FREQUENCY OF ATRIAL FIBRILLATION IN PATIENTS WITH IMPLANTATION OF VENTRICULAR DEMAND RATE RESPONSIVE AND DUAL CHAMBER RATE-MODULATED PACEMAKER

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ABSTRACT

Objectives: To determine the frequency of AF in patients after implantation of permanent pacemaker.

Methodology: This longitudinal observational study was conducted in the department of cardiology Hayatabad Medical Complex from 1st September 2018 to 31st August 2019 through a descriptive cross sectional study design, total of 58 patients were included in this study.

Results: Total of 58 patients were included in the study. Sample size calculated by WHO sample size calculator using 95%confidence interval and 5% error. 29 (50%) patients had no comorbidity, 5 (8.5%) patients were Diabetic, 17 (29.3%) patients were hypertensive, 7 (12.1%) patients were having CAD. 15 (25.9%) Patients had normal Echo Report with ejection fraction >55%, 34 (58.6%) Patients had Preserved LV Function, 9 (15.5%) Patients were recorded with impaired LV Function. 32 (55.2%) had VVIR Device implanted whereas in 26 (44.8%) patients DDDR Device was implanted. 58 (100%) patients had Sinus Rhythm during implantation. At one month follow up, 56 (96.6%) had Sinus Rhythm, 2 (3.4%) patients had Atrial Fibrillation. At one year, 50 (85.2%) patients had sinus Rhythm and 8 (13.8%) patients had AF. 13 (22.4%) patients had developed Heart Failure.

Conclusions: Our study showed AF burden initially decreased significantly but over long-term AF significantly increased progressively.

Keywords: Ventricular Demand Rate Responsive Pacing; Dual Chamber Rate-Modulated Pacing; Atrial Fibrillation; Sick Sinus Syndrome; Atrioventricular Block

INTRODUCTION

The use of cardiac pacemakers has become an integral intervention in several cardiology clinics.[1] It has significantly reduced the morbidity and mortality in patients with heart diseases and has also improved the quality of life.[2] However, it may induce and/or exacerbate complications related to cardiac rhythm like atrial fibrillation.

Several patients who are implanted permanent pacemaker develope heart failure leading to atrial fibrillation (AF).[3] Several complications of long-term AF are recognized. For example, AF can lead to cardiac dysfunction, an increased incidence of thromboembolic events, and atrial enlargement.[4] In addition, it is known that patients with AF exhibit a higher mortality and cardiac events.[5] In addition, it must be known that up to 40% of all patients with AF remain asymptomatic.[6] However, these patients are still at risk of developing an increased morbidity. These findings warrant a continuous monitoring of cardiac rhythm in high-risk patients. However, it is not possible in patients without monitoring devices.

The determination of Pacemaker insertion complication adverse events is related to the specific type of procedure and patient comorbidities.[7] Longer-term patient outcomes may also be affected by the procedure; thus, reporting of complications should include both short- and long-term results.[8] Major complications were those that placed the patient at significant risk, requiring an intervention, procedure, or hospitalization for management.Among many major complication , one of them is Atrial fibrillation post procedure.[9,10]

This study aims to bridge this gap in our knowledge by investigating the frequency of AF among Pakistani patients with VVIR and DDDR. We measured the frequency of AF with relevance to various confounding

factors, including age, gender, clinical presentation, and comorbidities, including diabetes mellitus (DM), hypertension (HTN), and coronary artery disease (CAD). We hypothesize that the occurrence of AF is affected by these confounding factors in Pakistani patients. In addition, VVIR and DDDR may also be useful in detecting AF in patients with these comorbidities.

