

# EFFECTS OF ELECTROMAGNETIC FIELD ON PATIENTS WITH IMPLANTED PACEMAKERS

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## ABSTRACT

Large number of people is getting pacemakers implanted. In US more than 5,00,000 people have implanted pacemaker and about 1,00,000 patients are added every year. The electromagnetic interference to the pacemaker due to EMF field generated by HV power lines, mobile phone towers and use of cellular phones can be dangerous to such patients. Here the state of the art situation regarding these interferences are explained as reported in latest research papers also suggestions to minimize the risk are dealt with.

**Keyword :** - Pacemaker, Heartbeat, Electromagnetic field, Mobile phones, Radio frequency.

## 1. INTRODUCTION

Pacemakers are a small device that helps a patient's heart to beat more regularly. It does this with a small electric stimulation that helps control the heartbeat of a patient [1]. The pacemakers are placed under the skin on the chest just under the collar bone and then it is hooked up to the heart with tiny wires. It permanently stays at its location and becomes a part of human body [9]. A pacemaker have helped many patients having cardiac problems like irregular beating by adjusting the heart to beat regularly, and also helps the body to get the oxygen it needs. Many patients are leading full lives taking part in daily activities as normal people due to the pacemaker implanted [8].

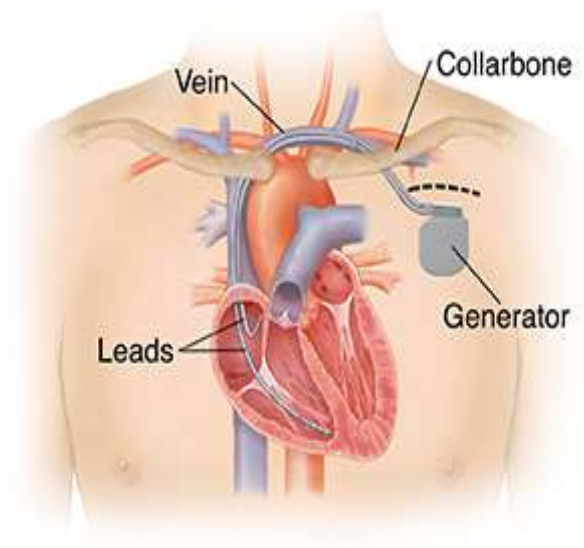
As pacemakers generate electric signals and are fed to the heart to normalize its function, it is necessary that no external source interferes with its operation [7]. The external signals generated at low frequencies due to power lines and high frequency interference due to cell phones and mobile towers can disturb the signals of pacemakers and render the pacemakers to malfunction .number of research workers have reported such problems and suggested safeguards to eliminate disturbance to working of pacemakers from external sources.

This paper reviews the state of the art situation about the reported interference, the tolerable intensity of external radiations [6]. Also though it is not conclusively proved about the external disturbance to pacemakers and the safe levels of surrounding radiation, all countries have prescribed threshold levels to limit the radiation. These are dealt with and need to lower this levels as recommended by researchers from the overwhelming evidence they have noticed is also suggested [3, 4].

