Erasmus MC
University Medical Center Rotterdam

BVIKM 2007

Pacemaker and ICD infections

Recent insights

BJ Rijnders, MD, PhD
Internal Medicine
Section Infectious Dis.
Erasmus MC
Rotterdam
The Netherlands
B.Rijnders@erasmusmc.nl

- ✓ **Clinical presentation and diagnosis**

- ✓ **Epidemiology**

  Etiology and origin of microorganisms

  Overall incidence

- ✓ **Treatment**

  - Antibiotic therapy

  - Removal of PM/ICD ?

Clinical presentation and diagnosis

Review of 52 suspected PM infections in referral center

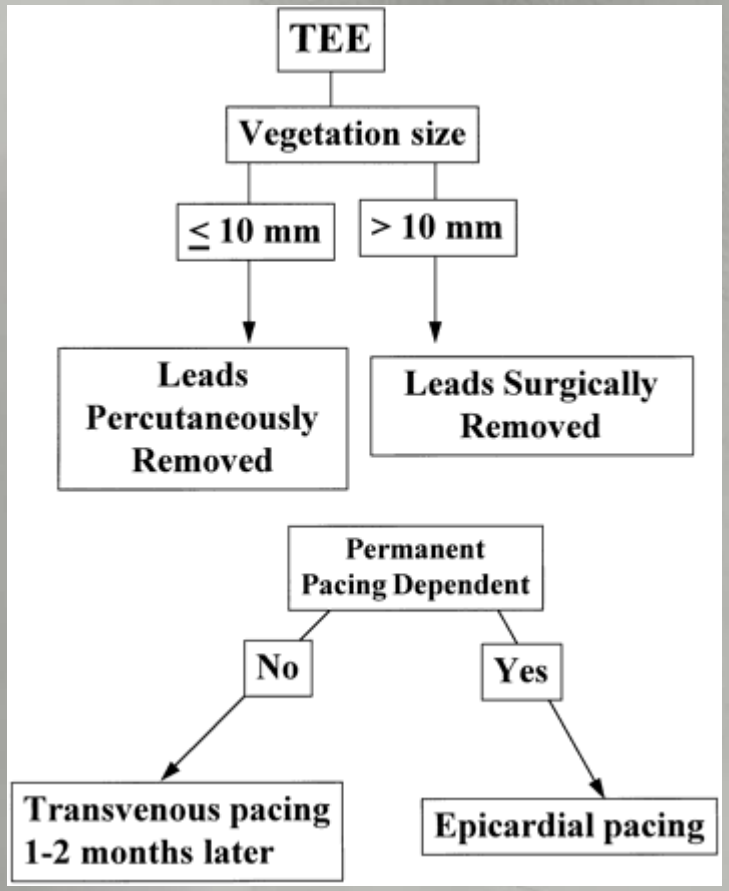
All patients underwent:

- Cultures of blood, pocket if appropriate, leads when extracted
- CRP, BSE
- TTE and TEE
- V/P scintigrafie before and after lead extraction (most patients)
- Search for other sources of the infectious syndrome (not standardized)

Lead and generator extraction attempted in all patients

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis



= Abdominal PM with epicardial leads

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis

Antibiotic therapy :

Not standardized. After extraction IV for 2 weeks + PO for 4 weeks.

Lead endocarditis: Duke criteria including as major

- Oscillating intracardiac mass on PM leads or on the endocardial structure in contact with PM leads
- Abscess in contact with PM leads
- Positive culture of lead

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis

14 had acute presentation (<6 weeks after procedure on the implant site)

- **4 days (1-12)** after procedure
- **13 fever**
- **6 local signs**
- **6 fever without any other local nor pulmonary signs/symptoms**
- **9** definite endocarditis

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Positive lead culture = Major Duke criterium ??

