Basit bir cep infeksiyonu mu ya da elektrod infeksiyonu mu?

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Kardiyoloji Anabilim Dalı

2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction

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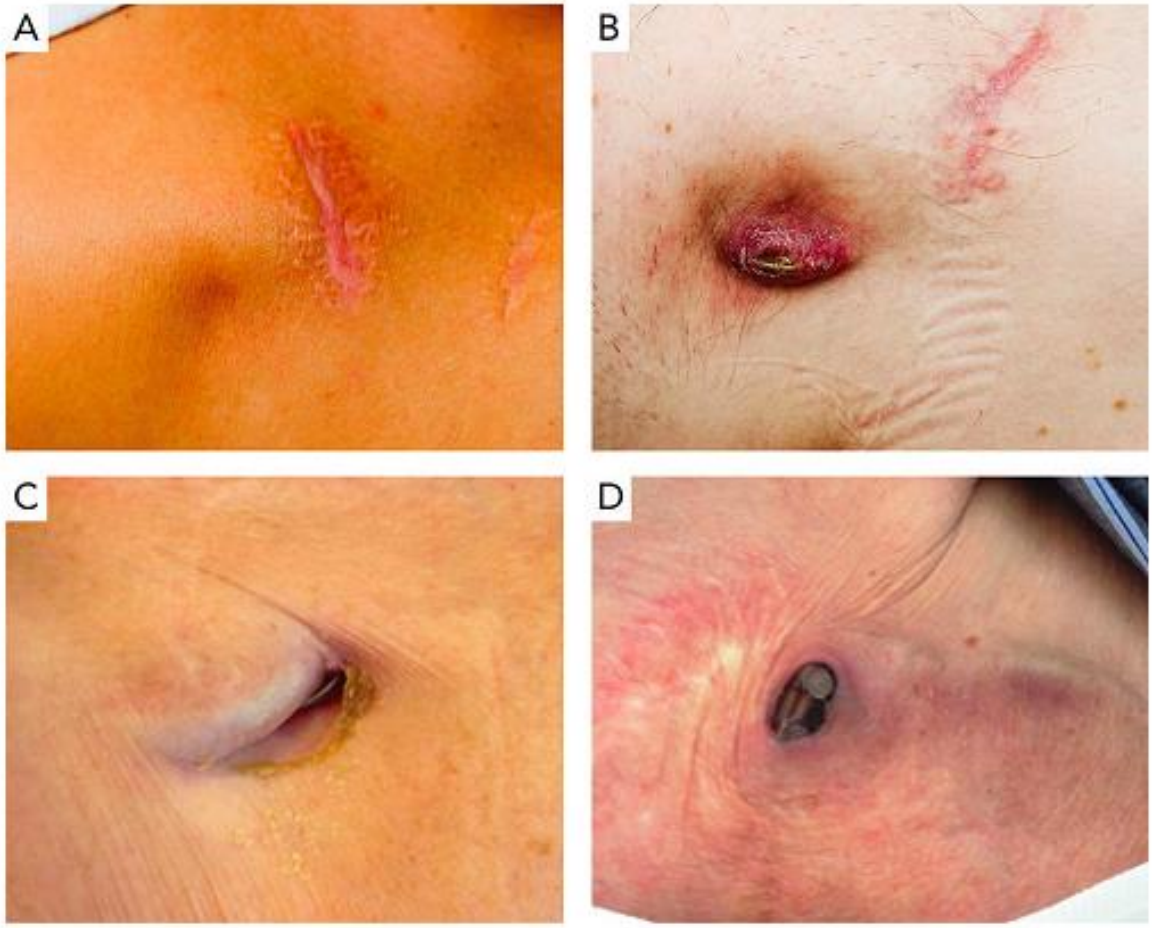
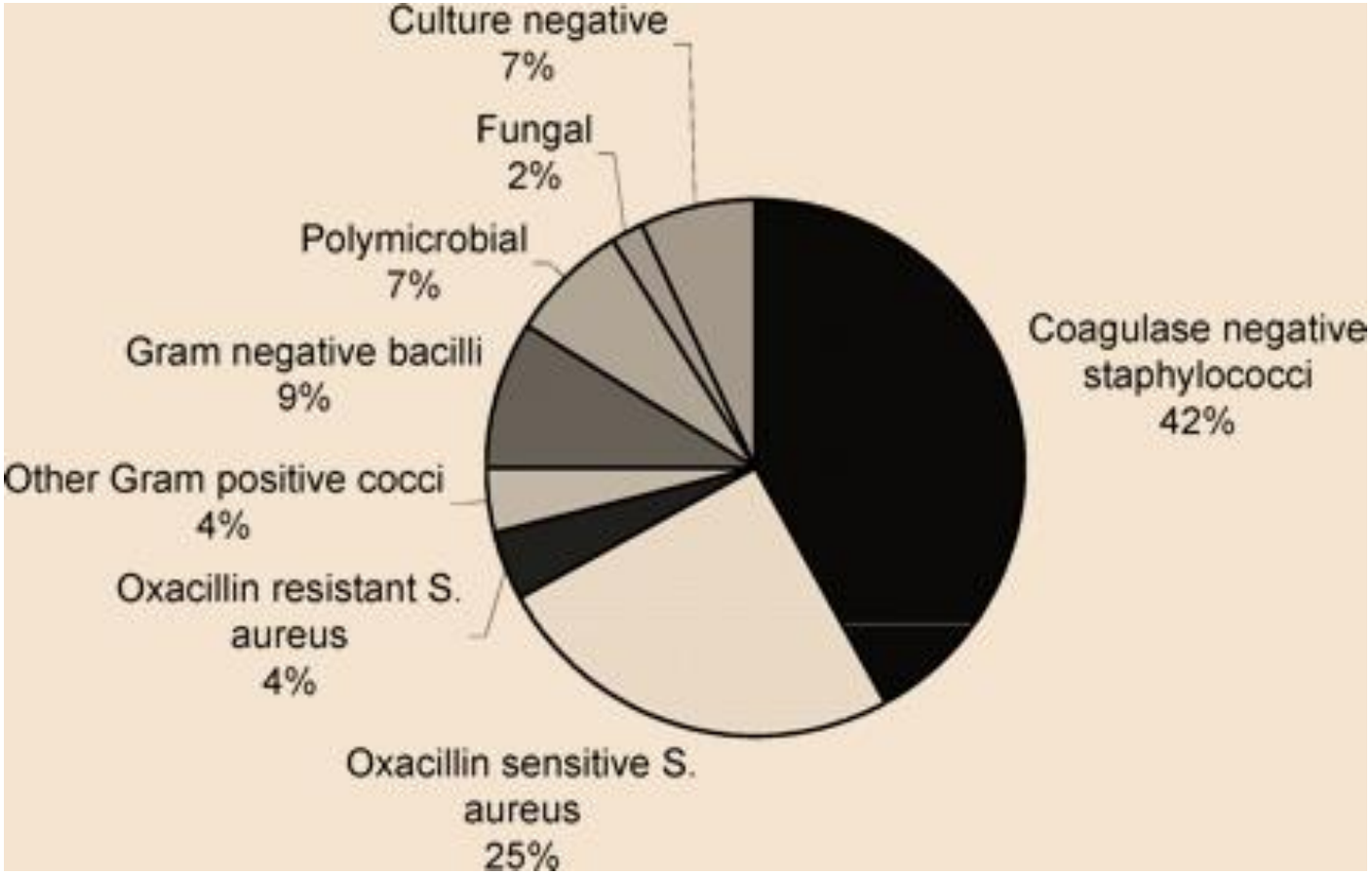
Figure 1: Manifestations of Pocket Infections: Adherence Between Skin and Generator (A), Adherence and Perforation (B) and Overt Erosion (C,D)



