

MANAGEMENT AND OUTCOMES OF PACEMAKER INFECTION

PRISE EN CHARGE DE L'INFECTION DE PACEMAKER

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Abstract

Introduction: Device infection is a serious complication. The aim is to report the management of pacemaker infection in our department. **Methods:** we report the observations of eight patients implanted with pacemaker complicated by infection. **Results:** It is about 5 men and 3 women. Seven patients had a history of recurrent interventions at the pocket site. The mean duration between last manipulation and symptom's onset was 21 months. Blood cultures were positive in 5 patients. Echocardiography showed vegetation over the tricuspid valve and the ventricular lead in one patient and vegetation only over the electrode in 3 patients. Three patients were treated medically. We extracted the whole device by transvenous traction in 3 patients and by surgery in 2 patients who died because of renal dysfunction. **Conclusion:** Early diagnosis of lead infection is difficult. So, we recommend to implant pacemaker in the best aseptic conditions and to minimize interventions on the pocket site.

Key words: Endocarditis; Extraction; Pacemaker; Prognosis.

Résumé

Introduction: L'infection de pacemaker est une complication grave. Nous rapportons la prise en charge et le pronostic des infections de stimulateur dans notre centre. **Méthodes:** Il s'agit de 8 patients implantés d'un pacemaker, présentant ultérieurement une endocardite. **Résultats:** Sept patients avaient des antécédents d'interventions récurrentes sur la poche. Les hémocultures étaient positives chez 5 patients. L'échocoeur a montré des végétations sur la valve tricuspide et la sonde ventriculaire chez un patient et des végétations seulement sur les sondes chez 3 patients. Trois patients étaient traités médicalement. Une extraction des sondes a été réalisée par voie percutanée chez 3 patients et chirurgicale chez 2 patients, décédés en postopératoire. **Conclusion:** Le diagnostic précoce de l'infection de sondes est difficile. Donc, nous recommandons d'implanter les stimulateur cardiaque dans les meilleures conditions d'asepsie.

Mots clés: Endocardite ; Extraction ; Pacemaker ; Pronostic.

ملخص

المقدمة: تعتبر الإصابة الخمجية لمنظم ضربات القلب من المضاعفات الخطيرة. نفيدكم بكيفية العلاج و الإنذار لحالات الخمج لجهاز تنظيم ضربات القلب في مركزنا.

الطريقة: قمنا برصد 8 مرضى وقع لهم زرع جهاز تنظيم ضربات القلب و في وقت لاحق تعرضوا لالتهاب الشغاف. **النتائج:** هناك سبعة مرضى لهم سوابق من التدخلات المتكررة على الجيب. كانت مزرعة الدم إيجابية لدى 5 مرضى. أظهر تصوير صدى القلب تنبئات على الصمام ثلاثي الشرف و المسبار البطني لدى مريض واحد و تنبئات فقط على المسابير لدى 3 مرضى. تم علاج ثلاثة مرضى طبيًا. وقد تم استخراج المسابير عبر الجلد لدى 3 مرضى و عن طريق الجراحة لدى مرضين توفيا عقب الجراحة.

الخلاصة: يعتبر التشخيص المبكر لخمج المسبار صعب. ولذا فإننا نوصي بزرع منظم ضربات القلب في أفضل ظروف التعقيم.

الكلمات المفاتيح: التهاب الشغاف ; الاستخراج ; منظم ضربات القلب ; الإنذار.

INTRODUCTION

Device infection is a serious complication of Pacemaker manipulating, whose diagnosis and management are difficult and controversial for both cardiology and infectious disease specialists. On literature, the incidence rate of pace maker infection range from 0,13% to 19,9%[1,2]. Many suggestions like antibioprohylaxis during the procedure or use of small device failed to decrease incidence of this event. In fact, according to American statistics, there was a 42% increase of implantation rate of cardiac device from 1990 to 1999 in the insurance beneficiaries "MEDICARE" whereas the increase rate of cardiac device infection among the same population was estimated at 124%[2]. In our country, and especially in our department, the stimulation device implantation is very developed during the last 20 years. We performed in our department 1507 procedures from 1987 to 2008. Eight cases of Pacemaker infection are noted so a rate of 0,53%. The aim of this publication is to report the clinical and the microbiological features, the management and the outcomes of pacemaker infection in our department.

