, endocarditis and stroke are well known. MVP is a significant cause of SCD where CE-CMR (contrast-enhanced MRI) might allow the identification of this arrhythmic substrate.

Transcatheter mitral valve interventions are progressively being introduced into clinical practice targeting a population of patients with mitral regurgitation (MR). Beyond percutaneous edge to edge repair (MitraClip®), a percutaneous surgical-like direct annuloplasty device but also transcatheter chordal replacement and indirect annuloplasty (using coronary sinus devices, radiofrequency-mediated annular remodeling and cinching devices) are in various stages of development. Meanwhile, we do have personal experience using Melody valves as MV replacement using the hybrid approach.

Rheumatic fever continues to be the commonest cause of acquired heart disease in the children and adolescent population of most developing countries. Until the early 1980s, the only option for patients with mitral stenosis (MS) uncontrollable by medical therapy was surgery. After several technical modifications balloon mitral valvotomy is a standard therapeutic modality for managing rheumatic mitral stenosis. Patients with sinus rhythm, less gross valve deformity, and a post-balloon mitral valvotomy area >1.75 cm² will have better intermediate outcomes. Detailed knowledge of MV pathology will lead to perfect solutions for each individual patient.

Key words: mitral valve, pathology, challenges.

Introduction

The mitral valve connects the left atrium (LA) and the left ventricle (LV) and is located obliquely behind the aortic valve. The normal function of the mitral valve depends on its 6 components, which are the left atrial wall, the annulus, the leaflets, the chordae tendineae, the papillary muscles, and the left ventricular wall (1). Any congenital or acquired disorder of individual components can disturb the finely coordinated mechanisms of the mitral valve and result in an incompetent valve, where the left atrial myocardium extends over the proximal portion of the posterior leaflet. Thus, left atrial enlargement may result in mitral regurgitation by affecting the posterior leaflet. The anterior leaflet is not affected, because of its attachment to the root of the aorta (1). The mitral annulus is a fibrous ring that connects with the leaflets. It is not a continuous ring around the mitral orifice and appears to be more D-shaped, rather than circular. The annulus functions as a sphincter that contracts and reduces the surface area of the valve during systole to ensure complete closure of the leaflets. Thus, annular dilatation of the mitral valve causes poor leaflet apposition, which results in mitral regurgitation (2). The free edges of the leaflets have several indentations. Two of these indentations, the anterolateral and posteromedial commissures, divide the leaflets into anterior and posterior. Normally, the leaflets are thin, pliable, translucent, and soft with an atrial and a ventricular surface. The anterior leaflet is located posterior to the aortic root and is also known as the aortic, septal or anteromedial leaflet. The posterior leaflet is also known as the ventricular, mural or posterolateral leaflet and is divided into 3 scallops by 2 indentations or clefts (3).

The chordae tendineae are small fibrous strings that originate either from the apical portion of the papillary muscles or directly from the ventricular wall and insert into the valve leaflets or the muscle. These 2 types are called true chordae tendineae and false chordae tendineae, respectively. The papillary muscles normally arise from the apex and middle third of the left ventricular wall. The anterolateral papillary muscle is normally larger than the posteromedial papillary muscle and is supplied by the left anterior descending artery or the left circumflex artery. The posteromedial papillary muscle is supplied by the right coronary artery (4).

Mitral valve pathology

Mitral valve prolapse

MVP is defined as mitral leaflet billowing by more than 2mm above the anterior and posterior edges of the mitral annulus during ventricular systole (5). Mitral regurgitation is due to a combination of leaflet and chordal extensibility and elongation probably together with superior papillary muscle displacement or traction (6, 7). The billowing leaflets may appear diffusely thickened (“Barlow’s syndrome”) or thin except in flail portions (“Fibroelastic deficiency”). Repair strategies aim to restore effective leaflet coaptation by reducing leaflet redundancy and mitral annular dimensions, and if needed implanting artificial chordae. Suitable mitral valve leaflet characteristics may also allow leaflet free edge approximation at the site of regurgitation (edge-to-edge technique) by a stitch or a clip (MitraClip). Repair techniques, pioneered by Alain Carpentier, aim to restore leaflet function while preserving the native valve. Mitral valve replacement is not commonly indicated with a skilled surgeon (8).

Functional/Ischemic Mitral Regurgitation

Functional or ischemic MR is caused by displaced papillary muscles in the setting of a distorted, remodeled LV with increased distance between PM heads and mitral annulus and inadequate leaflet coaptation. Global LV dilatation restricts systolic closure motion of the MV leaflets.

Repair strategies aim to restore LV shape and function, PM approximation (8), chordal cutting, leaflet edge-to-edge approximation technique (9, 10), mitral annulus area reduction or valve replacement. However, therapy strategies that deal with the annulus, but not the ventricular tethering are often limited, with recurrent MR (11) which can be reduced by chordal cutting.

MVR in the case of Hypertrophic cardiomyopathy

HCM is an autosomal dominant disease of myocyte disarray and fibrosis, morphologically characterized by significant LV hypertrophy in the absence of chronically elevated afterload or infiltrative diseases (12). HCM involves the papillary muscles and mitral leaflets:

The PMs are anteriorly displaced and the heads positioned closer to each other (13) displacing the anterior leaflet into the LV outflow tract. If anterior leaflet displacement is severe enough to impair posterior leaflet apposition, mitral regurgitation will occur (14). Since PM position is the main

mechanism, septal reduction therapy does not always eliminate SAM (15). Because of these mechanisms, repair strategies include papillary muscle repositioning and reducing leaflet redundancy.

Special Issues

Arrhythmogenic mitral valve prolapse

Mitral valve prolapse (MVP) is a common valvular abnormality with a prevalence of approximately 2–3% in the general population (16). Prospective studies, however, report sudden cardiac death (SCD) rates of 0.2–0.4% per year, approximately twice that of the general population (17). Among sudden death survivors the prevalence of bileaflet MVP (BiMVP) is high with a common clinical tetrad of 1) BiMVP, 2) female gender, 3) T wave abnormalities (biphasic or inverted T waves), and 4) complex ventricular ectopy (multi-form premature ventricular complexes, ventricular bigeminy, ventricular tachycardia [VT], or ventricular fibrillation [VF]) (18). More recently, however, Nordhues et al. showed that BiMVP is associated with an increased risk of ventricular tachycardia but, overall, does not appear to portend a poor prognosis at the population level when compared to patients with SiMVP or controls without MVP (19). Although the mechanism for proarrhythmia in MVP is not completely understood, mechanical stress on the papillary muscles resulting in fibrosis is a likely contributor (20). Han et al. demonstrated increased late gadolinium enhancement on cardiac magnetic resonance imaging (MRI) suggestive of fibrosis in the papillary muscles adjacent to the chordae tendineae in MVP patients with complex ventricular arrhythmias (21). Chesler et al. reported endocardial friction lesions suggesting mechanical contact from the prolapsing leaflets also likely plays a role (22).

Rheumatic mitral valve disease

The prevalence of rheumatic fever has declined significantly in most of the developed world. It continues, nonetheless, to be the commonest cause of acquired heart disease in the children and adolescent population of most developing countries (23). Rheumatic mitral stenosis (MS) developing as a sequel of rheumatic fever causing thickening and fibrosis of the mitral valve apparatus is still an important cardiac morbidity in developing nations. Balloon mitral valvotomy (BMV) has been considered the standard therapeutic modality since its introduction, as an alternative to surgical mitral commissurotomy or valve replacement (24). Most published series have reported

an immediate success rate of over 90% with balloon dilatation in children and young adults. These gratifying results are also reported from very young children of less than 12 years of age (25). The complications, seen in about 1% to 2% of cases, include development of significant mitral regurgitation and hemopericardium, secondary to cardiac chamber perforation. The long-term results indicate slightly higher restenosis rates in children than in adults. Most children with restenosis can undergo successful repeat dilatation (26).

Transcatheter mitral valve interventions

Mitralstenosis

All symptomatic patients of mitral stenosis with significant stenosis should be considered for percutaneous transvenous mitral commissurotomy (27). Since 1984 the use of the Inoue balloon has gained widespread acceptance. This balloon changes shape in three stages, depending on the extent of inflation. It is inserted from the saphenous vein into the mitral orifice transseptally, fixed across the mitral orifice with partial inflation, and finally inflated to its full extent, separating the fused commissures by its expansile force (28). It is recommended to start with a smaller balloon size and increase its size in a stepwise fashion to minimize complications. Detailed technical information are provided by Arora et al (27).

Mitral Regurgitation

Among the transcatheter MV repair technologies, edge-to-edge MV repair with the MitraClip system (Abbott Vascular, Abbott Park, IL, USA) has undergone the most extensive human investigation thus far, with more than 20,000 procedures already performed (29). In children however, percutaneous edge-to-edge mitral valve repair has been used extremely rarely (30). The same is true for indirect (The Carillon Mitral Contour System (Cardiac Dimension, Inc, Kirkland, WA, USA)) and direct transcatheter annuloplasty technologies (The Mitralign Percutaneous Annuloplasty System (Mitralign, Tewksbury, MA, USA) or The Cardioband System (Valtech Cardio Ltd, Or Yehuda, Israel)).

Surgical approach

Surgical repair is the reference standard treatment in primary MR. Percutaneous intervention in MR should currently be reserved for high-risk or inoperable patients. Mitral valve repair can be achieved using a variety of isolated

or combined techniques such as leaflet resection, implantation of artificial chordae, chordal transposition/transfer, edge-to-edge technique, annuloplasty using a prosthetic ring or band (31). In the case of rheumatic mitral valve regurgitation, initial experiences showed less good results after repair of rheumatic than with degenerative valves. However, Talwar et al. have similarly produced excellent results in children with a mean age of 11 years, having observed a 90% survival and up to 15 years of follow-up (32).

In secondary MR, medical therapy is the first choice, the role of surgery is controversial, particularly when concomitant revascularization is not an option, owing to significant operative mortality, high rates of recurrent MR, and absence of proven survival benefit (33).

Conclusion

Mitral valve pathophysiology and the resulting diagnostic and treatment options are complex. A detailed knowledge of MV pathology and high level of personal skill and experience will lead to a perfect solution for each individual patient.

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PATOLOGIJA MITRALNOG ZALISKA: IZAZOVI I RJEŠENJA – KRATAK PREGLED

Sažetak

Prolaps mitralnog zaliska (MVP) je najčešća bolest zaliska (prevalencija 2 do 3%). Iako se MVP generalno smatra benignim stanjem, dobro su poznate komplikacije kao što su mitralna regurgitacija, atrijske fibrilacije, kongestivno zatajenje srca, endokarditis i srčani udar. MVP je značajan uzročnik iznenadnog zastoja srca, gdje CE-CMR (kontrastni-MRI) može omogućiti identifikaciju ovog aritmijskog substrata.

