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HEART ELECTRICAL AXIS α ANGLE VALUES DISTRIBUTION IN PATIENTS, UNDERGOING PERMANENT PACEMAKER IMPLANTATION

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52 patients (24 male and 28 female) aged 71 ± 8 years, underwent permanent pacemaker implantation were included in the study. Analysis of heart electrical axis (HEA) α angle values distribution was carried out in three dimensions in patience before and after pacemaker (PM) implantation. The data processed in Microsoft Excel with calculation of the average and it's standard deviation. Significance of differences in data before and after PM implantation was assessed using Friedman ANOVA test and Kendall concordance coefficient. It was found, that α angle values distribution in patients with implanted PM is transformed from a unimodal to bimodal on the permanent cardiac pacing background. It's assumed, that α angle changes resulting due to right ventricular electrode positioning options during PM implantation. Clarification of the nature of this change requires a special study.

KEY WORDS: permanent cardiac pacing, heart electrical axis

РОЗПОДІЛЕННЯ ЗНАЧЕНЬ КУТА α ЕЛЕКТРИЧНОЇ ОСІ СЕРЦЯ У ПАЦІЄНТІВ З ПОСТІЙНОЮ ЕЛЕКТРОКАРДІОСТИМУЛЯЦІЄЮ

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Обстежено 52 пацієнта (24 чоловіка і 28 жінок) у віці 71 ± 8 років, які піддалися імплантації постійного електрокардіостимулятора. Проводився аналіз змін розподілу значень кута α електричної осі серця (ЕОС) в трьох площинах до і на тлі постійної електрокардіостимуляції (ЕКС). Вивчалися розподіл значень кута α в популяції пацієнтів до і після імплантації ЕКС. Дані оброблялися в Microsoft Excel з розрахунком середнього і його стандартного відхилення. Достовірність відмінностей в даних до і після імплантації ЕКС оцінювалася з використанням тесту Фрідмана ANOVA і коефіцієнта конкордації Кендала. Виявлено, що розподіл значень кута α у пацієнтів з імплантованими ЕКС трансформується з одномодального в бімодальне на тлі постійної ЕКС. Допускається, що отримані зміни кута α обумовлені варіантами позиціонування правошлуночкового електрода при імплантації електрокардіостимулятора. Уточнення природи змін вимагає спеціального дослідження.

КЛЮЧОВІ СЛОВА: постійна електрокардіостимуляція, електрична вісь серця

РАСПРЕДЕЛЕНИЯ ЗНАЧЕНИЙ УГЛА α ЭЛЕКТРИЧЕСКОЙ ОСИ СЕРДЦА У ПАЦИЕНТОВ, ПОДВЕРГШИХСЯ ИМПЛАНТАЦИИ ПОСТОЯННОГО ЭЛЕКТРОКАРДИОСТИМУЛЯТОРА

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Обследованы 52 пациента (24 мужчины и 28 женщин) в возрасте 71 ± 8 лет, подвергшихся имплантации постоянного электрокардиостимулятора. Проводился анализ изменений распределения значений угла α электрической оси сердца (ЭОС) в трех плоскостях до и на фоне постоянной

электрокардиостимуляции (ЭКС). Изучались распределения значений угла α в популяции пациентов до и после имплантации ЭКС. Данные обрабатывались в Microsoft Excel с расчетом среднего и его стандартного отклонения. Достоверность различий в данных до и после имплантации ЭКС оценивалась с использованием теста Фридмана ANOVA и коэффициента конкордации Кендала. Выявлено, что распределение значений угла α у пациентов с имплантированными ЭКС трансформируется из одномодального до в бимодальное на фоне постоянной ЭКС. Допускается, что полученные изменения угла α обусловлены вариантами позиционирования правожелудочкового электрода при имплантации электрокардиостимулятора. Уточнение природы изменений требует специального исследования.

КЛЮЧЕВЫЕ СЛОВА: постоянная электрокардиостимуляция, электрическая ось сердца

INTRODUCTION

The most widely used and effective treatment of hemodynamically significant bradyarrhythmias is permanent cardiac pacing (CP) [1–3]. It, however, does not solve the problem of associated cardiovascular pathologies and requires therapeutic monitoring [1–2, 4].

One of the most important electrophysiological parameters of heart condition in a variety of cardiovascular diseases is a heart electric axis (HEA) [5]. The most informative HEA reflection is projection of α angle on the frontal, sagittal and horizontal dimensions [6]. Unconditional effect on EOS, among other indicators, provides a permanent pacemaker [7], but its a little literature on this topic.

OBJECTIVE

Aim of this work is analysis of heart electrical axis α angle values distribution in patience, undergoing permanent pacemaker implantation.

MATERIALS AND METHODS

52 patients aged 71 ± 8 (M ± sd) (28 – female, 24 – male) were examined in the department of ultrasound and instrumental diagnostics with miniinvasive interventions of GI «Zaycev V. T. Institute of General and Urgent Surgery of NAMS of Ukraine». All patients were underwent permanent pacing therapy from 2006 to 2015 in modes: DDD (21 patients) and DDDR (15 patients), VVI (12 patients), VVIR (5 patients).