Clinical presentation and diagnosis

38 had chronic presentation (>6 weeks):

n=35 > 12 weeks after procedure

25 months after procedure

8 months from start of symptoms to diagnosis

11 several episodes of fever e.c.i. treated with antibiotics

21 local symptoms

36 definite endocarditis

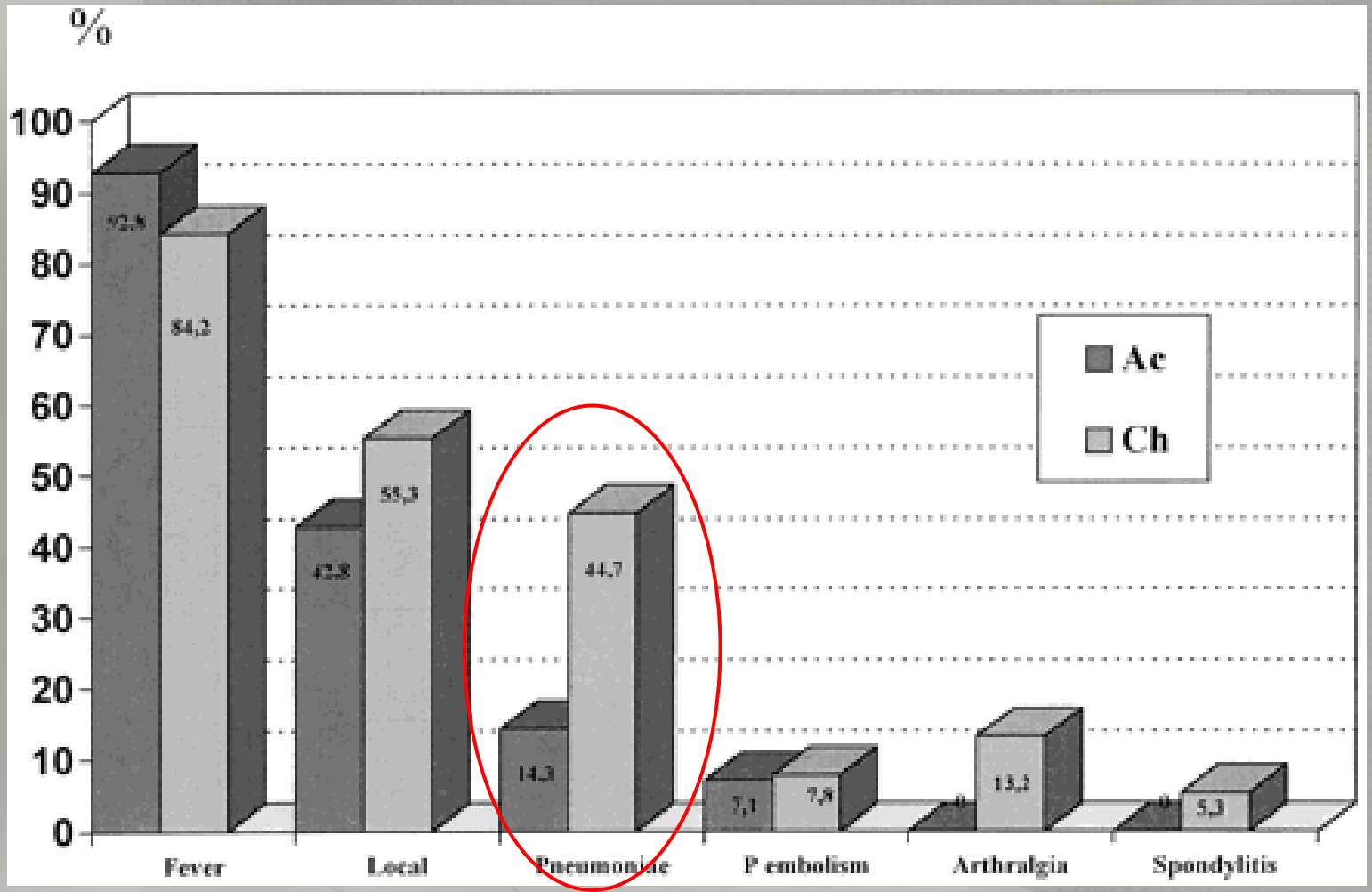
17 with pulmonary lesions:

