Original Article

NURSING INTERVENTIONS IN THE CARE OF PATIENTS AFTER THE PLACEMENT OF A CARDIAC PACEMAKER

Željko Vlaisavljević[1,2] Goran Stojanović[3], Dunja Milovanović[4], Vesna Paunović[2,5] Negra Terzić[3], Adriano Friganović[6,7]

[1] University Clinical Center of Serbia, Clinic for Gastroenterology and Hepatology, Serbia
[2] Medika College of Vocational Studies in Healthcare, Belgrade, Serbia
[3] Academy of Vocational Studies Belgrade, College of Vocational Studies in Healthcare, Belgrade, Serbia
[4] Zvezdara Clinical Hospital Center, Belgrade, Serbia
[5] Gynecology-Obstetrics Clinic Narodni Front, Faculty of Medicine, University of Belgrade, Serbia
[6] University Hospital Centre Zagreb, Department of Anesthesiology and Intensive Medicine, Croatia
[7] Faculty of Applied Health Sciences, University of Applied Health Sciences, Rijeka, Croatia

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Abstract

Background: Nurses/technicians are an important part of cardiological teams that take care of patients with cardiac pacemakers. (CP) **Aim**: The aim of this study was to determine the healthcare of patients with CP and the role and attitudes of nurses/technicians in this process. **Materials and Methods**: Two samples of 30 patients with cardiac pacemakers and 20 nurses/technicians from the Clinical Centre Zvezdara in Belgrade, were interviewed with a Patient Survey consisted of 17 questions and a Nurse Survey with 13 questions (demographic data, clinical data, educational data and attitudes). **Results and Discussion**: The most common indication for a CP is symptomatic bradycardia (50%). The most frequent complication after

CP implantation was hematoma (30%). Most of the patients had symptoms of vertigo and fainting after the CP installation (80%), limited mobility (90%), and the average length of hospitalization of the patient was up to 7 days (50%). Most patients go for regular check-ups (93%). The degree of satisfaction of patients with the work of nurses shows that most of them are satisfied or very satisfied (80%). Most nurses/technicians are satisfied with the cooperation with patients (80%) and colleagues (95%) and generally believe that there is teamwork in the department (75%). Respondents generally believe that there is active family cooperation in education (85%). About two-thirds of nurses/technicians go to continuing education. **Conclusion:** This study in a Belgrade clinic shows that nurses/technicians largely contribute to satisfactory healthcare of patients with pacemaker.

Keywords: cardiac pacemaker, patients, health care

Corresponding Author: Željko Vlaisavljević**,** prof.zeljko.medika@gmail.com

Introduction

A cardiac pacemaker (CP), electro stimulator, or artificial heart rhythm guide was first implanted in the world in 1958. Since then, this device has largely changed its appearance, thanks to the development of electronics, and intervention is nowadays considered a routine procedure. CP appearance and its indications have changed with system development. The goal of stimulating the heart muscle is to establish a proper rhythm, which is why the stimulator is called a CP. If the heart muscle is preserved, but the activation mechanism is disturbed for some reason, the muscle can be artificially stimulated or inhibited and thus enable a completely normal life. A very weak stimulation current is required for its functioning.

In recent decades, CP therapy has gained an increasingly important place in the treatment of complex cardiac patients, the indications are becoming wider, and an increasing number of patients are being treated in this way. This has been achieved through better diagnostics, better education of medical professionals, as well as increased life expectancy in the general population. Patient care after CP implantation depends on the professional assessment of the patient by a nurse who is part of the cardiology team. As the closest to the patient, the nurse has a significant role in providing quality health care and education to these patients.

Anatomy of the heart impulse transmission

The specific conduction system[1] in the heart serves to maintain the heart rhythm and transmit the action potential through the heart muscles, which enables contraction. The conduction system of the heart, which functionally represents an inseparable whole, can be schematically divided into the following parts:

• Sinoatrial (SA) node

• Atrioventricular (AV) node

• AV bundle with branches left and right and

• A network of Purkinje cells

The rhythmic activity of the heart is initiated and controlled by an electrical signal, which is generated in specialized cells that form the SA node. The SA node has an oval appearance, 2 to 3 cm long, and about 5 μm in diameter[2]. It is in the right atrium in the back part of the interatrial septum, proximal to the mouth of the superior vena cava, at the junction of the superior vena cava and the right atrium. The SA node is connected to the AV node by anterior, middle, and posterior internodal pathways and one pathway to the left atrium.

