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# THE STUDY OF MEDICAL DEVICE: PACEMAKER

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## ABSTRACT

A cardiac pacemaker is a tiny battery-powered device that sends electrical signals to the heart to ensure steady beats. Pacemakers come in three types based on active leads: single chamber, dual chamber, and bi-ventricular. Their programming can be fixed-rate, 'on demand', or rate-responsive. The device's operating mode depends on which chamber it paces and senses, how it reacts to sensed signals, and its rate adjustment. Pacing can be unipolar or bipolar, each showing different patterns in ECG readings. On the skin, pacing pulses have very quick rise times, often under 10 µs, and may be as small as a few hundred µV. Detecting these pacing signs is crucial as they show a pacemaker's presence and help assess the heart's response. All relevant medical guidelines require devices to capture and display these pacing markers. This article offers a brief overview of pacemakers – why they're used, device types, various operating modes, and pacing signals. It also highlights some common challenges in spotting pacemaker artifacts.

**Keywords:** Pacemaker, Pacemaker Components, Type, Symptoms, Complications, Future Prospects, Contraindications, Treatment, Etc.

## I. INTRODUCTION

When doctors can watch how implanted tissue works, a way to adjust treatment without more surgery or constant medical care would greatly improve its success. Pacemakers have come a long way since the first one was used nearly 60 years ago.

They're now safer and better at helping people with slow heart rhythms. But even with these improvements, pacemaker treatment still comes with significant risks before, during, and after the procedure. The human heart, a muscle-based organ, ensures constant blood flow throughout the body. Typically, heart rates range from 60 to 100 beats per minute (bpm), maintaining a steady rhythm.

However, various physiological factors like exercise, discomfort, or anxiety can significantly increase heart rate, causing it to beat much faster than normal. The implants consist solely of FDA-approved safe materials; however, they won't break down naturally and will remain in the patient's body permanently unless surgically extracted.

### Physiology

The heart functions as a rhythmic bioelectric pump, operating through the generation and propagation of electrical impulses, followed by relaxation and a refractory period until the next stimulus occurs. The mammalian heart's electrical activity is essential for its rhythmic pumping function, demonstrated by the sequential activation of cells in specialized cardiac pacemaker regions and the propagation of impulses through the ventricles.

The implants consist solely of FDA-approved safe materials; however, they won't break down naturally and will remain in the patient's body permanently unless surgically extracted.

### Components

- Pulse generator
- Pacemaker electrode/lead

1. **Pulse generator** – The electrodes deliver electrical impulses to heart to make it best normally,located at sinoatrial node.
2. **Pacemaker electrode /lead**- It contains battery and create electrical pulse.they are long 5 cm ,in Upper chest.

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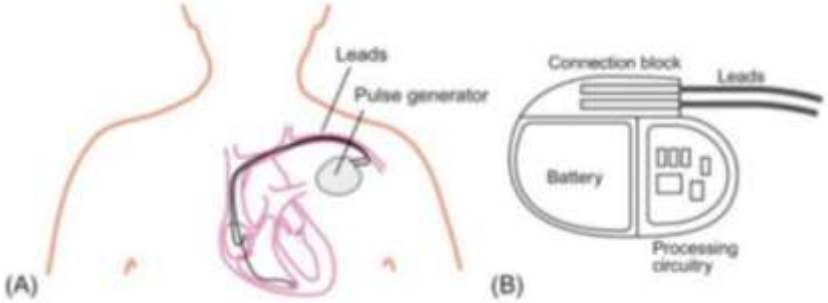
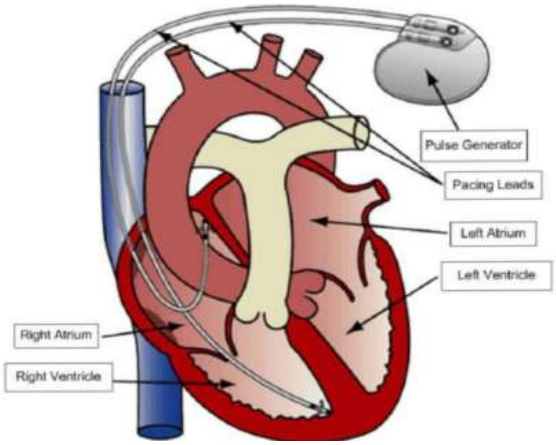



## II. TYPES

- Single chamber pacemaker
- Dual chamber pacemaker
- Biventricular

1. **Single chamber pacemaker** -A single chamber pacemaker has only one lead and place at one chamber of heart,.time cycle is not maintained.
2. **Dual chamber pacemaker** -The dual chamber pacemaker has two leads /electrodes ,normal circular blood is maintained.Dual chamber pacemaker are most popular and time cycle is maintained.