8 had extensive investigations for pulmonary signs and symptoms

3 recurrent pulmonary embolism

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis

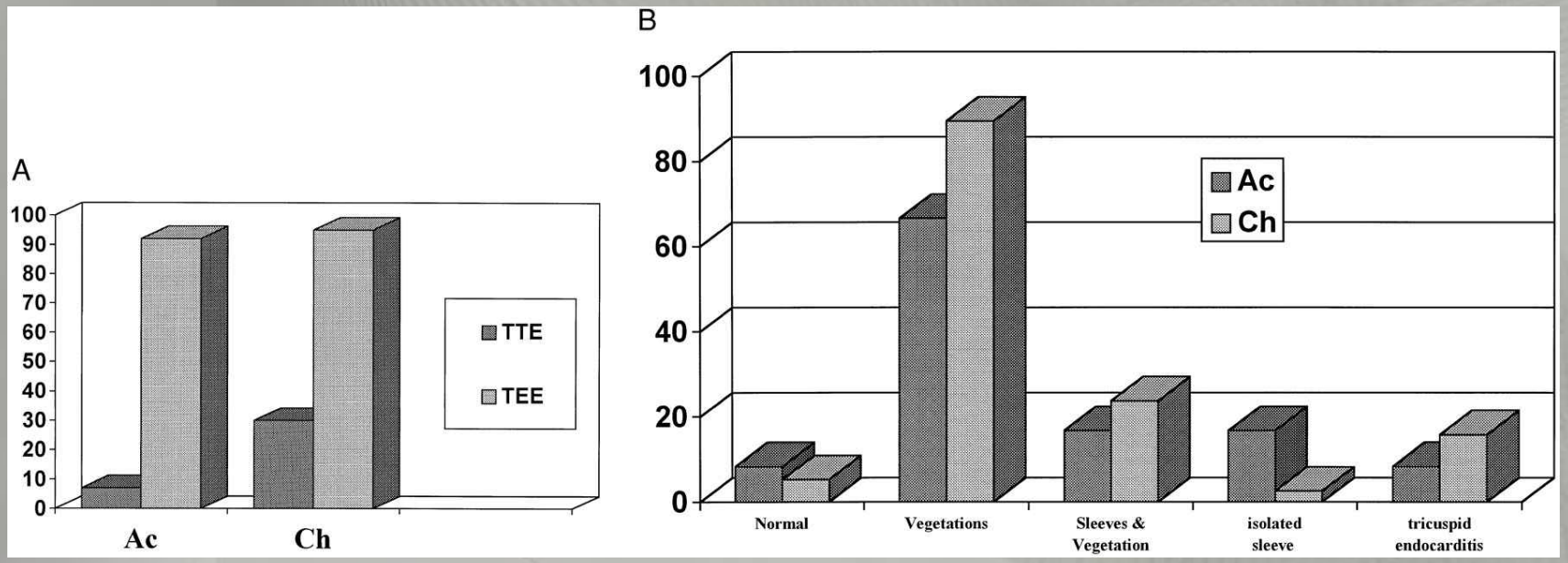


Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis

Echocardiography:

Transoesophagal >>>>>>> Transthoracic



Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis

Lung ventilation/perfusion scintigraphy:

Chronic infection (n=38):