CASES REPORTS

CASE 1:

A 68 year old diabetic male patient, with complete atrio-ventricular block underwent a single-chamber (VVI) pacemaker in February 1993. Three days after the procedure, he developed fever and he had pus on the wound with a biologic inflammatory syndrome. Blood and pus culture were negative. Echocardiography could not be performed. As the fever persist after 2 weeks of antibiotic treatment (oxacillin +gentamycin), we extracted the device (battery+ electrodes) and he received antibiotic for two weeks (vancomycin). After that, we implanted a new permanent pacemaker system on the contralateral pectoral region and he was treated by antibiotic for 2 weeks again. Infectious signs and symptoms had been regressing, gradually. In October 2003, the battery was electively replaced. Four weeks again, he complained of fever, and an abscess was visualized at the pacemaker pocket. However, blood and pus culture as echocardiography (transthoracic and transesophageal) failed to reveal signs consistent with infective endocarditis. The extraction of the device was performed once again, and a new single chamber pacemaker implantation was performed

after 2 weeks of antibiotic therapy (vancomycin + gentamycin).The treatment was received 2 weeks again after the procedure. In August 2005, the patient was admitted to our department for persistent fever without any other focus of infection. The transthoracic echocardiography showed vegetation over the tricuspid valve region; the transesophageal echocardiography revealed vegetation adjacent to the ventricular electrode (Figure 1) and S.aureus was isolated in blood cultures. The lung scintigraphy showed a pulmonary embolism. Thus, the patient was diagnosed with pacemaker related infective endocarditis complicated of lung abscess. He received long-term treatment for approximately 6 weeks (vancomycin + ciprofloxacin). He was referred to open heart surgery for complete removal of the pacemaker system. The device was successfully extracted, a vegetectomy over the tricuspid valve was achieved and a permanent pacemaker with an epicardial electrode were implanted during the operation. But the patient was died four days later from a severe renal dysfunction.



Figure 1: Transthoracic echocardiography:4 chamber views we noted a vegetation (arrow) attached to the lead and prolapsing among the tricuspid valve .

CASE 2:

A 75 year old male patient received a single chamber (VVI) pacemaker for bradyarrhythmia in August 2005. He had diabetes and suffered from a chronic renal dysfunction not yet on dialysis. He was admitted in January 2007 to our department for a left heart failure, and he was suffering during the last 3months before the admission from sweating and weakness with biologic inflammatory syndrome. An atrialisation was so performed. Fifteen days later, he developed a fever at 39° and arthralgia. The blood culture isolated streptococcus bovis at four times. The echocardiography revealed vegetation over the ventricular electrode.

The lung scintigraphy showed a pulmonary embolism. Thus infective endocarditis was diagnosed. The patient with and underwent 3 weeks of antibiotic (Ampicillin + Rifadin). As he was dependent on stimulation, he was referred to surgery. The extraction of the device was performed and a new pacemaker with epicardial electrode was implanted at the same time. After the operation, we continued the antibiotic treatment (ampicillin). However, the renal function had been impairing, he died because of an acute pulmonary edema.

CASE 3:

A 63 year old man with chronic renal failure was admitted to our hospital in July 1994 for syncope caused by a complete atrio-ventricular block. A cardiac pacing catheter had been positioned for 14 days. Then, a single-chamber pacemaker (VVI) was implanted. The procedure was repeated after three days because of the lead displacement, and the stimulation inefficiency. One week later, the patient had fever and we didn't isolate any germ on the blood culture. So he had been receiving anti staphylococcus antibiotic for three weeks. He was rapidly discharged. In 2001, an elective replacement of the battery was achieved. In 2005, he had erythema, warmth and pain at generator site, but he had no fever. Laboratory tests were normal and blood cultures were negatives. The lung scintigraphy didn't show any sign of pulmonary embolism. Echocardiography couldn't identify any sign consistent with infective endocarditis. Therefore, the patient had been received antibiotic (oxacillin + Gentamycin) for 2 weeks but we didn't achieve a device extraction. The local signs totally regressed at the eighth day of the treatment. Two years later (Juin 2007), the battery was electively replaced, that procedure was complicated of a pulmonary embolism treated by anticoagulant for six months. Follow up of one year was uneventful.

CASE 4:

The fourth patient is a 60 year old man. He had monoclonal gammopathy and he had been receiving corticoid. He had also diabetes mellitus and coronary disease. He received a dual chamber (DDD) in April 2006, for a complete AV block. Five months later, he was hospitalized because of a persistent fever without any focus of infection. There was a biologic inflammatory syndrome and the blood cultures were positive for streptococcus equizoepidermicus.