Transkateterske intervencije mitralnog zaliska se postepeno uvode u kliničku praksu cilja-jući populaciju bolesnika s mitralnom regurgitacijom (MR). Mimo perkutanih edge-to-edge popravki (MitraClip®), u različitim fazama razvoja su i perkutani uređaj za direktnu anuloplastiku sličnu hirurškoj, te transkateterska zamjena hordi i indirektna anuloplastika (uz korištenje uređaja za koronarni sinus, anularno remodeliranje uz korištenje radiofrekvencije i uređaje za sužavanje - cinching). U međuvremenu, imamo i lično iskustvo u korištenju Melody ventila kao zamjene za MV uz primjenu hibridnog pristupa.

Reumatska groznica i dalje je najčešći uzročnik stečene bolesti srca u populaciji djece i adolescenata u većini zemalja u razvoju. Prije ranih 1980-ih, jedina opcija za pacijente s mitralnom stenozom (MS) koja se nije mogla kontrolisati medicinskom terapijom bila je operacija. Nakon nekoliko tehničkih modifikacija, balonska mitralna valvulotomija je standardni terapijski model za upravljanje reumatske mitralne stenozе. Pacijenti sa sinusnim ritmom, manjim deformitetom ventila i područjem mitralne valvulotomije $> 1.75 \text{ cm}^2$ nakon balona će imati bolje srednjoročne rezultate.

Detaljno poznavanje MV patologije će dovesti do savršenog rješenja za svakog pojedinog pacijenta.

Ključne riječi: mitralna valvula, patologija, izazovi

ECHOCARDIOGRAPHY OF THE MITRAL VALVE

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Abstract

The mitral valve is a complex anatomical and functional structure, composed of the mitral leaflets, mitral annulus, chordae tendineae, papillary muscles and adjacent myocardium. Normal function of all parts of the mitral valve apparatus is essential for normal function of the mitral valve. Different conditions and diseases can cause mitral valve dysfunction, namely mitral regurgitation and mitral stenosis. Echocardiography is a key diagnostic procedure to evaluate the mitral valve. Transthoracic echocardiography is a basic investigation in assessing the mitral valve. When detailed evaluation of the mitral valve is required, transesophageal echocardiography is indicated with the advantage of better resolution and additional views. Two-dimensional echocardiography is useful in the evaluation of mitral valve morphology, heart size and function. Three-dimensional echocardiography is especially useful before surgical procedures, since it gives a better view of the complex mitral valve structure in a “surgeon’s view”. To detect possible mitral valve dysfunction, colour-Doppler echocardiography is used. To properly evaluate the degree of mitral valve regurgitation and stenosis, pulse and continuous-wave Doppler echocardiography is mandatory. Mitral valve evaluation requires a thorough echocardiographic investigation with different echocardiographic modalities and with the use of novel echocardiographic methods, such as three-dimensional echocardiography.

Key words: echocardiography, mitral valve, mitral regurgitation, mitral stenosis

Anatomy of the mitral valve

Mitral valve is a complex anatomical and functional structure. Mitral apparatus consists of three parts: mitral annulus, mitral valve leaflets and subvalvular apparatus (chordae tendineae and papillary muscles). For its function left atrial and ventricular myocardium is also important. Normal function of all parts of the mitral valve apparatus is essential for the normal function of the mitral valve (1, 2).

Mitral annulus is a saddle shaped fibrous structure, which anteriorly borders to the aorta. Posterior annulus is close to circumflex coronary artery at the lateral side and to coronary sinus at the medial side. Mitral annulus is in a fibrous continuity with aortic and tricuspid valve (3).

Mitral leaflets consist of a larger and longer anterior (AMVL) and shorter posterior mitral valve leaflet (PMVL). Based on Carpentier's classification mitral leaflets are divided in eight segments. Anterior and posterior leaflet have three scallops each: medial (A3, P3), middle (A2, P2) and lateral (A1, P1). The middle scallop is the largest. The leaflets are connected by two commissures: anterolateral, adjacent to left atrial appendage, and posteromedial commissure (1-5).

Subvalvular apparatus consists of chordae tendineae and papillary muscles. Chordae are thin filaments that connect margins of the mitral leaflets to the papillary muscles. There are primary, secondary and tertiary mitral chordae which are attached to two papillary muscles: posteromedial and anterolateral papillary muscle. Chordae from the medial part of both leaflets attach to the posteromedial papillary muscle and from the lateral part to the anterolateral papillary muscle (1-3, 5).

Assessment of the mitral valve

Echocardiography plays a central role in the evaluation of the mitral valve. It enables the assessment of its morphology and function. The basic investigation is transthoracic echocardiography (TTE) which can routinely be used in everyday clinical practice. When detailed evaluation of the mitral valve is required, transesophageal echocardiography (TEE) is indicated with the advantage of better resolution and additional views.

Transthoracic echocardiography

For the assessment of the mitral valve different views can be used. The mitral valve is best seen in the parasternal long and short-axis views and in the apical views (3, 6).

In the *parasternal long-axis view* both mitral leaflets and their motion can be evaluated (Figure 1). The mitral leaflets are thin. Chordae are attached to the free edge and to the ventricular surface of the leaflets and extend to the papillary muscles. The mitral annulus with its minor axis is seen in this view. With M-mode echocardiography motion of the mitral leaflets can be evaluated and this view is useful in the detection of mitral valve prolapse (Figure 2) (3, 6, 7).

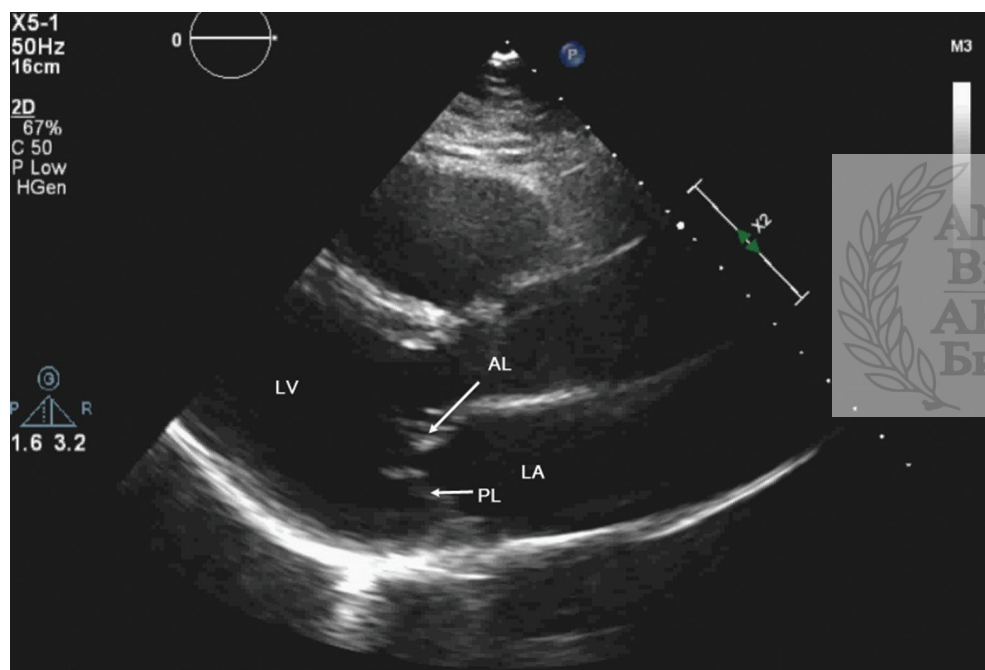


Figure 1. In the parasternal long axis view the anterior (AL) and posterior (PL) mitral valve leaflets are seen. LA – left atrium, LV – left ventricle.

Morphology of the mitral valve can be best evaluated in the *short-axis views*. At the mitral valve level both leaflets with the scallops and mitral commissures can be seen (Figure 3, 4). By planimetry, mitral valve area (MVA) can be measured in this view (Figure 5). Normal MVA is 4-6 cm². With angulation of the transducer more apically, the papillary or midventricular level is obtained where both papillary muscles can be visualized (3, 6, 7).

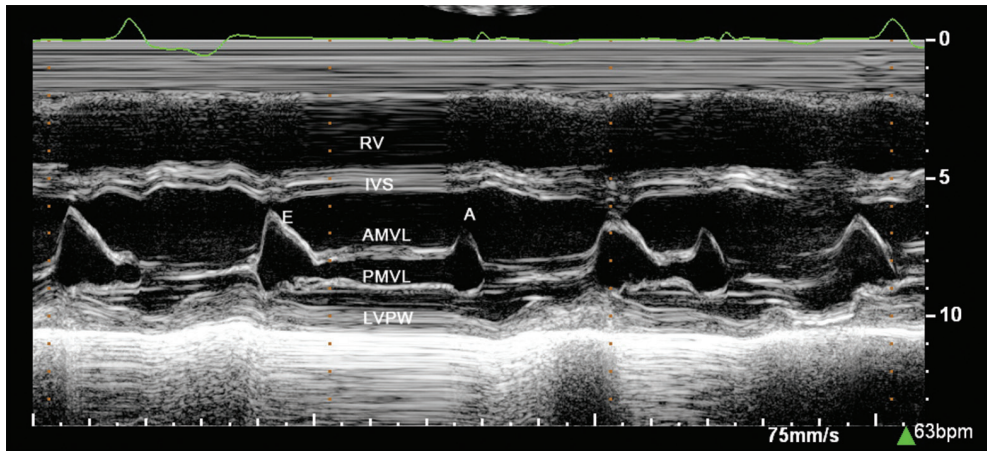


Figure 2. M-mode tracing of the mitral valve. In early diastole, the mitral leaflets open. The anterior leaflet (AMVL) moves towards the interventricular septum (IVS) and the posterior leaflet (PMVL) to the left ventricular posterior wall (LVPW). The maximum opening of the anterior leaflet in early diastole is termed the E point. In mid-diastole leaflets move closer to each other (diastasis) and in atrial systole open again, forming the A point of the anterior leaflet. The movement of the posterior leaflet is mirror-like. RV – right ventricle

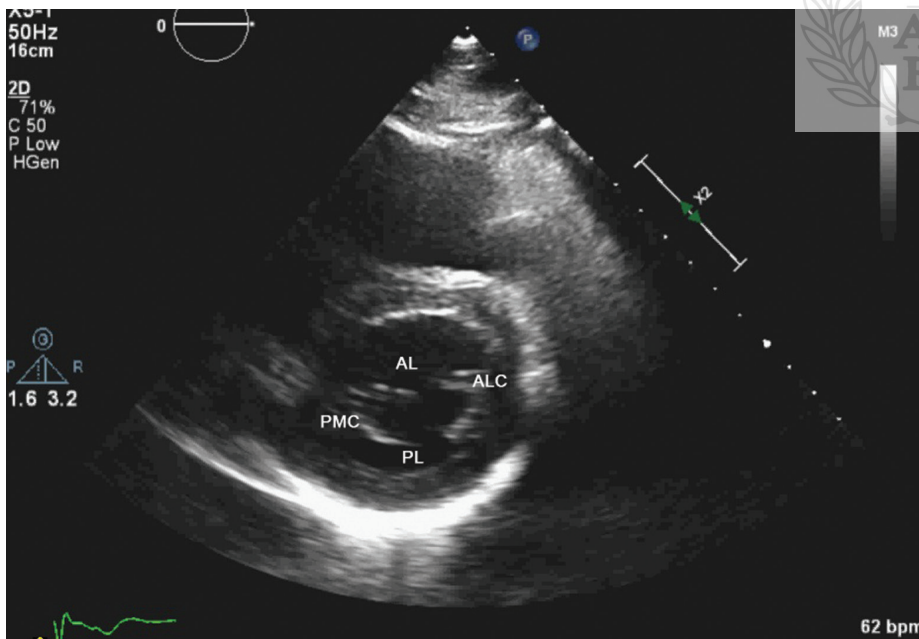


Figure 3. At the mitral valve short-axis level anterior (AL) and posterior (PL) mitral valve leaflets with anterolateral (ALC) and posteromedial (PMC) commissures are seen.