N=13 (34%) with pulmonary embolism

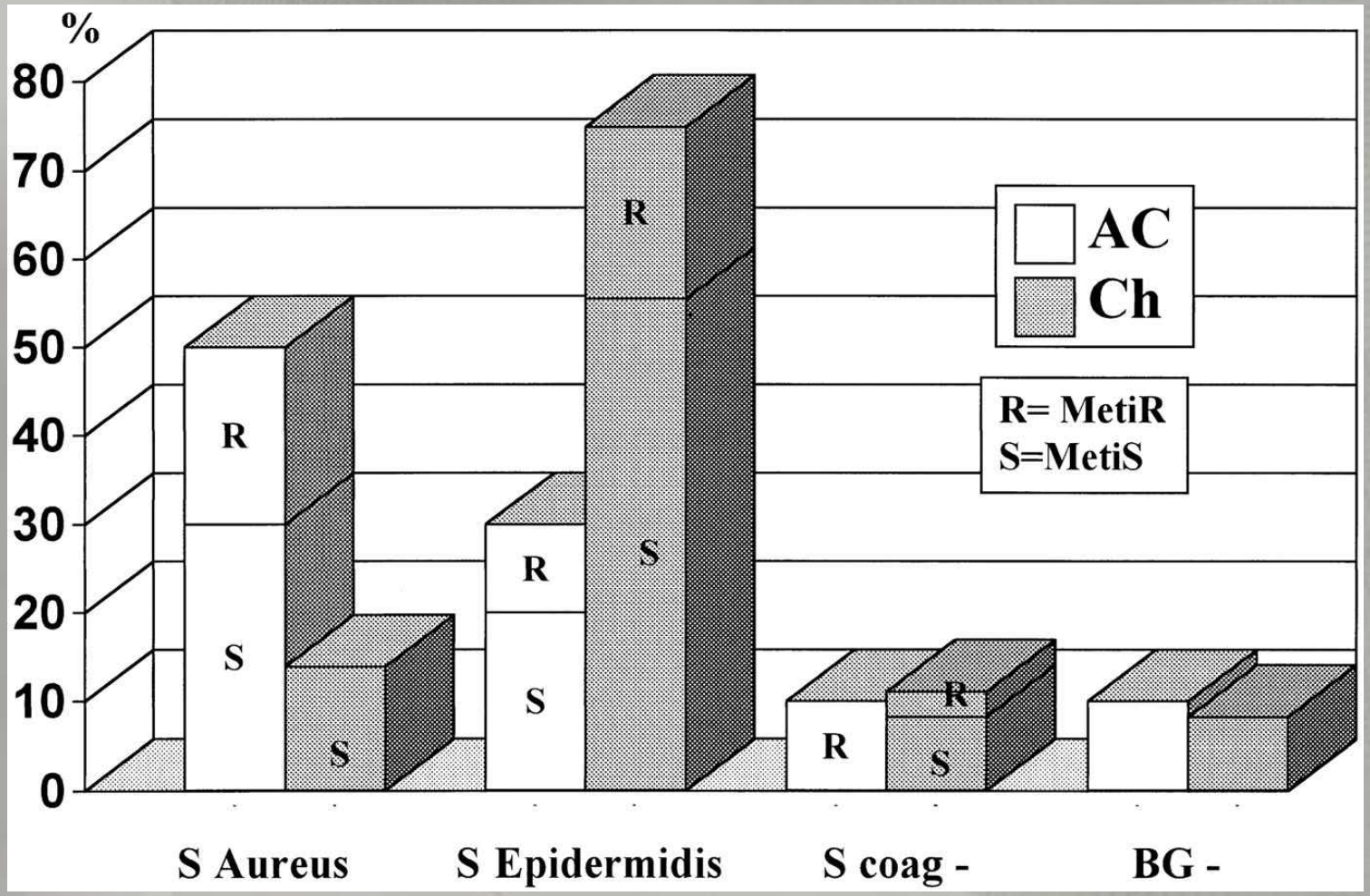
Only 3 already diagnosed before V/P scintigraphy !

Acute infection (n=12)

N=2 (10%) with pulmonary embolism

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis



Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Treatment and outcome

Percutaneous lead extraction : 38 patients = 78 leads

Vegetation size <5mm in 33 patients

N=2 extraction failed (broken proximal lead)

N=9 distal part of ventricular lead (wire-rope tip) could not be removed

N=3 tricuspid damage after removel (regurgitation, chorda rupture)

33 patients had scintigraphy before AND after *percutaneous* lead extraction:

10 patients (30%) had evidence of new pulmonary embolism

2 of 5 with vegetations >10mm had evidence of new embolism

1 patient had clinical signs of pulmonary embolism

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Treatment and outcome

Surgical extraction :

N=10 Primary 10 patients = 21 leads

N=2 after failed percutaneous extraction

Vegetation size >10 in all but 1 patient

Follow up:

N=1 Serratia endocarditis relapse 16 weeks after ***partial percutaneous*** lead extraction. 20 wks after tricuspidectomy + surgical lead extraction a second relapse was diagnosed. A small intramyocardial segment of the first PM was the cause and surgically removed.