## 2. WORKING OF PACEMAKER

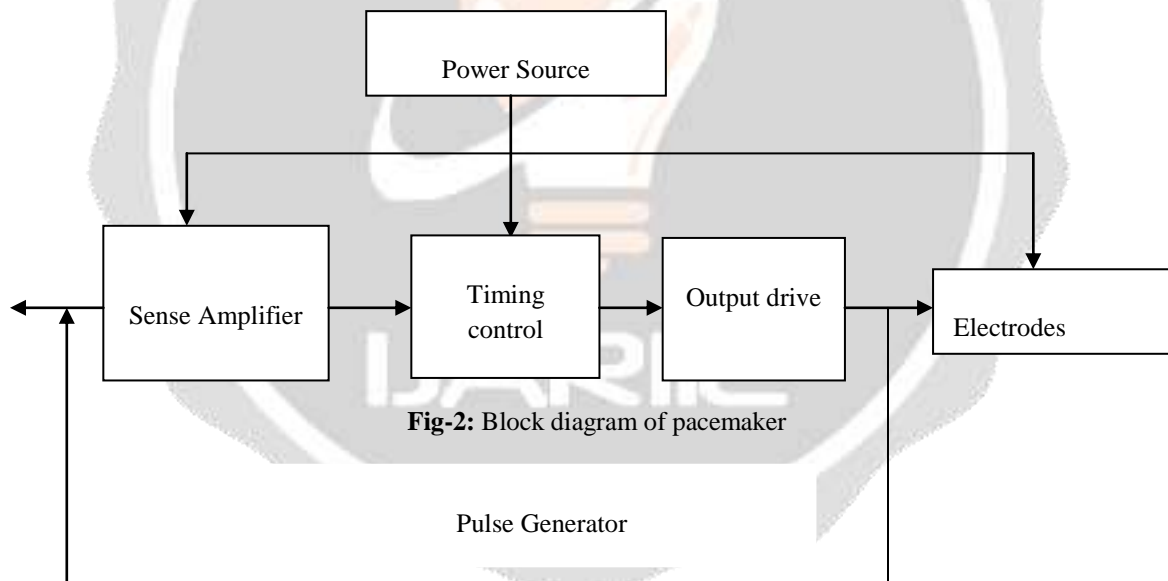
A pacemaker is a small device that which helps to control the heart beat with the help of small electric simulation. After heart attack, the doctor puts the pacemaker under the skin on your chest, just under collarbone as shown in fig. [1]. the patient may use the pacemaker regularly or short time depending upon the intensity of heart attack. This helps the body to get blood and oxygen it needs [8, 9, 10]. For short time the pacemaker is placed outside the skin for which the battery unit can be worn on a belt.

A pacemaker uses batteries to send electric signals to the heart which helps it pump the right way. The pacemaker is connected to your heart by one or more tiny wires. Pacemakers work only when needed that is when the heartbeats are irregular [11, 12].



**Fig-1:** Placement of pacemaker

The pacemaker has to be checked by the doctor for every three to six months. The battery in pacemaker should last for five to eight years. When the battery runs down, it has to be replaced by a surgery. The doctor's instructions have to be followed carefully [2]. The pacemaker senses the variations in the heartbeats. In case there is irregularity in the heartbeats, the pacemaker adjusts the levels so that the heartbeats will become regular. The working of the pacemaker is as shown in the fig. [2].



**Fig-2:** Block diagram of pacemaker

### 3. EFFECTS OF ELECTROMAGNETIC FIELD ON PACEMAKER

Pacemaker is affected by electromagnetic interference in several different ways, including temporary inhibition of the pacemaker, temporary function at fixed noise rate, temporary function at fixed magnet rate, permanent inhibition or malfunction and random reprogramming. For any of these results to occur electric field strength must be greater than 200 V/m or the magnetic field strength must be greater than 10 Gauss.

Cellular telephones can interfere with the function of implanted cardiac pacemakers. However, when telephones are placed over ear in the normal position, this interference doesn't pose a health risk [9].

When the phone antenna was in direct contact with patient's skin over the implant, electromagnetic interference effects occurred at maximum ventricular and trial sensing thresholds of 4 mv and 2.5 mv [1]. It is

observed that older pacemakers had a higher rate of being affected by mobile phones when compared to new generation of pacemaker are more protected against electromagnetic field, being equipment with radio frequency feed through filters incorporated to the internal pacemaker circuitry [5].

