



## Implantation Procedure of Permanent Pacemaker (PPM) in Patients with Clinical Total AV Blok: A case study in a Private Hospital in Tangerang City

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### ABSTRACT

Permanent Pacemaker (PPM) is a medical device that can electrically stimulate the heart muscle to contract to produce a heartbeat. One of the indications for installing PPM is Total AV Block, which is a condition in which there is a cardiac conduction disorder that occurs when the electrical supply from the SA Node to the AV Node is blocked. The PPM is placed subcutaneously on the left chest, its function is to stabilize irregular heart rhythms. This research is a qualitative research. Data collection was carried out in April-September 2022 at a private hospital in Tangerang City through observations, interviews and documentation of the team involved in the implantation-implantation of PPM. From the results, implantation-implantation of PPM is the best treatment given to patients with Total AV Block. Before the procedure, the patient's Heart Rate (HR) was 34bpm/minute but after the procedure the Heart Rate (HR) increased to 80bpm/minute. It was found that the PPM implantation procedure in a private hospital in Tangerang City includes several stages. The PPM implantation procedure includes patient preparation, tools and materials preparation, implantation techniques and post-action care. The team consists of Cardiologists, Scrub Nurses, Circular Nurses, Nursing Assistants, Cardiovascular Technicians and PPM Applicants. PPM implantation is performed with the guidance of *X-Ray Fluoroscopy*.

**Keywords:** Permanent Pacemaker (PPM), Total AV Block

### INTRODUCTION

According to the World Health Organization (WHO) in 2002 there were at least 6 million deaths in the world caused by heart disease, and an increase in 2012 was 7,4 million deaths or equivalent to 13,2% of deaths in the world. Cardiovascular disease is a disease caused by impaired function of the heart and blood vessels, such as coronary heart disease, heart failure, hypertension and stroke. Cardiovascular disease can be caused by disruption of vascular circulation, cardiac conduction system and hemodynamics, so that the therapy for each is also different, one of which is *Arrhythmia* or *Dysrhythmia*. *Arrhythmia* is a condition in which the heart

There are two types of Pacemaker, *Temporary Pacemaker* and *Permanent Pacemaker*. *Temporary Pacemaker (TPM)*

rhythm is irregular due to disruption of the mechanism of impulse formation and conduction, one of which is *Total AV Block*. <sup>(1)</sup> *Total AV Block (Atrioventricular Block)* is a condition of cardiac conduction disorder that occurs when the SA Node to the AV Node is blocked. *Total AV Block* is treated with medication and insertion of a *Pacemaker*.<sup>(2)(3)</sup>

*Pacemaker* is a medical device that can electrically stimulate the heart muscle to contract and produce a heartbeat. The pacemaker keeps the heart rate in accordance with the program so that the body gets an adequate supply of oxygen and nutrients contained in the blood. The pacemaker has two parts, namely the pulse generator which contains the battery and electronics that control the heartbeat, the other part is the electrodes that send electrical signal to the heart.<sup>(4)</sup>

used in emergency department patients with severe *bradyarrhythmia*. TPM is often used in emergency and

general conditions and is hemodynamically unstable. The TPM generator is placed outside the patient's body, and the main access to the TPM lead is femoral vein. *Permanent Pacemaker (PPM)* is a circuit in which a generator produces an electric current that flows to the heart muscle (*myocardium*) through a conducting wire to stimulate the heart to beat, and then returns to the generator (the circuit ends). PPM will restore the heart pacemaker system to physiological state so that it can increase cardiac output and improve circulation to the brain and other body organs. This PPM is permanent and is usually used for a long period of up to 10 years.<sup>(5)(6)</sup>

The Cardiologist will place the PPM in the upper chest area, just below the collarbone (*clavicular*). The Cardiologist will inject local anesthetic in the area, then make an incision of about 4-5 cm to create a PPM placement bag an access to the PPM lead will also be sought through that access. PPM leads will be inserted through the subclavian vein and then placed in the chambers of the heart (*atrium* and *ventricles*). PPM implantation is performed with the guidance of *X-Ray Fluoroscopy*.<sup>(6)</sup>

## METHODS

The research is qualitative research by a case study approach to get an overview of the procedure for installing a *Permanent Pacemaker (PPM)* device in patients with clinical *Total AV Block*. The research was conducted in April-September 2022 in the Cath-Lab Room at a private hospital in Tangerang City. Data was collected through observations, documentation and interviews with the team involved in the procedure such as Cardiologist, Scrub Nurses, Circular Nurses, Nursing Assistants, Cardiovascular Engineering and PPM Applicant. Transcript from the interview was developed to facilitate data analysis. Furthermore, from the data transcript, information relevant to the research topic was filtered and classified according to the research question to draw conclusion.

