Electrode Endocarditis: Diagnostics and Therapy

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Summary

Electrode endocarditis is one of the most dangerous complications in pacing and is associated with high mortality. Retrospective analysis of post-implantation infection complications was performed for 1,900 pacemaker implantations. Electrode endocarditis was diagnosed in 5 patients (0.26%), evidenced by hectic fever, leukocytosis, and positive inoculation of blood culture. Three patients exhibited signs of infection in the pacemaker pocket. A surgical approach is the most effective treatment in electrode endocarditis. Removal of the infected lead, and vegetation, as well as restoration of the damaged intracardiac structure, could only be achieved intraoperatively using artificial circulation (AC).

Key Words

Pacing, complications, electrode endocarditis

Introduction

Nowadays, pacemaker implantation is the most common treatment for patients with rhythm disturbances. Incidence of complication after this surgery is rare. The most dangerous complication is the particular case of electrode endocarditis.[8,9]. In the following, we present our diagnostic and therapeutic experience with this serious condition.

Materials and Methods

The retrospective analysis of complications after 1,900 pacemaker implantations (1992-1998) was performed. Five (0.26%) patients presented symptoms of bacterial (electrode) endocarditis (3 male, 2 female, aged 33-67 years).

2D-echocardiography, and in one case esophageal EchoCG, were performed for diagnostic purposes. Blood inoculation was undertaken to determine the cause of infection. Antibiotic therapy was performed with consideration of pathogen sensitivity.

Four patients were operated on under normothermic artificial circulation. Left atrial opening, intracardiac reconstruction, and lead- and vegetation extraction were carried out in all patients.

Results

Three patients showed late electrode endocarditis 2 to 3 years after implantation; one patient showed symptoms 6 weeks after implantation and one more patient after 14 days of temporary pacing prior to pacemaker implantation. In three patients, endocarditis developed after local signs of infection (pocket suppuration, bedsores). To suppress suppuration, between 2 and 5 operations were undertaken. In one patient, the endocardial lead was removed; in two other patients leads were cut down.

All patients presented similar symptoms, i. e. hectic fever, leukocytosis (more than 7000 in 1 ml). In 4 cases, diagnosis was proved by Staphylococcus aureus inoculation and in one - Staphylococcus epidermidis inoculation (Table 2).

No changes in intracardiac structure or electrodes were revealed by echocardiography. The duration of preoperative endocarditis treatment with artificial circulation was 18-20 days. Table 3 shows the intraoperative data and types of surgical procedures. Note that all ventricular electrodes were not only attached to the right ventricular wall but also to the tricuspid valve. Resection of the back leaflet with further suture plasty was performed in two patients (in one patient, the elec-

N	Age, sex	Pacemaker Implantation Indications	Stimulation type	First operation	Number of operations	Operation with AC
1.	67/M	total block after RFA in AF	VVI VVIR	1990 1995	5	1997
2.	33/M	SSS	AAI	1994	1	1997
3.	58/M	TAVB	VVI	1971	5	1997
4.	60/F	TAVB	VVI	1997	1	-
5.	67/F	total block after RFA in CA	VVI	1998	2	1998

Table 1. General patient characteristics note: RFA = radiofrequency ablation, AF = atrial fibrillation, TAVB = total atrioventricular block, SSS = sick sinus syndrome, AC = artificial circulation.

trode was removed 10 days prior to the AC operation; pacemaker system alteration and sanitation was carried out). Electrode removal by traction was unsuccessful in all cases. An epicardial electrode was used in further pacing, and the pacemaker was positioned under the fascia of the abdominal straight muscle.

Two patients were reoperated in the early postoperative period: Epicardial atrial electrode relocation to avoid diaphragmatic nerve pacing in one case and sewing up a disrupted bulla on left lung in another.

Two patients died. One patient died prior the AC operation of acute heart failure as a result of total aortic valve incompetence caused by leaflet detachment. Another patient died of multiple-organ incompetence in the early postoperative period. The follow-up period for other patients was 4-15 months. They are alive and feel well. One patient received another pacing system because of epicardial electrode fracture.

Discussion

The incidence of infection complications after pacemaker implantation is estimated to be 0.5-12.6% [10]. Acute infection may be evoked in any part of the pacemaker system, but mostly in the pacemaker pocket. Late infections usually occur 2 months after implantation. The most common cause of infection is Staphylococcus aureus.

Risk factors for infection are diabetes mellitus, long or repeated operations, postoperative hematoma and immune-system disturbances [12].

Among all the factors, repeated surgical intervention seemed to be the most common cause of infection [10, 12].

Late infections (more than 6 months after implantation) develop without any risk factors [10]. In these cases, Staphylococcus epidermidis is the most common cause of infection [18]. However, Staphylococcus aureus was the cause of infection in the 3 patients who developed endocarditis 2-3 years after implantation.

Our study has proved that electrode endocarditis is developed mostly from infected pacemaker pockets. Thrombosis at the endocardial electrode is less common but is still a cause of endocarditis [5]. The infection process at the endocardial electrode may involve the tricuspid valve [16] and right atrial wall [15].