Etkenler



Update on Cardiovascular Implantable Electronic Device Infections and Their Management. A Scientific Statement From the American Heart Association-2010

CIED infeksiyonu risk faktörleri

Early CIED re-intervention[19,21]	2.7–15.0
Pocket haematoma[21,40]	4.0–6.7
CIED replacement[18]	2.7
More complex CIED[4,18,21]	1.3–5.4
Temporary pacing[4,19]	2.5–5.0
Number of prior CIED procedures[18]	2.7–8.7
Prior CIED infection[37]	11.3
Fever/systemic infection[19]	5.8
Renal failure[21,37]	1.3
Haemodialysis[32]	8.6
Chronic skin disease[37]	10.6
Corticosteroid treatment[4]	13.9
Chronic obstructive pulmonary disorder[21,37]	1.2–9.8
Diabetes[85]	2.3
Higher Charlson comorbidity index[37]	2.7–3.0
Male gender[18]	1.5
Younger age[18]	1.4–4.5
Low operator experience[54,55,86]	NA
Longer procedure duration[24]	NA

CIED = cardiac implantable electronic device.

İnfektif komplikasyonlar

LOKAL
Dikiş apsesi ya da yüzeyel infeksiyon (subkutan doku sağlam)
Cep infeksiyonu ve apsesi
Cep fistülü ve ve kronik akıntısı
Cilt erozyonu ve perforasyonu ile beraber jeneratör ve/veya lead ekspozisyonu
SİSTEMİK
Lead infeksiyonu/vejetasyonu
Endokardiyal, kapak vejetasyonları (infektif endokardit)
Kalıcı ya da intermitan okült gram pozitif ya da negatif bakteremi veya sepsis
Septik embolizm (pulmoner ve nadiren sistemik)

Tanımlar

- İzole cep infeksiyonu: Lokalize eritem, şişlik, ağrı, hassasiyet, ısı artışı, drenaj; negatif kan kültürü
- İzole cep erozyonu: Cihaz ve/veya lead ciltten dışarı çıkmış, lokal infekisyon bulguları var veya yok
- Bakteremi: Pozitif kan kültürü; sistemik infeksiyon semptom ve bulguları var veya yok
- Bakteremi ile birlikte cep infeksiyonu: Pozitif kan kültürü ve lokal infeksiyon bulguları

H
e

Tanımlar

- Lead infeksiyonu: Lead vejetasyonu ve pozitif kan kültürü
- Lead/valvüler endokardit ile birlikte cep infeksiyonu: Lokal enfeksiyon bulguları, pozitif kan kültürü ve lead/valvüler vejetasyon
- CIED endokarditi (cep infeksiyonu olmadan): Pozitif kan kültürü, lead/valvüler vejetasyon
- Olası CIED infeksiyonu ve okült bakteremi: Alternatif odak yok, CIED çıkarılması sonrası düzelir

Heart Rhythm 2017;14:e503-e551

Tanımlar

- CIED infeksiyonunun kesin olmadığı durumlar: Dışarıya çıkma eğilimi gösteren CIED ve sol kalp valvüler endokarditi
- Yüzeyel insizyon infeksiyonu: Fasia ve kası gibi derin dokuları içermeyen, cilt ve yüzeyel ciltaltı doku infeksiyonu

Heart Rhythm 2017;14:e503-e551

Cep infeksiyonu

Non-komplike cep infeksiyonu

(i) Jeneratör bölgesini etkileyen selülit

(ii) kesi hattından pürülan eksuda gelmesi (basit dikiş apsesi hariç);

