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RESEARCH ARTICLE

A Holistic study on demographics and cardiac imaging in cardiac implantable electronic device users

Aleena Roy*[1], Nandini Palivela [2], Jessi Peruri [3], Kasturi De[4], Anurag Rajkonwar[5], Ratna Kumari Padamati[6], Chandramouli S Mantravadi[7]

[1] *Intern of Pharm. D at Aditya Pharmacy College, Surampalem, Andhra Pradesh, India.*
[2] *Intern of Pharm. D at Aditya Pharmacy College, Surampalem, Andhra Pradesh, India.*
[3] *Intern of Pharm. D at Aditya Pharmacy College, Surampalem, Andhra Pradesh, India.*
[4] *Assistant Professor at Aditya Pharmacy College, Surampalem, Andhra Pradesh, India*
[5] *Intern of Pharm. D at Aditya Pharmacy College, Surampalem, Andhra Pradesh, India.*
[6] *Associate Professor at Aditya Pharmacy College, Surampalem, Andhra Pradesh, India.*
[7] *Consultant Cardiologist at Trust Multi-speciality Hospitals, Kakinada, India.*

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Abstract: Worldwide there were reportedly 1.14 million pacemaker implantations starting around 2022. The number is supposed to ascend by 1.48 million by the year 2027. The remarkable ascent in pacemaker implantation throughout the course of recent many years might be credited to the aging population and the extension of pacing signs, for example, complete heart block and congestive cardiovascular breakdown. The embedded cardiovascular pacemakers have progressed from clear, non-programmable, non-coordinated ventricular pacing to complex multi-programmed double chamber and biventricular gadgets. Goals: The ongoing review plans to give point by point data with respect to segment profiles, ECG qualities, and 2D Reverberation discoveries of patients who went through pacemaker implantation. We conducted single centered focused, ambi-directional, cross-sectional study in a Tertiary care hospital, Kakinada with the data of 118 subjects for a review time of 1 year. 112 were signed up for our review while the leftover 6 were passing cases and individuals with positively no interest in cooperation. Results: Among 112 subjects, the larger part 38 (40%) subjects were determined to have Total heart block followed by Congestive cardiovascular breakdown 27 (24%). According to ECG irregularities, 41 (37%) subjects had total AV block followed by 36 (32%) subjects who were determined to have sick sinus syndrome. conclusion: The subjects with severe left ventricular ejection fraction are highly recommended to go through gadget implantation straightaway. The number of patients getting long-lasting pacemakers, Implantable Cardioverter defibrillators, and cardiovascular resynchronization treatments has expanded as a result of advancements that save lives, improve the quality of life and lower mortality.

Keywords: Cardiac Implantable Electronic Device; Cardiac Resynchronization Therapy; Complete Heart Block; ECG abnormalities; Implantable Cardioverter Defibrillator; Left Ventricular Ejection Fraction

1. Introduction

The term Cardiac Implantable Electronic Device is basically used to refer to all kinds of implantable medical equipment which mainly comprises pacemakers, cardiac defibrillators, specialized pacemakers, and defibrillator models. Pacemakers are compact electronic medical devices that detect electric impulses from electrodes and deliver electric stimulation as required. The aim of cardiac pacing is to maintain a healthy heart rate [1-2]. Pacemaker insertion is mainly performed in cardiac catheter laboratories by a team of health care experts comprising the consultant cardiologist, cardiac technician, cardiac nurse, and radiographer. The procedure is mostly carried out under local anesthesia and the left subclavian vein route is mostly preferred [3].

Bradyarrhythmias and tachyarrhythmia are treated with modern pacemaker devices, which are sometimes paired with implantable defibrillators [4].

