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Surgical Treatment in Infected Permanent Transvenous Pacemaker Systems: Ten Years' Experience

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İNFEKTE KALICI TRANSVENÖZ PACEMAKER SİSTEMİNDE CERRAHİ TEDAVİ: ON YILLIK DENEYİM

Pacemaker sistem infeksiyonu uzun dönem takip sonuçlarında potensiel ciddi bir problem olarak karşımıza çıkar. 1985-1995 yılları arasında infekte pacemaker sistem enfeksiyonu olan 36 olgu sunulmuştur. Bu dönem içerisinde 1800'den fazla kalıcı pacemaker implantasyonu yapılmış ve 36 olgu pacemaker infeksiyonu nedeniyle tedavi edilmiştir. Bu olguların kalıcı pacemaker implantasyon endikasyonu: 24 (% 66) olguda total atrioventriküler blok, 6 (% 17) olguda hasta sinüs sendromu, 3 (% 8) olguda Wenckebach fenomeni, 2 (% 6) olguda karotis sinüs sendromu, bir (% 3) olguda ise sinüs bradikardisi idi. Olguların 24'ünde (% 67) cep infeksiyonu karşı tarafa yeni pacemaker sisteminin aynı seansta takılması ile tedavi edildi (Grub A) (Olguların yedisinde (% 79) kesilerek kısaltıldı.). İnfekte kalıcı pacemaker sistemi 8 olguda vücut dışı dolaşım ile, bir olguda ise endovasküler teknik kullanılarak uzaklaştırıldı (Grub B). Bu grupta yeni pacemaker sistemi eş zamanlı yedi (% 78) olguda değiştirildi. Altı olguda epikardial elektrot, bir olguda ise endojen elektrot kullanılarak impante edildi. Her iki grubta, olguların ikisinde infekte pacemaker çıkarılmasını takiben yeni pace maker sistem implante etme ihtiyacı duyulmadı. Olguların bakteriolojik sonuçları: 17 (% 47) olguda üreme saptanmadı; 11 (% 31) olguda Staphylococcus coagulase (-), 4 (% 11) olguda Staphylococcus aureus, diğer 4 olguda ise sırasıyla Streptococcus equisimilis, Pseudomonas, penisilin rezistan staphylococcus, miks patojen (Enterobacter, Citrobacter, Klebsiella) izole edildi. Son pacemaker implantasyon tarihi ile infeksiyon başlaması arasındaki geçen süre bir ay ile 11 yıl arasında olup ortalama 31±36 ay idi. İnfeksiyonun başlaması ile cerrahi tedavinin yapıldığı tarihler arasındaki süre ise 1 ay ile 7 yıl olup, ortalama 7±17 ay idi. Uzun dönem takipler, 36 olgunun 35'inde (% 97) elde edildi ve en az 1 ay, en fazla takip ise 10 yıl olup ortalama 76±50 aylık uzun dönem takibi değerlendirildi. Serimizde erken dönem hastane mortalitesi olmadı ve postoperatif dönemleri komplikasyonsuz seyretti. Hastanede kalış süresi 1 gün ile 49 gün arasında değişmekte, ortalama kalış süresi 10.9±10 gün idi. Olguların % 53'ü oral antibiotik ile taburcu edildi. İmplantasyon sonrası 5 hafta ile 7 yıl arasındaki dönemde 6 olgu pacemaker dışı nedenlerle kaybedildi. Aktüariyel sürvi zamanı 10 yılda % 81 olarak bulundu. Septisemi ya da endokardit gibi dirençli enfeksiyon bulguları olan infekte pacemaker tanısı alan olgularda eğer elektrodun çıkarılması kapalı metodlar ile başarılamıyorsa veya bu metodların kullanımı kontraendike ise cerrahi girişim vücut dışı dolaşım, inflov oklüzyonu, kese ağzı teknik gereklidir.