The AV node is in the lower part of the central interatrial fibrous tissue, more on the right side. The AV node is divided into three parts: atrio-nodal, nodal, and nodal part of His. In the nodal part of His, cells of the AV node create a network of longitudinally distributed fibrils, which continues into the bundle of His. The bundle of His begins with the contraction of the AV node into a simple muscle network. It is divided into two parts: penetrating and branching (distal). The distal part of the bundle of His passes 5 to 15 mm downward into the ventricular septum towards the apex of the heart. Then the bundle is divided into left and right branches, which are located under the endocardium of the corresponding side of the septum. Each branch extends towards the top of the corresponding chamber, and there it divides into smaller branches that spread throughout the heart chambers and finally return to the base of the heart (network of Purkinje cells).

An action potential is generated in the SA node. The endings of the fibers of the SA node join the fibers of the atrial myocardium. In this way, the electrical signal, generated in the SA node, initiates the depolarization of the cells of the left and right atrium, which leads to the contraction of both atria and the pumping of blood into the ventricles. After that, repolarization and relaxation of the atrium muscle occurs. The electrical signal from the SA node passes to the AV node. The AV node and its associated conducting fibers are the main factor that slows the conduction of the cardiac impulse from the atria to the ventricles. This slowing of conduction allows sufficient time for the atria to empty their contents into the ventricles before ventricular contraction begins. The impulse, having appeared in the SA node, travels through the internodal pathways to the AV node in about 0.03 s. However, from then until the pulse reaches the bundle of His, an additional 0.09 s passes. The special feature of the His bundle is that it allows conduction in only one direction, forward from the atria to the ventricles[3]. The atrial muscles are separated from the ventricular muscles by a continuous fibrous barrier. This barrier

normally acts as an insulator preventing the passage of the cardiac impulse between the atria and ventricles by any route other than unidirectional conduction through the bundle of His. From the moment the cardiac impulse enters the bundle of His to the moment it reaches the terminations of the Purkinje fibers, about 0.03 s passes.

This means that once the cardiac impulse enters the Purkinje system, it spreads almost instantly over the entire endocardial surface of the ventricular muscle[2]. The final Purkinje fibers continue to the muscle fibers and when the heart impulse reaches the ends of the Purkinje fibers, it initiates the depolarization of the left and right ventricles, followed by their contraction and pumping of blood into the systemic, or pulmonary blood flow. After that, there is a repolarization of the ventricular muscles and their relaxation, and then a new cycle begins. The cardiac cycle is the period from the end of one ventricular contraction to the end of another contraction. It is divided into two periods: a period of relaxation, called diastole, during which the heart fills with blood; followed by a period of contraction, called systole.

The speed of conduction of the stimulus (action potential) from the SA node through the rest of the conduction system depends on several factors: the nature of the conductor and its diameter, the maximum diastolic potential, the stimulus threshold, the amplitude of the action potential and the speed of phase 0 of the action potential (Mohrman 2003)[4]. The velocity of impulse propagation in a normal human heart is:

- through the atria 1-2 m/s
- through the atrioventricular node 0.2 m/s
- through His bundle and its branches 2 m/s
- through the network of Purkinje cells 4-5 m/s
- through the myocardium 0.4 m/s

AV node fibers, when not stimulated by impulses from another source, send impulses at a frequency of 40 to 60 impulses per minute due to their own rhythmicity, and Purkinje fibers at a frequency of about 15 to 40 times per minute. These frequencies differ from the normal frequency in the SA node, which is 70 to 80 times per minute [3]. Each time the SA node sends an impulse, that impulse reaches the AV node and the Purkinje fibers and initiates depolarization of their membranes. After that, the mentioned tissues, as well as the SA node, recover from the action potential and become hyperpolarized.

In the SA node, the hyperpolarization is lost much faster than in the other two tissues, so the SA node transmits a new impulse before the membrane potential in the other two tissues has returned to the value of their own level of self-excitation. The new impulse again discharges both the AV node and the Purkinje fibers. It is constantly repeated, that is the SA node always re-stimulates other tissues that could self-excite, but before a spontaneous impulse can appear in them. Therefore, the SA node controls the heart's rhythm because the frequency at which it rhythmically transmits impulses is greater than the frequency in any other part of the heart. This is why the SA node is said to be the normal CP of the heart (often called the natural CP). If the lead is located anywhere outside the SA node, it is called an ectopic lead. In this case, certain parts of the heart will contract in an abnormal order.

Principle of CP operation

Many heart diseases are caused by improper synchronism between the information of the central nervous system and the sinoatrial node, or the sinoatrial node and the contractions of certain parts of the heart muscle. For example, if there is damage or a complete interruption of the nerve connection in the SA node - myocardium relationship, then the SA node receives

proper impulses from the brain, however, these impulses do not trigger synchronously with the myocardium. This manifests itself in various difficulties of the patient. An even more severe example is if the SA node stops working entirely. A CP is, in fact, an electrical stimulator that has the properties of an oscillator and is used to provide a rhythm to the myocardium. It consists of a power source, a pulse generator circuit, and a system of electrodes[5].