(iii) Yara ayrışması

(iv) Jeneratör ya da leadlerin deriyi erode ederek dışarı çıkması

(v) Flüktüasyon (apse) ya da fistül oluşumu

<u>Sistemik infeksiyon semptom ve bulguları yok ve kan kültürleri negatif</u>

Komplike cep infeksiyonu

- Komplike olmayan cep infeksiyonu bulgularına ek olarak

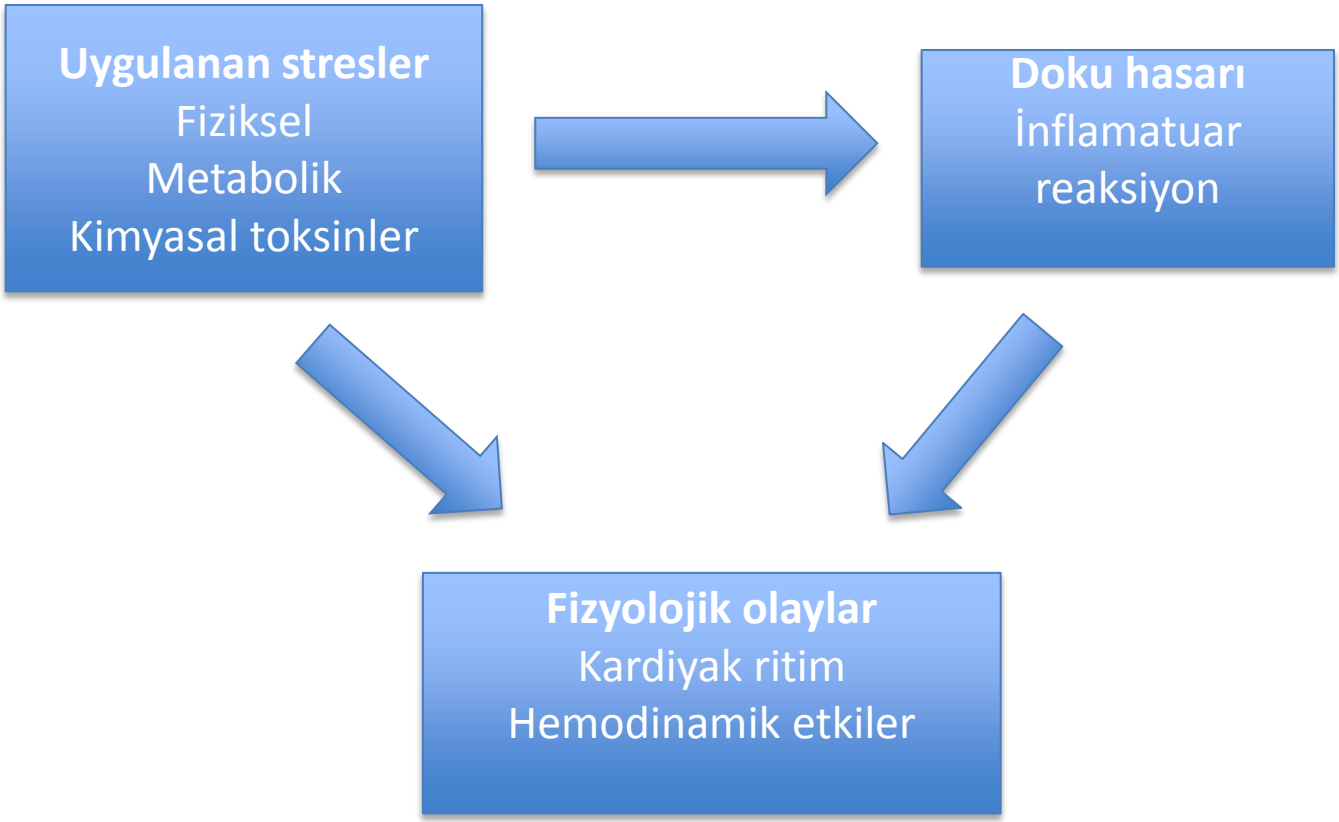
Transvenöz lead veya endokardiyal tutulum kanıtı/ sistemik infeksiyon belirti ve bulguları/pozitif kan kültürleri var

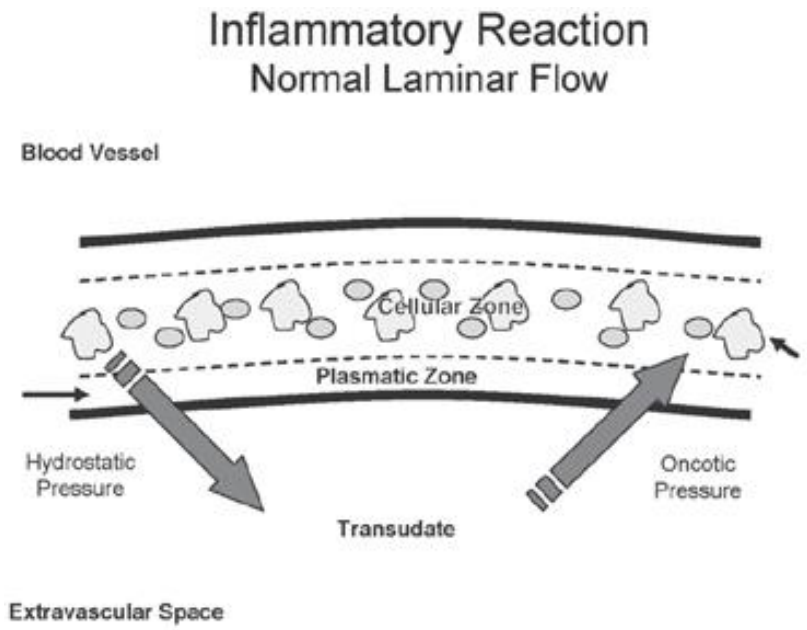
[1]JA Sandoe, G Barlow, JB Chambers, *et al.*Guidelines for the diagnosis, prevention and management of implantable cardiac electronic device infection. Report of a joint Working Party project on behalf of the British Society for Antimicrobial Chemotherapy (BSAC, host organization), British Heart Rhythm Society (BHRS), British Cardiovascular Society (BCS), British Heart Valve Society (BHVS) and British Society for Echocardiography (BSE) J Antimicrob Chemother, 70 (2015), pp. 325–359