Anahtar kelimeler: *Cerrahi girişim, infeksiyon, kardiyopülmoner bypass, pacemaker*

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Despite the management of patients with symptomatic bradycardia or heart block has been significantly improved by the utilization of permanent pacemakers, infection of permanent pacing system is an infrequently but still life threatening complication. Infection rates may vary depending on surgical techniques used, as prolonged placement of an external pacemaker or predisposing factors such as erosion of skin, cancer, diabetes mellitus, steroid use, immunocompromised patient, needle aspiration of fluid in the pocket, hematoma formation within the pocket, early manipulation of leads after implantation and infection source elsewhere on the body [1]. Pacemaker infection is in general managed by stepwise removal of pacemaker components according to the patient status. This retrospective study reviews our experience with treatment of the infected pacemaker systems over the last ten years.

PATIENTS and METHOD

In our institution from January 1985, until June 1995, there were more than 1800 new pacemakers implanted and thirtysix patients underwent surgical treatment for infected permanent cardiac pacemakers in this period. These patients, 31 males and 5 females, ranged in age from 11 to 84 years (mean (64 ± 17 years). Twentyfour patients have got

pacemakers implanted for complete heart block, six patients received units for sick sinus sydrome. Permanent pacemaker systems were also implanted in three patients for Wenckebach phenomenon, in two patients for carotis sinus sydrome and in one patient for sinus bradycardia. All pacemaker operations take place in a fully equipped cardiac surgical operation theatre. Total mean operation time is 34 minutes for single chamber and 76 minutes for dual chamber pacing. We regularly perform an antibiotic prophylaxis. Patients without sufficient rhythm go to our intensive care unit for 24 hours. The criteria for diagnosis of pacemaker infection ranged from simple skin erosions to draining sinus on pacemaker implanting site and septicemia or endocarditis.

We decided in advance to divide the patients into two groups. Group A: patients were treated with immediate implantation of a contralateral pacemaker percutaneously. Group B: Cardiopulmonary bypass or purse string technique were performed for removal of infected pacemaker systems in patients.

Group A: Twentyseven patients with an infected, painfull or eroded pacemaker implant site were treated. These patients ranged in age from 21 - 84 years (mean 67 ± 17 years). The conditions responsible for this intervention in pacemaker implant site were: redness and tenderness (18 patients); skin perforation and necrosis (7 patients); discharging sinus (1 patient); sternal infection (1 patient). Operative revisions of pacing systems were performed at least once in thirteen of 27 patients before last implantation. Twentytwo patient were treated with immediate implantation of a new pacemaker system on the contralateral site with a new pocket and subxyphoidal epicardial new pacemaker system was implanted in two patients because of repeated pocket infection in both pectoral aeras (VVI unit in 20 patients, DDD unit in 3 patients, VDD unit in 1 patient). One patient who had redness and tenderness in pacemaker site was treated with reimplantation of pacemaker in the same pocket that was not disconnected from the pacing wire and electrical contact was maintained between the pocket and patient during cleaning because of total heart block. Two patients did not get a new pacemaker system implanted postoperatively. Leads were also removed together with the pacemaker in seven patients by simple traction. The pacemaker box and the exposed lead were completely debrided of all inflammatory tissues and cleaned with betadine in all patients. Lead was retained in 19 patients (71 %). Wound swabs were taken in every case.

Group B: The 9 patients, 3 females and 6 males, ranged in age from 11 - 63 years (mean 56±22 years) and underwent open heart operation for removal of an infected permanent pacemaker system. Indications for complete removal of the pacemaker systems were endocarditis in two patients, severe pocket infection with fever in three patients and septicemia in four patients. A total 30 previous operative revisions of the pacing system was performed in eigth patients. These revisions consisted of pulse generator replacement for battery depletion, generator pocket infection or skin ulceration and changing of the pacing mode. A total 15 electrode revisons or replacements was performed in eigth patients. One patient had no operative revision. Median sternotomy was chosen for surgical access in all patients. Cardiopulmonary bypass under normothermia and induced ventricular fibrilation) was performed in 8 patients for removal of infected pacemaker systems and at the same time, simultaneous cardiac procedures (tricuspid valve reconstrutions in two patients, desobliteration of vena cava in one patient) were performed in three of 8 patients. Lead extraction was performed in one patient through a purse string suture without use of a pump oxygenator in one patient. A new pacing system was implanted after removal of the old one (DDD-R in two patients, VVI in two, VVI-R in three) and was not necessary in two patient. Blood and tissue cultures were taken in all patients.

The most serious patient in this series is presented in further detail.

