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THE EFFECT OF RIGHT VENTRICLE PACEMAKER LEAD POSITION ON LEADS STABILITY

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Summary: The aim of the study is an assessment of difference of RVOT and RVA lead position in pacemaker stimulation, on leads stability parameters, in a 12 month follow up period. Patients and Methods: This was a prospective, randomized, follow up study, which lasted for 12 months. Our research enveloped 132 consecutive patients who were implanted with permanent antibradicardiac pacemaker – at the Pacemaker Centre of the Health Care Centre, Zaječar during the period 2009-2011. Regarding the right ventricle lead position the pts were divided into two groups: RVA group - 61 pts, with right ventricle apex lead position; RVOT group -71 pts, with right ventricle outflow tract lead position. Results: on study enrollment there was no group difference in the distribution of sex, age, BMI, VVI to DDD pacemaker implantation ratio and atrial impendance, senzing, threshold and radioscopy duration, judged by the above mentioned tests. The only difference betwen groups was in ventricular impendance, sensing and threshold. The stability analysis of ventricle electrodes gave the conclusion that the electrodes impedance after the 12 month follow up was significantly lower in both groups as compared to the beginning. Both groups had the same R wave sensing. Threshold remained the same in RVA, and was statistically higher in RVOT group ($p<0.001$). Conclusion: RVOT lead positioning did not require additional fluoroscopy time. Acute parameters on implantation differed only due to active fixation lead being used in RVOT group. After a 12 month follow up and analyzing of stability parameters, we found that the RVOT position was equally reliable as the RVA position.

Keywords: RVA, RVOT, pacemaker stimulation, Leads stability

INTRODUCTION

Standard pacemaker lead position and thus stimulation from Right Ventricle Apex (RVA), is characterized by prolonging transseptal and intraventricular impulse conduction, with QRS duration at least doubling from normal duration (1). Pacemaker stimulation from Right Ventricle Outflow Tract (RVOT) gives us faster stimulus conduction, and enables chamber activation from septum to the rest of the myocardium which in turn gives less dissinchrony and shorter QRS duration (2-4). However, in ventricle lead positioning, the problem in identifying RVOT remains beside the fluoroscopy from different directions and QRS morphology measuring on ECG (5, 6). Based on up to date multi center randomized trials, the benefit of alternative pacemaker stimulation site is clear (7), but the question still remains about the reliability and long term stability of RVOT position.

The aim of the study is an assessment of difference of RVOT and RVA lead position in pacemaker stimulation, on leads stability parameters, in a 12 month follow up period.

PATIENTS AND METHODOLOGY

This was a prospective, randomized, follow up study, which lasted for 12 months.

Our research enveloped 132 consecutive patients who were implanted with permanent antibradicardiac pacemaker, at Pacemaker center – Health Care Centre Zaječar, during the period 2009-2011. The pacemakers used were SJM Verity ADx XL SR 5156 VVI, and Medtronic Sensia SEDR01 DDD. Regarding the right ventricle lead position the pts were divided into two groups: RVA group - 61 pts, with right ventricle apex lead position; RVOT group -71 pts, with right ventricle outflow tract lead position. In RVA group, ventricle passive fixation leads, Medtronic 4074-58 were used. In RVOT group an active fixation ventricle lead SJM Tendril 188TC/58 were used. All the patients with DDD pacemakers had a "J" passive fixation atrial lead Medtronic 4592-53.

Parameters of lead stability were measured on implantation (impedance, threshold, sensing), as well as during the follow up.

Statistical analasys: We used analytical and descriptive statistical methods: absolute and relative numbers, central tendency measures (arithmetic average), dispersion measures (SD). Parameter tests: t test, ANOVA for repeated measures. Non-parameter tests: Hi square test, McNemar test.

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RESULTS

On study enrollment there was no group difference in distribution of sex, age, BMI (body mass index), VVI to DDD pacemaker implantation ratio and atrial impendance, senzing, threshold and radioscopy duration, judged by the above mentioned tests. The only difference betwen groups was in the ventricular impendance, senzing, threshold (Table 1).

Table 1. Comparisson of RVA to RVOT group on study enrollment. BMI, QRSs - QRS duration in intrizing rhythm (senzing), QRSp - QRS duration in pacemaker stimulation, V-Ventricle, A-Atrial

Baseline characteristics	RVA group N=61	RVOT group N=71	Test and statistic significance
Male	43 (70.50%)	46 (64.78%)	p=0.48
Female	18 (29.50%)	25 (35.22%)	
Age	72.72±9.40	72.69±8.66	p=0.98
BMI	26.47±4.48	27.09±4.33	p=0.42
Fluoroscopy (min)	3.31±2.53	3.39±2.13	p=0.39
VVIR	26 (42.62%)	35 (49.29%)	p=0.44
DDDR	35(57.38%)	36 (50.71%)	
V-Impedance	688.73±197.05	611.01±236.14	p=0.002
V-Threshold	0.45±0.28	0.68±0.38	p<0.001
V-Sensing	3.27±4.04	5.46±4.51	p<0.001
A-Impedance	503.88±138.90	488.37±98.35	p=0.98
A-Threshold	0.60±0.29	0.50±0.25	p=0.11
A-Sensing	2.44±1.65	2.78±1.91	p=0.67

The stability analysis of ventricle electrodes gave the conclusion that the electrodes impedance after the 12 month follow up was significantly lower in both groups as compared to the beginning. (Table 2). There was no group influence to the impedance value.