## RESULT AND DISCUSSION

Implantation of a *Permanent Pacemaker* device was used for patients with *Total AV Block* clinical, in which one of the conditions of impaired conduction of the heart electrical impulses from SA Node to AV Node. In this study, data collection was carried out by observing and interviewing the implementing team consisting of 6 respondents: Cardiologist, Scrub Nurse, Circular Nurse, Nursing Assistant, Cardiovascular Technician and PPM Applicants. These team has their own role in the implantation of the Permanent Pacemaker in the Cath-Lab Room.

In this study, authors observed an examination of a male patient aged 64 years who came with symptoms of fatigue during activities, chest tightness and headache. Prior to the implantation of a permanent pacemaker, the patient having an ECG (*Electrocardiography*), Laboratory examination and Chest X-ray.

## *Procedure for Implantation of Permanent Pacemaker (PPM)*

### *Preparation of Tools and Materials*

Tools and materials used in the implantation of a *Permanent Pacemaker (PPM)* includes: C-Arm Angiography Machine and ECG monitoring device, angiography set, minor surgical instruments, personal protective equipment, emergency trolley, drugs such as: *Chlorhexidine Gluconate 2%, Marcain 0.5* and PPM Set (PSA Generator, Lead, Pacing Monitor). And if needed, *contrast media* should also be provided.

### *Patient Preparation*

Prior to the implantation of *Permanent Pacemaker (PPM)*, some of patient's preparations are:

- Patients must fill out an informed consent for approval of the examination. The purpose of filling in inform consent is as evidence that the patient has received an explanation of the examination to be carried out, both regarding the process, benefits and the side effects of the examination.<sup>(16)</sup> In addition, if something unexpected happens during the examination, this informed consent will be evidence that the patient has agreed to all risks involved.
- Patients fasting for 4-6 hours before the examination. The purpose of fasting is to reduce the acidity of the stomach and reduce the risk of lung aspiration. In addition, also in anticipation of the injection of contrast media to find venous access (*Venography*).<sup>(16)</sup> However, according to the American College of Radiology or known as ACR 2022 regarding contrast media, patients do not have to undergo fasting because there are already available types of contrast media nonionic, iso-osmolality, and low-based contrast media *gadolinium* which has a low risk of vomiting.<sup>(20)</sup>
- Patient shaves the fine hairs in the examination area, the aim is to ensure the examination area is sterile and anticipate that no fine hairs entering the incision area.<sup>(16)</sup>
- Patient having an ECG (*Electrocardiography*), laboratory tests, and chest X-Ray. ECG examination can provide supporting information to determine the presence of preoperative cardiac abnormalities, including: myocardial infarction, cardiac hypertrophy and arrhythmias. Thorax X-ray is to assess the condition of the heart and lungs. Complete laboratory bloods tests are carried out with the aim of knowing abnormalities in the levels of Hemoglobin, Hematocrit, Leukocytes, Platelets, Current Blood Sugar (GDS) to ensure the patient does nor experience Hyperglycemia or Hypoglycemia.<sup>(16)</sup>
- The patient must also be in calm condition so that the patent's blood pressure is normal.

It is very important for the patient to be able to make proper preparations, in order to avoid things that are not desirable during the procedure. In this case, the entire implementation team also plays an important role in evaluating patient preparation.



**Fig 1: C-Arm Fluoroscopy**



**(A)**



**(B)**

**Fig 2: (A) Minor Surgical Instruments, (B) Generator PPM**

### **Permanent Pacemaker (PPM) Implantation Technique**

In the implantation of a *Permanent Pacemaker* there are several professional teams that work together, Cardiologists, Nurses, Cardiovascular Technicians, Nursing Assistant, Radiographers and applicants from PPM providers (if needed) Each implementing team has its own duties and roles. The technique is:

- Angulation position: AP (*Antero Posterior*), LAO 30 (*Left Anterior Oblique*), RAO 30 (*Right Anterior Oblique*)
- Position the patient supine on the examination table.
- Attach the 6 lead ECG electrode, record the ECG.
- Prepare oxygen just in case the patient suddenly has trouble breathing.
- Sterilization of the entire chest, chin, neck area using 10% liquid betadine.
- Drapping the patient with sterile draped linen. The patient's head is positioned to the right.
- Local anesthetic puncture area and incision with 05% *marcain*.
- Puncture in the left subclavian vein, the wire is inserted up to the superior vena cava
- Make an incision  $\pm 5$  cm.
- Sheath is inserted, then the wire is pulled out.

