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PACING PARAMETERS CHANGES IN PATIENTS WITH IMPLANTED PACEMAKER IN DIFFERENT QRS COMPLEX DURATION CLASSES AT THE ANNUAL OBSERVATION STAGE

Shanina I. V.¹, Volkov D. E.²

¹V. N. Karazin Kharkiv National University, Kharkiv, Ukraine

²SI «V. T. Zaytsev Institute of General and Emergency Surgery of the NAMS of Ukraine», Kharkiv, Ukraine

100 patients (46 – women, 54 – men) 69 ± 7 years old with implanted pacemaker in three QRS complex duration classes (under 120, 120-149, 150 and more ms) were investigated in the early postoperative period, six months and a year of permanent pacing. Basic pacing rate, atrioventricular (AV) delay (stimulated and detected), ventricular threshold, ventricular lead impedance, percentage of ventricular pacing, percentage of atrial fibrillation/flutter time were measured. Basic pacing rate, stimulated and detected AV-delay, as well as the percentage of ventricular pacing were not associated with QRS complex duration classes and had not been changed in observation stages. Ventricular threshold, ventricular lead impedance and the percentage of atrial fibrillation/atrial flutter time in the annual monitoring stage were defined to QRS complex duration class. Ventricular threshold in the first six months of observation was not changed in any QRS complex duration classes and grew at an annual stage in class 3. The impedance of the ventricular lead in the first six months decreased in all classes, it was stabled at the year in classes 2 and 3 and was continued to decline in the class 1. Percentage of atrial fibrillation/flutter time was initially higher in class 3, and was decreased in six month observation stage, however, without reaching the values in classes 1 and 2.

KEY WORDS: permanent pacing, QRS complex duration, pacing parameters

ЗМІНИ ПАРАМЕТРІВ ЕЛЕКТРОКАРДІОСТИМУЛЯЦІЇ У ПАЦІЄНТІВ З ІМПЛАНТОВАНИМИ ЕКС В РІЗНИХ КЛАСАХ ТРИВАЛОСТІ QRS КОМПЛЕКСУ НА РІЧНОМУ ЕТАПІ СПОСТЕРЕЖЕННЯ

Шаніна І. В.¹, Волков Д. Є.²

¹ Харківський національний університет імені В.Н. Каразіна, м. Харків, Україна

² ДУ «Інститут загальної та невідкладної хірургії імені В.Т. Зайцева НАМН України», м. Харків, Україна

Обстежені 100 пацієнтів (46 – жінок, 54 – чоловіків) у віці 69±7 років з імплантованими ЕКС в трьох класах тривалості QRS комплексу (до 120, 120-149, 150 і більше мс) в ранній післяопераційний період, 6 місяців і рік постійної електрокардіостимуляції (ЕКС). Визначалися базова частота стимуляції, атріовентрикулярна затримка (стимульована і детектована), поріг стимуляції шлуночків, імпеданс шлуночкового електрода, відсоток шлуночкової стимуляції, відсоток часу фібриляції/тріпотіння передсердь (ФП/ТП). Базова частота, стимульована і детектована AV-затримка, а також відсоток шлуночкової стимуляції не були пов'язані з класами тривалості QRS комплексу і не змінювалися на етапах ЕКС. Поріг шлуночкової стимуляції, імпеданс шлуночкового електрода і відсоток часу ФП/ТП в річному етапі спостереження визначалися класами тривалості QRS комплексу. Поріг шлуночкової стимуляції в перші півроку спостереження не змінювався ні в одному з класів і зростав на річному етапі в класі 3. Імпеданс шлуночкового електрода в перші півроку зменшувався у всіх класах, стабілізувавшись до року в класах 2 і 3 і продовживши зменшуватися в класі 1. Відсоток часу ФП/ТП, спочатку більш високий в класі 3, до піврічного періоду зменшувався, не досягаючи, однак, значень у класах 1 і 2.

КЛЮЧОВІ СЛОВА: постійна електрокардіостимуляція, тривалість QRS комплексу, параметри електрокардіостимуляції

ИЗМЕНЕНИЯ ПАРАМЕТРОВ ЭЛЕКТРОКАРДИОСТИМУЛЯЦИИ У ПАЦИЕНТОВ С ИМПЛАНТИРОВАННЫМИ ЭКС В РАЗНЫХ КЛАССАХ ПРОДОЛЖИТЕЛЬНОСТИ QRS КОМПЛЕКСА НА ГОДИЧНОМ ЭТАПЕ НАБЛЮДЕНИЯ

Шанина И. В.¹, Волков Д. Е.²

¹Харьковский национальный университет имени В. Н. Каразина, г. Харьков, Украина

²ГУ «Институт общей и неотложной хирургии имени В.Т. Зайцева НАМН Украины», г. Харьков, Украина