N=1 tricuspid endocarditis 8 weeks after complete PM removal

N=2 died after discharge with signs of infection (1 with unsuccesful extraction, 1 with retained tip)

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

Clinical presentation and diagnosis

“ The diagnosis of systemic infection related to PM-lead infection must be systematically considered in the presence of chronic fever, recurrent bronchitis, or pulmonary infection or in case of recurrent or persistent evidence of infection at the implant site “

“ No correlation between vegetation size and pulmonary migration was observed during percutaneous lead extraction. Perhaps we should expand the indications for percutaneous removal to include patients with larger vegetation sizes “

Klug D et al. Systemic Infection Related to Endocarditis on Pacemaker Leads. Clinical Presentation and Management. *Circulation.* 1997;95:2098-2107.

- ✓ **Clinical presentation and diagnosis**

- ✓ **Epidemiology**

  Overall incidence

  Etiology and origin of microorganisms

- ✓ **Treatment**

  - Antibiotic therapy

  - Removal of PM/ICD ?

Epidemiology

Incidence of PM-infection:

Highest : 19.9% in era of abdominal implantation

Lowest: 0.13% with prepectoral implantation

Population based study in France : Incidence of endocarditis in PM recipients 0.55/1000 PM-years (1)

Incidence of ICD-infection:

0.7-1.2%. Abdominal > Prepectoral generator (3 versus 0.5%, p=0.03) (2)

Own hospital 2003-6 : 10 / 868 or 1.2%

Rising incidence (3)

1990-99 Medicare analysis:

3.3 implants/1000 clients in 1990 ⟶ 4.6/1000 in 1999 (42%)

0.94% in 1990 ⟶ 2.1% in 1999 (124%)

(1) Duval X et al. Clin Inf Dis 2004; 39: 68-74 (2) Mela T et al. Am J Cardiol 2001 oct 1; 88(7): 750-3.
(3) Cabell CH et al. Am Heart J 2004

Epidemiology: Sources of infection

Preaxillary flora at time of implantation (1) :

103 PM insertions. Cultures at time of insertion (skin, pocket)

4 had PM-infection: 2 with strains not found at time of insertion

2 with molecularly identical strain as found at insertion

at 4 and 16 months after insertion

Intercurrent bacteremia as the source (2) :

33 patients with **S. aureus** bacteremia (SAB) and a PM/ICD in situ

15 of 33 (45%) had confirmed PM/ICD infection

9 of 12 (75%) with early SAB (<12 months after implantation)

6 of 21 (28%) with late SAB

Only 6 of 15 with confirmed PM/ICD infection had local signs of infection

(1) Da Costa A et al. Circulation 1998 May 12;97(18):1791.
(2) Chamis AL et al. Circulation 2001; 104:1029-1033.

Epidemiology: Sources of infection

Intercurrent bacteremia as the source (3) :

49 patients with gram-negative bacteremia and PM in situ:

2 had probable PM infection (both clinically evident pocket infection)

1 had possible PM infection

Follow up >12 weeks:

- 3 had complete PM/ICD removal
- 12 (25%) died before week 12 (all cause mortality)
- 34 patients with alternate source of gram-neg. bacteremia were treated with antibiotic therapy and *without PM ICD removal*.

- 2 of the 34 had relapse of bacteremia. Both had alternative sources of relapse

(3) DZ Uslan et al. Frequency of PM ICD infection with gram-negative bacteremia. Clin Inf Diseases 2006