Transoesophageal echocardiography showed small vegetation (4mm) attached to the ventricular pacemaker lead. We extracted the whole device after 2 weeks of antibiotic treatment (Ampicillin + Gentamycin) and we implanted a new pacemaker (DDD) in the contralateral pectoral region. The culture of the two leads was negative. The antibiotic treatment was extended for three weeks again. The patient is still asymptomatic and has been followed up with clinic visits and echocardiographic control for two years.

CASE 5:

A 84 year old woman, received a single chamber pacemaker in January 2006, because of recurrent syncope from a complete AV block. She had hypertension. In April 2006, an unacceptable threshold of the ventricle lead was detected and a new intervention with reposition of this lead was necessary. Four months later, erosion developed over the pocket region of the battery and it prolapsed outside, with localized inflammatory signs (fig2). Contrariwise, the patient had no fever. She had a biologic inflammatory syndrome. A staphylococcus epidermis was isolated on blood culture. The echocardiography didn't show any sign consistent with infective endocarditis. So, we opted to extract the battery and the leads. After 2 weeks of antibiotic treatment, we implanted a new device (VVI) and we extended the medication for 4 weeks. The evolution was uneventful.



Figure 2 : Inflammatory signs on pocket site and exteriorisation of the pacemaker

CASE 6:

A 63 year old woman was admitted to our department in January 1998 for syncope because of a complete AV block. She had chronic renal failure. A cardiac pacing catheter was inserted initially because of a urinary tract infection. A single chamber pacemaker (VVI) was implanted after 10 days of antibiotic. In January 2003, the patient was hospitalized for fever. The exam revealed erythema and warmth at the pocket site. Erosion developed over the pocket region and it prolapsed outside. She had a biologic inflammatory syndrome. A staphylococcus epidermis was isolated at the blood culture. However, echocardiography didn't show any sign consistent with endocarditis. The woman received antibiotic (vancomycin +gentamycin) and we decided to extract the device. But, the electrodes could not be removed by simple traction, so their venous ends were cut and the remaining part were left in place. The patient was not dependent on stimulation, so a new pace maker was implanted after 2 weeks of antibiotic, continued for 21 days again. The patient remained asymptomatic for one year and then she was lost to follow up.

CASE 7:

The seventh patient is a 77 year old man, diabetic, who received in October 2007 a dual chamber pacing for complete AV block with recurrent syncope. The procedure was complicated of a humeral thrombophlebitis, so he had been receiving anticoagulant treatment for three months. In June 2008, he had inflammatory signs (warmth, erythema, swelling...) at the pocket site, without fever or biologic inflammatory syndrome. The blood culture was negative.

The echocardiography was normal. The lung scintigraphy did not reveal a pulmonary embolism. So, we extracted the battery and the leads which culture was positive of staphylococcus epidermis. The patient had been receiving Teicoplanin and ciprofloxacin for 15 days, and then we implanted a new dual chamber pacemaker in the contralateral region. We continued antibiotic for one month. The follow up was uneventful.

CASE 8:

A 70 years old woman received a single chamber pacemaker in December 1996 for bradyarrhythmia with syncope. An elective replacement of the battery was accomplished in July 2008. One month later, the device was prolapsed outside with purulent drainage and erythema at the pocket side. She was empirically treated by his family physician. But she became feverish and was admitted to our department after 5 days. Laboratory tests were normal. The blood and the pus culture were negative. The transoesophageal echocardiography revealed vegetation attached to the ventricular electrode. The lung scintigraphy showed a pulmonary embolism. The lead extraction by simple traction, had failed because of adherences. So, we cut the venous end, whereas the remaining part was left in place. The patient received antibiotic for six weeks (teicoplanin + ciprofloxacin). She well recovered and remained asymptomatic. The indication of pacing was reviewed and we decided to not implant the woman.

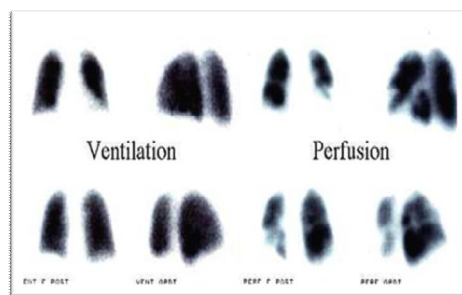


Figure 3: Lung scintigraphy: pulmonary embolism

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Table I: Clinical presentation, management and outcomes of device infection