Обследованы 100 пациентов (46 – женщин, 54 – мужчин) в возрасте 69 ± 7 лет с имплантированными ЭКС в трех классах продолжительности QRS комплекса (до 120, 120-149, 150 и более мс) в ранний послеоперационный период, 6 месяцев и год постоянной электрокардиостимуляции (ЭКС). Определялись базовая частота стимуляции, атриовентрикулярная задержка (стимулированная и детектированная), порог стимуляции желудочков, импеданс желудочкового электрода, процент желудочковой стимуляции, процент времени фибрилляции/трепетания предсердий (ФП/ТП). Базовая частота, стимулированная и детектированная AV-задержка, а также процент желудочковой стимуляции не были связаны с классами продолжительности QRS комплекса и не изменялись на этапах ЭКС. Порог желудочковой стимуляции, импеданс желудочкового электрода и процент времени ФП/ТП в годичном этапе наблюдения определялись классами продолжительности QRS комплекса. Порог желудочковой стимуляции в первые полгода наблюдения не изменялся ни в одном из классов и возрастал на годовом этапе в классе 3. Импеданс желудочкового электрода в первые полгода уменьшался во всех классах, стабилизировавшись к году в классах 2 и 3 и продолжив уменьшаться в классе 1. Процент времени ФП/ТП, изначально более высоких в классе 3, к полугодовому периоду уменьшался, не достигая, однако, значений в классах 1 и 2.

КЛЮЧЕВЫЕ СЛОВА: постоянная электрокардиостимуляция, продолжительность QRS комплекса, параметры электрокардиостимуляции

INTRODUCTION

Pacing parameters are estimated and programmed if necessary during each visit of patient with permanent pacemaker [1, 2].

Moreover, there are evidences about the relationship of separate pacing parameters with QRS complex duration for example ventricular lead impedance and threshold [3], the changes of pacing parameters on annual observation stage have not previously been studied.

OBJECTIVE

Purpose of this study – to assess pacing parameters changes in different QRS complex duration classes at the annual observation stage in patients with implanted pacemakers.

MATERIALS AND METHODS

100 patients (46 – women, 54 – men) with implanted pacemaker were examined in the department of ultrasound and clinical-instrumental diagnosis and minimally invasive interventions SI «V.T. Zaytsev Institute of General and Emergency Surgery NAMS of Ukraine». Mean age of the patients was 69 ± 7 years. The indications for pacemaker implantation were the atrio-ventricular (AV) block far-advanced II and III degree. We used

the following pacemakers: SJM Verity ADx XL SR 5156 and VVI Medtronic Sensia SEDR01 DDD.

Patients received indications of angiotensin converting enzyme inhibitors (ACE inhibitors, in moderate doses of enalapril maleate – 10 mg ramipril – 5mg, fosinopril – 10 mg, lisinopril – 10 mg, perindopril – 2 mg, captopril – 12.5 mg), angiotensin receptor antagonists II (ARA II, losartan in high doses – 50 mg, candesartan – 8 mg), beta-blockers (average dose bisoprolol – 5mg, metoprolol – 100 mg, carvedilol – 6.25 mg, betaxolol – 5 mg, atenolol – 50 mg) amiodarone (average dose 200 mg), acetylsalicylic acid (ASA – 75 mg), oral anticoagulants (AC at moderate doses of warfarin – 5mg or dabigatran – 220 mg), statins (atorvastatin in high doses – 20 mg, rosuvastatin –20 mg), and diuretics (furosemide in high doses – 40 mg, torasemide – 5 mg, hydrochlorothiazide – 12.5 mg, indapamide – 2.5 mg, spironolactone – 50 mg).

Electrocardiogram (ECG) was performed on the computer electrocardiograph Cardiolab + 2000. QRS complex duration was measured in leads II, V5, V6 (the average value of three consecutive complexes) with a choice of maximum value. Accuracy of measurement of QRS complex duration – 1 ms.

The pacemaker programmer defines the basic pacing rate, atrioventricular delay (stimulated and detected), the threshold of ventricular pacing, ventricular lead impedance, the percentage of ventricular pacing, the percentage of time atrial fibrillation/flutter.

Patients were assigned to three QRS complex duration classes according with Haghjoo M. et al: 1 – 120 ms (normal), 2 – 120-149 ms (long) and the 150 ms or more (substantially elongate). The above parameters were evaluated in selected classes in the early postoperative period (third to fifth day after pacemaker implantation), after 6 months and annual observation stage.

The data were brought into the Microsoft Excel base. For statistical evaluation of the results were used the parametric criteria (the mean – M, the standard deviation – sd). Comparing of QRS duration complex classes on the observation stages was conducted on each separate functional blood circulation value using a non-parametric U-Mann-Whitney test. Probable results were determined at levels of reliability $p < 0.05$.

RESULTS AND DISCUSSION

Table 1 shows the pacing parameters in patients in different QRS complex duration classes at the annual observation stage.

