

THE SIZE OF THE LEFT ATRIUM IN PATIENTS WITH PAROXYSMAL ATRIAL FIBRILLATION AND ARTERIAL HYPERTENSION

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Atrial fibrillation is common supraventricular arrhythmia associated with arterial hypertension. The mechanisms that affect arterial hypertension causing atrial fibrillation are various and include: left ventricular hypertrophy, myocardial ischemia, left ventricle impaired function and left atrial enlargement.

The aim of the study was to determine the size of the left atrium in paroxysmal atrial fibrillation and arterial hypertension patients.

The investigation comprised a group of 117 paroxysmal atrial fibrillation patients. Of this number, 87 patients had arterial hypertension, and 30 patients were without arterial hypertension and other disorders and diseases (LONE).

The arterial hypertension patients were divided into 3 groups: the arterial hypertension patients, those without left ventricular hypertrophy and without ischemia; the arterial hypertension patients, those with left ventricular hypertrophy but without ischemia and the arterial hypertension patients with concomitant ischemic heart disease. The patients without arterial hypertension and other disorders and diseases (LONE) represented the fourth group.

The size of the left atrium was recorded by echocardiography. The highest average left atrium size value was found in the arterial hypertension patients, those with concomitant ischemic heart disease and it was 43,39 mm; in the arterial hypertension patients with left ventricular hypertrophy but without ischemia, it amounted to 39,85 mm. The average left atrium size value in arterial hypertension patients, those without left ventricular hypertrophy and without ischemia was 37,24 mm, and the lowest average left atrium size value was documented in the patients without arterial hypertension (LONE) and it was 34,61 mm.

Of this number, 80.95% of arterial hypertension patients, those with concomitant ischemic heart disease, as well as 45.45% of arterial hypertension patients with left ventricular hypertrophy and without ischemia had the enlarged left atrium. The patients without arterial hypertension (LONE) did not have the enlarged left atrium.

It may be concluded that the left atrium size in the arterial hypertension patients in the presence of left ventricular hypertrophy, and especially with the concomitant ischemic heart disease, represents a significant prerequisite for paroxysmal atrial fibrillation genesis. The highest percentage of the patients with enlarged left atrium in the group with arterial hypertension and concomitant ischemic heart disease proves that the ischemic heart disease is the most common arrhythmic factor. Left ventricular hypertrophy immediately follows ischemic heart disease. *Acta Medica Medianae 2008;47(3):9-14.*

Key words: arterial hypertension, left ventricular hypertrophy, left atrial enlargement, myocardial ischemia, paroxysmal atrial fibrillation

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Introduction

Atrial fibrillation is the most common sustained cardiac arrhythmia which is characterized by the uncoordinated atrial activity with the consequent loss of atrial mechanical function (1).

In the wide spectrum of etiologic factors, arterial hypertension and ischemic heart disease play the leading role (2).

Arterial hypertension can lead to atrial fibrillation due to the left atrial dilatation, and/or increased inatrial pressure which comes out of decreased left ventricular compliance, and ischemia, especially in hypertensive subjects with left ventricular hypertrophy (3).

Arterial hypertension is an important risk factor for ischemic heart disease. Left ventricular hypertrophy is an independent risk factor in ischemic heart disease, while myocardial ischemia is the most common arrhythmic factor (4,5).

Aims

The aim of the study was to determine the left atrium size in the paroxysmal atrial fibrillation and arterial hypertension patients. The influences of left ventricular hypertrophy as well as concomitant ischemic heart disease on the left atrium size in arterial hypertension patients were taken into consideration, as well as the significance of the left atrium size in the genesis of paroxysmal atrial fibrillation.

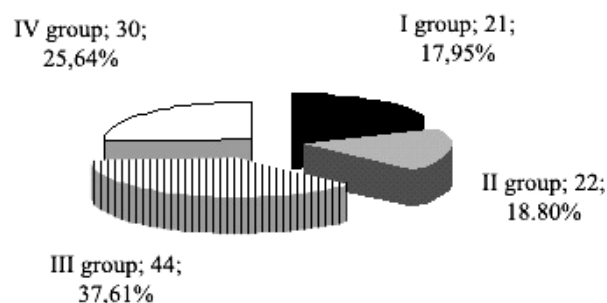
Material and methods

The research was carried out on a group of 117 paroxysmal atrial fibrillation patients. Out of this number, 87 patients had arterial hypertension (74,36%) and 30 patients were without arterial hypertension and other disorders and diseases (LONE) (25,64%).

