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The Nurse's Role in the Prevention of Infection After Pacemaker Implantation

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ABSTRACT

Similarly to all devices implanted into the human body, cardiac pacemakers are also prone to infection. Depending on the area which has been contaminated, infections of pacemakers present a wide spectrum in clinical presentation, treatment and clinical outcomes. The purpose of this literature review was to determine the risk factors which are responsible for causing infection after pacemaker implantation and to study the nursing interventions which may help reduce the risk of such a serious complication. The relevant literature regarding infections following pacemaker implantation was limited and made it difficult to calculate the exact incidence rate. Nevertheless, the numbers have increased over the past few years in Greece. The risk factors are associated with the patient's history, such as age or the presence of diabetes mellitus, the experience of the operator, progression of infection from the pacemaker pocket, or even the device type which has been used. The nurse's role in the prevention of infection after pacemaker implantation is of vital significance, and involves observation for early diagnosis of the symptoms, the precise implementation of basic nursing principles and interventions such as aseptic techniques, and the epidemiologic surveillance of incidents. Success in all the above may assist in the formation of nursing protocols regarding the prevention of infection after pacemaker implantation.

List of Abbreviations:
PI: pacemaker infection
CDI: cardiac device infection

KEY WORDS: *pacemaker infection, nursing intervention, surveillance, risk factors*

INTRODUCTION

The cardiac pacemaker, just as every device implanted into the human body, may be associated with complications after implantation. Non-infectious complications occur in almost 9% of patients, and these include hematoma and lead dislodgement [1]. Infections, although not common, can be the most troublesome of all potential complications after permanent pacemaker implantation [2]. Depending upon the site involved, pacemaker infections have different presentations, treatment and consequences. Infections can be confined to the pulse generator pocket and attached subcutaneous component of the lead. A subcutaneous element can also erode through the overlying skin. Infection can also involve the intravenous portion of the lead with or without involvement of the generator pocket [3].

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EPIDEMIOLOGY

Due to the limited number of studies concerning infection after permanent pacemaker implantation, it is difficult to exactly define its incidence. A prospective

study which evaluated patients over a 6- year period reported an unusually high overall incidence of cardiac device infections (CDIs) (45.4%) [4]. In general, the rate of infections has ranged from 0.8 to 5.7% [5].

RISK FACTORS

Risk factors that have been associated with PI include [4]:

- Diabetes Mellitus
- Underlying malignancy
- Operator inexperience
- Advanced age of the patient
- Prior treatment with anticoagulants or corticosteroids
- Recent surgery involving a pacemaker device, particularly elective secondary manipulations such as battery replacement.

PATHOGENESIS

The main cause of infections has been recently demonstrated to be local contamination during implantation [6]. It is mentioned that skin contamination at the time of surgery can lead to subsequent PI [7]. Erosion of a pacemaker component through the skin may be due to the trauma of pressure on overlying skin with infection as a secondary phenomenon. However, low grade infection persisting from surgical manipulation may result in later erosion through the skin [7].

Epicardial electrodes may be infected at the cardiac attachment as a result of intraoperative contamination or less likely by spread of infection along pacing electrodes from an infected pulse generator pocket [8]. Infection of the intravascular component of the electrode occurs primarily on the portion of the lead that is intracardiac along the right atrium, the tricuspid valve, or the right ventricle contact point.

MICROBIOLOGY

The most common causal organism responsible for PI is Staphylococcus (75 to 92% of the cases, Staphylococcus aureus being the cause of acute infections (less than 6 weeks), whereas Staphylococcus epidermidis is associated with cases of secondary infection (more than 2 months) [6].

According to Hans et al, Staphylococci aureus and epidermidis are the most common infecting organisms. They mention that in patients with vegetations, Staphylococcus aureus was isolated in 60%, whereas only 1 of 26 identified organisms was gram negative (S. marcenses) [9]. Other responsible organisms may include Corynebacterium species, propionibacterium acnes, gram negative bacillus and Candida.