2D ECHO findings of patients who underwent pacemaker implantation. The need to research the outcomes, and patient experiences is greater than ever due to the rising number of cardiovascular patients Devices that preserve synchronization between atria and ventricles are recommended in elderly patients. Adults with pacemakers are typically installed to address fascicular blocks, acquired atrioventricular blocks, and sinus node dysfunction. Additionally, they are efficient in the treatment and prevention of a few types of neurocardiogenic syncope and tachyarrhythmia. Recent studies have demonstrated that biventricular pacing is a successful treatment for advanced heart failure in patients with substantial intraventricular conduction [5]. Most pacemakers are comprised of

* Corresponding author: Aleena Roy

two main parts, the pulse generator and the leads. Battery and instructions for controlling the heartbeat are included in the pulse generator while the leads which are actually the wires send electrical signals from the generator to the heart [6].

Cardiac Implantable Electronic Device provides four primary functions, they detect electrical activity from the atrium or the ventricles, categorize these signals into several programmed "heart rate zones", and provides tiers of treatments to stop ventricular tachycardia or fibrillation and pace for bradycardia. Ventricular pacing improves ejection fraction using a biventricular Implantable Cardioverter defibrillator (ICD) commonly known as Cardiac Resynchronization Therapy (CRT) [7, 8]. In patients with low ejection fraction, severe interventricular conduction delay, or intraventricular dyssynchrony, cardiac resynchronization therapy has been demonstrated to cause problems which may affect the longevity of the person.

Despite these rising numbers, there hasn't been a comprehensive national database to assess the rate of pacemaker implantation, patient's demographical details, pacing strategies, modes of selection, newly invented implantable devices, and patient diagnostic reports 9Outcomes of successful pacemaker implantation mainly comprise reducing the number of cardiac If the patient is left untreated then the patient may suffer from slow heart rhythm which deprives the organs of oxygen and nutrients. Arrhythmias can harm the brain, heart, and other organs if it's not addressed. This may result in potentially fatal stroke, heart failure, or cardiac arrest. If not treated within a few minutes cardiac arrest can result in death as the heart stops beating suddenly and unexpectedly8.

A single chamber ventricular pacing mode with the rate response is known as the VVIR mode. This indicates that the pacing rate is based on the patient's activity as measured by a sensor. Patients with permanent atrial fibrillation should be given preference for VVI /VVIR mode (V for pacing the ventricle signals, V for sensing the ventricle signals, and I for inhibiting the electrical signals) patients experience intermittent bradycardia may also be programmed into this mode. The default programming option for dual chamber and resynchronization therapies (with an additional left ventricular lead) is called DDD mode (D for pacing the atrium and ventricle, D for sensing the atrium and ventricle, and D for inhibiting or triggering the electrical signals). When the intrinsic or paced atrial rate is high during exercise, it facilitates the maintenance of atrioventricular synchrony. In patients with Chrono tropic incompetence, the DDD mode will manage bradycardia and give AV synchronization, but not rate adaption in the event of Chrono tropic incompetence. The DDDR mode will offer distant rate adaption, preserves AV synchronization, and regulate bradycardia8.

For cardiac conductive problems, pacemakers are now often used as treatment. Due to the broadening of indications of pacemakers and the availability of improved technologies, pacemaker implantation has dramatically increased during the past few decades. Over 3 million people worldwide have pacemakers or 3 million people worldwide have been implanted with pacemakers or other cardiac rhythm control devices and over 7, 00,000 new pacemakers are paced each year [9]. Disorder symptoms including disorientation, nausea, palpitations, and chest pain and moreover avoiding uncomfortable symptoms brought on by arrhythmias like fainting. Thereby protecting the heart from malfunctioning and saving the patient's life.[10]

Our current study aimed at finding the demographic profiles, ECG characteristics, and utilizing pacemakers and paucity of studies in our area. The current study used qualitative research techniques to examine pacemaker patient's experiences. The findings can be used to deliver high-quality care, determine the best way to interact with patients, find solutions to pacemaker–related issues, and ultimately assist pacemaker users

2. Methodology

A single-centered, Ambi-directional cross-sectional study was performed by collecting relevant data from patients who underwent pacemaker implantation. The study was carried out at Trust Multi-Speciality Hospital, Kakinada. A total of 112 patients with CIED implantation from April 2022 to April 2023 were included in the study.