Today, there are already several types of CPs, but we can mainly divide them into two groups, namely[6]:

• internal CP - implanted

• external CP

According to the function they perform, CPs are divided into anti-bradycardia, anti-tachycardia with the potential to deliver a DC shock (ICD), as well as resynchronization. There are CPs with or without the ability to deliver a DC shock (CRT-P, CRT-D). Anti-bradycardia CPs ensure an adequate heart rate, and the prevention of Adam-Stokes syncope. According to the place of stimulation, anti-bradycardia CPs can be:

• AAI CPs with right atrial stimulation, in patients with sinoatrial (SA) node disease, and preserved conduction in the atrioventricular (AV) node.

• VVI CPs perform stimulation from the right ventricle, they are used in patients with a slow ventricular rate, when synchronization of the stimulation with the activity of the SA node is not possible (atrial fibrillation or atrial flutter).

• The DDD CP system stimulates the heart from the right atrium and right ventricle, used in patients with SA or AV node dysfunction, followed by a slow ventricular response. This is a physiological CP stimulation that allows synchronization of the work of the atria with the ventricles.

• VDD CP, used in AV node disease, with normal SA node function, so atrial stimulation is not required.

The mentioned types of anti-bradycardia CPs can be frequency adaptive, with the R (rate response) option used in patients with chronotropic competence[7]. With this function, thanks to the sensors, CPs provide an adequate increase in heart rate.

The implanted CP is characterized by the fact that, in addition to the electrodes that are in contact with the heart muscle, and the complete electronic part of the device with batteries for power, it is implanted inside the body. Therefore, an operative intervention is necessary for the installation of a CP. External CPs are located outside the body, only the electrodes are attached to the patient.

The biggest problem in the application of implanted CPs is their power supply. It is of interest to develop CP systems that, once installed, would function for the rest of the patients' lives without the need for subsequent surgical interventions. The original CPs used Hg-batteries (Hg-Zn cells), allowing the generator to last 30-36 months. Nuclear batteries, whose service life was over 10 years, were also used as an energy source, e.g., 5 Ci of 238 Pu. In those batteries, the radioisotope is a source of heat that is converted into electricity by the Zebeck effect. Due to the radioactive radiation that these energy sources emit, and other side effects for the patient, the use of these batteries is limited.

Implanted CPs in use today have lithium anode batteries. A lithium-iodine cell has a lithium anode and a cathode made of a mixture of molecular iodine and polyvinyl pyridine. There is no electrolyte in the cell itself since the lithium-iodide electrolyte is generated in a solid

aggregate state during chemical reactions between the anode and the cathode. As the thickness of the electrolyte layer increases with time, the internal resistance of the cell increases by 50-100 fi/month. The electromotive force of the cell drops sharply as all the iodine is extracted from the cathode. Another type of lithium cell is the so-called SAFT cell (acronym SAFT from Societe des Accumulateurs Fixes et de Traction, where this cell was constructed). It contains a liquid lithium-perchlorate electrolyte dissolved in propylene-carbonate, it is a lithium anode, while its cathode is made of a mixture of silver chromate and graphite. During the conversion of silver chromate to lithium chromate the cell voltage remains constant and then drops to a lower plateau as the chromate ion is converted to the much more stable chromium oxide. At the appearance of the second (lower) plateau, we can claim that the cell is emptying.

The construction of the generator is dictated by the following physiological parameters: heart rate and stimulation threshold. The pulse generator circuit usually contains an amplifier, an oscillator, and a voltage doubler. Considering the small dimensions of implanted CPs, these components (complete analog and digital circuits) are in a chip in an integrated technique[8]. The oscillator provides electric pulses of a certain frequency and duration, which are then fed to a voltage doubler where the pulse amplitude is regulated. The voltage doubler amplifies the pulse from the oscillator so that its amplitude reaches a value of about 5 volts when it reaches the electrodes.

On average, the parameter values of implanted CPs are as follows[8]: pulses are usually rectangular in the range of 40-120 beats/min. The pulse duration is usually between 2-5 msec and their amplitude is in the interval 5-15 volts. The amplifier serves to detect and amplify endocardial (heart) signals. For most generators, the detected signal should be greater than 2 mV. In addition, the amplifier defines a refractory period (most often 325 msec). After the

occurrence of the stimulation pulse or cardiac signal, the refractory circuit prevents signal detection in the amplifier for a given refractory period.

