МЕДИЦИНСКИЕ НАУКИ

Novikov E.V.,
PhD student of the department of multimodal diagnostics and propedeutics
Zaporizhzhia State Medical University
Al Kaddah D.
Intern of the department of multimodal diagnostics and propedeutics
Zaporizhzhia State Medical University

ELECTRICAL PROPERTIES OF MYOCARDIUM IN PATIENTS WITH ARTERIAL HYPERTENSION COMBINED WITH SUBCLINICAL HYPOTHYROIDISM.

Annotation. Electrical properties of the myocardium in patients with arterial hypertension combined with subclinical hypothyroidism.

Keywords: subclinical hypothyroidism, arterial hypertension, 24-h ECG monitoring, late atrial potentials, late ventricular potentials.

Main Problem. Arterial hypertension (AH) is one of the major health problems in the healthcare of Ukraine and in the world. Usually, pathogenic changes that develop with arterial hypertension are asymptomatic and such patients often do not receive the necessary treatment before the emergence of life-threatening complications of the disease [1,2]. Atrial and ventricular arrhythmia is a common concomitant pathology in patients with arterial hypertension [3].

The main pathophysiological factors of arrhythmias are systolic and diastolic pressure overload, secondary neurohormonal activation, left ventricular hypertrophy (LVH), which lead to myocardial fibrosis, causing significant electrophysiological changes that lead to the conduction delay and formation of the ectopic foci and substrate for appearance of the re-entry mechanism [4,5,6,7,8]. Metabolic and electrolyte disorders, other somatic pathology, such as endocrine system diseases, may also be the causative factors that potentiate arrhythmias. Premature atrial contractions and atrial fibrillation (AF) should be considered major supraventricular rhythm disorders.The last is the most common form of arrhythmia associated with hypertension. The relative risk of AF in arterial hypertension is modest compared to such conditions as heart failure and valve pathology, but hypertension is the most common, independent and potentially variable risk factor for AF [9]. Changes in the electrical properties of the atria occur at an early stage of arterial hypertension and precede the onset of LV hypertrophy and atrial enlargement [10]. In the AFFIRM study, normal sizes of the left atrium (transverse diameter <40 mm) were found only in 33% of patients [9], and these changes significantly preceded the onset of LVH. LVH, in turn, causes diastolic dysfunction and thus increases pressure in the left atrium. In the Fremingham study, patients with electrocardiographically diagnosed LVH had an almost 4-fold higher risk of AF development [11].

Verdecchia et al. has found that in individuals with arterial hypertension and sinus rhythm, the risk of AF increases with age and mass of the left ventricle, while increased size of the left atrium is associated with chronic AF [12].

Ventricular rhythm disorders are represented by premature ventricular contractions, tachycardia, and ventricular fibrillation, which are more uncommon. Their association with LVH is proved. It should be noted that asymmetric hypertrophy and eccentric LV hypertrophy are more closely associated with ventricular arrhythmias than concentric hypertrophy [13].

Late atrial and ventricular potentials are non-invasive electrocardiographic parameters that can be used to confirm pro-arrhythmic readiness in patients with arterial hypertension [14,15,16]. They are represented by electrical oscillations at the end of the "P" wave or ventricular ECG complex, have low amplitude (5–20 μV), and high frequency (more than 20–50 Hz) and are not detected on a normal ECG.

Taking into a consideration these peculiarities, given signals can only be analyzed if they are amplified, filtered, and averaged [17,18,19]. The analysis of the effect of subclinical reduction of thyroid function on the electrical properties of the myocardium of the atria and ventricles in patients with arterial hypertension is of great interest.

Materials and methods. After signing the informed consent, 124 patients with stage II arterial hypertension (AH) were enrolled in the study. The criteria for inclusion in the study were the presence of stage II arterial hypertension without pathology of the thyroid gland and combined with SH (for patients in the main group). The exclusion criteria were manifesting hypothyroidism, hyperthyroidism, presence of any cardiovascular disease (except stage II arterial hypertension), chronic heart failure of II and higher functional class (NYHA), other severe somatic pathology.