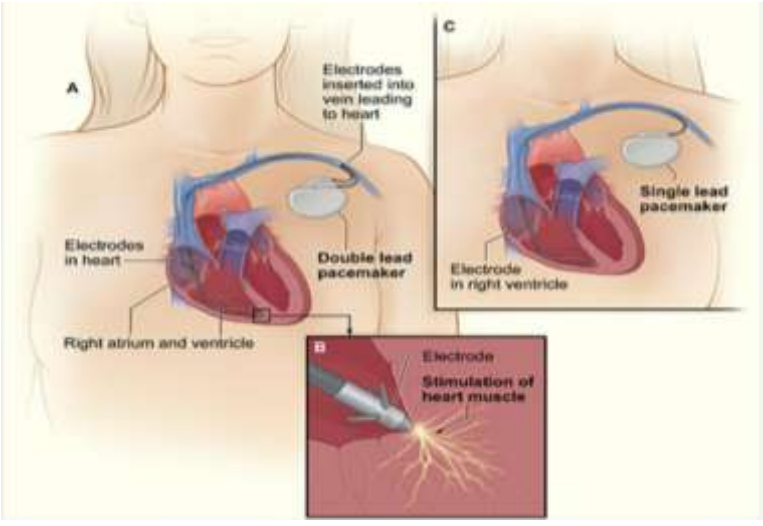



**How to pacemaker work?**

A doctor insert the pacemaker into a chest the heartbeat irregularly the pacemaker once inserted.The pacemaker battery generates an electrical pulsethis pulse travel through insulted wire called as lead.

Which are connected to the heart the lead delivered the pulse to the heart muscle stimulate to contract and produced heartbeat.

The pacemaker continuously aatchch monitor to show the response on heartbeat and adjust the signals.



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## III. SYMPTOMS

- Dizziness
- Fatigue
- Shortness of breath
- Lack of energy

## IV. TREATMENT

1. Pocket creation- left sided implant are suitable as they are non – dominant side for most patients.
2. Vascular aceess- vascular aceess is preferred by axillary under fluoroscony.
3. Pocket closure
4. Follow up visits
5. Postoperative care
6. Implantation of pacing leads
7. Long term care and Discharge
8. Immediate postoperative period

## V. FUTURE PROSPECTS

Integrating electronic components into various synthetic tissues holds promise for enhancing tissue growth and performances .Although current pacemakers effectively manage many arrhythmias (abnormal heart rhythms), they also have modules to aid patients with conditions like "heart failure", which happens when the heart's pumping ability is weaker than normal. This innovation in cardiac devices has significantly reduced death rates in modern society.

**Complications**

- Skin erosion
- Infection
- Pocket hatoma
- Prolongation of hospital stay
- Hemothorax
- Pneumothorax
- Surgery
- Mechanical lead complications
- Wond infection

**Contraindications**

- Active infection
- Patient refusal
- Terminal illness
- Bacteraemia
- Where pacemaker is not except improve life

## VI. CONCLUSION

This article reviews the wide range of pacemaker types, categorized by lead count (single, dual, or bi-ventricular) and programming (fixed-rate, on-demand, rate-responsive). It explains how they work based on which chambers are paced and sensed, how they react to electrical signals, and how they adjust heart rate. The paper clarifies the often confusing mode abbreviations, even for experts, and provides ECG examples to illustrate each mode. It covers both unipolar and bipolar pacing pulses. The review highlights challenges for pace pulse detection algorithms, such as low amplitude, unusual shapes, and issues with CRT devices that can lead to missed pulses. It also mentions noise sources like movement, muscles, breathing sensors, and wireless signals that might cause false detections. The paper notes potential improvements discussed in other studies. This overview serves as a helpful foundation for developing better pace pulse detection methods.

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