Via stimulation electrodes, the CP stimulates the heart, although in some models the same electrodes are used not only for stimulation, but also for recording ECG signals. The electrodes are connected to the generator via conductors, which usually have connections at the ends that create connections between the electrodes and the generator. This method of binding is justified because in the event of elemental failures or the need to charge the battery, the surgeon is able to remove the CP with a relatively simple operation while the electrodes still remain in place. Unipolar or bipolar electrodes can be used to stimulate the heart. Unipolar electrodes are applied by placing one electrode directly on or in the heart, while the other - a reference electrode - is placed in the immediate vicinity of the heart. Bipolar electrodes are placed so that both are on or in the heart.

Electrical stimulation works on an all-or-nothing basis. If the stimulation threshold and useful time are not reached, the action potential will not occur. Therefore, when the electrodes are placed in a stable position at the top of the chamber, an electrical test is used to check whether good contact of the electrode with the myocardium has been established, and the irritation threshold is determined.

The stimulation threshold is determined as follows: a pulse of amplitude 5 volts and a duration of 2 msec is usually sufficient to cause electrostimulation of the myocardium, that is, to realize the spread of depolarization from the point of contact of the electrode, which can be seen on the electrocardiogram that is recorded in parallel. We gradually decrease the pulse voltage until the ECG signal is lost, and after that we increase the pulse voltage up to the irritation threshold. ECG characteristics of CP stimulation are (ACC 2002)[9]:

• CP stimulation from the apex of the right ventricle presents with wide QRS complexes, with about 140 msec in healthy myocardium, and up to 200 msec in the case of conduction through scar tissue.

• CP stimulation from the apex of the right ventricle has a pattern like left bundle branch block

• It is characterized by a negative vector in DII, IIIaV, aVf, and a positive one in DI.

Indications for a CP

- The most important indications for CP implantation are:
- Complete AV block, intermittent or permanent, associated with:
- symptomatic bradycardia,
- arrhythmias or other medical conditions that require the use of drugs that suppress automaticity and lead to symptomatic bradycardia,
- a documented period of asystole longer than 3 seconds or an escape rhythm lower than 40/min, - after ablation of the atrioventricular (AV) node, if the procedure modifies the AV node,
- postoperative AV block, which is estimated to be a permanent change, neuromuscular diseases with AV block, - AV block second degree chronic or intermittent with symptomatic bradycardia ,
- symptomatic bradyarrhythmia with RR interval over 3 seconds [10].

Electro stimulator implantation is a surgical procedure during which all surgical principles must be observed. It is performed in a surgical room that must have a fluoroscopy machine or in a catheterization room. In addition to surgical instruments, it is necessary to continuously monitor the patient, a defibrillator and a suitable programmer that will examine the so-called

stimulation threshold after electrode positioning. The classic electro stimulator is implanted on the right side, unless the patient requests otherwise for some reason (hunters, fishermen, etc.). Patients are usually not given premedication and the patient does not take a meal before the intervention. An incision is made to the right or left in the prepectoralis sulcus, and the electrode is placed over the cephalic vein or over the subclavian vein. With two-chamber and multi-site CPs, we use both veins because it is necessary to implant two or three electrodes. After the intervention, the patient (unless a screw-on electrode is used, the so-called srewing) usually lies in bed that day, and is already able to get up the next day. Most often, the intervention passes without complications, but they still exist and do happen.

Complications after CP implantation

The most common complications after the installation of a CP are pneumothorax (which occurs when a subclavian vein is punctured) or hemothorax (which occurs if a blood vessel is lacerated), perforation of the myocardium with an electrode, dislocation of the electrode (the displacement of the electrode from the place where it was placed is accompanied by a loss of pacing or an increase in the threshold stimulation) exit block, (increasing the stimulation threshold of the electrode even though it did not move due to fibrosis of the place where it is located), arrhythmias during manipulation of the electrode, extracardiac stimulation, decubitus of the CP bed (due to battery pressure), and infection at the implantation site.

Death from complications is rare, however. The mortality rate is 0.08-1.1%[11]. The most common complication is displacement of the electrodes (there is a higher frequency of displacement of atrial than ventricular electrodes), followed by pneumothorax, infection, hematoma, and perforation of the heart.

Pneumothorax is a serious complication of implanting an electro stimulator, and it most often occurs due to the use of the subclavian vein puncturing technique. In the literature, there are different data on the incidence of pneumothorax when puncturing the subclavian vein, so the incidence varies from 0.6-1%, while on the other hand, there is data in some studies that indicate an incidence of 5.2%. However, the incidence is generally considered to be 1-3%[11]. After puncture of the subclavian vein, pneumothorax usually occurs ipsilaterally. Although cases of contralateral pneumothorax due to perforation by an endocardial atrial lead have also been described, it is still a rare complication. If it does not compress more than 30% of the lung parenchyma, and if severe symptoms or hemothorax have not developed, it is treated by draining the pleura through the 2nd intercostal space in the medio clavicular line directly into the pleural space.