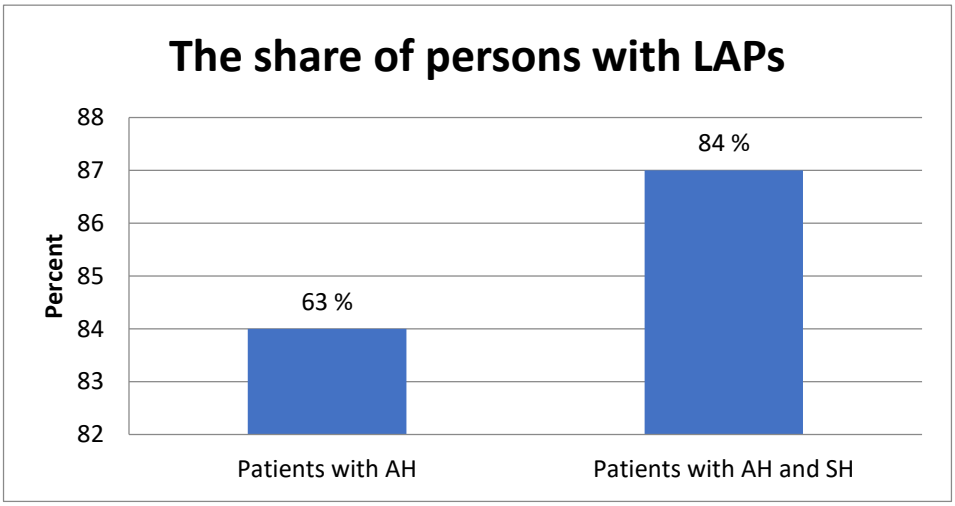
Depending on the level of thyroid-stimulating hormone (TSH), patients with AHare divided into 2 groups - with normal (0.4-4 mU / ml) and moderately elevated level of TSH (4-15.6 mU / ml, with normal levels of thyroid hormones). The group of patients with arterial hypertension without SH included 92 patients (women 81.52% (75), men 18.48% (17)), 32 patients were involved in the group of patients with AH with the concomitant SH (women 87.5% (28), men 12.5% (4).

Groups of patients were comparable by age (54.16 ± 10.16 years vs. 57.69 ± 9.76 years; p = 0.093), sex (p = 0.4319), height (p = 0.993), weight (p = 0.719), body surface area (p = 0.901), body mass index (p = 0.669). All patients underwent 24-h monitoring of BP and ECG (combined ECG and BP monitor "Kardiotechnica-04-AD-3" St. Petersburg, Russia). A 40 Hz cutoff filter was used, recording in the orthogonal X, Y, Z leads.

In the LAP analysis, the duration of the filtered P wave (P Total, ms) and the root-mean-square (RMS) amplitude over the last 20 ms of the P wave (RMS 20, μV) were studied. LVPs were evaluated by the duration of the filtered QRS complex (TotQRSF, ms), the root-mean-square amplitude of the last 40 ms of the filtered QRS complex (RMS 40, μV), and the filtered QRS complex duration at the level of 40 μV (LAS 40, ms).

The criteria for the presence of LAPs were: PTotal> 120 ms and RMS 20 <3.5 μV (Simpson). LVPs were recorded with a combination of two of three values: Tot QRSF> 120 ms, RMS40 <16 μV, and LAS 40> 38ms (NYHA, 1991). Data were processed using the program STATISTIKA 6.0. Data are presented as the median and inter-quartile range of Me (25%; 75%).