Age (years)	70 (63-84)
Gender	3 female/5male
Antecedents	Diabetes(4/8); Renal failure(3/8); corticoids(1/8); anticoagulant(1/8)
Pacemaker type	6VVI/2DDD
Indication	6 complete AV block/bradyarrhythmia
Manipulation before infection	21 months (1month-5years)
Pacing electrode Catheter	2/8
History of recurrent interventions	7/8
Antibioprophylaxis before procedure	8/8
Local signs without septic syndrome	3/8
Systemic symptoms without local signs	3/8
Local signs + systemic symptoms	2/8
Biologic inflammatory syndrome	5/8
Blood culture positive	5/8
Electrode culture positive	1/8
Germes	Staphylococcus Aureus=1 Staphylococcus Epidermis=3 Streptococcus Bovis=1 Streptococcus Zooepidermicus=1
Echocardiography	Normal=4/8 Vegetation attached to lead =4/8 Vegetation on the tricuspid valve=1/8
Lung Scintigraphy	Pulmonary embolism=3/5
Antibiotic (without extraction)	1/8
Device extraction(traction)	3/8
Surgical extraction + epicardial implantation	2/8
Failure extraction(adherences)	2/8
Antibiotic duration before a new implantation	18 days
Total antibiotic duration	48 days
Death	2/8

DISCUSSION

Last years, the increasing of pacing, is associated with an important risk of infection, resulting in high mortality and expensive financial cost.

A population-based study found an incidence of CIED infection of 1.9 per 1000 device-years and a higher probability of infection after implantable cardioverter defibrillators compared with permanent pacemakers [2].

In fact, the incidence is very changing due to the lack of common criteria to make the diagnosis from one hand, and the long duration between last manipulation and onset of symptoms from another hand. In our population, this period was estimated at 21 months, with an extreme of 5 years.

We usually based on the Duke criteria to discuss device infection, but on reviewing the clinical findings of many patients like in Mayo clinic study [3] or even in our eight patients, we conclude that these criteria are not very contributive to make the diagnosis. The clinical evidence of Device Infection included local signs of inflammation at the generator pocket in many times. On literature, the diagnosis was revealed by local signs in 70%, systemic symptoms in 10% and association of local and systemic symptoms in 20% [4]. In our population (Table I), 5 patients had local signs (>50%) and from them, 3 patients didn't have systemic symptoms. Moreover the seventh patient had local signs without fever and the electrode culture was positive for *Staphylococcus epidermidis*. Nevertheless, local signs were not included in Duke Criteria.

In fact, the infection results generally (75%) from a contamination during the procedure or after skin erosion at the pocket site, but the mechanism of septicemia with another focus infection could not be excluded [5].

Blood cultures are very contributive for diagnosis in patients with suspected infective endocarditis. According to the literature, the most frequently encountered pathogens isolated from blood, wound, and leads cultures of patients with pacemaker associated sepsis include coagulase positive and coagulase negative staphylococci (80%) [6]. This is consistent with blood or electrode culture findings of most of our patients: 3/6 patients had *staphylococcus epidermis* which considered as a blood contamination in the Duke criteria, and not in favor of endocarditis. Generally, early infections after implantation tend to be caused by *Staphylococcus aureus*, whereas late infections are caused by *S epidermidis*. Therefore, empiric antibiotics for suspected device infection should

include coverage for staphylococci while awaiting microbiology results or negative culture [7].

Echocardiography is of pivotal importance in the diagnosis of pacemaker-associated endocarditis. The aim of this investigation is to demonstrate the presence of any moving intracardiac mass or abscess formation over the pacemaker electrodes, tricuspid valve or endocardial structures where the electrode is placed [1]. The use of transoesophageal echocardiography is becoming increasingly useful as a diagnostic technique and it is much more sensitive (95%) than the transthoracic view (30%) [8]. In our series, all patients had echocardiographic investigation and vegetations were demonstrated over the tricuspid valve or electrodes in 4 patients. Today, transoesophageal echocardiography seems to be a systematic investigation if a stimulated patient had persisting bacteraemia or fever, especially when a staphylococcus was isolated.

In difficult cases, other modalities such as radiolabelled leucocyte scintigraphy and 18F-FDG PET/CT scanning [9] have been described as additive tools in the diagnosis of CDRIE and related complications, including pulmonary septic embolism.

The pulmonary scintigraphy is very helpful for diagnosis, but it is also not included in the Duke criteria. Many stimulated patients suffered for a long period from recurrent bronchitis which is actually caused by septic pulmonary micro-embolism. That's why, we should performed a pulmonary scintigraphy every time we suspected device related endocarditis. In our patients, in more than 50% of cases (3/5 patients), the lung scintigraphy had showed embolism, and so revealed an advanced stage of endocarditis.