Hemothorax is an extremely rare complication of electro stimulator implantation. It is usually caused by puncturing the subclavian artery and introducing a venous electrode into it. Hemothorax is usually treated with drainage, although in rare cases decortication is required.[12]

Air embolism is a complication associated with the use of Seldinger's percutaneous puncture technique[11] Deep inspiration during the use of venous access can lead to the introduction of air into the venous system due to the development of physiological negative pressure. To prevent this complication, it is recommended that the patient be well hydrated and placed in the Trendelenburg position. However, the most important step in the prevention of air embolism was the awareness of the doctor performing the implantation procedure about the possibility of developing the complication itself. The risk group for the development of air embolism is

elderly, dehydrated patients, and the riskiest part of the installation procedure is the extraction of the dilator from the venous introducer.

Venous thrombosis is a rather rare, but at the same time dangerous complication of electro stimulator implantation. It occurs at different time intervals after procedure[12].
Depending on clinical studies, the incidence of venous thrombosis is 30-45%, but most of them remain asymptomatic because adequate collateral circulation develops. The pathogenesis is not fully clarified, the literature mentions several risk factors that could influence the development of severe occlusion: the presence of multiple electrodes (compared to single-electrode systems), use of hormonal therapy, anamnestic data on previous venous thrombosis, previous electrostimulation therapy , endothelial trauma caused by electrode insertion and postoperative hypercoagulable state. Although only 1-3% of patients with venous thrombosis develop symptoms, it is necessary to routinely monitor and pay attention to the possible development of this complication because early diagnosis can reduce potential morbidity or mortality. The clinical picture depends on the place and size of the thrombosis.

Hematoma is a relatively common complication of electro stimulator implantation, especially in patients who are on oral anticoagulant or antithrombotic therapy. The introduction of perioperative anticoagulant therapy is a dilemma for doctors, especially in people with a medium to high risk of developing thromboembolism. Current guidelines recommend discontinuation of oral anticoagulant therapy and "bridging" therapy with heparin. However, the "bridging" strategy of heparin therapy was associated with an increased incidence of bed hematoma (up to 20%), and numerous observational studies later showed that the continuation of oral anticoagulant therapy is safe and does not increase the incidence of hematoma.

Wound erosion and dehiscence are subacute complications of CP implantation caused by progressive skin erosion. If the bed prepared for the generator during installation is too small for the device, the excessive tension of the skin covering the bed may gradually cause erosion of the subcutaneous tissue and possibly the skin. Erosion can also occur if the bed is placed too superficially, therefore the bed should be placed on the surface of the muscle. In the case of erosion, there is a high risk of infection, and therefore a complete extraction of electrodes and devices is recommended[7]. As the number of implanted devices increases, so does the incidence of infections associated with the implantation of electro stimulators. The complication can affect any structure - from generator beds and electrodes to endocardial structures, the latter of which is associated with extremely high mortality. Multiple and prolonged hospitalizations are common and attempts to rescue infected devices regularly fail. In the literature, the incidence of infections as a complication of the installation of all cardiac electronic devices is reported to be from 0.5 to 2.2%, with a slightly lower incidence if it is a question of permanent electro stimulators compared to implantable cardioverter defibrillators, and a slightly higher incidence if it is a question of a repeated procedure compared to the primary one.

Ventricular electrode malposition is an extremely rare complication, and cases of malposition in several different locations are described in the literature: left ventricle, coronary sinus, cardiac veins, and pulmonary blood vessels[13].

Electrode dislocation is a clinically significant and potentially dangerous complication. It usually appears in the early post-implantation period (within 24-48 hours). 88% of dislocations occur within the first 3 months, and a case of electrode dislocation 10 years after implantation is described in literature[14]. Atrial electrode dislocations are more common than ventricular dislocations. The incidence of atrial electrode dislocation is 1.6-4.4%, while the incidence of

ventricular electrode dislocation is 0.5-1.9%[12]. Possible risk factors for the occurrence of electrode dislocation are NYHA IV, atrial fibrillation and performing the procedure by an inexperienced physician. After dislocation, the lead usually remains intracardial. However, some mechanisms that cause electrode dislocation lead to the electrode being pulled toward the generator.

The aim of this work was to determine the importance of planned health care for patients after CP implantation, as well as the role of nurses/technicians in this process.

Materials and Methods

In this research, we used a questionnaire survey instrument, one specially designed for patients and one for nurses-technicians

The research instrument is a survey sheet containing a Patient Survey with 17 questions (demographic data, clinical data, attitudes) and a Nurse Survey with 13 questions (demographic data, educational data, attitudes).