Patience younger than 40 years, with concomitant stable angina IV functional class (FC), chronic heart failure (CHF) IV FC and/or stage III with right ventricular (RV) pacing and/or left ventricular (LV) pacing less than 50 % of all rhythm was excluded from investigation.

Value of α angle in a frontal, sagittal and horizontal plane projection was evaluated before pacemaker implantation and in acute postoperative period (3–5 days).

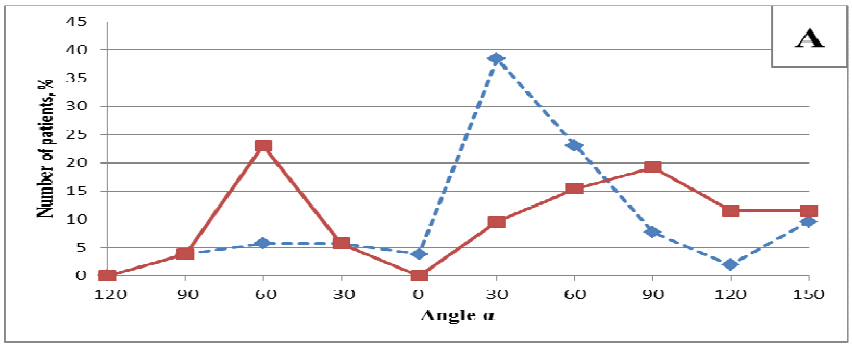
Electrocardiography registration were carry out to all patience on a computer ECG electrocardiograph «Cardiolab +» (HAI-Medica). Computer program «Cardiolab Imp» (HAI-Medica) were used for measuring an angle values. The α angle value is evaluated by the median complex for a 5 seconds period from 12 standard ECG leads.

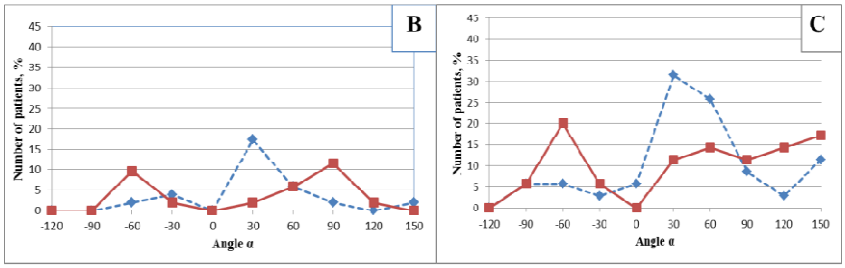
5 classes of electrical axis position (EAP) were allocated according to α angle values: normal – $\alpha = 30–70^{o}$, horizontal – $\alpha = 0–30^{\circ}$, vertical – $\alpha = 70–90^{o}$, right deviation – $\alpha > 120^{\circ}$, left deviation – $\alpha < 0^{\circ}$. α angle distribution values were studied in patients' population in all three dimensions before and after pacemaker implantation.

The data were processed after formation the Microsoft Excel using standard statistic procedure (for parametric data: mean – M, standard deviation – sd, for nonparametric ones: absolute (n, number) and relative (percentage of (p, %). The probability of differences of α angle values before and after PM implantation was determined using Friedman ANOVA test and Kendall concordance coefficient. The expected result is determined by level of reliability $p < 0.05$.

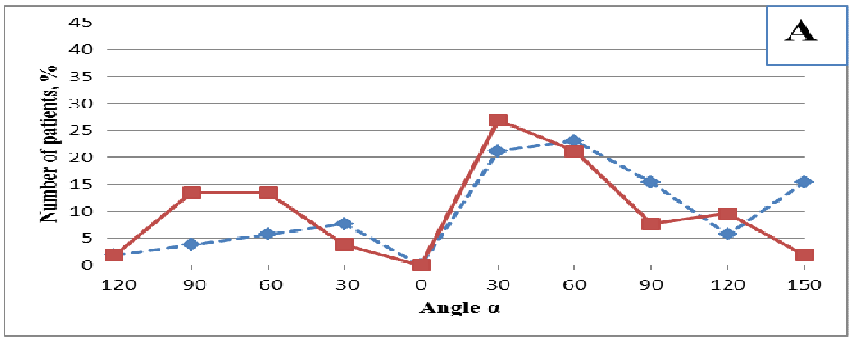
RESULTS AND DISCUSSION

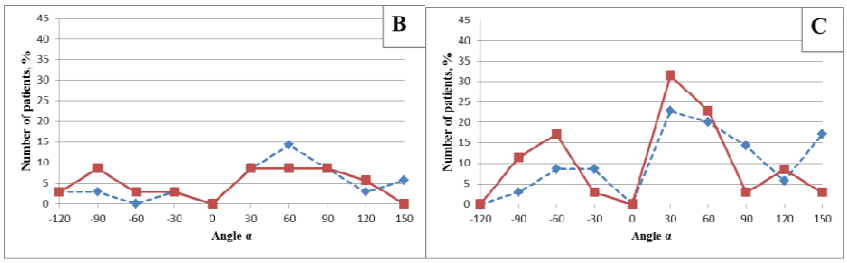
α angle values distribution in a frontal, sagittal, horizontal dimensions before and after PM implantation in the general population, in patients with VVI/VVIR and patients with DDD/DDDR pacemakers are shown in fig. 1.