Review of the literature presents some predisposing factors for pacemaker infection.

Some factors are related to the host [4] like elderly patients, diabetes mellitus (4 of our patients), kidney or heart failure (3 of our patients), neoplasm, dermatological diseases, the use of corticosteroids (1 patient) or anticoagulants (1 patient).

Others predictors are related to the implantation procedure [4] and as in our cases, recurrent surgical interventions (7 of our 8 patients) on the pacemaker system especially temporary pacing (2 patients) is the most important and these are responsible for 66–73% of the infections, in current analyses. The operator experience and the number of device implanted in the center are always predictors for infection. The infection risk increase also with the

number of electrodes used (single, dual or triple chamber).

Treatment of an infected pacemaker system depends on the knowledge of the clinical course and microbiological features.

The preferred optimal treatment is to associate an intensive antibiotic treatment covering staphylococci and a complete device removal whether it is endocarditis or an obvious pocket infection [3]. Two techniques could be used: a surgical removal by cardiectomy or a percutaneous lead extraction by manual traction, locking stylet or laser sheath. It has been shown that in the hands of experienced operators, with appropriate precautions and patient selection, the intravascular extraction technique allows the removal of up to 98% of intravascular leads [3]. The chosen technique depends on the size of the vegetation on transoesophageal echocardiography, the alteration of the tricuspid valve and the general condition of the patient. It is recommended to remove vegetations of more than 10 mm by thoracotomy, because of the risk of pulmonary embolization of lead vegetation fragments. In our patients, we extracted the electrodes by manual traction in 4 patients, and by sternotomy in two patients. The leads were left in place in two patients because of fibrosis; as we didn't dispose of the others techniques in addition to the high surgical risk.

The duration of antimicrobial treatment for pacemaker infection depended on the clinical presentation and the causative agent. In a large case series from the Cleveland Clinic Foundation, the median duration of antibiotic treatment in CDI cases with pocket infection and those with bacteremia was 26 days and 41 days, respectively. However, in Mayo clinic experience, cases of only pocket infection were treated with 10 to 14 days of antimicrobials and those with blood stream infection for 4 weeks after device removal [3]. Similarly, patients with cardiac device-related endocarditis limited to the right heart can be treated with 4 weeks of antibiotics instead of the 6-week treatment course that has been advocated by some. Infection by certain microorganisms may require longer antimicrobial treatment for complete eradication of CDI. However, in our practice, all patients were treated for at least 4 weeks.

Timing of reimplantation of a new device system after extraction of an infected device remains a subject of debate and is influenced by the clinical presentation and the dependence on permanent pacing. Some investigators have suggested delaying reimplantation of new device for 10 to 14

days in cases of pocket infection and up to 6 weeks in bacteremic patients. But the Mayo clinic guidelines [3] suggest that devices can be safely reimplanted once the pocket has been adequately debrided and blood cultures are negative. Moreover, we should consider if the patient is dependent on permanent pacing so an epicardial pacing should be performed, otherwise we could achieve a transvenous pacing 1 or 2 months later in the contralateral region.

Nevertheless, the need for placement of a new device system should be carefully assessed in all patients because an appreciable number of patients may not require a subsequent cardiac device. In the Mayo clinic study [3], reimplantation of a new device was not required in one third of patients. And in our population, we renounced to reimplant the eightieth patient.

Finally, pacemaker infection has a poor prognosis, the mortality rate range from 3% to 13% [4]. The causes of death could be related to the pathology evolution (sepsis), to the extraction procedure (bleeding complications, venous lacerations, valve damage) or to the general condition of the patient. Voigt and al had showed that renal failure and advanced age increase the risk of mortality [10]. In our population, two patients were died immediately after surgery from kidney and lung failure.

CONCLUSION

The pacemaker lead infection is a rare but life threatening condition. The diagnosis is usually belated. It must be considered in patients with permanent pacemaker when fever, local symptoms or positive blood cultures. The transoesophageal echocardiography is of pivotal importance. The pathogen isolated is usually staphylococcus. The pulmonary scintigraphy should be systematic in the recent European guidelines [7]. The optimal management is to associate a complete removal Pacemaker system and an intensive antibiotic. But prevention is usually better than cure. So we recommend to implant pacemaker in the best aseptic conditions, to shorten as possible the temporary pacing and to avoid recurrent interventions after implantation.

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