The signals produced by cell phone functions like turn on, ringing, conversation and turnoff contain components of low frequencies that can interfere with the implanted pacemakers causing them to become arrhythmia which is adverse conditions can put the patient to death [2]. The following precautions should be taken by the heart patients wearing pacemaker,

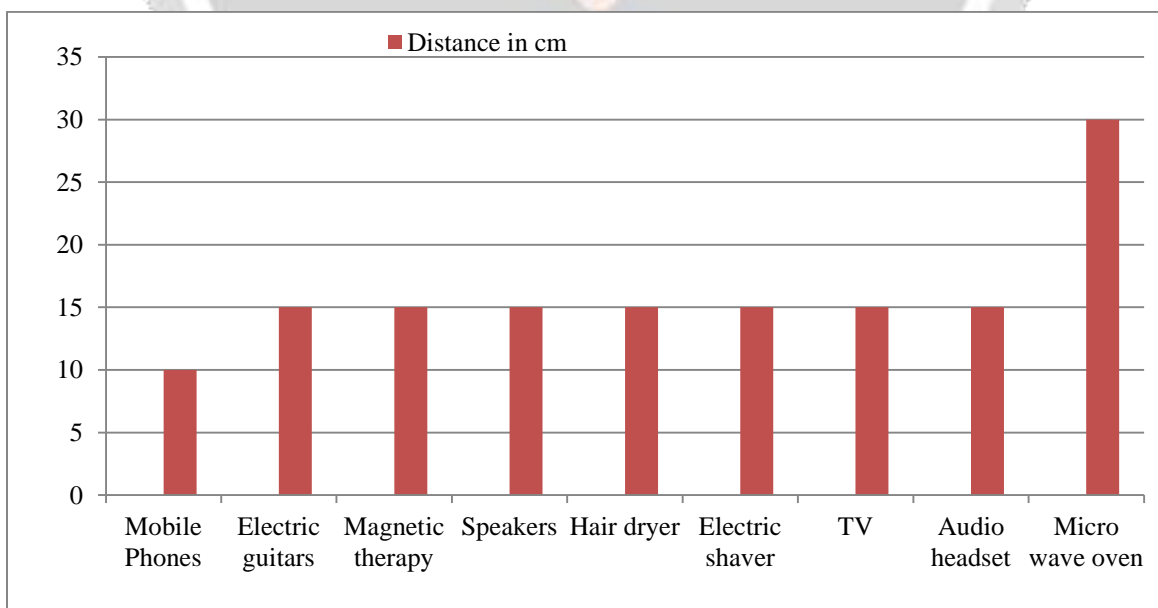
- a) When patient exposes to high voltage transmission lines, it effects on working of pacemaker [6].
- b) The patient has to maintain a distance from electric welding, electric melting furnaces and radio transmitters [6].
- c) Don't keep mobiles in shirt pocket.
- d) Don't receive calls from left ear [9].
- e) The heart patient should tell in advance about the pacemaker to the consulting doctor for any kind of tests like MRI, ECG and dental drill [4, 10].
- f) Carry an ID card with you so others know you have a pacemaker.
- g) Tell airport security that you so have a pacemaker [4].
- h) While using cell phones, decreasing wireless emission distance are the most useful methods of lowering the magnetic interference to the pacemakers [6].

**4. SAFE PERMISSIBLE LEVELS**

There is no consensus about the safe level of radiation. According to royal commission the real safe level is "0". It is not possible to find a place on earth, where EMF is zero. Majority of nations in advanced countries advocate levels which are nearly 1000 times lower than what is allowed in India [8].

Some researchers suggest that three zones can be identified from good to excellent and zones of levels high than them as risky [8]. Big power companies in America suggest that if a person with a pacemaker is in an electrical environment and the pacemaker begins to produce a regularly spaced pulse that is not related to a normal heartbeat, the person should leave the environment and consult a doctor [3]. Patients wearing pacemaker should be careful when there are electromagnetic waves in the surroundings. The following measures have to be adopted while dealing with electric equipments as shown in the fig. [3].

**TAB-I: SAFE DISTANCE TO BE MAINTAINED FROM ELECTRIC EQUIPMENTS**



#### 4. CONCLUSIONS

The patients having pacemaker implanted which is helping them to control their heart beat, pulse rate, blood pressure et al... , also is threatened with interference from external sources EMF field. As described there are various ways how a patient can be affected when he is in an environment of high intensity field. It is advisable to go for latest pacemaker with feed through filters to minimize the risk, also simple precautions to be taken while using cellular phone and avoiding being near certain gadgets which produce high intensity field are suggested.

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