- Lead is inserted with the stylet attached to it then it all the way to RV apex.
- The stylet is pulled back sufficiently to the superior vena cava.
- The measure the threshold surgical cable is connected to the PSA (Pacing System Analyzer) cable: measure output, current, R wave resistance.
- The stylet is pulled out once the lead is stabilized. The leads are fixed to the fascia with silk sutures.
- Make pockets for leads and generator, give flushing *bactecyn* 1,5 gram.
- The lead is connected to the generator and locking, insert the generator into the subcutaneous bag.
- Sew the incision with 1.0 silk thread.
- Apply 10% liquid betadine to the suture marks, cover the sterile gauze/wound dressing.
- Record ECG post implantation PPM.
- Document the result to the examination CD.

### **Patient Care Post Permanent Pacemaker (PPM)**

Implantation of a *Permanent Pacemaker* (PPM) should be performed in patients with heart rhythm disturbances (*Arrhythmias*) with *Total AV Block*. There are several life style changes that patients with *Permanent Pacemaker* (PPM)

implantation must undergo. Special care is needed in the area of the stitches to prevent infection.

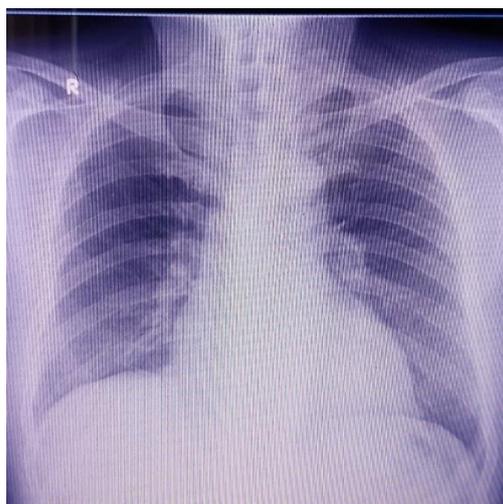
The next treatment is to carry out follow-up controls to the Cardiologist to ensure the condition of the device is good or not by *reprogramming*, to view pacemaker function, frequency, battery and presence of abnormal heart rhythms.<sup>(24)</sup> At the hospital where the author conducted the study, there are several other things that patients must pay attention to in the care of patients after the implantation of a *Permanent Pacemaker (PPM)* are:

- Patients are not allowed to wash their heads until 3 days after the insertion procedure.
- Gently wash the incision area, but do not apply lotion or powder around it.
- Do not do heavy work, such as pushing, pulling, and other strenuous activities.

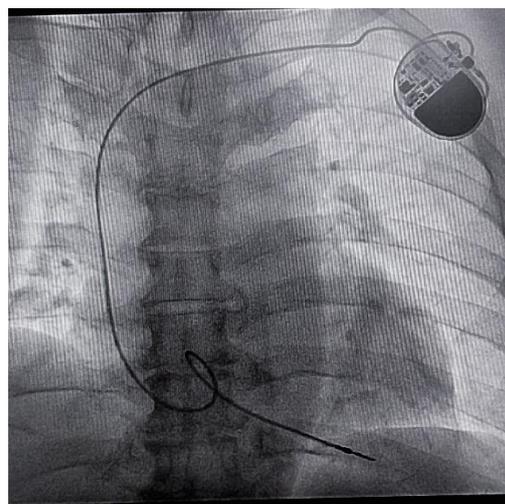
- If you want to do sports, first consult with a Cardiologist.
- Avoid being in areas with a high electrical charge.
- Recognize the symptoms of damage to the pacemaker.
- When going to travel through the airport, the PPM card is always carried.

**Results of Implantation of Permanent Pacemaker (PPM)**

The implantation of *Permanent Pacemaker (PPM)* lasted for  $\pm 90$  minutes in the Cath-Lab Room, the implantation team succeeded in placing the *Permanent Pacemaker Single Chamber* with the lead implanted in the Right Ventricle and the generator placed on the left chest under the collarbone (clavícula).