Results:



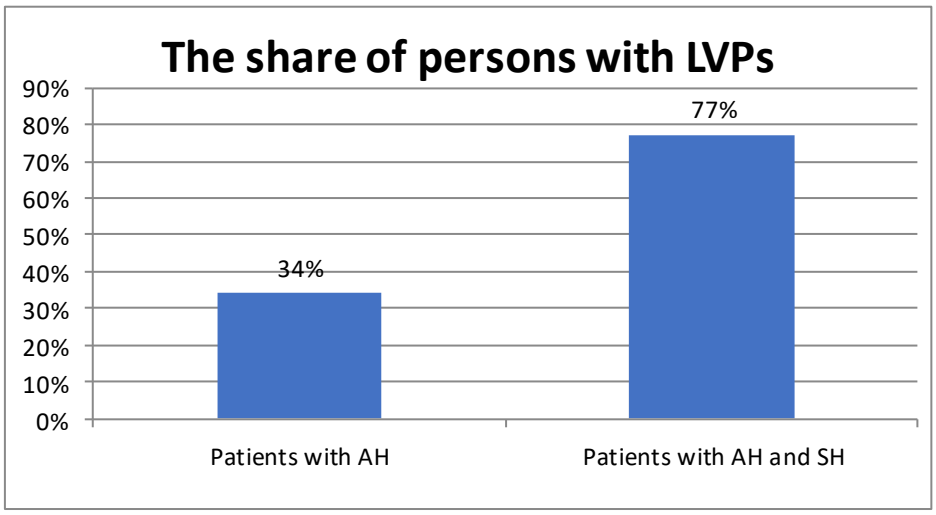


Fig 2.

Patients with AH with and without concomitant subclinical hypothyroidism did not differ in terms of indexes that characterize late atrial potentials P total max (148.47 ± 37.40 and 140.59 ± 20.73, p = 0.262), P total min (88 , 64 ± 16.07 and 86.00 ± 17.91 p = 0.443), P total mid (114.08 ± 10.30 and 113.00 ± 9.99, p = 0.610), and the percentage of LAPs detected by this index (29.26 ± 28.12 and 26.55 ± 26.87, p = 0.641), RMS20max. (6.04 ± 1.33 and 5.87 ± 1.08 p = 0.506), RMS20min. (39.49 ± 25.19 and 2.11 ± 0.97 p = 0.641), RMS20mid. (2.03 ± 0.80 and 13.09 ± 51.63 p = 0.094), and the percentage of LAPs detected by RMS20 (39.49 ± 25.19 and 44.90 ± 25.73 p = 0.309), frequency of detection of LAPs in analyzed cardiocycles (14.98 ± 16.74 and 15.35 ± 13.63, p = 0.901). There was also no statistically probable difference in indexes of the quantity of premature atrial contractions (262.63 ± 1169.36 and 435.41 ± 1666.37, p = 0.527), paired premature atrial contractions (31.96 ± 151.61 and 4.56 ± 8.09, p = 0.449), group premature atrial contractions 1.46 ± 2.79 and 0.71 ± 1.53, p = 0.314).

Particular attention is paid to the changes in indexes of late ventricular potentials. In patients with AH with concomitant subclinical hypothyroidism, a significant decrease of the maximum was observed by 21.3% (62.22 ± 28.50 versus 48.97 ± 38.70, p = 0.043), minimal by 27.1% (22.91 ± 14.11 vs 16.69 ± 14.77 p = 0.037) and average by 27.2% (37.33 ± 19.54 vs 27.16 ± 20.98, p = 0.015) of the RMS40 values; increase of the maximal by 7.1% (93.40 ± 9.43 vs. 100.00 ± 16.47 p = 0.007) minimal by 7% (80.28 ± 7.19 vs 85.09 ± 14.57, p = 0.017), and average of 7% (86.33 ± 7.36 vs. 92.34 ± 14.52, p = 0.003) of Tot QRSF values; also a 1.34-fold increase (39.20 ± 8.38 vs. 52) , 41 ± 14.65, p = 0.0001), the minimal by 20.1% (from 24.38 ± 6.59 to29.28 ± 14.67, p = 0.013) and the average by 22% (from 31 , 63 ± 6.79 to 38.59 ± 14.67, p = 0.001) of the Las 40 index values.