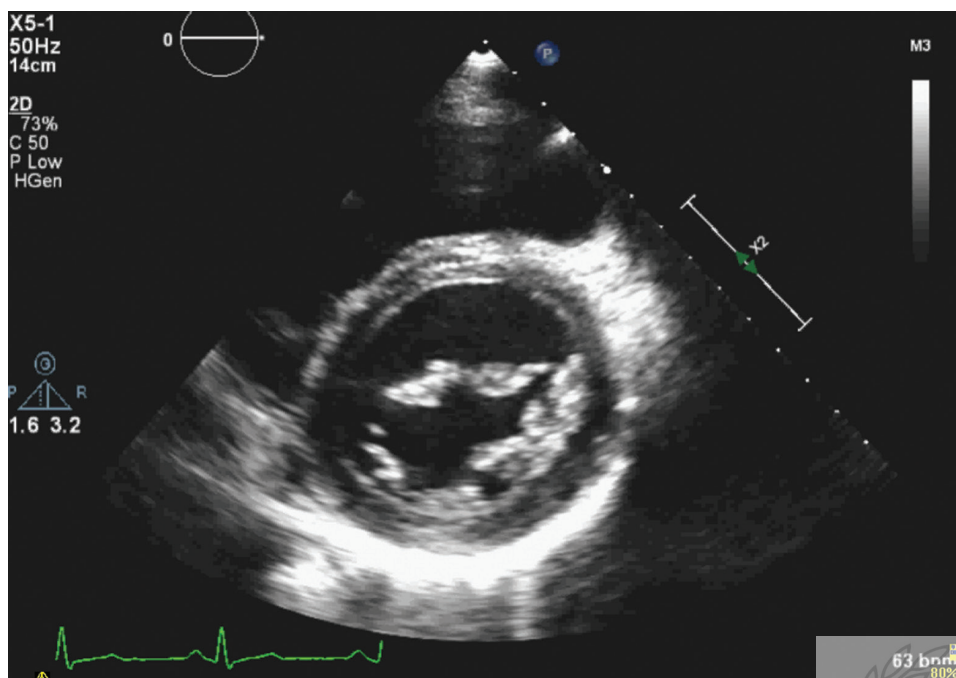


Figure 4. At the mitral valve short-axis level myxomatous changes of the mitral valve leaflets are seen. The leaflets are thickened and redundant.

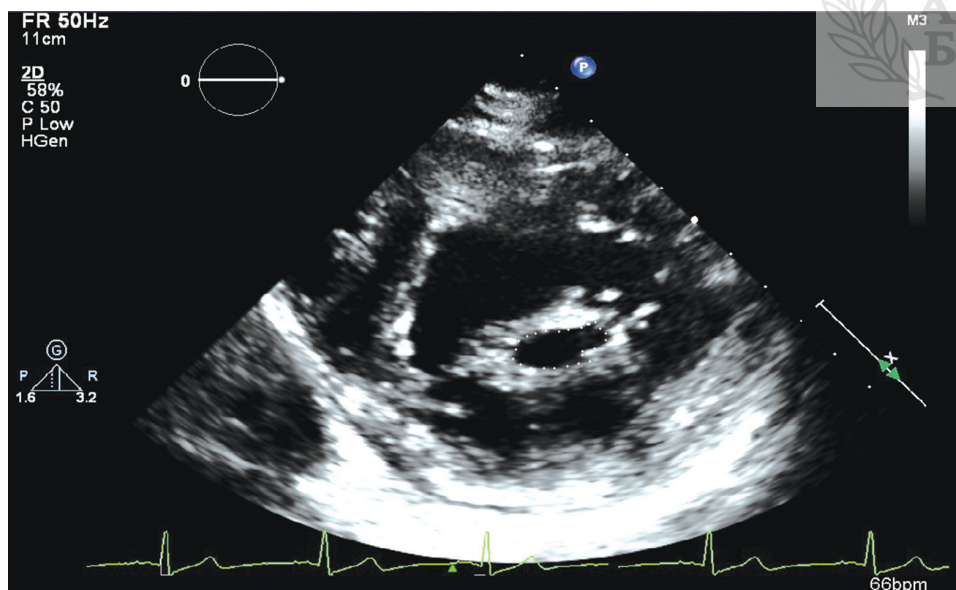


Figure 5. By planimetry mitral valve area (MVA) can be measured in the parasternal short-axis view. The figure shows severe rheumatic mitral valve stenosis with MVA of 0.9 cm².

In the *apical four-chamber view* the anterior leaflet is located closer to the interventricular septum, while the posterior leaflet is adjacent to the lateral wall of the left ventricle. Chordae from both leaflets extend and attach to the anterolateral papillary muscles. The major axis of the mitral annulus can be measured in this view. The mitral annulus normally lies less apically than the tricuspid valve annulus (Figure 6). To evaluate mitral valve function, colour-flow Doppler is used. In this view, mitral inflow by pulsed-wave Doppler and MVA by pressure half-time can also be assessed (Figure 7). The *apical two-chamber* and long-axis view are used for additional views of the mitral valve, to evaluate mitral valve scallops and with the use of colour-flow Doppler to assess the degree of mitral regurgitation (3, 6, 7).

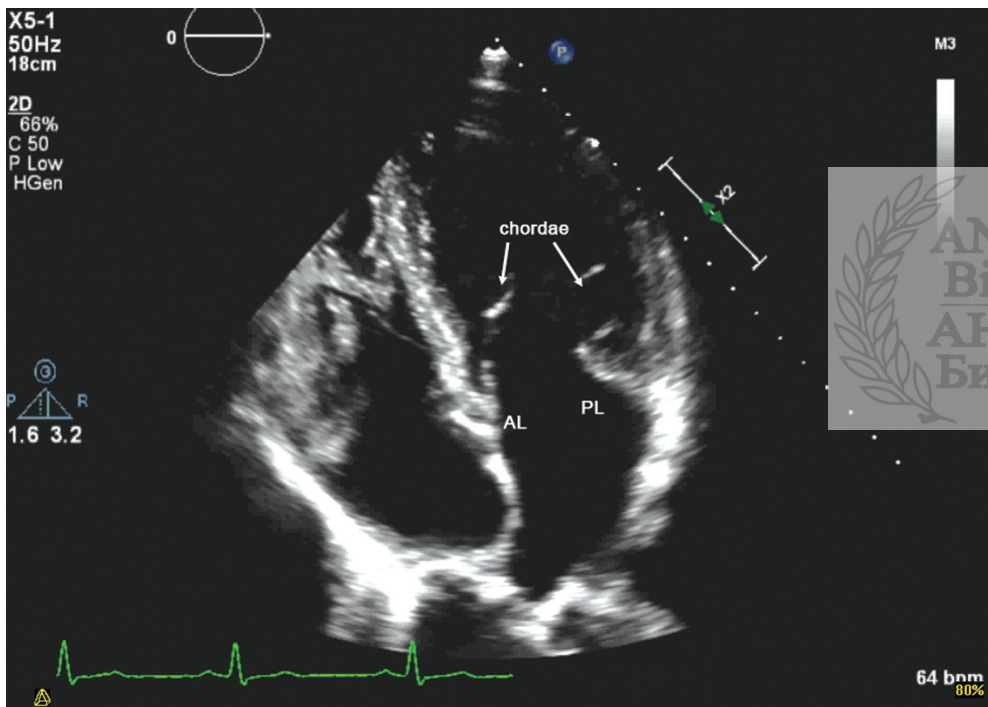


Figure 6. The apical four-chamber view with the anterior (AL) and posterior (PL) mitral valve leaflet.

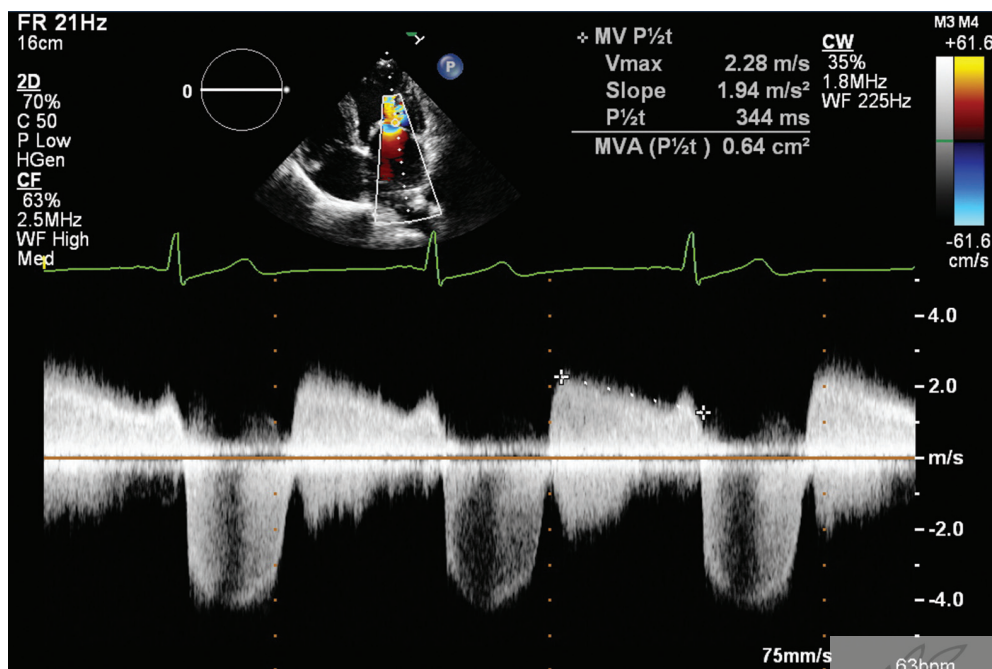


Figure 7. In apical four-chamber view mitral valve area (MVA) is calculated by pressure half-time method. The patient has severe rheumatic mitral valve stenosis. The continuous-wave Doppler signal of mitral regurgitation is dense and parabolic, indicating associated moderate mitral regurgitation.

