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FUNCTIONAL BLOOD CIRCULATION VALUES IN PATIENTS WITH IMPLANTED PACEMAKERS IN THE FIRST SIX MONTHS OF PERMANENT PACING IN DIFFERENT STIMULATED QRS COMPLEX DURATION CLASSES

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In the department of ultrasound, clinical and instrumental diagnosis and minimally invasive technologies 100 patients (46 – women, 54 – men) who underwent permanent pacemaker therapy were examined. The average age was 69 ± 7 years. The indications for pacemaker implantation were: atrio-ventricular block of varying degrees – 66 people (60 %), sick sinus syndrome – 34 patients (30 %). Patients were divided to three classes of QRS complex duration in accordance with Haghjoo M. et al.: 1 – under 119 ms (normal), 2 − 120-149 ms (extended) and more than 150 ms (significantly extended). Permanent pacing with medical support in the first 6 months results in the elimination bradyarrhythmia rhythm disorders without significant changes of functional blood circulation values with systolic blood pressure increase only. Standard antihypertensive therapy consisting of medical support in patients with implanted pacemaker is sufficient to control systolic blood pressure in patients in classes 1 and 2 and insufficient – in class 3 of QRS complex duration. Patients with implanted pacemaker in 3 QRS complex duration class require intensification of antihypertensive therapy.

KEY WORDS: permanent pacing, QRS complex duration, functional blood circulation

ФУНКЦІОНАЛЬНІ ПОКАЗНИКИ КРОВООБІГУ У ПАЦІЄНТІВ ІЗ ІМПЛАНТОВАНИМИ ЕЛЕКТРОКАРДІОСТИМУЛЯТОРАМИ В ПЕРШІ 6 МІСЯЦІВ ПОСТІЙНОЇ ЕКС У РІЗНИХ КЛАСАХ ТРИВАЛОСТІ СТИМУЛЬОВАНОГО QRS КОМПЛЕКСУ

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У відділенні ультразвукової та клініко-інструментальної діагностики та мініінвазивних втручань були обстежені 100 пацієнтів (46 − жінок, 54 − чоловіків) з імплантованими електрокардіостимуляторами (ЕКС). Средній вік становив 69 ±7 років. Показаннями для імплантації ЕКС були: атріовентрикулярна блокада різних ступенів − 66 пацієнтів (60 %), синдром слабкості синусового вузла − 34 пацієнта (40 %). Пацієнти були розділені на три класи тривалості QRS комплексу відповідно до Haghjoo M. та ін: 1 − до 119 мс (нормальний), 2 − 120-149 мс (подовжений), 3 − 150 і більше мс (значно подовжений). Постійна електрокардіостимуляція з медикаментозною підтримкою в перші 6 місяців призводить до усунення брадіаритміческіх порушень ритму поза істотних змін встановлених до неї функціональних показників кровообігу з підвищенням тільки систолічного артеріального тиску. Стандартна антигіпертензивна терапія у складі медикаментозної підтримки пацієнтів з імплантованими ЕКС виявляється достатньою для контролю систолічного артеріального тиску у пацієнтів у класах 1 і 2 та недостатня − в класі 3 тривалості QRS комплексу. Пацієнти з імплантованими ЕКС з класу 3 тривалості QRS комплексу вимагають інтенсифікації артігіпер-тензівной терапії.

КЛЮЧОВІ СЛОВА: постійна електрокардіостимуляція, тривалість QRS комплексу, функціональні показники кровообігу

ФУНКЦИОНАЛЬНЫЕ ПОКАЗАТЕЛИ КРОВООБРАЩЕНИЯ У ПАЦИЕНТОВ С ИМПЛАНТИРОВАННЫМИ ЭЛЕКТРОКАРДИОСТИМУЛЯТОРАМИ В ПЕРВЫЕ ШЕСТЬ МЕСЯЦЕВ ПОСТОЯННОЙ ЭЛЕКТРОКАРДИОСТИМУЛЯЦИИ В РАЗНЫХ КЛАССАХ ПРОДОЛЖИТЕЛЬНОСТИ СТИМУЛИРОВАННОГО QRS КОМПЛЕКСА