Case report

A 65-year-old female patient was admitted to hospital May 22, 1995 because of septicemia. In 1990, a permanent pacemaker system (DDD-R) had been implanted via the left subclavian vein due to sick sinus syndrom. She had a radiation ulcer for one year in the right pectoral area resulting from radiotherapy because of breast cancer. Three months before, the patient felt ill with fever and had an effusion in the left knee. Normal heart function was observed in echocardiography. Streptococcus equisimilis was isolated in aspiration fluid from the left knee. She was treated with surgical drainage of the left knee and appropriate intravenous antibiotics. Blood cultures were sterile during treatment. The antibiotics were discontinuated ten days later and the patient was discharged. One month later, on May 11, 1995, a septic shock developed. Streptococcus equisimilis was isolated from blood culture and the patient was transferred to us due to suspicion of infected pacemaker system. She was intubated and put on vasopressor therapy. A right ventricular thrombus and vegetations in tricuspid valve were seen in echocardiography. After further stabilization and appropriate intravenous antibiotics against streptococcus sepsis, open heart surgery was performed on June 1, 1995.

Vegetations on the anterior leaflet of tricuspid valve and a thrombus that extended into the right ventricular apex and the pacemaker system were removed. Anterior leaflet of tricuspid valve was repaired with partial De-Vega anuloplasty technique and anterior leaflet tendon reattacment were also performed for prevention of tricuspid valve insufficiency. At the

same time epicardial leads and pacemaker (DDD-R) were implanted as the patient depended on the pacemaker. The patient was maintanied on intravenous antibiotics for three more weeks and was discharged with oral antibiotics for two further weeks.

RESULTS

The length of time from the last pacemaker procedure to onset of infection ranged from 1 month to 11 years (mean 31±36 months); the range from onset of infection to surgical therapy was 1 month to 7 years (mean 7±17 months) (Figure 1). Total follow-up of these patients ranged from 1 month to 10 years (mean 74±51 months), there was no hospital mortality and postoperative period was free of complication (Figure 2). Six patients died due to unrelated causes between 5 week and 7 years after implantation (Figure 3 and Table 1). Hospital stay ranged from 1 to 49 days (mean 10.9 ±10 days). Antibiotic treatment was given to ten patients after discharge from hospital in group A, all patients in group B got an antibiotic treatment (Figure 4).

Group A: All infected pacemakers were replaced, except for three patients. The pacemaker was reimplanted in the same pocket in one patient whose follow-up is no 7 months and no reccurrence of infection occured. Two patients did not have a pacemaker

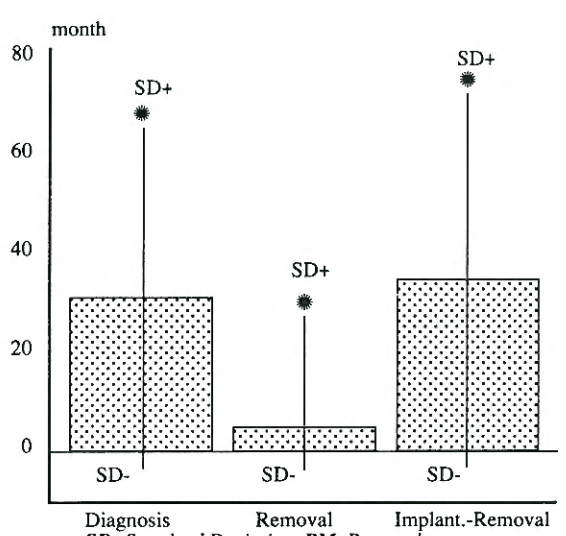


Figure 1. Mean interval between PM implantation and infect (diagnosis), between diagnosis and reoperation (removal), between implantation and removal