Transesophageal echocardiography

When detailed assessment of the mitral valve is necessary or prior to surgical correction of the mitral valve, TEE is indicated. It provides better imaging of the mitral valve and its morphology. For detailed information on mitral morphology different views are used. The mitral valve is usually evaluated by transducer rotation from the four-chamber to the long-axis view. If needed, transgastric views can also be used. TEE is useful before surgery in mitral valve prolapse, flail mitral valve, to determine the mechanism of mitral regurgitation or to evaluate in more detail the mitral stenosis (Figure 8, 9) (8).

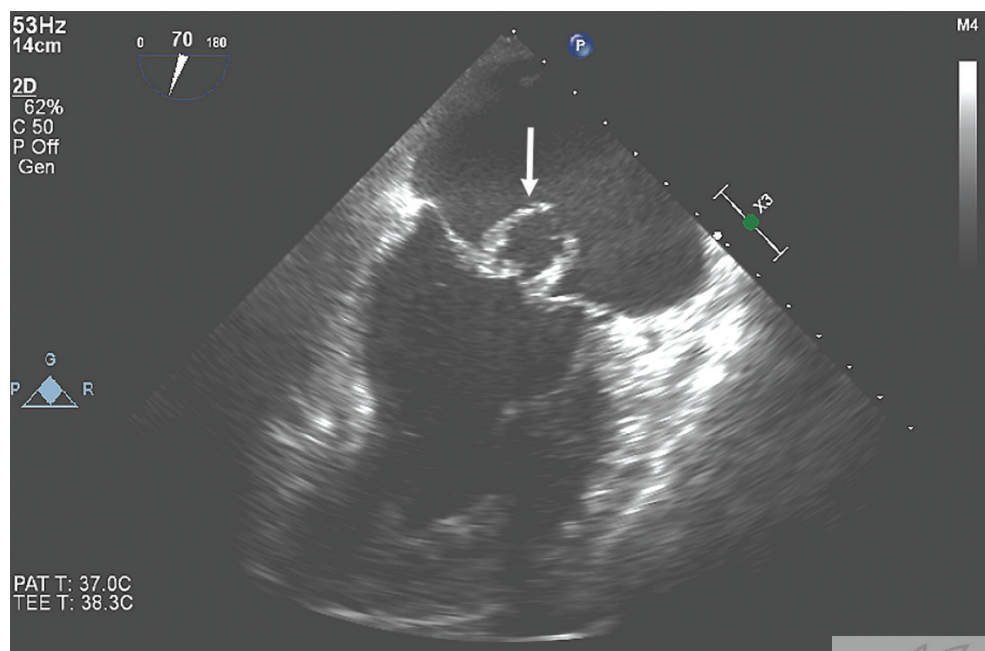


Figure 8. In TEE two-chamber view flail mitral leaflet is seen.

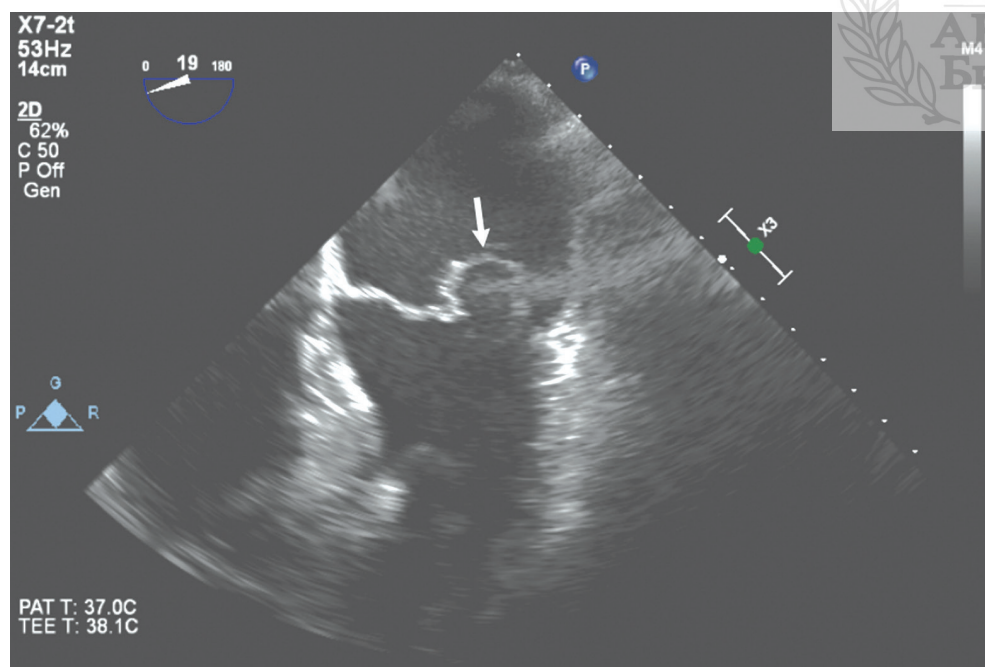


Figure 9. In TEE four-chamber view the mitral valve prolapse is seen.

Three-dimensional echocardiography

Three-dimensional echocardiography upgrades classical two-dimensional echocardiography. It gives “en face” view of the mitral valve. The valve is visualized either from left atrium or left ventricle. The view of the mitral valve from the left atrium (“surgeon’s view”) facilitates communication with the surgeons since the view is the same as in the operating theatre (9, 10).

To visualize the mitral valve “3D ZOOM” mode is used (Figure 10). For evaluation of subvalvular apparatus and surrounding structures “full volume 3D” is used. Image acquisition is made during breath-hold to avoid stitching artefacts. Colour Doppler can also be used (9, 10).

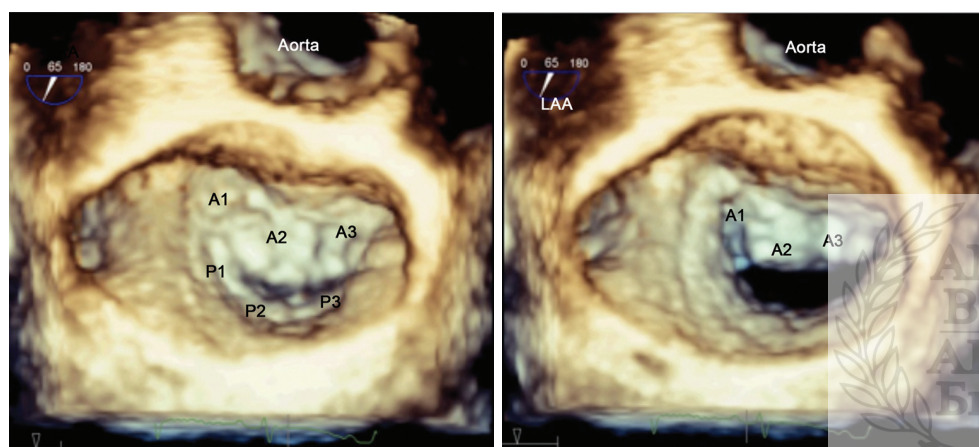


Figure 10. Three-dimensional TEE of closed (left) and open (right) mitral valve with its scallops in a ZOOM mode from the left atrium in a “surgeon’s view”. LAA – left atrial appendage

Mitral valve disease

In the Western countries, mitral valve disease is the second most common valvular heart disease after aortic valve disease (11). Disease of the mitral valve can result in mitral valve regurgitation, stenosis or combined lesion (7).

Mitral stenosis

Mitral stenosis is caused by rheumatic heart disease in more than 90% of cases. Other causes like mitral annular calcification, infective endocarditis, carcinoid heart disease, or others are rare and usually do not progress to severe stenosis. Nowadays, in the Western countries mitral stenosis is rare (11-13).

Commissural fusion is the most characteristic feature of rheumatic heart disease. It results in doming of the leaflets in diastole (hockey-stick appearance of the anterior leaflet), which is best seen in parasternal long-axis view (Figure 11). The doming results from the restricted mobility of the leaflet tips due to commissural fusion, while the base and mid-section of the leaflets remain relatively mobile. Subvalvular apparatus is also affected with thickening, shortening, fusion, fibrosis and calcification of the mitral chordae (7, 12, 13).

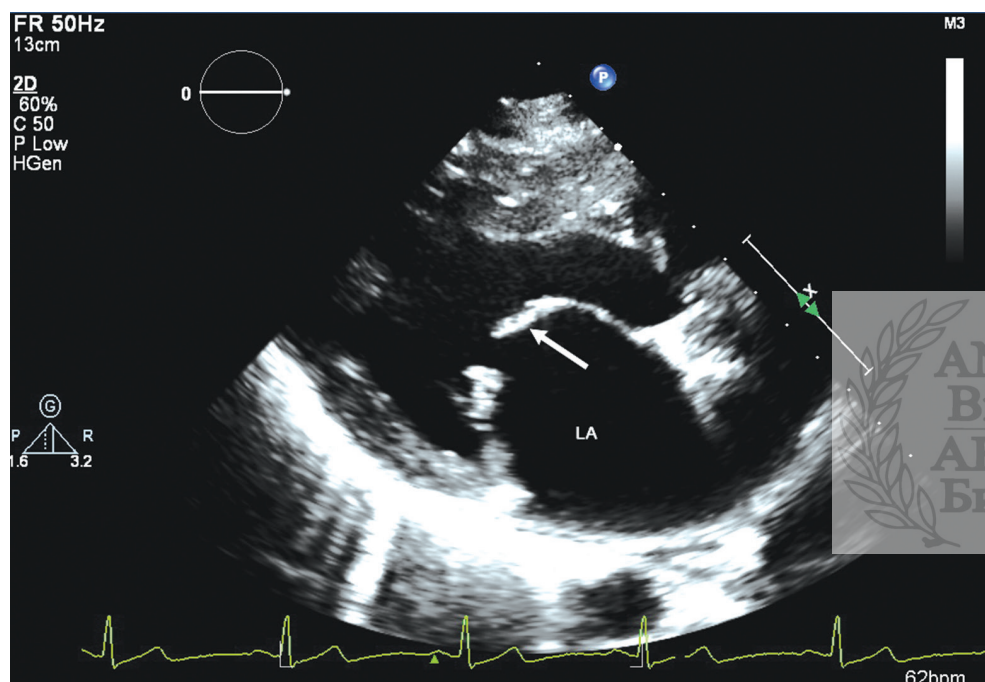


Figure 11. In the parasternal long-axis view of a patient with severe rheumatic heart disease the doming of the mitral valve is shown. Anterior mitral valve leaflet has hockey-stick appearance (arrow). The tips of the leaflets are thickened. Left atrium (LA) is enlarged.