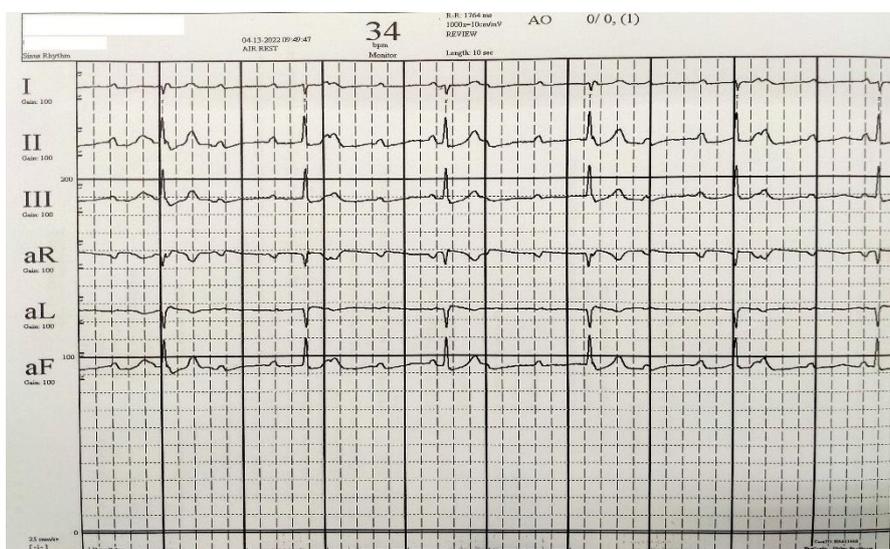
(A)



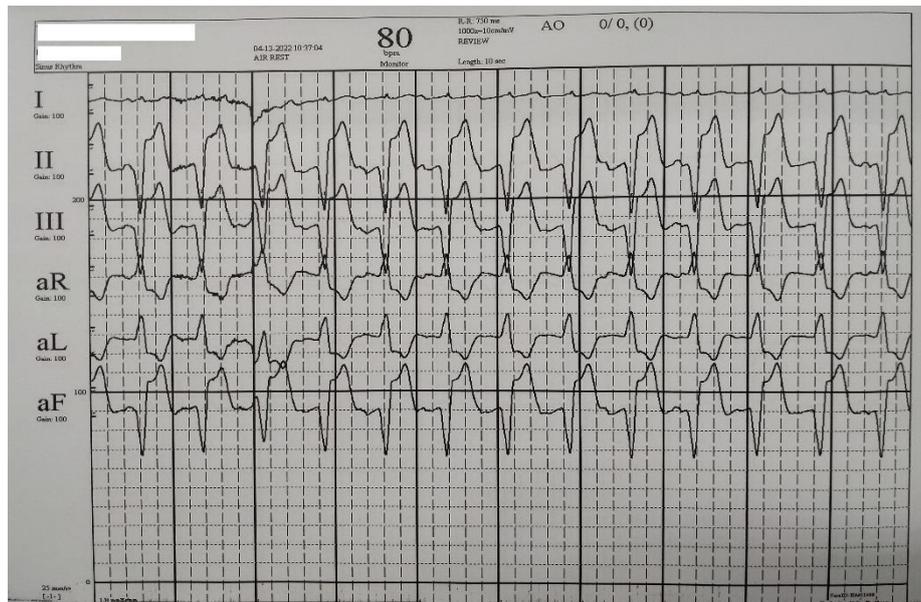
(B)

**Fig 3: (A) Chest X-Ray pre insertion PPM, (B) Chest X-Ray post insertion PPM**

Figure A is a Chest X-Ray patient using conventional tools before the PPM implantation with *Aorta Elongation* and *Cardiomegaly* expertise is performed. While figure B is a Chest X-Ray of a patient with C Arm Fluoroscopy after PPM installed.



**Fig 4: ECG (Electrocardiography) Pre-Implantation PPM**



**Fig 5: ECG (Electrocardiography) Post-Implantation PPM**

There is a difference between the ECG figure 4 and figure 5. The normal heart rate is 60-100bpm/minute. On ECG figure 4 (pre implantation of PPM), the patient's heart rate is 34bpm/minute and there is a picture of *Total AV Blok*. This figure is far below the normal limit so that a permanent pacemaker is needed. While on the ECG B (post PPM implantation), after installing a permanent pacemaker and setting threshold the patient's heart rate increased to 80bpm/minute.