METHODOLOGY

We recruited 58 patients. The sample size calculated by WHO sample size calculator using 95%confidence interval and 5% error at Hayatabad Medical Complex Peshawar after obtaining written informed consent. An ethical approval was obtained from the hospital ethics committee. Patients with AF at the time of presentation were excluded from the study. Conversely, patients with sinus rhythm, complete heart block, and 2nd heart block with VVIR or DDDR, were included after explanation of the procedure and capabilities of the implanted devices. The selection of VVVIR (Vpaced Vsensed Inhibitory Mode Rate Responsive Single chamber PACEMAKER) or DDDR (both Atrial and Ventricular pacing Both Atrial and Ventricular Sensing Both inhibitory and tracking Rate Responsive DUAL CHAMBER PERMANET PACEMAKER) for individual patients was based on generalized health and financial status of the patient as well as sponsor scheme and availability of the device. The study was conducted in accordance with the ethical guidelines of the declaration of Helsinki.[11]

RESULTS

All patients got pre-procedure preparation, including chest shaving in male patients, cleaning the chest with pyodine, sedation and IV antibiotics. Before the surgical procedures, patients had an overnight fast, were scrubbed and the targeted vein on the selected site located with contrast under fluoroscopy. Axillary vein was used as the most common approach for pacemaker implantation. All patients received injectable antibiotics for up to five days and then oral for another five days. Device programming was performed on the next day and a chest x-ray was conducted for any procedure complication.

At time of discharge the follow up plan was given monthly for one year. If Atrial Fibrillation complication had developed during follow up, patients presented with palpitations and confirmed on ECG and Pacemaker programmer with irregularly irregular R wave and no discrete p waves. Data was retrieved from Pacemaker Programmer and ECG.

Data was analyzed on SPSS version 22 for frequency, means and mode. Chi Square test was applied for qualitative data like gender with statistical significance keeping P value < 0.05.

Quantitative data like age, risk factors, number of patients with complication, was calculated as mean median. The basic characteristics of the study population are described in table 1. Among the total of 58 subjects, a small number of patients presented with DM (8.5%), HTN (29.3%), and CAD (12.1%). Among the pacemakers, DDDR was implanted in 26 patients (44.8%) and VVIR in 32 patients (55.2%) (table 1).

All patients had sinus rhythm at the time of implantation. However, one month after implantation, two patients (3.4%) presented with AF, which remained at six months. However, one year after implantation, eight patients (13.8%) presented with AF (table 2). AF which persists for more than one year is permanent AF while the one which lasts for less than 24 hours is paroxysmal AF.

We next investigated the echocardiography parameters in the study population. At the time of implantation, 15 (25.9%) patients exhibited normal echocardiography parameters. Conversely, 34 patients (58.6%) presented with preserved, while 9 (15.5%) patients presented with impaired echocardiography parameters.

About 45 patients (77.6%) had no adverse outcome following the implantation. However, 13 patients (22.4%) presented with heart failure. Among those 13 patients, six were males and seven were females. Among the patients with heart failure, two patients had no comorbidity, four patients had DM, five patients had HTN, and two patients had CAD. Similarly, eight patients with VVIR and five patients with DDDR were presented with heart failure.

When we compared the outcome according to the cardiac rhythm, all the patients who exhibited with heart failure had sinus rhythm at the time of implantation, and one and six months after implantation. However, one year after implantation, two patients with AF developed heart failure compared to 11 patients with normal sinus rhythm (table 3).

Last, we compared the outcome according to the echocardiographic findings at the time of implantation. Out of 15 patients with normal echocardiographic findings at the time of implantation, only one patient developed heart failure. Conversely, out of 27 patients with preserved echocardiographic findings at the time of implantation, seven patients developed heart failure with symptoms of shortness of breath, palpitation. Lastly, out of nine patients with impaired echocardiographic findings and no symptoms of heart failure at the time of implantation, five developed heart failure. When we compare the frequency of atrial fibrillation in single versus double pacemaker chamber, we see significant p value of 0.006 in single pacemaker at 1 year.

DISCUSSION

Permanent pacemaker implantation is a

Table 1: Basic characterization of the study population.

S.No	Variable	Percetage
1	AGE	61+17.230
2	MALE	27 (46.6%)
3	FEMAE	31(53.4%).
4	DM	5 (8.5%)
5	HTN	17 (29.3%)
6	CAD	7 (12.1%)
7	DDDR	26 (44.8%)
8	VVIR	32 (55.2%)
TOTAL	58	

Table 2: Outcomes of the patients according to the type of pacemaker device.