Typical changes in mitral stenosis can usually be accurately assessed by two-dimensional TTE, if detailed visualization is necessary TEE or three-dimensional echocardiography can be performed. By colour-flow Doppler a turbulent flow across the mitral valve in diastole can be detected (7, 12, 13).

The severity of mitral stenosis is assessed by MVA and pressure gradients (7, 12, 13). Echocardiographic classification of mitral stenosis severity is presented in Table 1.

Table 1. Echocardiographic classification of mitral stenosis severity

	Mild	Moderate	Severe
MVA (cm ²)	>1.5	1.0–1.5	<1.0
Mean pressure gradient (mmHg) ^a	<5	5–10	>10
Systolic PAP (mmHg)	<30	30–50	>50

MVA—mitral valve area, PAP—pulmonary artery pressure; ^a—in sinus rhythm at heart rates 60–80 bpm

There are several methods to calculate MVA. By *planimetry* MVA can be directly traced in parasternal short-axis view (Figure 5). This is the method of reference; however it requires adequate image quality. The measurement should be done at mid-diastole at the tips of the leaflets. In atrial fibrillation, average of 5 consecutive beats should be used (7, 12, 13).

MVA can be calculated from by *pressure half-time (PHT) method* with the formula: $MVA = 220/PHT$. PHT is obtained by tracing the slope of the E-wave from the continuous wave Doppler signal in apical four-chamber view (Figure 7) (7, 13).

MVA can also be calculated by *continuity equation*, where stroke volume of the mitral valve equals stroke volume of the aortic valve:

$$MVA = CSA_{LVOT} \times VTI_{LVOT} / VTI_{MV}$$

(CSA – cross sectional area ($CSA = \pi \times r^2$), VTI – velocity time integral, LVOT – left ventricular outflow tract, MV – mitral valve, r – LVOT diameter)

Transmitral pressure gradient is obtained by tracing the continuous wave Doppler signal through the mitral valve in apical four-chamber view (Figure 12). Mean pressure gradient is determined using simplified Bernoulli equation (7, 12, 13).

When evaluating mitral stenosis, systolic pulmonary artery pressure from tricuspid regurgitation should also be estimated. In patient with significant mitral stenosis, left atrium is typically enlarged (7, 12, 13).

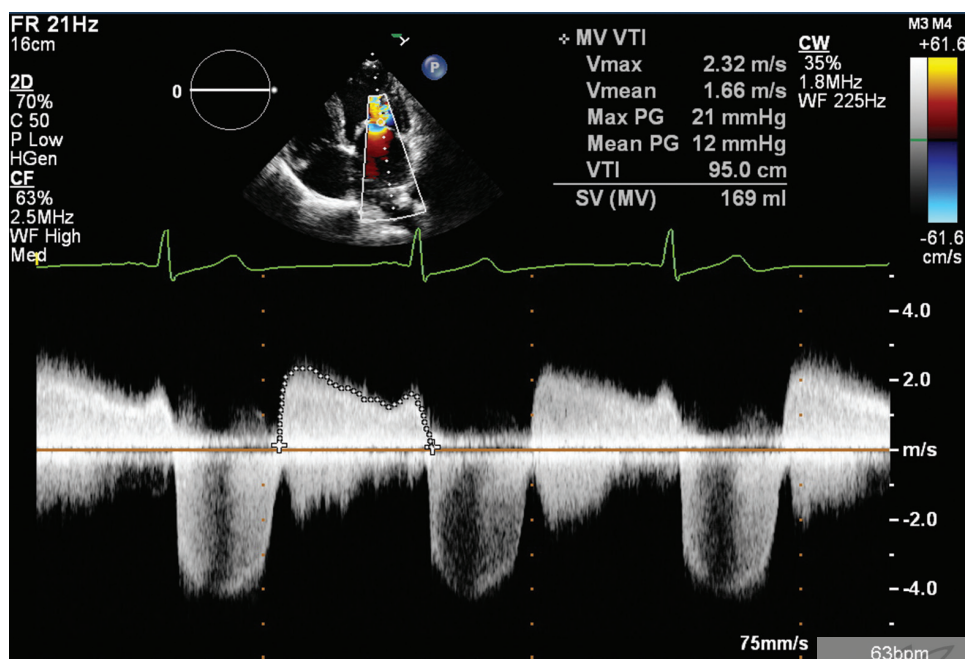


Figure 12. The assessment of mean pressure gradient in a patient with severe rheumatic mitral stenosis.

Mitral regurgitation

Mitral regurgitation is classified as primary (organic) and secondary (functional). Organic mitral regurgitation is caused by disease of the mitral valve. Functional mitral regurgitation is caused by geometrical changes of the subvalvular apparatus due to left ventricular remodelling while the valve itself is structurally normal (7, 10, 13).

Etiology of mitral regurgitation is diverse. Organic mitral regurgitation is most commonly caused by degenerative disease (myxomatous changes, Marfan, etc.), followed by rheumatic valve disease, ruptured papillary muscle due to myocardial infarction and infective endocarditis. Functional mitral regurgitation is caused by left ventricular dilatation and systolic dysfunction due to ischemic heart disease or dilated cardiomyopathy (7, 10, 13).

To determine the mechanism of mitral regurgitation Carpentier's classification is used (7):

Type I: normal leaflet motion with leaflet perforation (infective endocarditis) or annular dilatation

Type II: leaflet prolapse – leaflets are excessively mobile and the free edge of one or both leaflets is displaced beyond the mitral annular plane

Type III: restriction of leaflet motion; IIIa – restricted motion in diastole and systole due to shortening of chordae or leaflet thickening (as in rheumatic heart disease) and IIIb – restricted motion in systole (functional mitral regurgitation in ischemic or non-ischemic cardiomyopathy).

To grade the severity of mitral regurgitation several echocardiographic methods are used (Table 2) (11).

Table 2. Grading of the severity of organic mitral regurgitation

Parameters	Mild	Moderate	Severe
Qualitative			
MV morphology	Normal/abnormal	Normal/abnormal	Flail leaflet/ruptured PM
Colour-flow jet	Small, central	Intermediate	Very large central or eccentric adhering the LA wall
PISA	No or small	Intermediate	Large
CW signal of MR jet	Faint/parabolic	Dense/parabolic	Dense/triangular
Semi-quantitative			
VC width (mm)	<3	Intermediate	≥7
Pulmonary vein flow	Systolic dominance	Systolic blunting	Systolic flow reversal
Mitral inflow	A wave dominant	Variable	E wave dominant (>1.5 cm/s)
VTI_{MV}/VTI_{AV}	<1	Intermediate	>1.4
Quantitative			
EROA (mm ²)	<20	20–29; 30–39 [*]	≥40
RVol (ml)	<30	30–44; 45–59 ^{**}	≥60

* plus LV and LA size and systolic pulmonary artery pressure; PM – papillary muscle, MV – mitral valve, AV – aortic valve, CW – continuous wave, EROA – effective regurgitant orifice area, RVol – regurgitant volume, VC – vena contracta, MR – mitral regurgitation, VTI – velocity time integral, ^{*} – moderate regurgitation is classified to mild-moderate and moderate-severe.

For ischemic mitral regurgitation EROA > 20 mm² and RVol > 30 ml is considered significant.

The initial screening for mitral regurgitation is done by colour-flow Doppler (Figure 13). The method has many limitation and is not recommended for severity quantification. If the jet is central and its area <20% of left atrial area, the regurgitation is considered mild (7, 11).

The intensity of continuous-wave Doppler signal of mitral regurgitation is related to mitral regurgitation severity (Figure 7). In severe regurgitation the signal is dense and has a full envelope (7, 11).

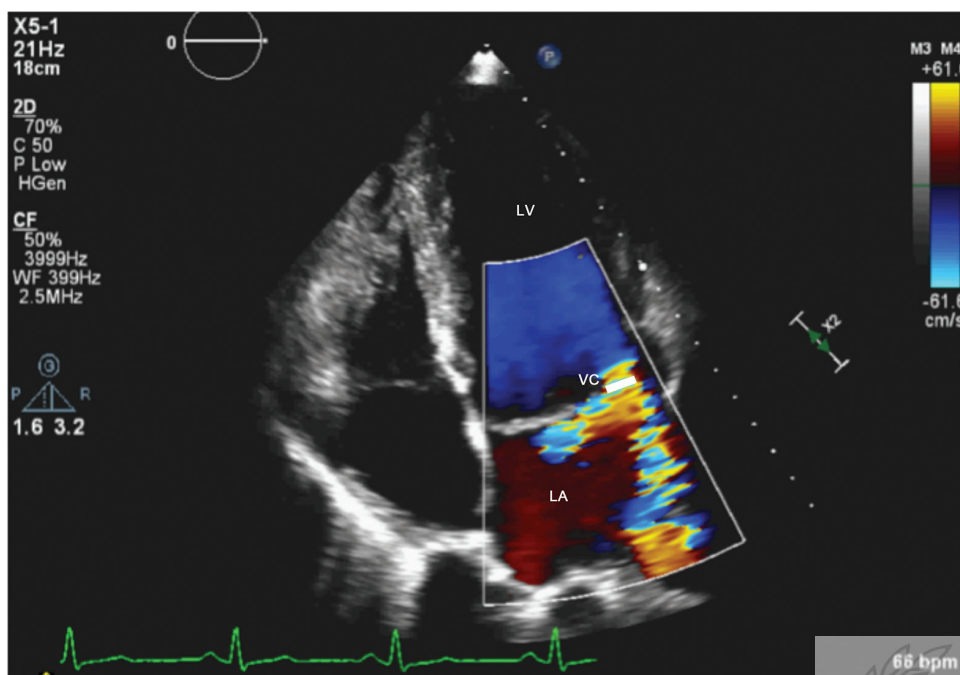


Figure 13. In apical four-chamber view colour-flow Doppler of the mitral regurgitation is seen. The regurgitant jets extends to the lateral wall of the left atrium (LA). VC – vena contracta, LV – left ventricle

The size of vena contracta, the narrowest portion of the regurgitant jet downstream from the regurgitant orifice, is the semi-quantitative measure of mitral regurgitation severity (Figure 13). It is recommended to measure it in two orthogonal planes (7, 11).