Both groups had the same R wave sensing (Table 2). The position of the lead had no influence on sensing value (p=0.29).

Threshold remained the same in RVA, and was statistically higher in RVOT group (p<0.001) (Table 2). Threshold was dependent on the lead position.

The stability analysis of atrial leads gave that impedance values, threshold, and P wave sensing remained unchanged in both groups during the 12 month follow up period. (Table 2).

Table 2: Pacemaker programming parameters comparison on 1-th month and 12-th month after pacemaker implantation in RVOT and RVA groups

Characteristics	RVA group n-61		Test and statistic significance	RVOT group n-71		Test and statistic significance
	1. month	12. months		1. month	12. months	
V-Impedance	624.28±147.71	584.79±132.56	p=0.01	536.40±191.87	480.58±139.99	p=0.001
V-Threshold	0.55±0.25	0.50±0.29	p=0.61	0.66±0.79	0.72±0.34	p<0.001
V-Sensing	10.42±6.26	10.09±6.56	p=0.63	8.07±3.87	8.77±5.30	p=0.29
A-Impedance	576.93±75.31	567.07±48.02	p=0.45	575.15±82.67	573.41±70.66	p=0.88
A-Threshold	0.66±0.39	0.54±0.32	p=0.11	0.50±0.25	0.60±0.37	p=0.40
A-Sensing	2.59±1.90	2.20±1.54	p=0.98	3.04±2.19	2.97±1.88	p=0.89

DISCUSSION

Our research enveloped pts which were followed in regards to pacemaker lead position in different positions in right ventricle, comparing its influence on leads stability, during the 12 month period in real life circumstances.

RVOT represents a trapezoid shaped space between the tricuspid and pulmonary valve, bordered with right chamber free wall in front, and with the upper part of the interventricular septum from the back (2-4, 8). In literature, RVOT is often presented as the above described, but also as a mid portion of the septum, and sometimes even as the region near apex. So, this confusion in defining the RVOT leads to the term of Non RVA pacing (5). Bharat et al (4) measured whether the RVOT lead positioning needed extra fluoroscopy time compared to RVA. They concluded that no extra fluoroscopy time was needed compared to RVA, 8.95 min for RVOT and 9.37 min for RVA. Our analysis also did not show any difference in fluoroscopy time between RVOT and RVA, 3.39 min and 3.26 min respectively. The same authors (4) also analyzed stability parameters on implantation, and concluded that threshold level in RVOT group was significantly higher than in the RVA group. Impedance and sensing did not differ. In the other paper, analysis of lead parameters on implantation, in RVA and RVOT, showed similar values for sensing and impedance, while the threshold was higher in RVOT group (9).

Our analysis implantation values were practically the same as in other studies, the lead position influenced the stimulation threshold, which was significantly higher in RVOT group compared to RVA. However, impedance and R sensing also showed significant difference. This was due to the different type of electrode used in RVOT, compared to RVA, active fixation vs. passive fixation lead, respectively. This was confirmed by the fact that atrial leads showed no difference, due to the fact that they were passive fixation type in both groups.

Long term follow up of the patients with RVOT lead position, showed that the lead was stable after one (10) and nine (11) years. Kristiansen et al followed the CRT patients with the right ventricle lead was implanted in RVA or RVOT. Stability parameters showed no difference between the groups after 2 year follow up (12). The data analysis from 20 randomized trials, on 1,114 patients showed the same stability characteristics in RVOT during a long term follow up as in RVA (13). The stability of RVOT lead position was also demonstrated with the results of long term follow up of threshold levels, which did not differ from RVA (10, 14-16).

In our study , after a one year follow up, impedance was equally changed in both groups, which was explained with electrode maturation, there was no group influence on impedance level change ($p=0.44$). R sensing did not change significantly after one year in both groups. Threshold level remained the same in RVA group. However, the average threshold level on ventricle lead in RVOT group was 0,72V ($p<0.001$) which was statistically significant higher value compared to the implantation value, but still within the clinically acceptable range, meaning that it had no influence on battery drain.

The atrial lead stability analysis showed no change of threshold, impedance and sensing after a 12 month follow up.

CONCLUSIONS

RVOT lead positioning did not require additional fluoroscopy time. Acute parameters on implantation differed only due to active fixation lead being used in RVOT group. After 12 months of follow up, analyzing stability parameters, we found that the RVOT position was equally reliable as the RVA position.

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