Pacemaker and ICD infections

Recent insights

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✓ 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 scintigraphy 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

Clinical presentation and diagnosis


=Abdominal PM with epicardial leads
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

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
Positive lead culture = Major Duke criterion ??
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

Clinical presentation and diagnosis

Echocardiography:

Transoesophageal >>>>>>> Transthoracic

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
Clinical presentation and diagnosis

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 removal (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

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 unsuccessful extraction, 1 with retained tip)
"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."

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%)

(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

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 alternate 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>
<thead>
<tr>
<th>Author(s), Year</th>
<th>Total*</th>
<th>No of Patients With Pacemaker Endocarditis</th>
<th>Cultures With Staphylococcus Isolates (%)</th>
<th>Electrode Removed (%)</th>
<th>Medical Mortality†</th>
<th>Medical/Surgical Mortality§ (%)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Definite</td>
<td>Probable</td>
<td>S. aureus</td>
<td>S. epidermidis</td>
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<td>Corman and Levitin, 1975</td>
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<td>0</td>
<td>12</td>
<td>92</td>
<td>0</td>
<td>67</td>
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<td>Blohm et al, 1982</td>
<td>14</td>
<td>4</td>
<td>10</td>
<td>64</td>
<td>21</td>
<td>57</td>
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<tr>
<td>Choo et al, 1981</td>
<td>44</td>
<td>14</td>
<td>0</td>
<td>14</td>
<td>57</td>
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<td>Gloc et al, 1986</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>71</td>
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<td>Löffler et al, 1988</td>
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<td>9</td>
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<td>Smyth and Pollister, 1989</td>
<td>14</td>
<td>14</td>
<td>0</td>
<td>86</td>
<td>14</td>
<td>ND</td>
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<td>Arber et al, 1994</td>
<td>44</td>
<td>25</td>
<td>12</td>
<td>50</td>
<td>25</td>
<td>57</td>
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<td>Present series</td>
<td>33</td>
<td>33</td>
<td>0</td>
<td>21</td>
<td>52</td>
<td>100</td>
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<tr>
<td>Total</td>
<td>182</td>
<td>80</td>
<td>65</td>
<td>61</td>
<td>25</td>
<td>80</td>
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</table>

*Number of patients with pacemaker-associated infection or sepsisemia.
†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.
Treatment options

No randomized trials comparing antibiotic therapy with surgical removal of the PM/ICD in 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
- 2 of 12 (17%) died when PM/ICD was removed

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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 unsuccessful:

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

Treatment options

Percutaneous extraction and large vegetations:


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.

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!

Antibiotic therapy: Recent hot trials!


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.
Antibiotic therapy: Recent trials.


Daptomycin or vanco + genta + rifa for the treatment of endocarditis treated without lead extraction. A double dummy controlled non-inferiority trial. Riding Hood LR 2007, in press.
Treatment: Antibiotic therapy

Available recent guidelines


Duration of therapy after complete lead extraction?

If successful 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>
<thead>
<tr>
<th>Author</th>
<th>Locking stylets only</th>
<th>Conventional counter traction with telescoping sheaths</th>
<th>Laser assisted counter traction</th>
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<tbody>
<tr>
<td>Number of patients</td>
<td>105</td>
<td>1299</td>
<td>2338</td>
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<tr>
<td>Number of leads extracted</td>
<td>150</td>
<td>2195</td>
<td>3540</td>
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<tr>
<td>Complete extraction (%)</td>
<td>81</td>
<td>86.8</td>
<td>93</td>
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<tr>
<td>Partial extraction (%)</td>
<td>12</td>
<td>7.5</td>
<td>5</td>
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<tr>
<td>Failure (%)</td>
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<tr>
<td>Major complications (%)</td>
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<td>2.5</td>
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<tr>
<td>Death (%)</td>
<td>0</td>
<td>0.6</td>
<td>0.04</td>
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</tbody>
</table>

Table 1  Results of major studies of pacemaker lead extraction