PISA (proximal isovelocity surface area) is the most recommended quantitative method to evaluate mitral regurgitation in central jets (Figure 14). Regurgitant volume and orifice area are derived from PISA. It is optimally measured in an apical four-chamber view, using narrow sector, minimal depth and zoom mode. The Nyquist limit should be set at 20 to 40 cm/s. With additional measurement of maximal velocity and velocity time integral of the regurgitant jet, effective regurgitant orifice area (EROA) and regurgitant volume are calculated (7, 11):

$$\text{EROA (cm}^2\text{)} = \text{PISA} \times v_a / v_{\text{max MR}}$$

$$\text{RVol (ml)} = \text{EROA} \times \text{VTI}_{\text{MR}}$$

(v_a – aliasing velocity, $v_{\text{max MR}}$ – maximal velocity of mitral regurgitation, Rvol – regurgitant volume, VTI_{MR} – velocity time integral of mitral regurgitation; $\text{PISA} = 2 \pi r^2$)

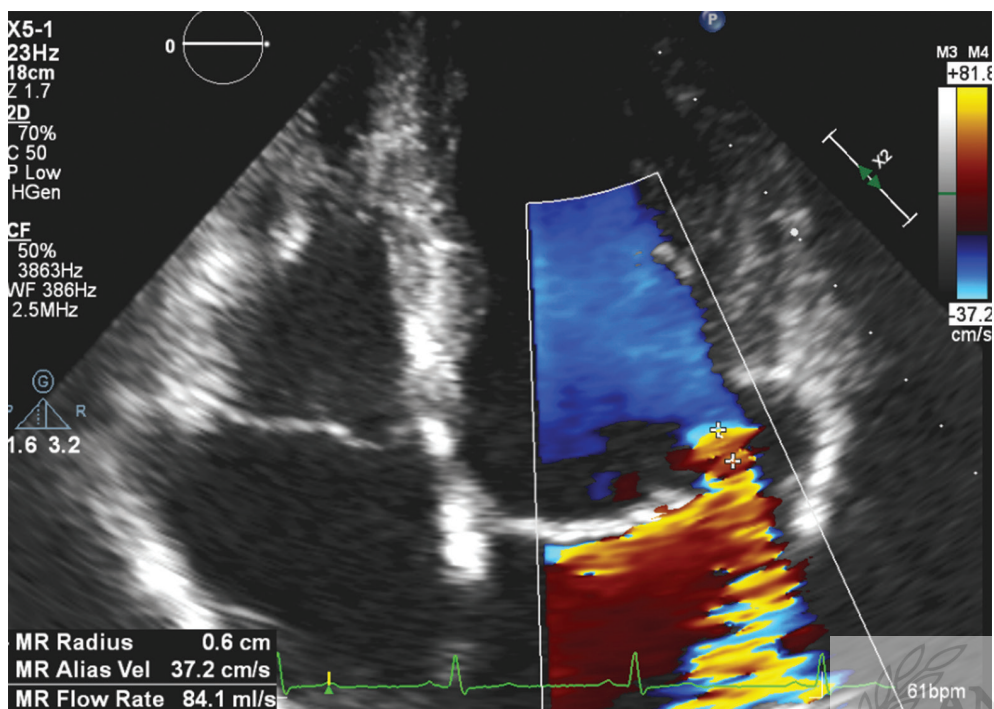


Figure 14. The measurement of PISA radius of the mitral regurgitation.

For complete assessment of the mitral regurgitation, size of left atrium and ventricle, left ventricular function and systolic pulmonary artery pressure must be evaluated (7, 11).

In conclusion, echocardiography is a key imaging modality in assessment of the mitral valve. With different techniques, morphology and function of the mitral valve can be reliably assessed. Novel modalities, like three-dimensional echocardiography, are especially useful when planning surgical correction.

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EHOKARDIOGRAFIJA MITRALNOG ZALISKA



Sažetak

Mitralni zalistak je složena anatomska i funkcionalna struktura, sastavljena od mitralnih listića, mitralnog prstena, srčanih niti zaliska, papilarnih mišića i susjednog miokarda. Normalna funkcija svih dijelova aparata mitralnog zaliska je od suštinskog značaja za normalnu funkciju mitralnog zaliska. Različite bolesti i sindromi mogu da izazovu disfunkciju mitralnog zaliska, odnosno mitralnu regurgitaciju i mitralnu stenozu. Ehokardiografija je ključni dijagnostički postupak za pregled mitralnog zaliska. Transtorakalna ehokardiografija je osnovna pretraga u procjeni mitralnog zaliska. Kada je potrebna detaljna evaluacija mitralnog zaliska preporučuje se transezofagealna ehokardiografija zbog prednosti bolje rezolucije i dodatnih pogleda. Dvodimenzionalna ehokardiografija je korisna u procjeni morfologije mitralnog zaliska, veličine srca i funkcije. Trodimenzionalna ehokardiografija je posebno korisna prije hirurških zahvata, jer daje bolji pogled na složenu strukturu mitralnog zaliska iz “perspektive hirurga”. Za otkrivanje moguće disfunkcije mitralnog zaliska koristi se kolor-dopler ehokardiografija. Za pravilnu procjenu stupnja regurgitacije mitralnog zaliska i stenoze, obavezna je pulsna i kontinuirana dopler ehokardiografija. Pregled mitralnog zaliska zahtijeva temeljitu ehokardiografsku istragu s različitim ehokardiografskim modalitetima, uz upotrebu novih ehokardiografskih metoda, kao što je trodimenzionalna ehokardiografija.

Ključne riječi: ehokardiografija, mitralni zalistak, mitralna regurgitacija, mitralna stenoza

AN OVERVIEW OF THE TRENDS OF CARDIOVASCULAR DISEASES IN BIH

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Abstract

Aim: The aim of this paper is to assess the available data sources on the trends of cardiovascular diseases (CVDs) and related risk factors in Bosnia and Herzegovina (BiH), in comparison with data from some of the neighbouring countries and the European Region average of the World Health Organization (WHO). **Background:** Mortality and morbidity from cardiovascular diseases in BiH are influenced by interaction of different socio-economic factors, metabolic and behavioural risk factors. **Methods:** Analysis of trends of CVDs mortality in BiH in the 2005-2014 period, with use of available data from the Agency for Statistics of BiH, entity Institutes for Public Health and the results of the population surveys conducted and analysed for BiH. **Comparison of CVD mortality trends and risk factor exposure in BiH with the recent data for CVD trends in neighbouring countries and WHO average for the European Region.** **Results:** The analysis showed that more than half of the population in BiH is dying from CVDs, while hypertension, overweight/obesity, lack of physical activity, alcohol and tobacco consumption contribute as main risk factors. CVD mortality and risk factor exposure are above the average of neighbouring countries and the WHO average for the European region. **Conclusion:** Emerging trends in morbidity and mortality from cardiovascular diseases are one of the major public health challenges in BiH. Preventive oriented health services, mainly at primary health care, should be supported by health promotion interventions directed towards whole population and groups under risk.

Key words: cardiovascular diseases, risk factors, Bosnia and Herzegovina

Introduction

Noncommunicable diseases (NCDs) with particular overview on the CVDs as strategic public health priority are underlined by WHO in the Health 2020 policy framework, Global Action Plan for prevention and control of NCDs 2013-2020 and furthermore in the UN Sustainable Development Goals 2015-2030 (1-4).

Noncommunicable diseases (NCDs) remain a major public health challenge all over the globe, with dominant role of cardiovascular diseases (CVDs), cancer, diabetes and chronic respiratory diseases, responsible for the largest share of diseases burden, premature deaths and disability (5).

The European Region of World Health Organization (WHO) has the highest burden of noncommunicable diseases worldwide, while cardiovascular diseases and cancer cause almost three quarters of mortality in the Region. Reinforcing the evidence that at least 80% of all NCDs and CVDs are preventable, cross-country surveys show that alcohol consumption, smoking, overweight and obesity are leading CVD risk factors responsible for premature mortality in most of the member States of the WHO European region (5).

Over the last two decades, Bosnia and Herzegovina (BiH) has gone through numerous and complex changes in demographic, socio-economic, political, cultural and environmental determinants.

Similarly to other countries in the Region, BiH is faced with globalization and urbanization life trends, often associated with consumption of unhealthy diets that are high in energy, saturated fats, salt and sugar, overweightness, less physical activity, alcohol and tobacco consumption, all of which have serious implications on the health of population.

The objective evaluation of socio-economic and health consequences of cardiovascular disease trends in Bosnia and Herzegovina remains a challenge for public health because of the absence of a single registry for cardiovascular diseases in BiH.

Aim

The aim of this paper was to assess the trends of cardiovascular diseases (CVDs) and related risk factors in the population of Bosnia and Herzegovina, through the analysis of available national databases as well the results of population surveys recently implemented in Bosnia and Herzegovina. Furthermore, this paper is aimed to assess the trends of CVDs in BiH in comparison with neighbouring countries and WHO average for the European Region.

Methodology

As a part of comparative and descriptive assessment, the most recent data were used from Agency for Statistics of BiH, entity Institutes for Public Health, as well the results of recent population surveys in terms of health risks of population in BiH. In terms of international comparison, most recent CVDs data and leading risk factors are assessed for Croatia, Montenegro, Serbia, Slovenia, the Former Yugoslav Republic of Macedonia and the average of WHO European Region (6-9).

Results

Similarly to other countries, the trends of increasing morbidity and mortality from cardiovascular diseases in BiH are caused by interaction of different socio-economic factors, metabolic and behavioural risk factors.

Over the last two decades, demographic statistics showed a permanent trend of declining birth-rate and increasing mortality in BiH. Birth-rate in BiH has significantly decreased, from 12.8‰ in 1996 to 7.9‰ in 2014, while mortality increased from 6.9‰ in 1996 to 7.9‰ in 2014, which resulted in negative natural growth in BiH, -0.3‰ in 2007 to -1.5‰ in 2014 (6).

Over the last 50 years, mortality from CVDs in BiH increased by about six times among the population of Bosnia and Herzegovina. According to data of the Agency for Statistics of BiH, total number of deaths caused by CVDs has increased from 2984 in 1965 to 17858 in 2014. Furthermore, the analysis of CVD mortality in BiH for period 2005-2014 showed a persistent rising trend in CVD mortality, from 17.700 deaths in 2005 to 17930 deaths in 2014, with continuous trend of more women dying from circulatory diseases compared to men. In terms of total deaths, more than half of the BiH population (53.2%) are dying from cardiovascular diseases, among which the dominant diseases are strokes, cardiomyopathy, heart failure and acute myocardial infarction (Graph 1).