- ✓ **Clinical presentation and diagnosis**
- ✓ **Epidemiology**

  Etiology and origin of microorganisms

  Overall incidence

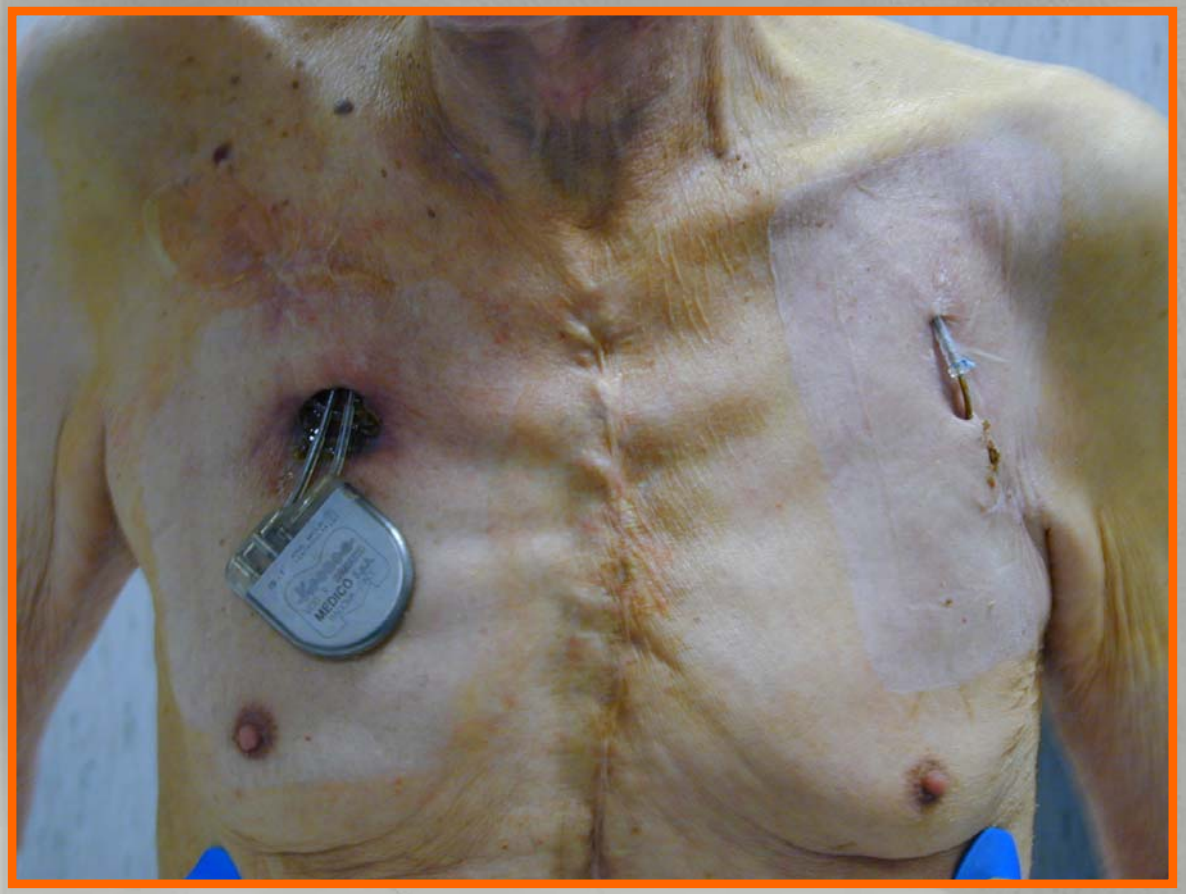
- ✓ **Treatment**

  - Antibiotic therapy

  - Removal of PM/ICD ?

Treatment options

No randomized trials comparing antibiotic therapy with surgical R/



Treatment options

No randomized trials comparing antibiotic therapy with surgical R/

TABLE II Comparison With Previous Series of Patients With Pacemaker Endocarditis

Author(s), Year	Total*	No. of Patients With Pacemaker Endocarditis†		Cultures With *Staphylococcus* Isolates (%)		Electrode Removed (%)	Medical Mortality‡ (%)	Medical/Surgical Mortality§ (%)
		Definite	Probable	*S. aureus*	*S. epidermidis*			
Corman and Levison, 1975[5]	5	4	1	80	20	60	50	33
Morgan et al, 1979[8]	12	0	12	92	0	67	50	25
Bluhm et al, 1982[4]	14	4	10	64	21	57	33	13
Choo et al, 1981[12]	44	14	0	14	57	100	—	0
Glock et al, 1986[6]	7	0	7	71	14	100	—	29
Löffler et al, 1988[7]	9	0	9	67	22	100	—	0
Smyth and Pallister, 1989[9]	14	0	14	86	14	ND	ND	ND
Arber et al, 1994[10]	44	25	12	50	25	57	31	20
Present series	33	33	0	21	52	100	—	24
Total	182	80	65	61	25	80	41	18

*Number of patients with pacemaker-associated infection or septicemia.
†Pacemaker endocarditis was classified as definite or probable as defined by Arber et al.[10]
‡Mortality among patients treated with antibiotics alone.
§Mortality among patients treated with antibiotics and electrode removal.
ND = no detail.