A
Number of patients, %
Angle α

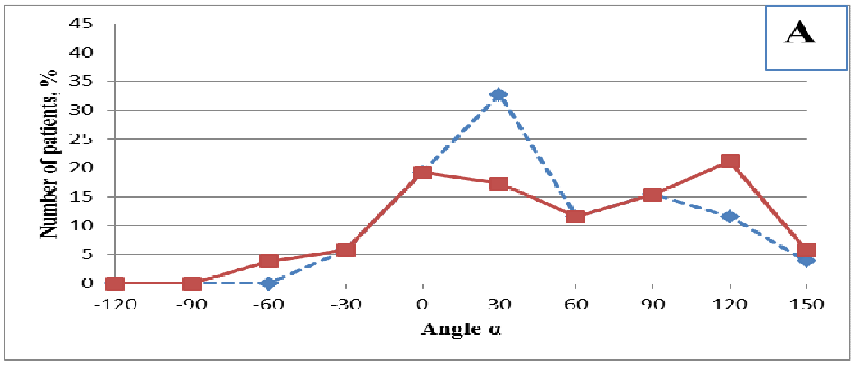

B
C
Number of patients, %
Angle α

II


A
Number of patients, %
Angle α


B
C
Number of patients, %
Angle α

III


A
Number of patients, %
Angle α

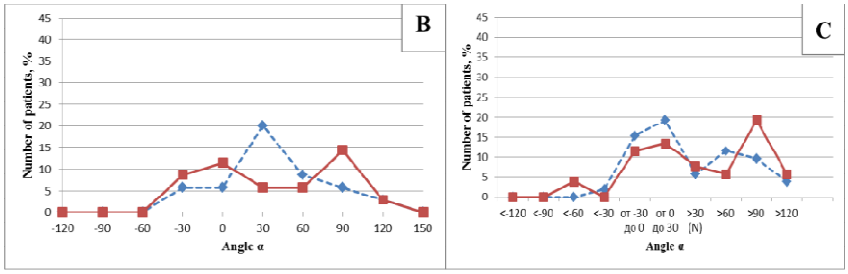


Fig. 1. α angle values distribution in a frontal (I), sagittal (II), horizontal (III) dimensions before and after PM implantation in the general population (A), in patients with VVI/VVIR (B) and patients with DDD/DDDR pacemakers (C)

α angle values distribution in all patience in a frontal dimension was unimodal in class of horizontal EAP before PM implantation (0 to 30°). α angle values distribution became bimodal during permanent cardiac pacing, with peaks in classes of EAP displacement to the left ($\alpha < 0°$) and to the right ($\alpha > 90°$).

α angle values distribution in sagittal and horizontal dimensions were close to bimodal, both before and after implantation of the pacemaker with maxima in classes of normal EAP (30 to 70°) and horizontal EAP (0 to 30°) positions, before it's left ($\alpha < 0°$) and right ($\alpha > 90°$) deviation after PM implantation. Installed changes in α angle values distribution of EAP with pacemaker implantation in all three dimensions were statistically significant at $p < 0.05$.

EAP is an important diagnostic sign of heart condition in a variety of cardiovascular diseases, followed by as a ventricular myocardial hypertrophy, intraventricular conduction disturbances, focal lesions of the myocardium [8], as a permanent PM implantation [7], and so its regular assessment has an important clinical implications. Our data on α angle values distribution in frontal, sagittal and horizontal planes in the studied group of patients before PM implantation characteristic of patients with coronary heart disease, hypertension, atrial fibrillation, congestive heart failure, diabetes, according to literature data [5, 8].

Referring variants we found of two α angle deviation, and so on EAP, in patients during permanent cardiac pacing, left and right, respectively, it can be noted that such data is not available in the literature. Most likely, the received changes of positioning options were seen due to right ventricular pacing electrode position, which, however, requires a special study [9].

The same patterns of change in α angle values distribution after PM implantation in all dimensions and most informative it's projection onto the frontal dimension give grounds to limit the results of this plane for practical purposes.

The fact of the transformation of unimodal α angle distribution in bimodal with a change in the maximum from the class of normal EAP highs in displacement for classes of left and right EAP deviation in the studied group of patients sets the task to study it's possible values in the changing health status of patients with implanted PM.

CONCLUSIONS

1. α angle values distribution in patients with implanted PM transformed from a unimodal to bimodal on the background of permanent cardiac pacing.
2. Changing of α angle values distribution in patients with implanted PM occurs in all three dimensions, turning out the most informative in the frontal dimension.
3. Determination of α angle values distribution changes in patients with implanted permanent PM may have diagnostic value and therefore requires dynamic control.
4. It's a quite limited to control α angle values changes in the frontal plane in clinical practice.

PROSPECTS FOR FUTURE STUDIES

It seems appropriate to investigate the links in the nature of changes of heart's electrical axis position with the health changes in patients with implanted permanent pacemaker.

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