In terms of international comparison, the share of circulatory diseases of 53.2% in total deaths in BiH is above the average for neighbouring countries, and above the 45.3% average of the WHO European Region in 2013 (Graph 2).

Prevalence of raised blood pressure in adults in BiH is above the average of some of the neighbouring countries, and is above the average of WHO European Region. In 2014, prevalence of raised blood pressure in adults (18 years and over) in BiH was 28.4%, in comparison with 23.3% for the WHO European Region, and the trend is present in both sexes, with 30.9% in males

and 25.9% in females in BiH, compared to 27.1% in males and 19.7% in females in the WHO European Region (Graph 3).

Prevalence of population with fasting glucose > 7.0 mmol/l (18 years and over), in 2014 shows no significant cross country differences, with 10.4% in males and 8.8% in females in BiH, which is slightly above some neighbouring countries and the average of 9.0% in males and 7.6% in females of the WHO European Region (Graph 4).

Latest available data shows that alcohol consumption continues to be a public health challenge which contributes to CVD morbidity and mortality among the population of BiH. Recorded alcohol consumption per capita among the population of 15 years and older (in litres of pure alcohol) in BiH in 2010 was 4.6, compared to WHO European average of 8.8.

Also, the percentage of population with heavy episodic drinking in the past 30 days was 6.5% which is under the 16.2% average of the WHO European Region (Graph 5).

Tobacco is still the largest addiction disease in all sex and age population groups in BiH, with a significant influence on CVD morbidity and mortality and the health status of population in BiH.

Results of cross-country population surveys in 2013 show that current smoking prevalence in population 15 years and over in BiH is 39.2%, with 48.3% prevalence in males and 30.8% in females, which is significantly above the neighbouring countries and the average of WHO European Region with 28.3% in total, 37.7% in males and 20.1% in females (Graph 6).

Discussion

Trends of CVDs in BiH are included in the national morbidity and mortality statistical system, with lack of single registry for CVDs. Monitoring of exposure to CVD risk factors in BiH is covered by periodical population surveys, as significant evidence for evaluation of health related knowledge and behaviour of population as well the quality of health care.

Assessment of available data on CVDs confirmed that the proportion of all deaths due to circulatory diseases in BiH is above the average of neighbouring countries as well the WHO European Region average.

Prevalence of hypertension in BiH as a main CVD risk factor is above the average of neighbouring countries as well the WHO European Region average, in total population and females, while in males it is below average of the neighbouring countries and above the WHO European Region average.

Prevalence of population in BiH with fasting glucose > 7.0 mmol/l (18 years and over) is close to neighbouring countries and slightly under average of the WHO European Region.

Alcohol consumption seems to be not a significant CVD risk factor in BiH. Heavy episodic drinking of population (15 years and over) in past 30 days in 2010 was under the average of neighbouring countries and under the average of the WHO European Region.

Tobacco consumption is the largest risk factor for CVDs in BiH. Total smoking prevalence is above the WHO European Region average and all neighbouring countries except Serbia, while smoking prevalence in males in BiH is above all the neighbouring countries and average of the WHO European Region.

Conclusion

Emerging trends in morbidity and mortality from cardiovascular diseases are one of the major public health challenges in BiH, causing significant rates of premature deaths, disability and reduced ability to work, and increasing costs within the health and social care system.

CVDs prevention as a part of systematic monitoring of NCDs should include preventive services at all levels of health care. Metabolic and behaviour risk assessment in primary health care services is essential, through development of appropriate registry, monitoring system and diagnostic and therapeutic protocols for CVDs as a part of all levels of health care (10).

Preventively oriented health services should be supported by health promotion interventions directed towards whole population, aimed to increase their knowledge and change their attitude and behaviour related to CVDs and health risk factors.

Furthermore, enforcement of legislative measures such as restrictions of smoking and exposure to second-hand smoking through increases in tobacco prices, health warnings, smoke-free environments, and a complete ban on all forms of tobacco promotion are advised.

Reduction of the harmful use of alcohol should be supported through increases in alcohol taxes, enforcing advertising bans and restricted access to retailed alcohol.

Finally, promotion of healthier diets through food pricing, labelling and marketing controls and daily physical activity, may significantly prevent

premature deaths, morbidity and disability due to cardiovascular diseases of population in BiH (11, 12).

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PREGLED TRENDOVA KARDIOVASKULARNIH BOLESTI U BiH

Sažetak

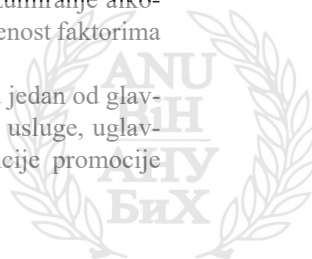
Cilj: Cilj ovog rada je procijeniti dostupne izvore podataka o trendovima kardiovaskularnih bolesti (KVB) i s njima povezanih faktora rizika u Bosni i Hercegovini, u poređenju s nekim od susjednih država i prosjekom Evropske regije Svjetske zdravstvene organizacije (SZO). **Pozadina:** Mortalitet i morbiditet od kardiovaskularnih bolesti u BiH uzrokovani su interakcijom različitih socio-ekonomskih faktora, metaboličkih i ponašajnih faktora rizika. **Metode:** Analiza stopa smrtnosti od KVB-a u BiH u periodu 2005–2014, uz korištenje dostupnih podataka iz Agencije za statistiku Bosne i Hercegovine, entitetskih zavoda za javno zdravstvo i rezultata istraživanja stanovništva koja su provedena i analizirana za BiH.

Poređenje trendova smrtnosti od KVB-a i izloženosti faktorima rizika u BiH s najnovijim podacima za KVB trendove u susjednim zemljama i prosjeku SZO za regiju Evrope.

Rezultati: Analiza je pokazala da više od polovine stanovništva u BiH umire od KVB-a, dok hipertenzija, višak kilograma / gojaznost, nedostatak fizičke aktivnosti, konzumiranje alkohola i duhana doprinose kao glavni faktori rizika. Mortalitet od KVB-a i izloženost faktorima rizika iznad su prosjeka susjednih zemalja i prosjeka SZO za Evropu.

Zaključak: Trendovi morbiditeta i mortaliteta od kardiovaskularnih bolesti su jedan od glavnih izazova za javno zdravstvo u BiH. Preventivno orijentisane zdravstvene usluge, uglavnom u primarnoj zdravstvenoj zaštiti, trebaju biti podržane kroz intervencije promocije zdravlja, usmjerene na cjelokupno stanovništvo i rizične grupe.

Ključne riječi: kardiovaskularne bolesti, faktori rizika, Bosna i Hercegovina



CIRCULATORY SYSTEM DISEASES IN SARAJEVO CANTON

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Abstract

Noncommunicable diseases, including diseases of the circulatory system, are very widespread in the population and represent a mass phenomenon in which the etiologic factors are not biological or infectious factors, they have a lengthy course and usually last a lifetime, causing serious consequences for human health. The main risk factors for the development of noncommunicable diseases, except genetic predisposition, are conditioned by habits and lifestyle, and can be significantly reduced by application of effective measures and interventions for prevention and control of these diseases. The diseases of the circulatory system have a major public health importance as the leading causes of mortality and the leading diseases in the world, especially in developed countries, but also in developing countries.

The objective of this paper is to present the prevalence and trends of diseases of the circulatory system in the morbidity and mortality of the population of Sarajevo Canton. The paper uses retrospective descriptive statistical methods, such as data on morbidity registered in primary health care in the Sarajevo Canton and mortality data of the Institute for Statistics of Federation of BiH. The results show that hypertensive disease, apart from acute upper respiratory infections, is the leading disease in morbidity of the population of Sarajevo Canton (10.95%), and that the diseases of the circulatory system are the leading cause of death of the population of Sarajevo Canton (41.69%). More women die of these diseases (53.78%) in relation to men (46.22%), but in the age group below 65 years of age more men (69.71%) die from circulatory diseases in relation to women (30.29%). The leading causes of death for women in the Sarajevo Canton among diseases of the circulatory system are stroke/cerebral infarction and chronic ischemic heart disease, while among men these are stroke/cerebral infarction and acute myocardial infarction.

Key words: noncommunicable diseases, diseases of the circulatory system, the leading disease, the leading cause of death

Introduction

Chronic mass noncommunicable diseases, including circulatory system disease, are widely spread in population and represent a mass phenomenon where etiological factors are not biological; they have extended duration and usually last for life, causing serious health consequences. Characterized by co-morbidity, they cause high treatment costs because they require specialist and subspecialist work, as well as usage of expensive and highly sophisticated medical equipment (1). Apart from this, chronic mass non-communicable diseases are leading causes of death, not only in Bosnia and Herzegovina, but also in the world, especially in developed countries, but in developing countries as well.

Main risk factors for occurrence and development of chronic mass non-communicable diseases are caused by habits and lifestyle i.e. smoking, physical inactivity, alcohol, improper diet, as well as exposure to stress (2), which, as a consequence, leads to development of biological risk factors (high blood pressure, overweight and obesity, high cholesterol and high blood sugar), which, with genetic predisposition, leads to creation and development of chronic mass non-communicable diseases (3).

Interest for chronic mass non-communicable diseases accrued, not only because of growing trend of these diseases, but also because of their negative impact on economy and development, so the World Economic Forum marked chronic mass non-communicable diseases as one of the key risks for world economy, not only because high treatment costs, but also because of low productivity caused by premature death, invalidity and absence from work (sick leave) because of these diseases.

Among chronic mass non-communicable diseases special place and public health importance belongs to circulatory system diseases, registered as leading causes of death and leading diseases in Sarajevo Canton (4).

Paper objective

Objective of this paper is to show representation and trends of circulatory system diseases in morbidity and mortality of Sarajevo Canton's population.

Methods

Paper uses retrospective and descriptive statistical method, and among data used is: morbidity data registered in primary health care in the Sarajevo Canton area and mortality data from Institute for Statistic of FBiH.

Results

Among leading diseases of Sarajevo Canton's population in 2015, in the second place are hypertensive diseases with index structure of 10.95% and morbidity rate of 1.274,74 per 10.000 inhabitants. Hypertensive diseases are registered in the first place among leading diseases in 19-64 age group with an index structure of 16.26% and in the age group of 65 and above with an index structure of 21.91%.