The percentage of the detected LAPs according to the mentioned indexes also logically increased: RMS40 2.9-fold (from 17,43 ± 30,33 to 50,69 ± 40,57, p = 0,0001); Las 40 3.47-fold (from 12.68 ± 25.23 to 43.94 ± 36.95, p = 0.0001); Tot QRSF from 0.00 ± 0.00 to 5.75 ± 22.25 percent (p = 0.016). According to the share of patients with LVPs, the groups of patients with AH and AH with SH differed significantly (32.61% versus 76.67%; p = 0.0001, Fig. 2), also the percentage of detected LVPs in the analyzed cardiocycles by 3.48 times (12.22 ± 24.88 vs. 42.56 ± 36.96, p = 0.005).

Therefore, late ventricular potentials were significantly more frequently found in the group of patients with AH with SH. Changes in the electrical properties of ventricles in patients with AH with concomitant subclinical hypothyroidism were associated with an increase in the number of premature ventricular contractions by 6.69 times (from 42.56 ± 36.96 to 441.53 ± 1414.97, p = 0.026) compared to the same index in patients with AH without concomitant subclinical hypothyroidism.

It should be noted that no significant difference between the number of analyzed cardiac cycles among the groups of patients examined was found, which creates equal conditions and makes the analysis more accurate.

Analysis of the latest investigations and publishings

Literature data evidences the effect of the arterial hypertension and associated LVH on the enhancement of the pro-arrhythmic activity of the myocardium of the atria and ventricles [14,15,16,20,21]. Palatini et al found late ventricular potentials (LVPs) in 27 patients (25%) out of 107 patients examined with LVH. In the works of Bushra R. et al. and Palmiero et al. during the examination of such patients, LVPs were found in 31.3% [22] and 20% [23] cases, with the relationship between LVPs and LVH being quite strong (p-value <0.001) in therecent work.

In the work of Riaz with co-authors LVPs were detected in 17% out of 64 patients with arterial hypertension [24]. The effect of endocrine pathology on changes in LVPs parameters has been proved: in acromegaly [25,26,27], hyper- and hypothyroidism with regression of the parameters characterizing LVPs, with substitution therapy for hypothyroidism [25,28]. We found data on the negative impact of even subclinical forms of thyroid dysfunction on LVPs parameters. The authors indicate that the pro-arrhythmogenic effect of SH can be eliminated by propranolol, even at low doses [29]. Particular attention should be paid to the new data on preclinical myocardial injury in subclinical hypothyroidism according to T1 mapping by MRI [30].

Late atrial potential (LAP) analysis assists in the identification of patients at risk of supraventricular arrhythmias, in particular atrial fibrillation in various categories of patients, including patients with hypothyroidism [31,32].

Some difficulties in analysis of the data we have obtained and their comparison with other results are due to the fact that, to date, there is no common idea regarding which technique, temporal, spatial, or spectral analysis, is more accurate for detection of LVPs and which threshold values tot QRS, RMS40, LAS40 have greater diagnostic accuracy. [33,34]. A further search of the amplitude-temporal parameters for the Simson method is carried out [35]. Similar peculiarities are characteristic for carrying out the LAP analysis [31,32].

However, we found a probable pro-arrhythmogenic effect of arterial hypertension on the function of the atria and ventricles according to the analysis of LAP and LVP, and an additional effect of SH on the electrical properties of the ventricular myocardium in patients with arterial hypertension II stage. Therefore, can be stated that arterial hypertension is considered to be a strong independent risk factor for the development of supraventricular and ventricular arrhythmias, while the presence of late atrial and ventricular potentials in patients with arterial hypertension on averaged ECG is the evidence of major anatomical and electrophysiological changesthat can cause atrial fibrillation and life-threatening arrhythmias.

The results obtained confirm the data of the analyzed literature sources, particularly the single ones concerning the electrical properties of the ventricular myocardium in SH. The results regarding such changes in patients with stage II arterial hypertension and the electrical properties of atria in SH were obtained for the first time.