Table 1

Pacing parameters in patients in different QRS complex duration classes at the annual observation stage

| Pacing parameters, (M±sd) | | QRS complex duration | | | | | | | | |
|-------------------------------------|-----------|----------------------------|----------------|------------|----------------------------|----------------|-------------|----------------------------|----------------|-------------|
| | | Under 120 ms | | | 120-149 ms | | | 150 and more ms | | |
| | | Early postoperative period | 6 months later | Year later | Early postoperative period | 6 months later | Year later | Early postoperative period | 6 months later | Year later |
| Basic pacing rate, 1/min | | 68 ± 6 | 65 ± 3 | 63 ± 6 | 70 ± 10 | 65 ± 7 | 64 ± 4 | 65 ± 6 | 60 ± 6 | 62 ± 7 |
| Ventricular threshold, V | | 0.55 ± 0.25 | 0.50 ± 0.29 | 0.75 ± 0.4 | 0.58 ± 0.27 | 0.60 ± 0.33 | 0.84 ± 0.58 | 0.74 ± 0.34 | 0.75 ± 0.43 | 1.4 ± 0.6** |
| Ventricular lead impedance, Om | | 484 ± 65 | 367 ± 51* | 295 ± 62** | 430 ± 58 | 350 ± 48* | 390 ± 21 | 504 ± 79 | 390 ± 14* | 440 ± 36 |
| AV - delay, ms | AV-paced | 168 ± 24 | 172 ± 28 | 208 ± 35 | 194 ± 36 | 200 ± 53 | 170 ± 45 | 232 ± 23 | 175 ± 27 | 220 ± 28 |
| | AV-sensed | 124 ± 25 | 130 ± 23 | 186 ± 60 | 130 ± 21 | 136 ± 27 | 154 ± 45 | 146 ± 31 | 155 ± 36 | 200 ± 48 |
| Ventricular pacing, % | | 96.4 ± 11.6 | 97.8 ± 12.1 | 97.4 ± 4.8 | 94.5 ± 15.6 | 95.3 ± 15.8 | 93 ± 34 | 98.2 ± 10.9 | 99.3 ± 11.8 | 99 ± 11.3 |
| Atrial fibrillation/flutter time, % | | 3 ± 0.1 | 2 ± 0.2 | 2 ± 0.2 | 10 ± 4 | 11 ± 5 | 11 ± 6 | 31 ± 21 | 17 ± 13* | 15 ± 8 |

* $p < 0.05$ – significant differences of pacing parameters in different QRS complex classes after 6 month of permanent pacing vs. early postoperative period

** $p < 0.05$ – significant differences of pacing parameters in different QRS complex classes after one year vs 6 month follow-up

Basic pacing frequency, stimulated and detected AV-delay, as well as the percentage of ventricular pacing did not depend on QRS complex duration class and retain their values in all observation stages.

Ventricular pacing threshold were not

changed in the first 6 months in any of the QRS complex duration classes, but was increased at the annual observation stage in class 3 ($p < 0.05$).

Ventricular lead impedance in the first six months was decreased in all QRS complex

duration classes and then was stabilized at the annual observation stage in classes 2 and 3, meanwhile it was continued to decrease in class 1.

Atrial fibrillation/flutter time was initially higher in class 3 than classes 1 and 2. In six months observation stage this value has not changed in classes 1, 2 and was decreased in class 3 ($p < 0.05$), but did not reach the values of class 1 and 2. Atrial fibrillation/flutter time in annual observation stage was not changed within the classes against the six month period.

Absence of change of basic pacing rate, stimulated and detected AV-delay, as well as percentage of ventricular pacing at all observation stages does not depend on the QRS complex duration and indicates the reaching of the optimal values already in the early postoperative period.

Raising of ventricular threshold at the annual observation stage in patients of QRS complex duration class 3 might can be attributed to greater atherosclerosis frequency what was shown earlier (14 % in patient with QRS complex duration more than 120 ms vs. 3 % less than 120 ms) [1].

Levine P.A. et al. [2] associated pacing threshold raising at deferred observation stages with the formation of connective tissue scar at the electrode-myocardium region. Our study suggests that these changes are more prominent in patients of QRS duration complex class 3.

We could suspect that the reduction of ventricular pacing lead impedance is caused by so-called «maturation» of the electrode. Data on more pronounced decrease in the impedance in the shorter QRS complex are

consistent with Mitov V. et al [3].

Reducing of atrial fibrillation/flutter time in class 3 of QRS complex duration approach to that of patients of 1, 2 can be attributed to the optimization of medical management of patients with a permanent pacemaker [4, 5].

CONCLUSIONS

1. Basic pacing frequency and AV-delay, as well as the percentage of ventricular pacing is not related to QRS complex duration classes and do not change at observation stages of permanent pacing.

2. Ventricular pacing threshold, ventricular lead impedance and atrial fibrillation/flutter time in the annual observation stage defines the QRS complex duration class: ventricular pacing threshold in the first six months of observation was not changed in any of classes and was increased the annual stage in the class 3, ventricular lead impedance was decreased in the first six months in all classes, and it was stabilized in annual observation stage in class 2 and 3 and was continued to decline in class 1, atrial fibrillation/flutter time was initially higher in class 3, in six months stage was decreased without reaching, however, the values in class 1 and 2.

3. Ventricular pacing threshold, lead impedance and atrial fibrillation/flutter time can be used in the control of management patients with pacemakers

PROSPECTS FOR FUTURE STUDIES

It seems appropriate further investigation of possibility of management optimization taking into account QRS complex duration in patients with implanted pacemaker.

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