The selection of the sample was done on the basis of criteria by using data collection forms. Subjects were patients from all age groups of both genders who got implanted with different types of CIEDs. The patients with temporary pacemakers who had the reversible causes of 1st & 2nd-degree atrioventricular block was been excluded. Data analysis was usually performed using statistical tools like MS-EXCEL The patient details like age, gender, chief complaints, diagnosis, ECG & ECHO reports were been reviewed and documented.

3. Results and discussion

In a total of 112 subjects, 50 (45%) subjects were between the age group of 55-65 years, followed by 39 subjects (35%) in the age range of 66-75 years whereas 9 (8%) subjects were less than 54 years. In our study, of 112 subjects, 67 subjects (60%) were males and 45 subjects (40%) were females. So, we can conclude that the males are in greater need of pacemaker implantation as compared to females. The male predominance can be attributed to cholesterol buildup, work stress, Alcohol drinking, and smoking habits. (Figure 1a and 1b).

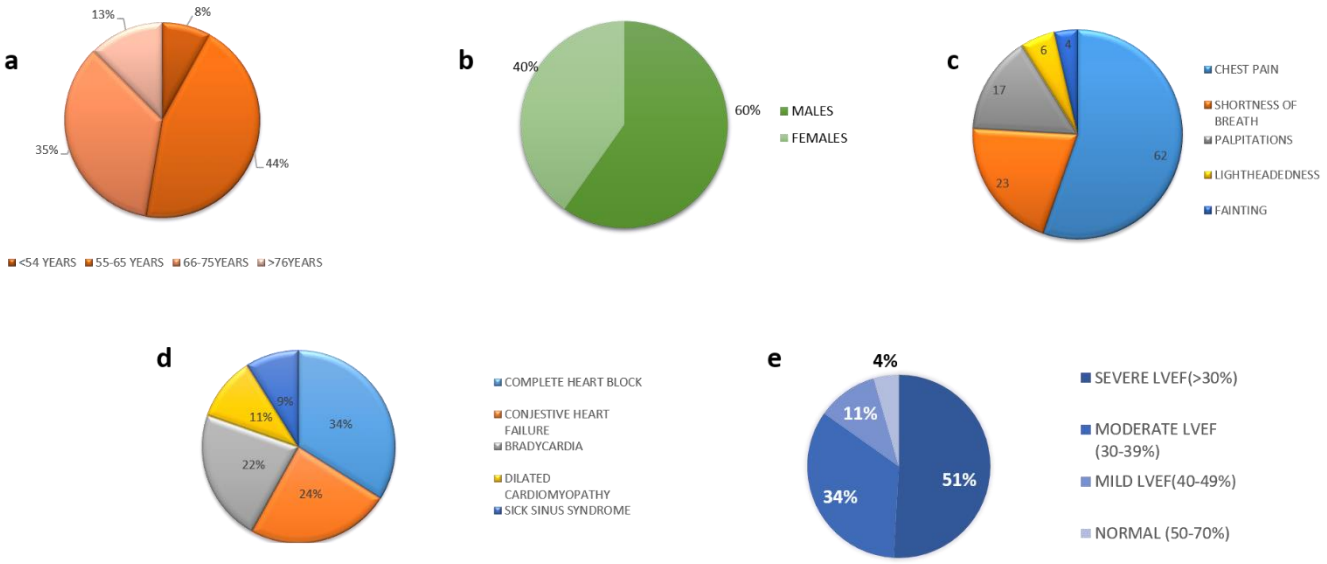

Figure 1. a. Age-wise Distribution of Study Subjects b. Gender Wise Distribution c. Distribution of Subjects based on Reasons for Admission d. Distribution based on Diagnosis made e. Distribution based on 2D Echo Findings