Am J Cardiol 1998;82:480–484

Treatment options

No randomized trials comparing antibiotic therapy with surgical R/

123 cases of PM/ICD infection (1):

3 of 6 (50%) treated without PM/ICD removal had relapse of infection

4 of 117 (3%) treated with PM/ICD removal had relapse of infection

S. Aureus PM/ICD infection (2):

10 of 21 (48%) died when PM/ICD was not removed died

2 of 12 (17%) died when PM/ICD was removed

(1) Chua JD et al. Diagnosis and management of infections involving implantable electrophysiologic cardiac devices. Ann Int Med 2000. (2) Chamis AL et al. Circulation 2001; 104:1029-1033.

Treatment options

Significance of isolated local symptoms ?

50 of 105 patients had clinical findings strictly limited to implantation site. No fever, no CRP, blood cultures negative, pulmonary + cardiac imaging (TEE included) normal.

In 36 of these (72%) the cultures of the intravascular and extravascular parts of the leads were positive.

5 patients refused extraction, 3 extractions were unsuccesful:

Infection recurred in 4 of these 8 versus 1/97 patients with complete PM extraction ($p < 0.001$)

Klug D et al. Local symptoms at the site of pacemaker implantation indicate latent systemic infection. Heart 2004;90:882–886.

Treatment options

Percutaneous extraction and large vegetations:

Robbins MJ et al. Influence of vegetation size on clinical outcome of right-sided infective endocarditis. Am J Med 1986;80:165–71.

This study reported that a vegetation size of 10 mm was a bad prognostic factor (=surgery was needed for ongoing infection)

(1) 38 percutaneous removals. 9 patients had vegetations >10mm.

5 of 9 had evidence of PE.
All 5 survived with AB and anticoagulant R/
1 developed small lung abces (S. aureus)

(2) 9 percutaneous removals with vegetations >10mm.
Non had clinically apparent PE.

(1) Meier-Ewert HK et al. Am Heart J 2003;146: 339–44. (2) Victor F et al. Heart 1999;81:82-7.

Treatment

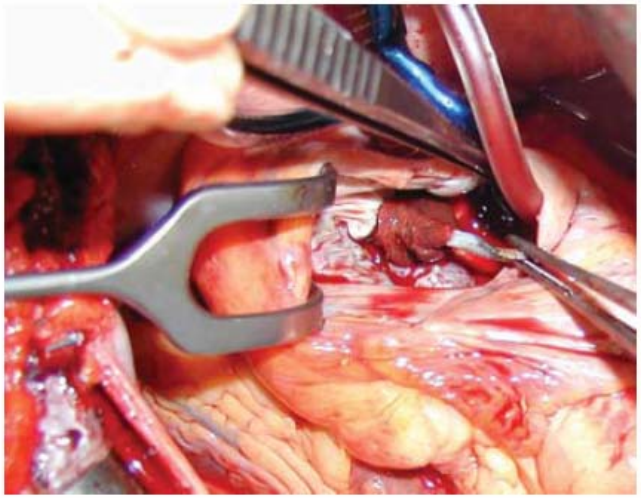
Percutaneous extraction and large vegetations :