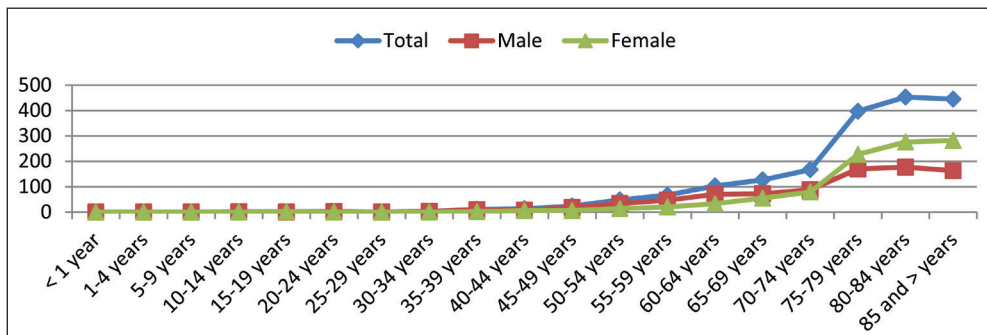
Table 1: Morbidity of Sarajevo Canton population from circulatory diseases in 2015, review by age groups

Disease name by X MKB	Sarajevo Canton's population					
	Total		19-64 age		65 > age	
	Rank	Index structure	Rank	Index structure	Rank	Index structure
Hypertensive diseases (I ₁₀ -I ₁₅)	2	10.95%	1	16.26%	1	21.91%

Also, among ten leading chronic mass non-communicable diseases in Sarajevo Canton, in the first place are hypertensive diseases, then other ischemic heart diseases in the fifth place and other circulatory diseases in the eight place (5).

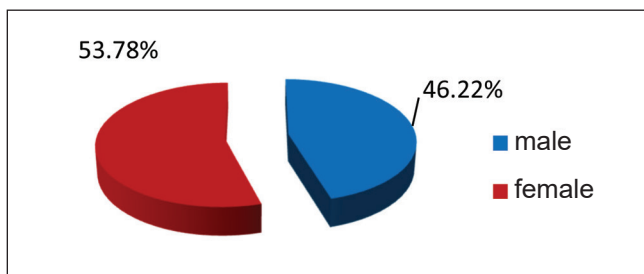
Leading causes of death of Sarajevo Canton's population in 2015, as in previous years of mortality monitoring, are circulatory system diseases with an index structure of 41.68% and mortality rate of 4.17%. Circulatory system diseases mostly threaten the life of age group of 65 and older (85.29%), while the population under 65 years of age died from circulatory system diseases in significantly lower percentage (14.71% in this age group died from circulatory system diseases).

Chart 1: Mortality of Sarajevo Canton's population from circulatory system diseases in 2015, overview per five-year groups and by gender



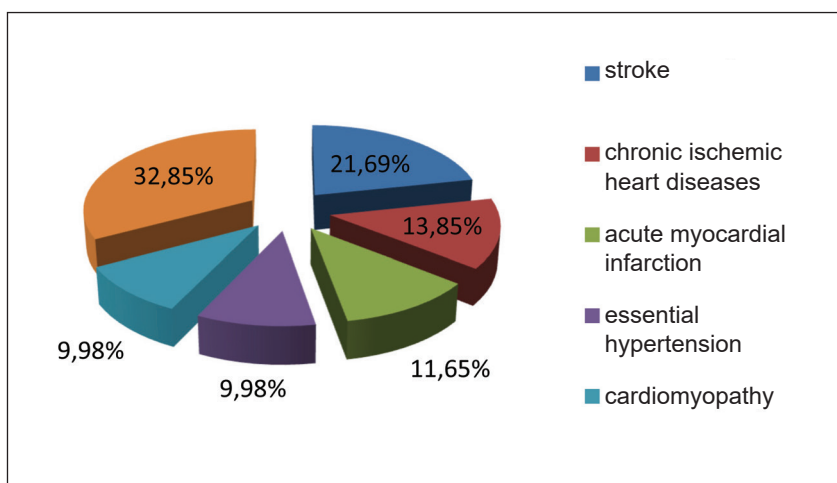
Female population in Sarajevo Canton died more from circulatory system diseases (53.78%) in comparison to men (46.22%). However, in the age group under 65, men died more (191 men or 69.71%) in comparison to women (83 women or 30.29%).

Chart 2: Gender structure of persons who died from circulatory system diseases in 2015



Leading death causes of Sarajevo Canton's population from circulatory system diseases in 2015 were: stroke, chronic ischemic heart diseases, acute myocardial infarction, essential hypertension and cardiomyopathy. Circulatory system diseases from which women mostly died are stroke and chronic ischemic heart diseases, while men mostly died from stroke and acute myocardial infarction (6).

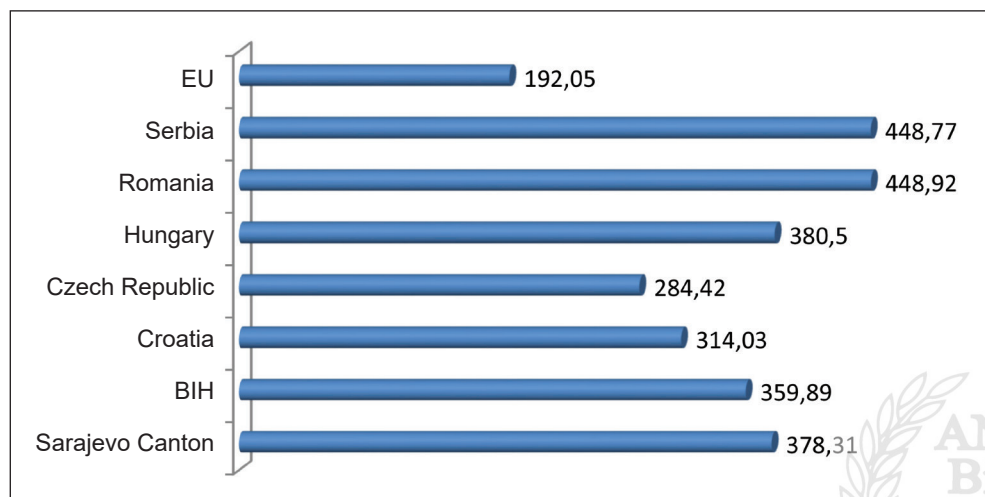
Chart 3: Structure of leading causes of death of Sarajevo Canton's inhabitants from circulatory system disease in 2015



According to latest available data from WHO database "Health for All" (WHO/EUROPE, EUROPEAN HFA Database) mortality rate from

circulatory system diseases for EU in 2014 was 192.05 per 100,000 inhabitants. According to the same source, mortality rate from circulatory system diseases in 2014 for Bosnia and Herzegovina was 378.31 per 100,000 inhabitants (7).

Chart 4: Mortality rate from circulatory system disease per 100,000 inhabitants in selected European countries, 2014



Discussion

Circulatory system diseases, as chronic mass noncommunicable diseases, hold special place and public health importance because they are registered as leading causes of death and as leading diseases with continuous growth trend, not only in the world, but also among the population of Sarajevo Canton.

In total morbidity structure of Sarajevo Canton, chronic mass non-communicable diseases makes more than 20.00% of all registered diseases, and hypertensive diseases are registered in second place among leading diseases in Sarajevo Canton's population. In Sarajevo Canton, mortality from chronic mass non-communicable diseases represents leading death causes, with participation of circulatory system diseases of 41.68%.

Circulatory diseases have negative impact on economic development as well, not only because treatment cost is rising, but also because productivity loss due to early deaths, invalidity and absence from work due to sick leaves because of these diseases.

According to Institute for Public Health of Sarajevo Canton, main risk factors for creation and development of noncommunicable diseases, including circulatory system diseases, are conditioned by habits and lifestyles, such as smoking, physical inactivity, excessive alcohol use, inappropriate diet and stress exposure.

It is known that for long term results, it is better to invest in prevention than in disease treatment, and that with preventive activities it is possible to significantly reduce circulatory system diseases (8). It is proven that there are efficient interventions to prevent and control these diseases, primarily by reducing the risk factors, early detection of disease and by timely treatment.

Recommendations

Integrated approach in prevention of circulatory diseases is necessary, especially on primary health and public health levels.

Preventive activities on public health level should include campaigns against smoking and obesity, with promotion of healthy lifestyle and conduction of early detection/screening of disease.

Preventive activities on primary health care level, in relation to family medicine teams, should include activities on determining total cardiovascular risk by which ten-year risk from creation or development of circulatory system disease is estimated.

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OBOLJENJA CIRKULATORNOG SISTEMA U KANTONU SARAJEVO

Sažetak

Hronične masovne nezarazne bolesti, uključujući i oboljenja cirkulatornog sistema, su veoma raširene u populaciji i predstavljaju masovnu pojavu kod kojih etiološki faktori nisu biološki faktori, imaju dugotrajan tok i obično traju doživotno, izazivajući ozbiljne posljedice po zdravlje ljudi. Glavni faktori rizika za nastanak i razvoj hroničnih masovnih nezaraznih bolesti, pored genetske predispozicije, su uslovljeni navikama i stilom života, koji se mogu značajno reducirati primjenom efikasnih mjera i intervencija za prevenciju i kontrolu ovih oboljenja. Oboljenja cirkulatornog sistema imaju veliki javnozdravstveni značaj kao vodeći uzroci mortaliteta i vodeća oboljenja u svijetu, naročito u razvijenim zemljama, ali i u zemljama u razvoju.

Cilj ovog rada je prikazati zastupljenost i trendove kretanja oboljenja cirkulatornog sistema u morbiditetu i mortalitetu stanovništva Kantona Sarajevo. U radu je korištena retrospektivna deskriptivno-statistička metoda, a od podataka korišteni su: podaci o morbiditetu registrovani u primarnoj zdravstvenoj zaštiti na području Kantona Sarajevo i podaci o mortalitetu Federalnog zavoda za statistiku.

Rezultati pokazuju da su hipertenzivna oboljenja, pored oboljenja gornjih respiratornih puteva, vodeća oboljenja u morbiditetu stanovništva Kantona Sarajevo (10,95%), a da su oboljenja cirkulatornog sistema vodeći uzrok smrtnosti stanovništva Kantona Sarajevo (41,69%). Od ovih oboljenja žene više umiru (53,78%) u odnosu na muškarce (46,22%), ali u dobnoj skupni ispod 65 godina života umire više muškaraca (69,71%) od oboljenja cirkulatornog sistema u odnosu na žene (30,29%). Vodeći uzroci smrtnosti žena u Kantonu Sarajevo od oboljenja cirkulatornog sistema su moždani udar i hronična ishemična oboljenja srca, dok su kod muškaraca moždani udar i akutni infarkt miokarda.

Ključne riječi: hronične masovne nezarazne bolesti, oboljenja cirkulatornog sistema, vodeća oboljenja, vodeći uzroci smrtnosti



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