The group of arterial hypertension patients concerning either the presence of left ventricular hypertrophy and myocardial ischemia or their absence was divided into 3 subgroups:

- I. The arterial hypertension patients, those without left ventricular hypertrophy and without ischemia - 21 (17,95%) patients.
- II. The arterial hypertension patients, those with left ventricular hypertrophy but without ischemia - 22 (18,80%) patients.
- III. The arterial hypertension patients with concomitant ischemic heart disease - 44 (37,61%) patients.

The patients without arterial hypertension and other disorders and diseases (LONE) represented the IV group 30 (25,64%) (Graph 1).



Graph 1. Structure of the tested groups of patients with paroxysmal atrial fibrillation

Echocardiography was performed in all patients thanks to HP device 2500 Sonos.

The presence of left ventricular hypertrophy was estimated using the ultrasound scanner method. The criterion used for the left ventricular hypertrophy was the thickness of the intra-ventricular septum that was measured using the M-mode technique of 11 mm or even more.

The presence of myocardial ischemia was estimated using the exercise test on ergobicycle.

The patients with positive exercise test had a stable form of angina pectoris.

The criterion for the positive exercise test was the depression of ST segment of horizontal or descending type that was either equal to or greater than 1 mm (0,1 mV) lasting for at least 0.08 s.

The left atrium size was measured using the M-mode ultrasound scanner technique with the longitudinal parasternal section according to ASE association references.

The criterion for the left atrium enlargement was the left atrium size greater than 40 mm.

The analyzed group was the group with the paroxysmal atrial fibrillation and without arterial hypertension.

Ischemic heart disease in our research included steady angina pectoris, unsteady angina pectoris and recovered myocardial infarction.

The research was carried out in the Emergency Medical Service, Health Centre Leskovac.

Results

The research was carried out on a group of 117 paroxysmal atrial fibrillation patients (Graph 1).

The average age of the arterial hypertension patients was 60,61 ± 9,81 years.

The average age of the patients with arterial hypertension among groups was the following: the first group - 58,62±11,70 years; the second group - 57,82±11,18 years; the third group - 62,95±7,49 years.

The average age of the patients without arterial hypertension (LONE) was 50,53 ± 11,92 years.

The arterial hypertension patients were significantly older than the patients without arterial hypertension (LONE) ($p < 0,001$).

Using the Student's t-test for independent samples, a statistically significant difference between the third and the fourth group of patients was established ($p < 0,001$).

In the group of arterial hypertension patients, 41 (47,13%) subjects were male with the average age of 58,88 ± 11,48 years, and 46 (52,87%) subjects were female with the average age of 62,15 ± 7,84 years.

In the group of patients without arterial hypertension (LONE), 20 (66,67%) subjects were males with the average age of 48,45 ± 12,31 years, and 10 (33,33%) subjects were females with the average age of 54,70 ± 10,41 years.

According to statistics, there was not a significant difference concerning the age of both sexes in these groups.

Table 1. Aaverage duration of arterial hypertension (the age) in the analyzed groups

Group	X	SD	N	CV	95%	CI
I	12,90 ^{b*}	8,91	21	69,05	8,85	16,96
II	8,05	5,92	22	73,53	5,42	10,67
III	14,52 ^{b***}	8,65	44	59,56	11,89	17,15

ANOVA: $F=4,70$, $p=0,0116$

^b - towards the second (II) group

* - $p < 0,05$, *** - $p < 0,001$

The average duration of arterial hypertension considering the age in the following groups of patients was the following: in the first group of patients with arterial hypertension and without left ventricular hypertrophy as well as without ischemia the duration was 12,90±8,91

teras; in the second group of patients with arterial hypertension, left ventricular hypertrophy but without ischemia it was $8,05 \pm 5,92$ years, and in the third group of patients with arterial hypertension and concomitant ischemic heart disease it was $14,52 \pm 8,65$ years (Table 1). Thus, statistically significant difference in arterial hypertension duration among groups was established ($p < 0,05$). This is certainly the consequence of significantly longer arterial hypertension duration considering statistics in the third and the first group compared with the second group of patients (Using the Student's t-test, $p < 0,01$; $p < 0,05$, respectively).