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В отделении ультразвуковой и клинико-инструментальной диагностики и миниинвазивных вмешательств были обследованы 100 пациентов (46 – женщин, 54 – мужчин) с имплантированными электрокардиостимуляторами (ЭКС). Средний возраст составлял 69 ± 7 лет. Показаниями для имплантации ЭКС являлись: атрио-вентрикулярные блокады различных степеней – 66 пациентов (60 %), синдром слабости синусового узла – 34 пациента (40 %). Пациенты были разделены на три класса продолжительности QRS комплекса в соответствии с Haghjoo M. и др.: 1 – до 119 мс (нормальный), 2 − 120-149 мс (удлиненный), 3 – 150 и более мс (значительно удлиненный). Постоянная электрокардиостимуляция с медикаментозной поддержкой в первые 6 месяцев приводит к устранению брадиаритмических нарушений ритма вне существенных изменений установленных до нее функциональных показателей кровообращения с повышением только систолического артериального давления. Стандартная антигипертензивная терапия в составе медикаментозной поддержки пациентов с имплантированными ЭКС оказывается достаточной для контроля систолического артериального давления у пациентов в классах 1 и 2 и недостаточна − в классе 3 продолжительности QRS комплекса. Пациенты с имплантированными ЭКС из класса 3 продолжительности QRS комплекса требуют интенсификации артигипертензивной терапии.

КЛЮЧЕВЫЕ СЛОВА: постоянная электрокардиостимуляция, продолжительность QRS комплекса, функциональные показатели кровообращения

INTRODUCTION

Permanent pacing is the primary treatment in patients with significant bradyarrhythmias, in which rhythm slowing is associated with life-threatening hemodynamic disturbances [1, 2].

Functional blood circulation values monitoring on the follow-up periods is one of the major challenges for evaluating the effectiveness of permanent pacing with its medical support [3, 4].

Moreover, in patients with permanent pacing, QRS complex duration is associated with changes of functional blood circulation values [5−8], their relationship was not been studied until nowadays.

OBJECTIVE

The purpose of this study to assess the functional blood circulation values in patients with implanted pacemakers in the first 6 months of permanent pacing taking into account the QRS complex duration classes.

MATERIALS AND METHODS

100 patients (46 – women, 54 – men) who underwent permanent pacemaker therapy were examined in the department of ultrasound, clinical and instrumental diagnosis and minimally invasive technologies SI «Zaitsev V.T. Institute of General and Emergency Surgery NAMS of Ukraine». The average age was 69 ± 7 years. The indications for pace-maker implant-tation were: atrio-ventricular block of varying degrees (AV block) – 66 people (60 %), sick sinus syndrome (SSS) – 34 patients (30 %).

Before, in the early postoperative period (the third - fifth day after pacemaker implantation) and 6 months later was evaluated ventricular contractions (VC) spontaneous and induced rhythm, QRS complex duration; systolic (SBP) and diastolic blood pressure (DBP), left ventricular ejection fraction (LVEF), end-diastolic (EDV) and end-systolic (ESV) volumes, the thickness of the interventricular septum (IVS) and posterior wall (PW), left (LA) and right atrium (RA), right ventricular (RV) dimensions.

SBP and DBP were measured by Korotkov's method according to the recommendations of the Association of Cardiologists of Ukraine for the prevention and treatment of hypertension by tonometer Microlife BP AG1- 20 in clinostaze after 5 minutes rest. The measurement accuracy was 2 mm Hg.

Electrocardiogram (ECG) was performed on a computer electrocardiograph Cardiolab

+2000. The stimulated QRS complex duration was measured in leads II, V5, V6 (the average of three consecutive complexes) with a choice of maximum value. Measurement accuracy proved to be 1 mc.

Patients were divided to three QRS complex duration classes in accordance with Haghjoo M. et al: 1 – under 119 ms (normal), 2 − 120-149 ms (extended) and more than 150 ms (significantly extended). In selected classes defined functional blood circulation values.