Thromboses developed on electrodes remain symptom-free [14].

Long-term temporary pacing appears to be an important etiological factor. In the 4th patient, endocarditis developed after temporary pacing. Septic complications in temporary pacing are more common than in permanent pacing [15]. Diagnosis is based on the typical clinical picture, blood inoculation results, and echocardiography. The echocardiograph is a very sensitive diagnostics method for intracardiac vegetations developed on electrodes or on other structures [11,13,14,16].

Esophageal ECG is performed if not enough informa-

N	Sepsis	Local signs	Fever	Leukocytosis in 1ml	Hemoculture	EchoCG
1.	+	+	hectic	20200	S. aureus	-
2.	+	-	hectic	5200	S. aureus	-
3.	+	+	hectic	12400	S. aureus	-
4.	+	-	hectic	7600	S. epidermidis	-
5.	+	+	hectic	14600	S. aureus	-

Table 2. Diagnosis criteria.

tion is gained with standard ultrasonic investigation.
Nevertheless, according to our data this method has low sensitivity, probably because specialists have insufficent experience with electrode endocarditis due to the rarity of the condition.
Removal of infected pacing systems (pacemaker and leads) is the most effective method in suppuration treatment, and prevents the spread of infection. We use different approaches to treat pacemaker pocket suppuration and lead infection.
In cases of pacemaker-pocket infection, the preservation of the pacing system is possible at the first treatment stage. This stage includes wide pocket debridement, irrigation, and sub fascia pacemaker relocation [2,3]. If this approach is ineffective, removal of the entire pacemaker system is necessary. Incomplete removal shows a reinfection rate of 77% [17].
We feel that leads involved in an infection must be removed completely, since the mortality rate with incomplete treatment is 25% [17]. Electron-microscopy has shown that microfractures in the lead body may be the site of bacterial colonization resistant to antimicrobial therapy. Staphylococcus bacteria create colonies on the lead body which penetrate into extracellular amorphous substance on the surface. The substance itself protects the bacterial colonies and prevents penetration of antimicrobial treatments into this biological film [15]. This is the reason for difficulties in the elimination of infection when the pacing lead is not removed.
Difficulties may occur during the removal of leads implanted more than 8 weeks ago. In fact, the endocardial electrode has a tendency to develop a dense capsule around itself at the site of implantation (right atrium or right ventricle) [4]. This causes difficulties for lead extraction. The majority of authors indicate the possibility of lead extraction without artificial circulation [6,7]. Various techniques and devices are used for this purpose.

1. Constant traction with increasing weight [1].
2. Intravascular lead extraction by means of endoscopic clamp, Dormia basket, Dotter basket, etc. [6].

Although these methods are considered to be rather effective, their implementation may cause serious complications (rate 2.5%) [17]. Among them are: tachyarrhythmias, heart arrest, cardiac tamponade, rupture of atrial or ventricular wall, tearing of leaflet or subvalvular structures of the tricuspid valve, damage of the vena cava and so forth [4], with a combined mortality rate of up to 0.6%.
In our opinion, nonsurgical methods of infected lead extraction are not optimal.
We prefer to remove infected leads during an operation with artificial circulation, because this procedure is conducted with direct visual contact and has several advantages over indirect methods. It is obvious that the risk of mechanical heart damage and the spread of vegetation are decreased due to a lack of mechanical lead stress and a stoppage of bloodflow in the pulmonary heart system during the main stage of operation. Lead extraction in a working heart via purse-string suture is associated with the risk of incomplete vegetation extraction and, as a result, process continuation [17]. In open heart operations, surgical interventions are possible on other heart structures: tricuspid valve reconstruction, vegetation and thrombus extrac-

N	AC Min	Acl min	Operation type	Intraoperative findings	Outcome
1.	59	20	pulmonary heart revision, vegetations and electrode extraction	vegetations	lethal
2.	47	30	pulmonary heart revision, vegetation and atrial electrode extraction, TV plasty, BV revision	vegetations and TV vegetation	15 months
3.	60	38	pulmonary heart revision, vegetation extraction, TV plasty	vegetations and TV vegetation	13 months
4.	-	-	pacemaker implantation	AV distension	lethal
5.	24	8	pulmonary heart revision, vegetation and electrode extraction	vegetation	4 months

Table 3. Operative data. AC =artificial circulation, ACl = aortic clamping, TV = tricuspid valve, BV = bicuspid valve, AV = aortic valve.

tion (that was necessary in all our patients), and the alteration of other valves.

In conclusion, electrode endocarditis is a rare and severe postimplant complication that is potentially lifethreatening. It occurs mostly in the late postoperative period. The most common causal pathogen of electrode endocarditis is the pathogenic Staphylococcus. Diagnostic manifestations are hectic fever, leukocytosis and pathogen inoculation from blood. With appropriate experience, echocardiography appears to be a very valuable diagnostics method. Surgical treatment of endocarditis seems to be most effective. Only during artificial circulation, extraction of the infected lead vegetations, and restoration of damaged intracardiac structures can be performed.

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