The arterial hypertension patients had the average left atrium size value of $40,95 \pm 5,07$ mm, which is considered to be statistically higher average value than in the patients without arterial hypertension (LONE) ($\chi^2 = 5,26$, $p < 0,001$) (Table 2).

Table 2. Left atrium size (in mm) in the tested groups of patients

Group	X	SD	N	CV	95%	CI
I	37.24 ^{d*}	3.87	21	10.40	35.48	39.00
II	39.85 ^{d***}	4.67	22	11.72	37.78	41.93
III	43.39 ^{b**,ad***}	4.53	42	10.43	41.98	44.80
IV	34.61	4.40	21	12.72	32.61	36.61

The Anova analysis: $F=21.30$. $p=0.0000$

^a - to I. ^b - to II. ^d - to IV group

* - $p < 0,05$. ** - $p < 0,01$. *** - $p < 0,001$

Comparing the groups one by one using the Student's t-test, it was established that the largest average left atrium size value was in the group III with arterial hypertension patients and concomitant ischemic heart disease (43,39 mm), and it was statistically higher compared with the II group of arterial hypertension patients, those with left ventricular hypertrophy and without ischemia (39,85 mm) ($p < 0,01$), and with the I group with arterial hypertension patients, those without left ventricular hypertrophy and without ischemia (37,24 mm) and IV group of the patients without arterial hypertension (LONE) (34,61 mm) ($p < 0,001$). Compared with the IV group of patients without arterial hypertension (LONE), which has the lowest average value of this parameter, both I group ($p < 0,01$) and II group of patients ($p < 0,001$) had statistically higher values (Table 2).

According to the ANOVA analysis statistics, it was shown that the medium values of the left atrium size differed significantly ($p < 0,001$). The coefficient of variation showed the homogeneity of all groups concerning this parameter (Table 2).

The enlarged left atrium was documented in 49 patients, which was over 40% (42,61%) of all patients, and that was 57,65% of arterial hypertension patients. Thanks to the Hi square test it was confirmed that the groups completely differed in the frequency of enlarged left atrium finding ($\chi^2=50,63$, $p < 0,001$) (Table 3).

While in the IV group of the patients without arterial hypertension (LONE) the left atrium enlargement was not detected, the same was detected, even in higher percentage, in the patients

of group III, those with arterial hyper-tension and concomitant ischemic heart disease (80,95%), which was statistically more significant compared with the II group with arterial hypertension, left ventricle hypertrophy and without ischemia (45,45%) ($p < 0,01$) and the group I with arterial hypertension but without left ventricular hypertrophy and without ischemia (23,81%) ($p < 0,001$) (Table 3).

Table 3. Enlarged left atrium in the tested groups of patients

Group	Enlarged left atrium		Without left atrium enlargement	
	N	%	N	%
I	5	23,81%	16	76,19%
II	10	45,45%	12	54,55%
III	34	80,95%	8	19,05%
IV	0	0,00%	30	100,00%
Total	49	42,61%	66	57,39%

The repetition of attacks was the most frequent in the patients from the third group, those with arterial hypertension and concomitant heart disease - 72,73%, which was, according to statistics, significantly higher when compared to the patients from group IV, those without arterial hypertension - 33,33% ($p < 0,01$) and group I with arterial hypertension but without left ventricular hypertrophy and without ischemia - 19,05% ($p < 0,001$). Fifty percent of the patients from the second group, those with arterial hypertension, left ventricular hypertrophy and without ischemia sustained repeated attacks (Table 4).

Table 4. Number and percentage of patients with repeated series of PAF in the course of the following year from the moment of the current attacks by groups

Group	N	%
I	4	19,05%
II	11	50,00%
III	32 ^{d**,a***}	72,73%
IV	10	33,33%
Total	57	48,72%

^a - to I, ^d - to IV group

** - $p < 0,01$, *** - $p < 0,001$

Discussion

In the past, atrial fibrillation was considered to be an insignificant condition, but now it is increasingly recognized that atrial fibrillation finding makes an independent contribution to mortality, morbidity and worsened life quality (6).