Echocardiography study was conducted on the ultrasound machine Toshiba Applio 400. LF, RF, RV sizes and IVS, PW thickness was measured. To calculate the EDV and ESV used method of Simpson. LV EF was calculated using the formula EF = (EDV - ESV) / EDV * 100 %.

Medication support of patients with permanent pacemakers was carried with antiarrhythmic drugs (AAR) (beta-blockers and amiodarone)), renin-angiotensin- aldosterone inhibitors (RAAI) (angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor antagonists II (ARA II)), antithrombotic drugs (antiplatelet agents (acetylsalicylic acid (ASA)), oral anticoagulants (AC) (warfarin/dabigatran), statins, and diuretics.

The data were brought into the Microsoft Excel base. For statistical evaluation of the results were used the parametric criteria (the mean – M, the average deviation – sd). The probability of differences between groups was determined using a non-parametric U-Mann-Whitney test. The likely result is determined by the level of reliability $p < 0.05$.

RESULTS AND DISCUSSION

Table 1 shows the comparative characteristics of functional blood circulation values in patients in different QRS complex duration classes before implantation in the early postoperative period and 6 months.

Table 1

Functional blood circulation values in patients with permanent pacemakers in different QRS complex duration classes, (M ± sd)

Functional blood circulation values		QRS complex duration, ms								
		Under 119 ms			120-149 ms			150 and more ms		
		Before	Early postoperative period	6 months later	Before	Early postoperative period	6 months later	Before	Early postoperative period	6 months later
VC, (1/min)		52 ± 11	68 ± 6*	64 ± 3	46 ± 8	71 ± 11*	69 ± 7	46 ± 9	68 ± 7*	70 ± 7
Blood pressure (mm Hg)	**SBP**	150 ± 15	154 ± 17	140 ± 27	140 ± 15	139 ± 16	124 ± 14	153 ± 18	151 ± 19	144 ± 25
	DBP	82 ± 6	89 ± 9	80 ± 7	81 ± 9	83 ± 10	84 ± 9	79 ± 7	87 ± 9	85 ± 17
Echo values	**LVEF (%)**	53 ± 10	54 ± 11	65 ± 8	47 ± 8	53 ± 8	50 ± 9	50 ± 6	47 ± 8	55 ± 12
	ESV (ml)	63 ± 28	59 ± 26	52 ± 11	70 ± 31	58 ± 22	66 ± 19	83 ± 35	81 ± 36	102 ± 64
	EDV (ml)	135 ± 44	127 ± 29	148 ± 16	133 ± 29	122 ± 24	132 ± 27	166 ± 35	153 ± 48	227±129
	IVS (sm)	1.2 ± 0.1	1.2 ± 0.1	1.0 ± 0.2	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1
	PW LV (sm)	0.9 ± 0.1	0.9 ± 0.1	1.2 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.2	1.1 ± 0.2	1.1 ± 0.2	1.1 ± 0.2
	LA (sm)	4.9 ± 0.6	4.8 ± 0.6	4.5 ± 0.5	4.3 ± 0.5	4.3 ± 0.5	4.8 ± 0.6	4.5 ± 0.5	4.5 ± 0.5	4.5 ± 0.5
	RA (sm)	4.8 ± 1.0	4.8 ± 1.0	4.5 ± 1.0	4.4 ± 0.5	4.4 ± 0.5	4.4 ± 0.5	4.4 ± 0.5	4.3 ± 0.5	4.6 ± 0.6
	RV (sm)	3.0 ± 0.4	3.0 ± 0.4	3.0±0.4	3.2 ± 0.6	3.2 ± 0.6	3.2 ± 0.7	3.2 ± 0.6	3.2 ± 0.6	3.2 ± 0.9

Notes:
* $p < 0.05$ — the level of significance of differences between values on the observation periods

In patients with permanent pacemaker in all QRS complex duration classes, VC was initially below the physiological norm, and after pacemaker implantation reached to the normal level ($p < 0.05$), which remained the whole observation period.