Further scientific explanation for the identified changes is needed. The data obtained indicate the effect of SH on the structure of the left atrium in patients with arterial hypertension (a likely increase in a transverse size by 3.5% (p <0.05)), but which is not accompanied by changes in the electrical activity of the atria in SH. At the same time, the morphological and functional peculiarities of the LV myocardium with arterial hypertension combined with SH (a likely increase in myocardial mass index by 11.1% (p <0.05), distribution of geometry types, etc.) have functional confirmations - the response of LAP indexes, the number of ventricular arrhythmias. It should also be reminded that there are some effects of SH on the parameters of 24-h BPM in patients with arterial hypertension. In our opinion, such peculiarities may be due to multiple metabolic changes in SH, wider expression of genes for thyroid hormones and more active energy metabolism in the ventricular myocardium.

Highlighting the parts of the main problem that were unsolved previously: Late atrial and ventricular potentials are non-invasive electrocardiographic criteria for the presence of high arrhythmic readiness and risk of life-threatening arrhythmias. The electrical properties of myocardium in patients with stage II arterial hypertension combined with subclinical hypothyroidism have not been studied previously.

Formulation of the main goals of the article: studying the electrical properties of the myocardium of atria and ventricles in patients with AT combined with subclinical hypothyroidism.

Presentation of the main material of the investigation with the full explanation of the scientific results received.

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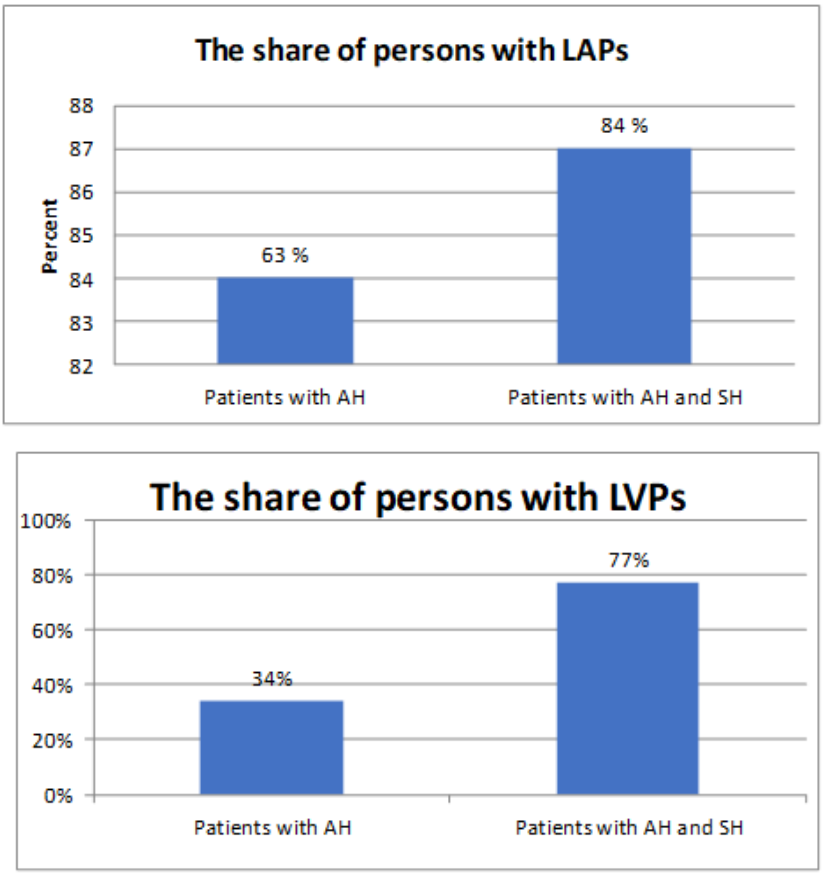

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It should be noted that no significant difference between the number of analyzed cardiac cycles among the groups of patients examined was found, which creates equal conditions and makes the analysis more accurate.