CLINICAL PRESENTATION

Pacemaker infections can either be superficial, involving the pulse generator pocket and attached leads, or deep, infecting the epicardial electrode or the transvenous lead5. Infections involving the pulse generator pocket typically develop soon after implantation or battery exchange. These infections present as acute or subacute wound infections with swelling, erythema, pain, and occasionally drainage through a dehisced incidion [5].

When the epicardial electrodes are infected, fever, constitutional symptoms, and signs of pericarditis or mediastinitis can occur. Bacteremia arises commonly in patients with infection at the site of attachment to the epicardium5. Infection of the transvenous electrode primarily involves the intracardiac lead and is essentially a right sided endocarditis. Approximately one- third of the cases of pacemaker endocarditis occur within three months of a pacemaker manipulation and are promptly recognized because of the concurrence of systemic symptoms and generator pocket infection [8].

The most common symptoms in patients with pacemaker endocarditis are fever (84 to 100%) and chills (75 to 84%). Clinical evidence of CDI is defined as erythema, warmth, fluctuance, wound dehiscence, erosion, or tenderness at the generator site [4]. Although the presentation is commonly subacute, occasionally patients present with sepsis syndrome and shock. Twenty to 45% of patients have pulmonary symptoms or radiologic changes consistent with pneumonia, bronchitis, lung abscess, or embolism [7]. Pulmonary embolism has been shown to occur in 30 to 40% of cases, whereas tricuspid regurgitation may develop in 25% of patients [8].

Laboratory criteria of infection include increased white blood cell count, increased C-reactive protein, and positive blood cultures, or positive cultures from either the intravascular part of the leads or the pacemaker pocket [8].

DIAGNOSIS

Pacemaker infection is generally suspected based upon the clinical presentation. On the other hand, pacemaker endocarditis presents in a more subtle way and is more difficult to diagnose. Generator infection should be considered when there is inflammation over the implanted device or erosion of the device through the skin. The diagnosis is confirmed by culture of material aspirated from the inflamed site using sterile technique.

For the diagnosis of pacemaker endocarditis studies have proposed the use of the Duke criteria [8]. Imaging studies for the diagnosis of PI include chest x- ray, transthoracic echocardiography (TTE), and transoesophageal echocardiography (TEE) [8].

TREATMENT

Successful treatment of pacemaker infection generally involves removal of the entire infected system and administration of antibiotics for the responsible organisms [9]. Infection involving the subcutaneous components of the system, in the absence of bacteremia, can be treated with antibiotics and direct exchange of the pacing system in a single procedure. After control of the local infection, the entire infected pacing system is removed and during the same procedure a new system may be inserted at a different site using sterile technique, although most authorities prefer to wait for 7-14 days of antibiotic therapy before implanting a new system at the contralateral side. The infected pocket is packed open and treated with local wound care and antimicrobials are continued for 10 o 14 days [9]. The recommended treatment for pacemaker endocarditis complicated by bacteremia and systemic symptoms combines parenteral antimicrobial therapy with removal of the entire pacemaker system, and implantation of a new system at the contralateral side only after completion of antibiotic therapy [8,9].

NURSING INTERVENTION

The nurse's role in the prevention of infection after pacemaker implantation is of great importance and involves all stages concerning the procedure, thus prior, during and following the implantation. Although specific protocols and guidelines have not yet been planned for nurses in Greek hospitals, there are some rules that may assist in the prevention of infection after PI.

EARLY DIAGNOSIS OF SYMPTOMS

It is important for the nurse to have full knowledge of the clinical presentation of infection after PI; hence nursing staff may therefore enhance the immediate initiation of the therapeutic measures, such as cultures and administration of antibiotics for the responsible organisms, along with possible removal of the contaminated device.

PATIENT RISK FACTORS

Preoperatively, the blood glucose levels of patients with diabetes mellitus should be optimized and hair depilation must be avoided the night before surgery. Borer et al suggest that patients wash their entire body with an antiseptic solution (triclosan 1%) the evening prior to the procedure and are educated regarding the optimal washing method [10].