Among 112 subjects, the majority of subjects who are 62 in number (55%) were suffering from chest pain followed by 23 subjects (22%) who came with the complaint of shortness of breath (SOB), while 4 subjects (4%) underwent fainting episodes before admission (Figure 1c). 38 Subjects (34%) were suffering from complete heart block followed by 27 subjects (24%) with Heart failure, while 25 subjects (22%) were diagnosed with Bradycardia (Figure 1d). Echocardiography is mainly based on the parameter of left ventricular ejection fraction (LVEF). LVEF is further subdivided into severe (>30%), moderate (30-39 %), mild (40-49%) and normal (50-70%). In our current study, 57 subjects (51%) had severe dysfunction followed by 38 subjects (34%) with moderate LVEF, 12 subjects (11%) with mild LVEF, and 5 subjects (4%) with fair/good LVEF (Figure 1e). 41 Subjects (37%) had complete AV block, 36 subjects (32%) had sick sinus syndrome, 24 subjects (21%) had atrial fibrillation, 6 subjects (5%) with premature ventricular contractions as only 5 subjects (4%) were subjects with abnormalities of his bundle branch block (Table 1)

Table 1. Distribution of ECG characteristics

S. No	ECG Characteristics	No. of Subjects (n=112)
1	Complete AV block	41 (37%)
2	Sick sinus syndrome	36 (33%)
3	Atrial fibrillation	24 (21%)
4	Premature ventricular contractions	6 (5%)
5	His bundle branch block	5 (4%)

Table 2 shows the distribution of subjects based on the types of devices implanted. The subjects admitted to this hospital were mostly 89 subjects (79%) implanted with temporary pacemakers which are mainly replaced by permanent pacemakers followed by 10 subjects (9%) subjects who were implanted with a similar device which is basically known as a Implantable Cardioverter Defibrillators (ICDs), 9 subjects (8%) underwent Cardiac Resynchronization Therapy (CRT) while the least number of subjects of number 4 (4%) went for pulse generator replacement

Table 2. Distribution based on Types of Devices

S. No	Types of Devices	No of Subjects (n=112)
1	TPI followed by PPI	89 (79%)
2	Implantable Cardioverter defibrillator	10 (9%)
3	Cardiac resynchronization therapy	9 (8%)
4	TPI & PG Replacement	4 (4%)

Table 8 shows the distribution of subjects based on modes of pacing. While doing this study we came across dual chamber modes like DDDR and DDD as well as single chamber modes like VVIR and VVI. Mostly 39 subjects (44%) were implanted with DDDR mode followed by 23 subjects (26%) with DDD mode. Single chamber modes like VVI were recommended for 15 subjects (17%) and VVIR for 12 subjects (13%)

Table 3. Distribution based on Modes of Pacemakers

S. No	Modes of Pacemakers	No of Subjects (n=89)
1	DDDR	39 (44%)
2	DDD	23 (26%)
3	VVI	15 (17%)
4	VVIR	12 (13%)

4. Conclusion

From our current study findings, it's evident that the geriatric population constitutes the maximum number of pacemaker implantations which is directly associated with the dysfunctional conduction system of the heart which results from physiological changes that arise with aging. Moreover, we observed male predominance which simply shows that men are in greater need of device implantation as compared to women may be because of cholesterol buildup, work stress, drinking & smoking habits. The majority of implantations were done for patients diagnosed with complete heart block where the electrical impulses are inhibited & unable to pass through the ventricles in such cases pacemakers will help restore the heart's normal rhythm.
From the present study, it is evident that the majority of subjects are Implanted with dual chambers as dual chamber pacing which is thought to have an advantage over single-chamber ventricular pacing Because it more closely resembles cardiac physiology by maintaining atrioventricular synchrony and dominance of sinus node thereby helping the subjects to live longer and have a better quality of life by lowering cardiovascular morbidity and mortality.

Compliance with ethical standards

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Conflict of interest statement

The authors declare no conflicts of interest.

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Informed consent was obtained from all individual participants included in the study.

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Author's short biography

Aleena Roy - Being an intern at Trust Multi-speciality hospitals, I am very much interested in surgery related, and gastrointestinal research topics and I am a proactive listener, who is having long term goals of pursuing masters.