Atrial fibrillation is the most frequent, clinically important arrhythmia that approximately 1,0-1,5% of the world population suffer from, and thus it is anticipated that by 2050, some 15,9 millions of people in the USA will have certain problems with it (6).

These data stand for a kind of warning of the "epidemic time bomb" that the physicians of the future should await.

Atrial fibrillation is certainly the "epidemic" nowadays (6).

Due to many studies of the world population, arterial hypertension is the most common etiologic factor in the atrial fibrillation genesis (7).

In our research, out of 117 paroxysmal atrial fibrillation patients, 87(74,36%) patients with average age of $60,61 \pm 9,81$ years had arterial hypertension. Out of it, as well, 30 patients (LONE) (25,64%) with average age of $50,53 \pm 11,92$ years did not suffer from arterial hypertension. The results of the Euro Heart Survey studies on atrial fibrillation, which included 5,333 atrial fibrillation patients in 35 countries in Europe, with the objective to confirm fundamental clinical characteristics of atrial fibrillation patients and the adjustment of atrial fibrillation therapy to the valid recommendations, published for the first time in October in 2005, showed that arterial hypertension was the most frequently joined with atrial fibrillation, then heart failure and coronary disease (8).

Arterial hypertension is associated with the left atrium structural changes associated with atrial fibrillation. They include left atrium enlargement, the left atrium changes in mechanical function, the left atrium electrophysiological changes and the increase of the left atrium ectopic activity (9).

The left atrium enlargement is a significant phase in the progression from arterial hypertension to atrial fibrillation.

Our results point to the influence of arterial hypertension on the left atrium enlargement in paroxysmal atrial fibrillation patients.

Thanks to the Framingham Heart study, it was shown that the left atrium enlargement could be associated with the duration of hypertension and with the degree of systolic blood pressure in general population (10).

In our research, the statistically significant difference in the duration of arterial hypertension considering the age of patients with arterial hypertension and concomitant ischemic heart disease was established, as well as in the patients who had arterial hypertension but were without left ventricle hypertrophy and without ischemia compared to the group of patients with arterial hypertension, left ventricular hypertrophy but without ischemia.

Whether the left atrium size enlargement in arterial hypertension is a direct result of the arterial hypertension or a result of the underlying left ventricular hypertrophy and subsequent diastolic dysfunction is still not quite clear.

The left atrium size is significantly greater in arterial hypertension patients compared with the patients with normal blood pressure (11).

In our research, according to the statistics, arterial hypertension patients have significantly higher average value of the left atrium size compared with the patients without arterial hypertension (LONE).

The left atrium size also correlates with left ventricular hypertrophy and diastolic dysfunction (11).

The average left atrium size in the group of arterial hypertension patients, left ventricle hypertrophy and without ischemia is greater than the average left atrium size in the group with arterial hypertension but without left ventricular hypertrophy and without ischemia.

Our finding confirms the positive correlation between left ventricular hypertrophy and the left atrium size.

During diastole, except in the period of isovolumetric relaxation, the left atrium is exposed to the direct left ventricular pressure through the open mitral valve. Because of the left ventricular wall thickening in the patients with hypertensive heart disease, left ventricle's filling in diastole is worsened, and as a result of the blood flow from the left atrium to the left ventricle is worsened (11,12).

Taking into consideration that the left atrium has thin walls, it widens, its size becomes greater depending as well on the left atrium pressure increase. Thus, the left atrium enlargement is probably the result of the left atrium chronic high pressure, so that echocardiographic enlargement of the left atrium is an early sign of hypertensive heart disease (11).

This finding is supported by the presence of the enlarged left atrium in electrocardiograph and/ or echocardiography even before the development of the apparent left ventricular hypertrophy (11).

Some studies show that 21% of the hypertensive patients without echocardiographic proofs of the left ventricular hypertrophy had the enlarged left atrium over 4 cm (13).

Once the left ventricular hypertrophy has developed, which can be detected by the electrocardiograph, the prevalence of the left atrium size enlargement is high; 56% in female and 38% in male population (14).

The left atrium enlargement developed in this manner with decreased "left atrium transport function" may predispose arterial hypertension patients to develop atrial fibrillation, due to dispersion enlargement of effective refractory period of the left atrium (12).

Left ventricular hypertrophy detected by electrocardiograph or by echocardiography is a significant risk factor in atrial fibrillation.