High baseline SBP in patients decreased more pronounced in 1 and 2 QRS complex duration classes, and less – in class 3. DBP on all follow-up periods in all QRS complex duration classes was on the physiological range.

Pacemaker implantation had no influence on the ESV and EDV, which were initially normal in classes 1 and 2, and an increase in class 3. Accordingly, LVEF after pacemaker implantation was not changed.

Pacemaker implantation did not affect on the IVS and PWLV thicknesses in selected QRS complex duration classes, and it has remained unchanged whole observation period.

LA size was increased in all QRS complex duration classes before and after pacemaker implantation. Initially normal RA and RV sizes were not changed in all classes.

In accordance with the findings the permanent pacemaker implantation has led to the elimination of bradyarrhythmias, maintaining VC in normal range during 6-month period, what corresponds to [1, 2], in all QRS complex duration classes.

SBP reductions in toward the physiological level value reaches by antihypertensive control which was not sufficient, after all, in 3 QRS complex duration class patients.

A positive result of pacemaker implantation is the preservation of geometric and hemodynamic parameters of the heart, as well as DBP.

CONCLUSIONS

1. Permanent pacing with medical support in the first 6 months results in the elimination bradyarrhythmia rhythm disorders without significant changes of functional blood circulation values with systolic blood pressure increase only.
2. Standard antihypertensive therapy consisting of medical support in patients with implanted pacemaker is sufficient to control systolic blood pressure in patients in classes 1 and 2 and insufficient – in class 3 of QRS complex duration.
3. Patients with implanted pacemaker in 3 QRS complex duration class require intensification of antihypertensive therapy.

PROSPECTS FOR FUTURE STUDIES

It seems promising to further monitoring of functional blood circulation values to evaluate circulatory long-term results of permanent pacing and medical support.

REFERENCES

1. Tracy C.M. 2012 ACCF/AHA/HRS focused update of the 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society / C.M. Tracy, A.E. Epstein, D. Darbar [et al.] // Circulation. – 2012. – Vol. 126. – P. 1784.
2. Brignole M. 2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy: Addenda / M. Brignole, A. Auricchio, G. Baron-Esquivias [et al.] // European Heart Journal. – 2013. − Vol. 15. – P. 1070–1118.
3. Roman A. Gebauer Predictors of left ventricular remodelling and failure in right ventricular pacing in the young / A. G. Roman, V. Tomek, A. Salameh // European Heart Journal. − 2009. – Vol. 30. – P. 1097–1104.
4. Xue G. Is Right Ventricular Outflow Tract Pacing Superior to Right Ventricular Apex Pacing in Patients with Normal Cardiac Function? / G. Xue, Y. Su, W. Pan [et al.] // Clinical Cardiology. – 2009. – Vol. 32 (12). – P. 695−699.
5. Takemoto Y. Beta-blocker therapy induces ventricular resynchronization in dilated cardiomyopathy with narrow QRS complex / Y. Takemoto, T. Hozumi, K. Sugioka [et al.] // Journal of American College of Cardiology. – 2007. – Vol. 49. – P. 778–783.
6. Su Y. Relationships between paced QRS duration and left cardiac structures and function / Y. Su, W. Pan, X. Gong [et al.] // Acta Cardiologica. – 2009. – Vol. 64(2). – P. 231−238.
7. Chen S. Paced QRS duration as a predictor for clinical heart failure events during right ventricular apical pacing in patients with idiopathic complete atrioventricular block: results from an observational cohort

study (PREDICT−HF) / S. Chen, Y. Yin, X. Lan [et al.] // European Journal of Heart Failure. – 2013. – Vol. – 15(3). – P. 352−359.

8. Shanina I.V. Functional parameters of blood circulation in patients with permanent pacemakers in the early postoperative period in different QRS complex duration classes / I.V. Shanina, D.E. Volkov, N.I. Yabluchansky [et al.] // Medicina transporta. – 2013. − № 4. – P. 15−21.