STERILE TECHNIQUES FOR THE INSERTION OF PERIPHERAL VENOUS LINES AND EXECUTION OF BLOOD CULTURES

One of the first important techniques nurses are taught during their studies is sterilization of insertion and surgical sites. Sterilization is necessary when the skin is about to be incised. Various guidelines exist concerning the preparation and sterilization of the skin, to avoid intravascular catheter-related infections, and each hospital adopts those that are more suitable for their resources and practices. However, most guidelines are based on the initial ones recommended by the Center of Disease Control and adjusted to each hospital's setting.

LOCAL CARE OF THE WOUND SITE USING STERILE TECHNIQUES

Prior to caring of the wound, hand washing should be performed and sterile gloves must be worn. Sterile, dry gauze pads should be used to cover surgical incisions for 24 hours [10].

Strict implementation of sterile procedures for the preparation of the operating or procedure room and use of these throughout the implantation, thus enhancing sterile practice by the medical staff- It is the responsibility of the nursing personnel to ensure high- quality of the environment, such as quality control of reusable equipment, high- level disinfection, strict environmental cleansing, and disinfection of visibly soiled surfaces [10]. The behavior of personnel in the operating theater regarding decontamination, hand antisepsis, and compliance with universal precautions are major risk factors for surgical- site infections [11] However, their knowledge of these areas is alarmingly limited, as a surprisingly low number of only 38% routinely used all barrier techniques (gloves, masks and protective eye wear) [12]. Many physicians use the povidone- iodine solution to wash the pacemaker pockets during the implant procedure. However, the impact of this solution on the pocket infection rate is unknown. A study by Lakidireddy et al concluded that povidone- iodine wash of the device pocket does not affect the rate of pocket infection in centers with low infection rate [13].

ADMINISTRATION OF ANTIMICROBIAL THERAPY ACCORDING TO THE MEDICAL INSTRUCTIONS

Every hospital and physician ensures that the patient receives the appropriate prophylactic antimicrobial therapy prior to the operation and after, to protect the patient from organisms that are a threat at all stages of the procedure. It is a vital role of the nurse to ensure that the patient receives the proper dosages of the therapy and that the time of administration is strictly respected, to avoid the growth of resistant organisms.

CONTINUOUS EDUCATION

All medical professionals involved in patient care are compelled throughout their professional career, to expand their knowledge. Today, nurses more than any other time, are faced with increasing obligation to evaluate and improve their practice, while their motivation to improve their skills

may spring either from internal will, or from external pressures [14]. Conditions such as changing ways of work and the developing focus on continuing professional development have created a need for lifelong learning [15]. There are two means of continuous education available to nurses. The first are the numerous seminars and study programs that are available, journals and texts, access to the internet, all which contribute to the accumulation of all current and updated literature and studies which add to the existent knowledge. The second is the widely known procedure of reflective practice, which is either refection in or on action. Schon refers to reflection on action as the process of making sense of an action after it has occurred and possibly learning something from the experience, while reflection in action occurs when the individual thinks about practice whilst doing it, and influences the decisions made and the care given [16]. Through close observation during nursing practice, nurses are possible to either detect areas that could be improved or suggest techniques that could help to limit the cases of infection after PI.

EPIDEMIOLOGICAL SURVEILLANCE

Active surveillance can be performed by nursing personnel throughout the intervention period, during which they can collect information regarding the patient's history, the possible risk factors for each individual based on their history, and details of each treatment recommended and administered. Thereafter, follow-up visits of the patient can be used for any further gathering of information and surveillance of incidents of infection.

CONCLUSIONS

Nursing personnel is present during all stages of pacemaker implantation and is therefore an important member of the multidisciplinary team involved in the procedure. The nurse's various roles make apparent the need for a high quality of knowledge and skills, concerning all aspects of general nursing principles, along with details of this specialized cardiac procedure. Unexpectedly, few data regarding this area of cardiology nursing is available in the Greek literature. The need not only for further studies, but for continuous education as well is obvious. Perhaps the surveillance of infections throughout Greek hospitals could enhance the development of guidelines and protocols, and help prevent incidents of infection after pacemaker implantation.

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