In Framingham Heart group, the patients with left ventricular hypertrophy diagnosed by electrocardiograph had 3 to 3,8 times increased risk of atrial fibrillation development.

The risk of atrial fibrillation development also increases by 28% per every 4 mm thickening of the left ventricular wall measured by ultrasound scanner (9).

The ischemic heart disease, also associated with diastolic abnormalities and the increased filling pressures, leads to the left atrium enlargement, and as in hypertension and hypertensive heart disease, predisposes to atrial fibrillation (12).

The arterial hypertension patients with concomitant ischemic heart disease had the highest average left atrium size value which is statistically more than in the group of arterial hypertension patients, those with left ventricular hypertrophy but without ischemia, and in the groups of patients with arterial hypertension but without left ventricular hypertrophy and without

ischemia and the patients without arterial hypertension (LONE).

Our finding corresponds to the statement that ischemic heart disease contributes to the left atrium enlargement, and especially it does contribute more if it is concomitant with arterial hypertension, as it is in our research.

Myocardial ischemia is a significant complication of hypertensive heart disease, and it is the most common arrhythmic factor (5).

In our research, the greatest percentage of patients with the left atrium enlargement was found in the group of arterial hypertension patients with concomitant ischemic heart disease, which is statistically more than in the group of arterial hypertension patients, those with left ventricular hypertrophy but without ischemia, and the group of arterial hypertension patients without left ventricular hypertrophy and without ischemia.

Thus the finding proves that ischemic heart disease, concomitant with atrial hypertension, is the most common factor in the left atrium enlargement and atrial fibrillation genesis.

Thanks to the Framingham Heart study, it was shown that among 4.731 patients who were subjected to the basic ultrasound scanner, the risk of atrial fibrillation development increased up to 39% per every 5 millimetres of left ventricular size enlargement after some other risk factors were taken into consideration (9).

Our results are in accordance with the previous bibliography citations considering that the majority of repeated attacks were reported in the third group of patients, those with arterial hypertension and concomitant ischemic heart disease which had the highest average left atrium size value. That is statistically more significant when compared to the patients without arterial hypertension as well as with the patients with arterial hypertension but without left ventricular hypertrophy and without ischemia.

Besides arterial hypertension, left ventricular hypertrophy, ischemic heart disease, repeated atrial fibrillation attacks, the age of the patients could have an impact on the left atrium size. With advancing age and decreasing myocardial distension, as well as getting longer relaxation phase, the diastolic function becomes disturbed and that can cause the left atrium enlargement (15).

In our research, the oldest patients had the highest average left atrium size value. These were the patients with arterial hypertension and concomitant ischemic heart disease, and they were, statistically speaking, much older compared to the patients without arterial hypertension (LONE).

Conclusion

Our research of the paroxysmal atrial fibrillation patients resulted in the following changes:

1. The arterial hypertension patients with concomitant ischemic heart disease had the

highest average left atrium size value which is, according to statistics, significantly higher than in the arterial hypertension patients without left ventricular hypertrophy and without ischemia as in the patients without arterial hypertension (LONE) and the arterial hypertension patients, those with left ventricular hypertrophy but without ischemia. Thus, a significant influence of ischemic heart disease concomitant with arterial hypertension on the left atrium enlargement is emphasized.

2. The largest percentage of the patients with the enlarged left atrium is in the group of patients with arterial hypertension and concomitant ischemic heart disease, which is, according to statistics, significantly more than in the group of patients with arterial hypertension without left ventricular hypertrophy and without ischemia and in the group of patients with arterial hypertension with left ventricular hypertrophy and without ischemia, which confirms that ischemic heart disease is a significant arrhythmic factor in comorbidity with arterial hypertension.

3. The average left atrium size value in the arterial hypertension patients, those with left ventricular hypertrophy and without ischemia is, according to statistics, higher than in the arterial hypertension patients without left ventricular hypertrophy and without ischemia, and especially in the patients without arterial hypertension (LONE). Thus, the influence of the left ventricular hypertrophy on the left atrium size is particularly emphasized.

4. The frequency of the enlarged left atrium in the arterial hypertension patients, those with left ventricular hypertrophy and without ischemia is statistically higher compared with the arterial hypertension patients without left ventricular hypertrophy and without ischemia, and particularly in the patients without arterial hypertension (LONE), who did not have the enlarged left atrium. Thus, it is confirmed that left ventricular hypertrophy also stands for a significant arrhythmic factor.

