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Evaluation of left ventricular dysfunction after permanent pacemaker implantation using global longitudinal strain

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Abstract

Around one million pacemakers are installed every year, with atrio-ventricular (AV) block being the reason for more than a third of these procedures. High-burden right ventricular (RV) pacing is often tolerated for decades without any overt left ventricular (LV) failure in the majority of patients. It has been shown, however, that prolonged RV pacing reduces LV function and ultimately causes heart failure (1). Left ventricular ejection fraction (LVEF) may decrease in certain individuals with pacemaker implants following pacing. Pacing-induced cardiomyopathy (PICM) is the medical term for this issue (2). However, pacing-induced LV dysfunction (PIVD) at milder severity levels has also been documented. (3). Predicting PICM and PIVD one year after pacemaker installation is made possible by measuring global longitudinal strain (GLS) one month after implantation.

Keywords: pacemaker, pacemaker induced left ventricular dysfunction, global longitudinal strain.

1.Introduction

However, some people show indications of heart failure after having a pacemaker implanted, a condition called pacing-induced cardiomyopathy. As a result of abnormal ventricular activity that does not involve the conduction system, this occurs. As one of the primary causes of pacing-induced cardiomyopathy, ventricular dyssynchrony has been the subject of much study (4). It is difficult to determine whether patients will develop PIVD or PICM in the early stages.

2. Material and methods

Study Design

It is single center; observational study that was conducted at Benha University hospital‖.

Patients

Fifty patients with high degree AV block elicited for permanent pacemaker implantation were enrolled in this study.

Inclusion criteria

Patients above 18 years with high degree AV block elicited for permanent pacemaker implantation.

Exclusion criteria

- Patients with impaired systolic function (LVEF <50%).
- Ischemic heart disease.
- Significant valvular heart disease (moderate at least in severity)
- Pregnancy
- Poor echogenic window.
- Patient refusal.

Methods

The following data were collected:

A) Ethical considerations

- Every person who took part gave their informed permission. The Benha University School of Medicine's Ethical Review Board for Human Subjects Research gave its stamp of approval to the study.

B) Patients Characteristics:

- Demographics: Age, sex, and risk factors.
- Admission details: baseline electrocardiogram (ECG) and indication of pacemaker implantation.

C) Study protocol:

- Echocardiography and electrocardiography utilising Simpson's technique and GLS to determine ejection fraction as a starting point.
- Patients were to have permanent pacemakers with two chambers implanted, with the ventricular lead placed at the right ventricular apex following the protocol (5).
- Monitoring included recording QRS length and pacing % once a month for a year to re-evaluate EF and GLS.

2.1Statistical analysis

All results were statistically analyzed and tabulated using the suitable program.

3.Results

A total of 50 patients with advanced AV block were included in the final analysis, all patients had their permanent pacemaker implanted. Patients had a mean age of 72.7 + 13.5 years old **(table 1).**

Table (1) Clinical characteristics between patients with and without decline in LVEF.

Variable	All (n = 50)	Decline in LVEF (n=8)	No decline in LVEF (n = 42)	p
Age	72.7 + 13.5	72.4 + 13.4	70.8 + 11.8	0.937
Male (%)	35 (17)	12	23	0.208
Baseline LVEF (%)	61.1 + 5.4	60.7 + 6.2	61.3 + 5.1	0.708
Diabetes (%)	10(20)	3	7	0.633
Hypertension (%)	20 (10)	8	2	0.066
Post-pacing QRS duration	127.3 +46.3	158.7 + 53.0	120.0 + 37.1	0.163
Mean Cum%VP at 12m	43.5 + 40.0	84.8 + 31.0	43.7 +43.2	0.005

Baseline GLS values were not significantly different between patients who developed PIVD at 12 months and those who did not. However, one-month GLS values were significantly lower in the group who went on to develop PIVD at 12 months **(table 2).**

Table (2) Differences in LVEF and GLS values between patients with and without pacing-induced LV dysfunction.

	Decline in LVEF PIVD and PICMP cases (n = 15)	No decline in LVEF (n = 40)	p
LVEF			
Baseline	62.7 + 642	60.3 + 3.1	0.780
1 month	52.5 + 6.5	60.4 + 4.5	0.002
12 months	46.7 + 8.9	58.7 4.5	0.010
Global longitudinal strain			
Baseline	-16.3 + 0.5	-17.5 + 0.6	0.515
1 month	-12.6 + 0.9	-16.4 + 0.6	0.022
12 months	-11.9 + 2.5	-15.8 + 3.9	0.008

4.Discussion

Although the majority of RV paced patients do not have pacing-related heart failure, LV systolic dysfunction is well recognised in certain individuals after RV pacing. [6].

Predicting which patients may be impacted remains a difficult clinical problem. It has been observed that GLS, as assessed by 2D STE, may be used to detect subclinical LV dysfunction in various circumstances, such as after chemotherapy [7].

Additionally, GLS has been studied as a gauge of LV dysfunction after pacing [8]. However, the goal of this research is to see whether GLS can anticipate changes in EF ahead of time.

Our goal with this research was to give a thorough evaluation of LVEF and GLS by integrating information from before the implant, one month after the implant, and one year after the implant.

Patients who developed PICMP 12 months after pacemaker implantation showed a substantial drop in GLS and LVEF at the 1-month post-implant mark. Nonetheless, we have shown that GLS assessed at one month after pacemaker installation may detect a subset of patients who show signs of PIVD after 12 months. Therefore, GLS might be a therapeutically effective technique for identifying this subset of patients who could benefit from increased echocardiographic monitoring of LV dysfunction after pacemaker installation. There was also a strong correlation between a GLS of 12.6 at 1 month and the subsequent development of PIVD at 12 months.

5. Conclusion

When performed 1 month following pacemaker installation, GLS may help identify individuals at risk for developing pacemaker-induced LV dysfunction earlier than EF alone does.

6. Limitations

A sufficient sample size was employed in this investigation, yet it is still too small to draw broad conclusions.

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