Sample

The sample consisted of 30 patients of both sexes who had a CP implanted at the cardiology department of the KBC "Zvezdara" in Belgrade. The second sample consisted of 20 nurses/technicians working in this department. The research was conducted from June 1 to June 30, 2022.

Statistical Analysis

The statistical method we used was descriptive statistics made in the SPSS 17 program and presented in tables and graphically with absolute and relative numbers.

Results and Discussion

Patients

Distribution of respondents by gender shows that the frequency of males (24; 80%) is four times higher than females (6; 20%). The synergistic or opposing effects of sex and gender on cardiovascular traits and on ischemic heart disease and heart failure mechanisms have not yet been systematically described. Specific considerations of sex-related and gender-related factors in gender dysphoria or in heart-brain interactions and their association with cardiovascular disease are still lacking [14,15]

The results show that every other respondent (15; 50%) with an implanted CP is in the age category of 61-70 years, 30% 8 is over 70 years old, while 20% (6) is under 60 years old.

According to the level of education, most respondents (11;36%) completed secondary school, 20% (6) college, 17% (5) high school, 20% (6) university, while 7% (2) completed elementary school.

The largest share (14; 47%) of respondents live in a suburban settlement, 33% (10) lives in a city, while 20% (6) lives in rural areas .

As many as 80% (24) of respondents had symptoms of vertigo and fainting after the CP installation, while 20% (6) did not.

The results show that 90% (27) of subjects had limited mobility after CP implantation, while 10% (3) did not.

Every other respondent (15; 50%) was hospitalized for up to 7 days, 30% (9) for 8-10 days, while 20% (6) were hospitalized for more than 10 days.

The perception of pain on the Norton scale after CP implantation was mild for the majority (12; 40%) and scored from 0 to 2, 33% (10) of respondents assessed the pain as moderate (3-5), 20% (6) as moderately strong (6-8), while 7% (2) assessed it as severe pain (9-10).

A need for analgesics had 20 (67%) of respondents, while 10 (33%) did not.

As many as 93% of respondents went to regular CP checkups, and 7% did not go to checkups regularly.

As many as 28 (93%) of respondents went to regular CP checkups, and 2 (7%) did not go to checkups regularly.

The largest share (27; 90%) of the respondents stated that they received instructions on daily activities, while 3 (10%) claimed that they did not.

The results show that 21 (70%) of the respondents claimed to have received instructions on physical activities after CP implantation, while 9 (30%) did not.

Most respondents (50%) received instructions about activities after CP implantation from nurses, 30% from doctors, 13% from the Internet, while 7% did not receive instructions.

As many as 29 (97%) of respondents stated that they had received information about contraindicated procedures after CP implantation, while only one (3%) stated that they had not received this information.

The results indicate that 12 (40%) respondents are very satisfied with the work of nurses, 40% (12) are satisfied, while 20%(6) are not satisfied.