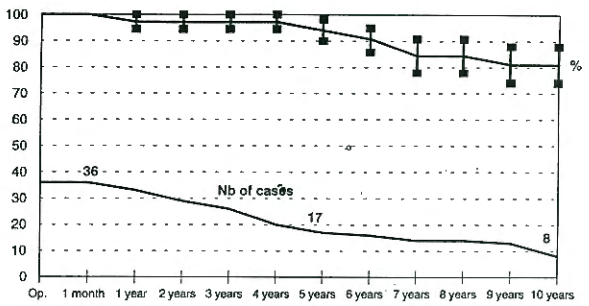
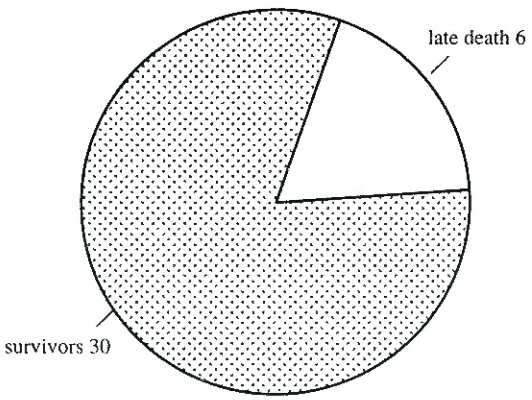


Figure 2. Actuarial survival after surgical treatment for PM infection

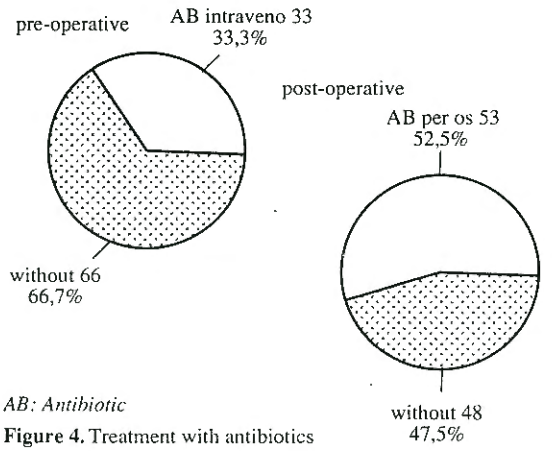
system reimplanted postoperatively. One of two patients had carotis sinus sydrome, another one had AV block III with sternal infection because of radiotherapy for Hodgin's disease and she died due to aggresive hepatitis 5 months later. In 17 patients, bacteria could not be isolated from wound swabs. Staphylococcus coagulase (-) strain was grown from 7 patients, staphylococcus aureus from 2 patients, penicillin resistance staphylococcus strain from one patient. The pacemaker lead was retained in 19 patients. From these patients, we isolated staphylococcus coagulas (-) strain from initial wound swabs in 5 patients, staphylococcus aureus in 2, penicillin resistance staphylococcus strain in 1 and no growing in 12 patients. One patient with retained lead who was 84 years old died at home five weeks after implantation and five other patients who have retained lead died due to unrelated causes in between 5 months and 7 years after pacemaker implantation. All the other patients are alive and well, there is no complication in the follow-up (69 months ± 51 months).

Group B: Infected pacemaker systems were removed in all patients. At the same time tricuspid valve reconstruction (leaflet perforation by electrode in one and vegetation in anterior leaflet in another patient) and vena cava superior thrombectomy were performed in three patients. A simultaneous implantation of a new pacing system was performed in seven patients with a total of one endogenous and six epicardial electrodes (VVI-R in three, VVI in two, DDD-R in two). The results of the blood and tissue cultures were the following: Four patients were infected with Staphylococcus coagulas (-) strains, three with Staphylococcus aureus, one with Pseudomonas, one together with Citrobacter, Enterobacter, Klebsiella... A 24-hours ECG recording did not show any indication for permanent cardiac pacing in two patients.



PM: Pacemaker *all: 36 patients*

Figure 3. Mortality of PM infections



AB: Antibiotic

Figure 4. Treatment with antibiotics

There were no mortalities and the postoperative period was free of major complications. The average hospital stay was 18 days. All patients are alive and well, there is no complication in the follow-up (91 months±50 months).