		Device Implanted in Patient	
		VVIR (n=32)	DDDR (n=26)
Outcomes	Nil	24	21
	HF	8	5

Table 3: Frequency of atrial fibrillation with single chamber pacemaker at 1month,6 month and 1 year.

	AFIB		Single chamber		chi square value	pvalue
			No	yes		
Single Chamber	1 month	Nil	26	30	1.683	0.195
		yes	0	2		
	6 months	Nil	26	30	1.68	0.195
		yes	0	2		
	1 year	Nil	26	24	7.540	0.006
		yes	0	8		
Double Chamber	1 month	Nil	30	26	1.68	0.195
		yes	2	0		
	6 months	Nil	32	24	2.54	0.110
		yes	0	2		
	1 year	Nil	26	24	1.475	0.225
		yes	6	2		

lifesaving procedure and is an integral part of cardiology, particularly of cardiac electrophysiology.[12] After sixty years of first device implantation, there is continuous improvement in device implantation technique, device structure, size and leads texture.[8] The first device ever implanted weight was in kilograms and now the smart devices came to a size of one Ounce (28 g). The first-generation leads were mostly unipolar, harder, and more prone to erosion but continuous improvement in leads structures.

We conducted this study to observe the effects of device on rhythm, both in single chamber devices and Dual chamber devices. The ratio was more with single chamber devices as compared with the dual chamber devices. The same was reported from study as possible cause of AF with VVIR. We also noted that AF was more in male gender, elderly peoples.[19] Pacing is perceived as an assault to cardiac muscles and if ratio of pacing is reduced, the ratio of arrhythmias is also directly affected. But as it has been noted over the years that dilation of atria has directly proportional with AF.[9] The same thing happened in mitral stenosis where dilation of atria leads to AF and once AF occur, it begets AF. The same was observed with devices, heart cannot bear the assault of pacing both with single chamber and dual chamber devices. However, with single chamber devices apart from pacing stimulus, the asynchrony also plays a role in the dilation of atria's and so leads to initiation of AF. But we have noted in our EP Lab that a very transient pacing in some peoples can lead to AF. It was mostly seen in fast pacing and high intensity pacing, more the amplitude, more the chance of arrhythmias. It was also noted in patients who are undergoing electrophysiological study and their study prolongs due to any reason develops transient AF.[5] So, if we look for the causes of AF in these patients it is evidenced that there is no single factor responsible for this cumbersome arrhythmia, but it is more with single chamber devices. The possible reason may be asynchrony, ratio of pacing, atrial dilation, intensity of current and possible racial and some gender factors. Some people's hearts are more vulnerable to arrhythmias with pacing.[7,20]

These adverse situations were more noted with VVIR pacemakers than with dual chamber pacemakers. These patients are exposed to the drastic consequences of AF.[7] To sum up there is no one single cause of AF and still there is room to investigate the causes of AF and method of prevention of AF by decreasing the pacing, making the lead smart to decease the intensity of current and make texture of leads more compatible to the human heart. The biological AV/AS mode may be the future of devices.

LIMITATIONS

Our study is limited by observing the effects of hormonal and psychological factors of the patients. Also, the stduy fails to observe any relation with the intensity of current and closely looking to the threshold and amplitude effects. The length and texture of lead and folded lead in chamber also needs considerations. To sum up this a field still needs to be revealed.

CONCLUSIONS

Pacemaker implantation is a lifesaving procedure but it's not without its complications. Our study showed AF burden initially decreased significantly but over long-term AF significantly increased progressively.

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Author's Contribution

JK and ZA conceived the idea, designed the study and collected the data, and helped in the write up of the manuscript, RI, SH, SA collected data, RN performed data analysis. All authors made substantial intellectual contributions to the study.

Conflict of Interest

Authors declared no conflict of interest

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None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.