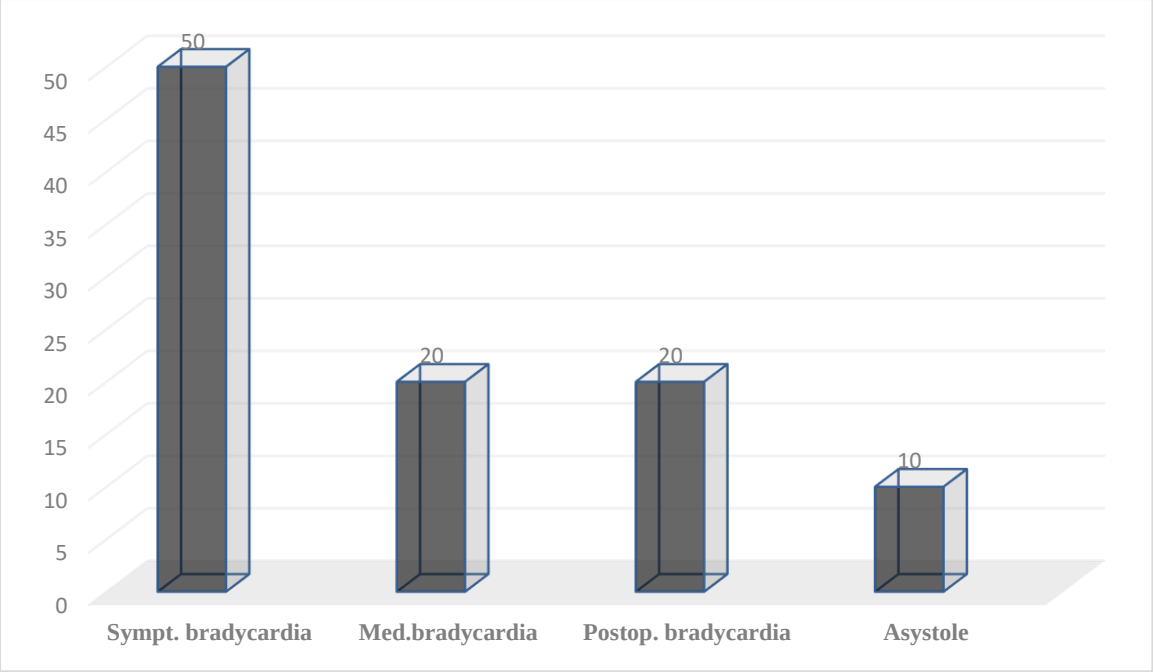

Figure 1. Distribution of respondents by the indication for cardiac pacemaker

In every other subject (50%), the indication for the implantation of a CP is symptomatic bradycardia, in 20% it is medication bradycardia, in 20% postoperative bradycardia, while short-term asystole is the indication in 10% of subjects (Figure 1).

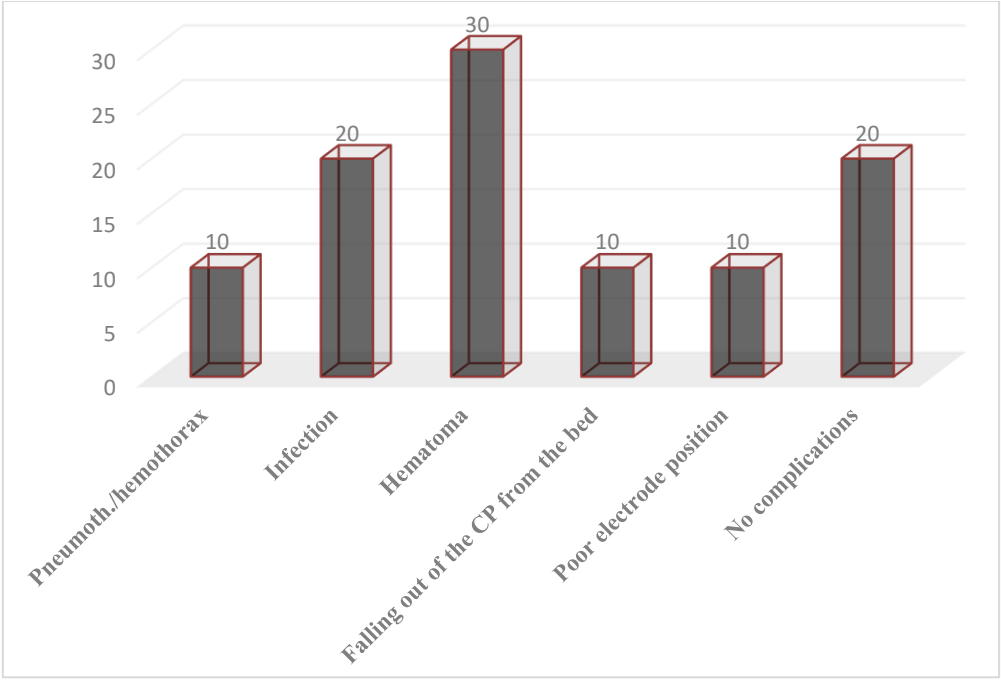

Figure 2. Complications after pacemaker implantation

The most common complication was hematoma at the implantation site, which occurred in 30% of subjects, in 20% infections, 20% had no complications, 10% had pneumothorax or hemothorax, 10% CP falling out of the socket and 10% electrode malposition. Many studies indicate that the most common complication is hematoma [16]. As many as 80% of respondents had symptoms of vertigo and fainting after the CP installation, while 20% did not. Vertigo is expected after the intervention, as our results indicate (Figure 2).

Nurses/Technicians

Respondents are predominantly female (16;80%), while 20% (4) are male. Half (50%) of respondents (10) are in the age category 31-40, 40% (8) are under 30, while 10% (2) are over 40. According to the level of professional education, the majority (8;40%) of respondents have a secondary education, 30% (6) have a higher education, while 30% (6) have a university education. The results show that 40% (8) of respondents had a length of service of up to 5 years, 40% (8) had 5-10 years, while 20% (4)had more than 10 years.

Half (10; 50%) of respondents are satisfied with cooperation with patients, 30% (6) are very satisfied, while 20% (4) are dissatisfied. The results show that 45% of respondents (9) are very satisfied with the cooperation with colleagues, 40% (8) are satisfied, while 15% (3) are dissatisfied.

The results show that 70% of respondents (14) participate in continuous education, while 30% (6) do not. Half (10; 50%) of respondents claim that they often go to education, 30% (6) rarely, while 20% of respondents (4) do not go to education. More than half (11; 55%) of respondents had education about patient care after CP implantation in the last year, while 45% (9) had not.