DISCUSSION

Infection after pacemaker implantation is reported to occur in 0.5 % to 7 % of all patients [1,2]. A new unit implantation on the contralateral site is the most widely used therapy in local pocket infection. This is successful in more than 90 % patients [3,4]. Griffith et al. [5] suggested that the most significant predictor of success is the absence of bacterial growth from wound swabs in patients with pocket infection, because only mechanical pressure on the pacemaker might be the cause of non-infected skin erosion. In group A, negative bacterial growth from wound swab was obtained in 12 patients. In this subgroup, redness and tenderness occured in 10 (83. %) of them and skin perforation at the pacemaker location was observed in 2 (16. %) of them. No infections were seen during follow-up. Byrd et al [6] reported that if the pocket infection was localized (no septicemia) and did travel along the lead to the venous entry site, pacemaker and proximal leads segment can be removed through a pocket incision. In these patients the pocket must be completely debrided of all inflammatory tissues and foreign bodies (suture materials). We also performed such debation. Furman et al. [7] reported no complications in 15 patients whose leads were contaminated with Staphylococcus epidermidis at the time of abandonment. Also Jara et al. [8] found that conservative treatment was successful in nine patients with infected retained lead due to Staphylococcus epidermidis. We observed 7 patients with possibly infected retained lead according to initial wound swabs cultures in group A and isolated Staphylococcus coagulase (-) strain from initial wound swabs in 5 patients and Staphylococcus aureus in 2, penicillin resistance Staphylococcus in one. During the follow-up of these patients (mean 77 months ± 61 months), two patients died due to unrelated causes in between five weeks and 7 years, no complications were diagnosed in other five patients. Our results are in agreement with those of Pary et al. (9) who claimed that results of initial bacteriological investigation do not predict future events, even initial culture of Staphylococcus aureus from the pacemaker site was not associated with a significantly increased incidence of subsequent complications when compared to isolation of other organisms.

Surgical methods have to be employed to remove the pacemaker system or the retained lead by one of the following criteria: septicemia, endocarditis, lead migration [10]. Simple traction of the lead during procedure has been attempted in all patients and was successful in only 7 (19.4 %) patients. There are some reports about internal traction tecniques with use of grasping tools like forceps [11], snare [14], basket [12] and intravascular countertraction [6] which were applied with success. In group B, intravascular-traction techniques were not used in three patients because open heart surgery was indicated by other simultaneous intracardiac procedure (tricuspid valve reconstruction in two patients, cava desobliteration in