### **Team Work in The Implantation of Permanent Pacemaker (PPM)**

The implementing team involved in the implantation of *Permanent Pacemaker (PPM)* at The Private Hospital where the study is located are:

- **Cardiologist**

In this permanent pacemaker implantation, Cardiologist has a very important main role. The Cardiologist is responsible for determining venous access, placing a pacemaker lead in the problematic part of the heart chamber, and suturing the incision where pacemaker generator is located.

Cardiologist are also responsible for educating patients about the examination that the patient will undergo.

- **Scrub Nurse**

In this action, a scrub nurse is responsible for being the main assistant to the Cardiologist. The scrub nurse is tasked with assisting doctors in performing the implantation of a permanent pacemaker and preparing sterile instruments needed during the procedure.

- **Circular Nurse**

Circular nurses are tasked with assisting doctors and scrub nurses in preparing tools and materials as well as drugs needed during the implantation of a permanent pacemaker. Circular nurses also perform the task of being the operator of the C-Arm aircraft which is used to monitor the passage

of leads into the heart chambers. Contrast preparation (if required) is also carried out by the circular nurse.

- **Nursing Assistant**

Nursing assistants play a role in preparing sterile linen and sterile instruments used for procedures. Nursing assistants also assist in preparing the patient by placing the patient on the examination table. After the procedure is complete, the nursing assistant is tasked with cleaning the room and sterilizing the examination table area.

- **Cardiovascular Technicians**

Cardiovascular technicians play a role in placing ECG electrodes on patients, monitoring hemodynamics, and preparing patient examination results. In terms of hemodynamic monitoring of the patient, the cardiovascular technician will notify the doctor if there is a change in the hemodynamic monitor.

- **PPM Application**

PPM Applicant is a person in charge of preparing a sterile PPM kit that will be used by patients. A PPM applicant is also responsible for setting up the PPM monitor.

Unfortunately, *Radiographer* was not involved in the implantation of PPM in this Hospital. Whereas in the Indonesian State Work Competency Standards, or known as SKKNI, issued by The Indonesian Government in 2020, the competence of a Radiographer is to carry out an Interventional Thorax Radiology examination using an Interventional X-Ray. The competencies of Radiographer are: <sup>(18)</sup>

- To perform procedures before examination: identity patient data, clinical examination and patient history of allergies to drugs and food.
- To prepare equipment and supplies: prepare interventional angiography X-Ray machine, perform radiographic image processing, prepare contrast injector machine, prepare radiation protection equipment and ensure all teams involved have used it.

- To perform patient preparation: re-examine related to patient preparation, patient support results, patient education and informed consent.
- To perform examination management: position the patient on the examination table, carry out the examination protocol, operate the equipment during the examination.
- To perform post-examination procedures: processing radiographic image and documenting examination results.

Considering that the competence of the Radiographer is closely related to the use of modalities that are sourced from ionizing radiation, this is where the important role of the radiographer is involved in the implantation of a Permanent Pacemaker (PPM) and other examinations carried out in the Cath-Lab room.

## CONCLUSION

Permanent Pacemaker (PPM) is a medical device that can electrically stimulate the heart muscle to contract to produce a heartbeat. One of the indications for installing PPM is Total AV Block, which is a condition in which there is a cardiac

conduction disorder that occurs when the electrical supply from the SA Node to the AV Node is blocked.

The procedure for installing *Permanent Pacemaker (PPM)* in patients with clinical *Total AV Block* at a Private Hospital in Tangerang City includes: Patient Preparation, Preparation of Tools and Materials, Examination Techniques and Post PPM Patient Care.

The role of the radiographer is very important in the implantation of a Permanent Pacemaker (PPM), especially in the operation of fluoroscopy equipment that utilizes X-ray radiation. In addition, according to the Indonesian State Work Competency Standards or SKKNI, other competencies possessed by a radiographer are processing radiographic images, radiation protective equipment, preparing contrast injector machines, positioning patients on the examination table and providing education related to examinations.

## Suggestion

In future research, I hope other authors can conduct research involving an intervention Radiographer as a respondent to find out different points of view so that more varied research result can be obtained regarding the role of the Radiographer.

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