The largest share (15; 75%) of respondents is of the opinion that teamwork exists in the CP department, while 25% (5) do not share this opinion. In the opinion of 85% of respondents (17), the family shows cooperation in patient care, while 15% (3) think that this cooperation does not exist. The results show that 40% of respondents have the opinion that patients are satisfied with health care, 30% believe that they are satisfied, while 30% believe that they are dissatisfied.

Conclusion

Based on the research carried out at the department of cardiovascular diseases of KBC "Zvezdara", we reached the following conclusions:

Most patients are male, average age 61-70 years. The most common indication for CP is symptomatic bradycardia. The most frequent complication after CP implantation was hematoma, while every fifth respondent had no complications. Most of the subjects had symptoms of vertigo and fainting after the CP installation, limited mobility, and the average length of hospitalization of the patient was up to 7 days. Most respondents go for regular check-ups. The degree of satisfaction of the respondents with the work of nurses shows that most of them are satisfied or very satisfied.

Socio-demographic characteristics of nurses show that respondents are mostly younger, predominantly female. Most often, they have a secondary vocational education. Most respondents are satisfied with the cooperation with patients and colleagues and generally believe that there is teamwork in the department. Respondents generally believe that there is active family cooperation in education. Almost two-thirds of respondents go to continuing education. Most of the education is given at professional lectures.

This study in a Belgrade clinic shows that nurses/technicians largely contribute to satisfactory healthcare of patients with pacemaker.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Berne RM, Levy MN, Koeppen BM, and Stanton BA. (eds.). Physiology. St. Louis, MO: Mosby; 2004.
2. Zhang Y, Bharati S, Mowrey KA, Shaowei Z, Tchou PJ., and Mazgalev TN. His electrogram alternans reveal dualwavefront inputs into and longitudinal dissociation within the bundle of His. Circulation. 2001, 104, 832–8.
3. de Cock CC, Giudici MC., and Twisk, J.W. Comparison of the haemodynamic effects of right ventricular outflow-tract pacing with right ventricular apex pacing: a quantitative review. Europace 2003; 5, 275–8.
4. Mohrman DE. and Heller LJ. (eds.) Cardiovascular Physiology, 5th Ed. New York, NY: Langer Medical Books/McGraw-Hill; 2003.
5. Mitov V, Jolić A, Adamović D, et al. Uticaj poloţaja pejsmejker elektrode u desnoj komori na dijastolnu disfunkciju leve komore. Srce i krvni sudovi. 2013;32:252.
6. Vassalo JA, Cassidy DM, Miller JM, et al. Left ventricular endocardial activation during right ventricular pacing: effect of underlying heart disease. J Am Coll Cardiol 1986;7:1228-33.
7. Kotsakou M, Kioumis I, Lazaridis G. et al. CP insertion. Ann Transl Med. 2015 ;3(3):42.
8. Yarlagadda C. Permanent CP insertion technique. Medscape.[Online]. 2014. Available at: http://emedicine.medscape.com/article/1839735-technique [20.6. 2022]
9. ACC/AHA/NASPE, 2002. Guideline update for implantation of cardiac CPs and antiarrhythmia devices: sumary article. Circulation 2002;106(16):2145-61.

10. Schiariti M, Cacciola M and Puddu P.E. Complications of CP Implantation. [Online] In: Das M.K. ed. Modern CPs - Present and Future. Intech. 2011. Available at: ://www.intechopen.com/books/modern-CPspresent-and-future/complications-of-CP-implantation [21.06. 2022]
11. Pavia S, Wilkoff B. The management of surgical complications of CP and implantable cardioverter-defibrillators. Curr Opin Cardiol 2001;16(1):66-71.
12. Tarakji KG, Wilkoff BL. Management of cardiac implantable electronic device infections: the challenges of understanding the scope of the problem and its associated mortality. Expert Rev Cardiovasc Ther 2013;11:607–16.
13. Di Fusco SA, Palazzo S, Colivicchi F, Santini M; World Society of Arrhythmias. The influence of gender on heart rhythm disease. Pacing Clin Electrophysiol. 2014 ;37(5):650-7.
14. O'Neil A, Scovelle AJ, Milner AJ, Kavanagh A. Gender/Sex as a Social Determinant of Cardiovascular Risk. Circulation 2018; 20;137(8):854-64.
15. Haddadin F, Majmundar M, Jabri A. et al. Clinical outcomes and predictors of complications in patients undergoing leadless pacemaker implantation. Heart Rhythm. 2022; 19(8):1289-96.
16. Sideris S, Benetos G, Toutouzas K. Et al. Outcomes of Same Day Pacemaker Implantation after TAVI. Pacing Clin Electrophysiol 2016; 39(7):690-5.