5. The repetition of atrial fibrillation attacks was mostly present in the patients with arterial hypertension and concomitant ischemic heart disease (the highest average left atrium size value), which is statistically significantly higher compared to the patients without arterial hypertension (LONE) as well as compared to the patients with arterial hypertension but without left ventricular hypertrophy and without ischemia. The contribution and significance of repeated atrial fibrillation attacks on the left atrium enlargement was thus emphasized.

6. The average age of the patients with arterial hypertension and concomitant heart disease (the highest average left atrium size value) is statistically higher when compared to the patients without arterial hypertension (LONE). Therefore, it can be concluded that the age of the patients can also contribute to the left atrium enlargement.

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VELIČINA LEVE PRETKOMORE KOD BOLESNIKA SA PAROKSIZMALNOM ATRIJALNOM FIBRILACIJOM I ARTERIJSKOM HIPERTENZIJOM

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Atrijalna fibrilacija je česta supraventrikularna aritmija udružena sa arterijskom hipertenzijom. Mehanizmi kojim arterijska hipertenzija dovodi do nastanka atrijalne fibrilacije su različiti i uključuju hipertrofiju leve komore, ishemiju miokarda, pogoršanu funkciju leve komore i uvećanje leve pretkomore.

Cilj rada bio je utvrđivanje veličine leve pretkomore kod bolesnika sa paroksizmalnom atrijalnom fibrilacijom i arterijskom hipertenzijom.

Istraživanjem je obuhvaćena populacija od 117 ispitanika sa paroksizmalnom atrijalnom fibrilacijom. Arterijsku hipertenziju imalo je 87 ispitanika, a 30 ispitanika činila je grupa bez arterijske hipertenzije i bez drugih poremećaja i bolesti (LONE).

Ispitanici sa arterijskom hipertenzijom su podeljeni u tri grupe: ispitanici sa arterijskom hipertenzijom, bez hipertrofije leve komore i bez ishemije; ispitanici sa arterijskom hipertenzijom, hipertrofijom leve komore, bez ishemije; ispitanici sa arterijskom hipertenzijom i pridruženom ishemijskom bolešću srca. Ispitanici bez arterijske hipertenzije i bez drugih poremećaja i bolesti (LONE) predstavljaju četvrtu grupu.

Veličina leve pretkomore određivana je ehokardiografski. Najveća prosečna vrednost veličine leve pretkomore dobijena je kod ispitanika sa arterijskom hipertenzijom i pridruženom ishemijskom bolešću srca 43,39 mm, potom kod ispitanika sa arterijskom hipertenzijom, hipertrofijom leve komore i bez ishemije 39,85 mm. Prosečna vrednost veličine leve pretkomore kod ispitanika sa arterijskom hipertenzijom, bez hipertrofije leve komore i bez ishemije bila je 37,24 mm, dok su najmanju prosečnu vrednost veličine leve pretkomore imali ispitanici bez arterijske hipertenzije (LONE) 34,61 mm.

Uvećanu levu pretkomoru imalo je 80,95% ispitanika sa arterijskom hipertenzijom i pridruženom ishemijskom bolešću srca, a 45,45% ispitanika sa arterijskom hipertenzijom, hipertrofijom leve komore i bez ishemije. Ispitanici bez arterijske hipertenzije (LONE) nisu imali uvećanu levu pretkomoru.

Zaključak je da veličina leve pretkomore u bolesnika sa arterijskom hipertenzijom u prisustvu hipertrofije leve komore, a posebno pridružene ishemijske bolesti srca predstavlja značajan preduslov za nastanak paroksizmalne atrijalne fibrilacije. Najveći procenat ispitanika sa uvećanom levom pretkomoru u grupi sa arterijskom hipertenzijom i pridruženom ishemijskom bolešću srca, dokazuje da je ishemijska bolest srca najčešći aritmogeni faktor. Hipertrofija leve komore je odmah iza nje. *Acta Medica Medianae* 2008;47(3):5-10.

Ključne reči: arterijska hipertenzija, hipertrofija leve komore, uvećanje leve pretkomore, ishemija miokarda, paroksizmalna atrijalna fibrilacija.