Conclusions of this investigation and its prospects for the further development in this sphere:

1. In patients with stage II arterial hypertension with and without SH, no significant difference was found in LAP (p = 0.837) and supraventricular arrhythmias (number of premature atrial contractions (p = 0.527), paired premature atrial contractions (p = 0.499), group premature atrial contractions (p = 0.314)).

3. In patients with stage II arterial hypertension with SH, compared with the group without SH, there were changes in the indexes characterizing LVPs (decrease of maximal by 21.3% (p = 0.043), minimal by 27.1% (p = 0.037) , average by 27.2% (p = 0.015) values of RMS 40 index, an increase in Tot QRSF max values of 7.1% (p = 0.007), Tot QRSF min of 7% (p = 0.017), Tot QRSF average by 7% (p = 0.003), LAS40max 1.34-fold (p = 0.0001), LAS40min by 20.1% (p = 0.013), LAS40mid by 22% (p = 0.001) and a share of LVPs detected by these parameters: Tot QRSF (p = 0.016), RMS 40 2.9-fold (p = 0.0001), Las 40 3.47-fold (p = 0.0001), percentage of LVPs detected in analyzed cardiocycles 3.48-fold (= 0.005)), indicating additional pro-arrhythmogenic impact of the associated subclinical hypothyroidism. Changes in the electrical properties of ventricles in patients with AH with concomitant subclinical hypothyroidism were associated with an increase in the number of premature ventricular contractions by 6.69 times (p = 0.026) compared with the similar index in patients with AH without concomitant subclinical hypothyroidism.

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Prospects for further research. Taking into a consideration the increasing amount of data about the effect of AH on the structure and function of the cardiovascular system, the prospects for the research lay in the further study of such consistent patterns as factors that significantly influence the course of AH.

Conflict of interests is absent.

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Dubova L. V.
Doctor of Medical Sciences, Head of the Department of Prosthodontic Dentistry
MSUMD named after A.I.Evdokimov
Ozhigov E.M.
Postgraduate Student, Department of Prosthodontic Dentistry
MSUMD named after A.I.Evdokimov
Zolotnitskiy I.V.
Doctor of Medical Sciences, Professor of Prosthodontic Dentistry
MSUMD named after A.I.Evdokimov
Malik M.V.
Candidate of Medical Sciences, Associate Professor of Prosthodontic Dentistry
MSUMD named after A.I.Evdokimov

ANALYSIS OF CHANGES OF CHEWING PATTERN VALUES OF PATIENTS USING REMOVABLE IMPLANT-RETAINED DENTURES FOR 12 MONTHS

Дубова Любовь Валерьевна
Доктор медицинских наук, заведующий кафедры ортопедической стоматологии с/ф
МГМСУ им. А.И.Евдокимова
Ожигов Евгений Михайлович
Аспирант кафедры ортопедической стоматологии с/ф
МГМСУ им. А.И.Евдокимова
Золотницкий Игорь Валерьевич
Доктор медицинских наук, профессор кафедры ортопедической стоматологии с/ф
МГМСУ им. А.И.Евдокимова
Малик Мария Васильевна
Кандидат медицинских наук, доцент кафедры ортопедической стоматологии с/ф
МГМСУ им. А.И.Евдокимова

АНАЛИЗ ИЗМЕНЕНИЙ ПАРАМЕТРОВ ЖЕВАТЕЛЬНОГО ЦИКЛА У ПАЦИЕНТОВ, ПОЛЬЗОВАВШИХСЯ СЪЕМНЫМИ ПОКРЫВНЫМИ ПРОТЕЗАМИ С ОПОРОЙ НА ИМПЛАНТАТЫ В ТЕЧЕНИЕ 12 МЕСЯЦЕВ

Summary. Edentulism is a common worldwide pathology. The development of diagnostic and prosthodontic methods has led to the possibility of making removable implant-retained dentures. However, the absence of parodont of the teeth calls a question of the physiology of the functioning of such types of dentures.

Аннотация. Полное отсутствие зубов на одной челюсти – часто встречаемая патология по всему миру. Развитие методов диагностики и ортопедического лечения таких пациентов привели к