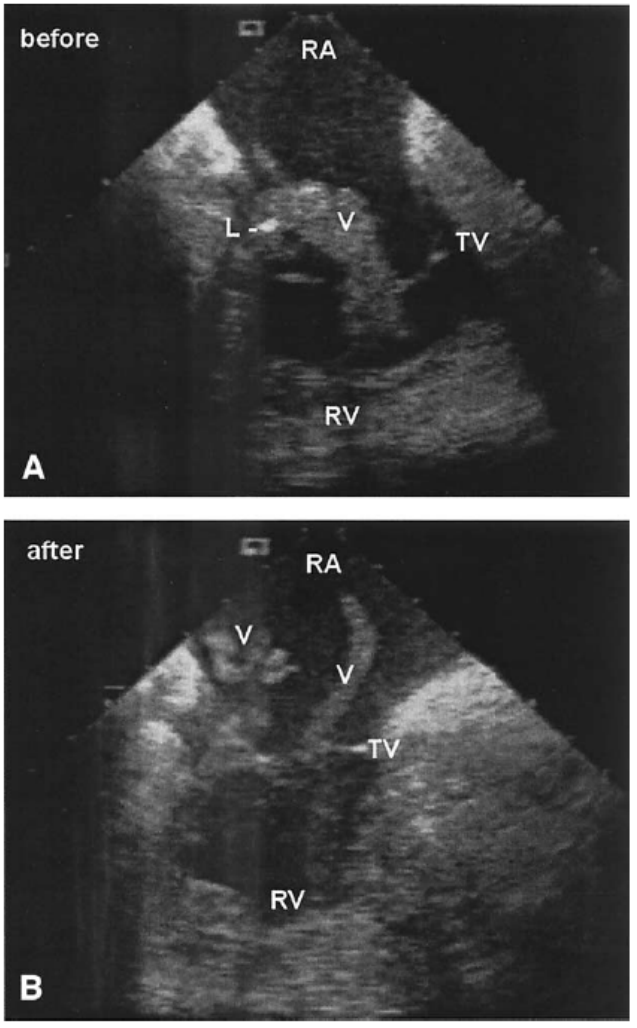
30 patients with PM vegetations

Percutaneous lead removal

23 of 30 patient had PM-vegetations >10mm

None of them died !





Ruttmann E. et al. PACE March 2006. Meier-Ewert HK et al. Am Heart J 2003;146: 339–44. (2)

Treatment

Antibiotic therapy : Recent hot trials !

Vancomycine *versus* vanco + genta *versus* vanco + genta + rifa for the treatment PM-lead endocarditis treated without lead extraction. Double blind, double dummy controlled trial. **Cinderella PM et al. New Engl J Med 2007, in press.**

Daptomycine or vanco + genta + rifa for the treatment of PM-lead endocarditis treated without lead extraction. A double blind double dummy controlled non-inferiority trial. **Riding Hood LR et al. JAMA 2007, in press.**

Treatment

Antibiotic therapy : Recent trials.

Vancomycine *versus* vanco + genta *versus* van
the treatment PM-lead endocarditis treated wit
Double blind, double dummy controlled trial. **Cinderella PM et al. New Engl J Med 2007, in press.**

Daptomycine or vanco + genta + rifa for the treatmen
endocarditis treated without lead extraction. A double
dummy controlled non-inferiority trial. **Riding Hood LR 2007, in press.**

Treatment: Antibiotic therapy

Available recent guidelines

Infective Endocarditis: Diagnosis, Antimicrobial Therapy, and Management of complications. Circulation 2005; 111: 394-434.

Guidelines on the prevention, diagnosis and treatment of infective endocarditis. European Heart Journal 2004 feb;25(3): 267-76.

Guidelines on non-vascular cardiac device related infections. Circulation 2003; 108: 2015-31.

Duration of therapy after complete lead extraction ?

If succesful and *complete removal: Treat* as native valve right-sided endocarditis ?

In case of retained tip treat as prosthetic valve endocarditis ?

Time for questions and coffee !

Table 1 Results of major studies of pacemaker lead extraction

	Technique				
	Locking stylets only	*Conventional counter traction with telescoping sheaths*		*Laser assisted counter traction*	
Author	Alt *et al*[6]	Smith *et al*[11]	Byrd *et al* [12]	Kennergren[9]	Reiser *et al*[10]
Number of patients	105	1299	2338	149	1463
Number of leads extracted	150	2195	3540	179	2249
Complete extraction (%)	81	86.8	93	89.5	90
Partial extraction (%)	12	7.5	5	6	3
Failure (%)	7	5.8	2	4.5	7
Major complications (%)	0	2.5	1.4	0.6	3.3
Death (%)	0	0.6	0.04	0	0.8