Table 1. Case description

Case Nb	Age	sex	ECG	PM Typ at 1. Impl.	Interval Impl.-Infect (month)	Interval Infect-Surgery (month)	Organism	Surgical Procedure	PM Typ at Procedure	State at Last Control
1	65	F	Sick Sinus	DDD-R	52	4	Strep. equisimils	CPB, TVR, El removed, new PM and epicardial leads	DDD-R	A & W
2	73	M	A-V Block III	DDD	1	5	Staph. Coagulas (-)	Tranvenous, El removed, new PM	VDD-R	A & W
3	84	M	A-V Block II/2	DDD	10	1	Staph. Coagulas (-)	Tranvenous, new PM	VVI-R	A & W
4	55	M	A-V Block III	VVI	1	1	Penicilin resis staf	Tranvenous, new PM	VVI-R	A & W
5	70	M	A-V Block III	DDD-R	29	5	none	Tranvenous, new PM	VVI-R	A & W
6	69	M	A-V Block II/2	VVI	1	5	none	Tranvenous, new PM	VVI-R	A & W
7	48	M	A-V Block II/2	DDD	22	1	Staph aureus	CPB, El removed, new PM and epicardial leads	VVI	A & W
8	11	M	A-V Block III	VVI	112	2	Staph aureus	CPB, PM and El removed	none	A & W
9	62	M	A-V Block III	DDD	29	1	none	Transvenous, new PM	VVI-R	A & W
10	70	M	A-V Block III	VVI	1	1	Staph. Coagulas (-)	Transvenous, El removed, new PM	VVI	A & W
11	54	F	A-V Block III	VVI	13	1	Staph. Coagulas (-)	CPB, El removed, new PM	DD-R	A & W
12	81	M	A-V Block III	DDD	20	1	Staph aureus	Subxyphoidal, new PM and epicardial leads	VVI-R	A & W
13	72	M	Sick Sinus	VVI	111	1	Staph. Coagulas (-)	Tranvenous, new PM	VVI	A & W
14	81	F	Atrial Fibrilation	VVI	1	3	none	Transvenous, El removed, new PM	VVI	A & W
15	80	M	A-V Block III	DDD	9	1	none	Tranvenous, new PM	VVI-R	A & W
16	83	M	Sick Sinus	VVI	18	1	none	Tranvenous, new PM	VVI	A & W
17	21	M	A-V Block III	DDD	125	7	none	Transvenous, El removed, new PM	DDD	A & W
18	62	M	Hyper sen carotid	VVI	14	1	none	PM removed	none	A & W
19	67	M	A-V Block III	DDD	2	1	none	Transvenous, new PM	DDD	A & W
20	47	M	A-V Block III	?	7	1	staph aureus	PM removed	none	Dead
21	66	M	A-V Block III	VDD	10	36	none	Old PM and lead in place	old one	A & W
22	82	M	A-V Block II/2	VVI	20	1	none	Transvenous, El removed, new PM	VVI	A & W
23	53	M	A-V Block III	?	63	1	none	Subxyphoidal, new PM and epicardial leads	VVI	Dead
24	59	F	A-V Block III	VVI	2	4	Pseudomonas	CPB, El romeved, new epicardial leads	VVI-R	A & W
25	76	M	not known	?	44	1	none	Transvenous, new PM	VVI	Dead
26	57	M	Sick Sinus	VVI	31	48	none	Transvenous, El removed, new PM	VVI	A & W
27	63	M	A-V Block III	?	41	1	none	Transvenous, new PM	DDD	A & W
28	77	M	Carotis sinus syd	VVI	4	1	Citrobac, Klebsiella	Pursestring, El removed, new epicardial leads	VVI-R	A & W
29	64	M	A-V Block III	DDD	110	4	Staph. Coagulas (-)	Transvenous, El removed, new PM	VVI-R	A & W
30	69	F	Sick Sinus	VVI	1	1	none	Transvenous, new PM	VVI-R	A & W
31	72	M	A-V Block III	DDD	26	3	none	Transvenous, new PM	VVI	Dead
32	84	M	A-V Block III	VVI	90	1	Staph. Coagulas (-)	Transvenous, new PM	VVI	Dead
33	59	M	A-V Block III	DDD	12	1	Staph. Coagulas (-)	Transvennous, new PM	VVI-R	Dead
34	63	M	A-V Block III	DDD	44	1	Staph. Coagulas (-)	CPB, El removed, new PM and epicardial leads	VVI	A & W
35	50	M	Sick Sinus	VVI	24	81	Staph. Coagulas (-)	CPB, PM and El removed	none	A & W
36	44	M	A-V Block III	VVI	7	24	Staph. Coagulas (-)	CPB, El removed, new PM and epicardial leads	VVI	A & W

Leqend: CPB= cardiopulmonary Bypass, TVR= Tricuspid Valve Repair, El.= Electrode, A & W+ Alive and Well, Impl.= Implantation

patient) and in four patients because the lead type and localisation were considered inappropriate for catheter removal. In two patients operated before 1986, the necessary catheters were not available. If there is thrombus formation around the lead and mobile vegetation in the rigth atrium or ventricle, open heart surgery is indicated without delay in order to prevent possible massive lung embolisation and death. Open heart surgery allows controlled explantation of the electrode under direct vision and simultaneous repair of eventual intracardiac lesions [9] as we leave done in three of our own patients. Weighted traction or external and internal traction may cause lead breakage with subsequent migration, myocardial avulsion, of tricuspid valve leaflet, myocardial rupture and tamponade with subsequent death [6]. If explantation by closed methods fails or is contraindicated, we suggest open cardiotomy in unstable patients (septicemia, endocarditis). A purse string suture on the beating heart without cardiopulmonary bypass can be used for removal of leads in patients without vegetations or thrombus. Implantation of a new pacing system after removal of the old one, i.e one stage procedure, is preferable, second intervention and temporary pacing unneccesary [3]. Specific long-term antibiotic treatment is mandatory for control and elimination of infection in patients with septicemia or endocarditis.

In conclusion, all possibly infected leads have to be removed rather than retained but in some cases, functionless possibly infected leads may not be easily removed by lead extraction techniques. If the patient is not stable, has septicemia or endocarditis or lead migration, early surgical intervention (cardiopulmonary bypass, inflow occlusion, purse string technique) will not only reduce the overall mortality-morbitidy but also will reduce the duration of hospital stay.

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