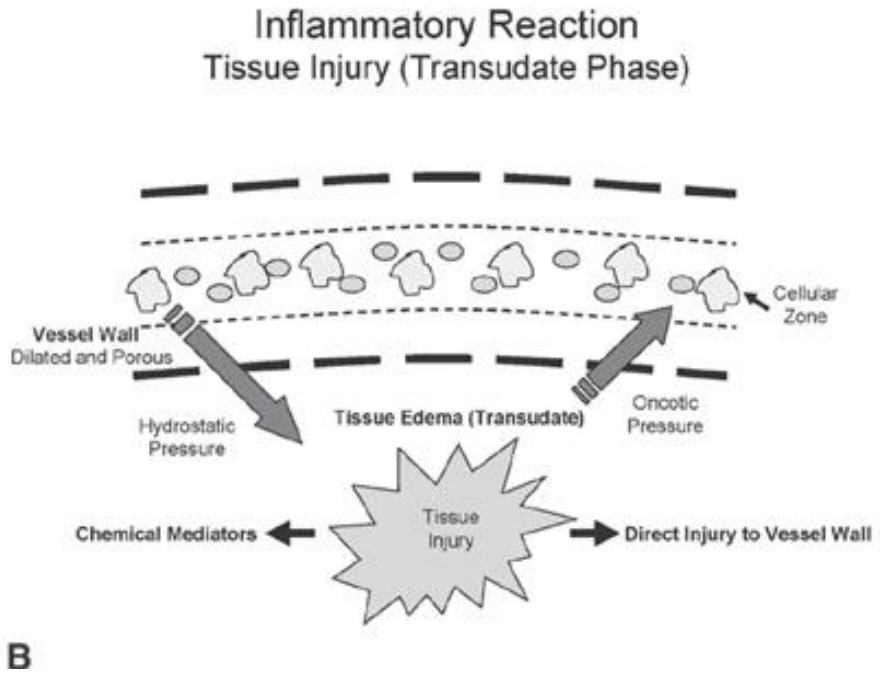
Ayırıcı tanı

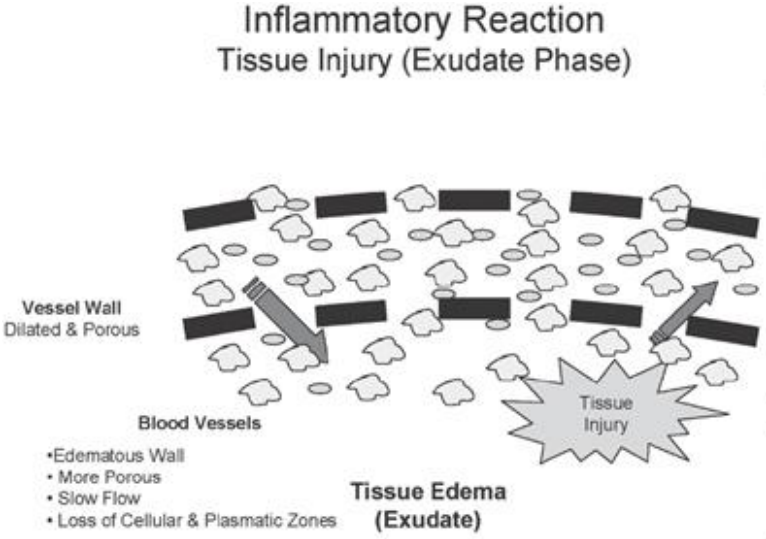
- Erken post-implant inflamasyon (< 30 gün)
- Dikiş apsesi ve/veya yüzeyel infeksiyon (subkutan dokuyu, pil jeneratörünü, leadler tutulmamış)
- Cep derisinde incelme, tethering –çoğu zaman okült infeksiyon göstergesi

Biyofiziksel Arayüz

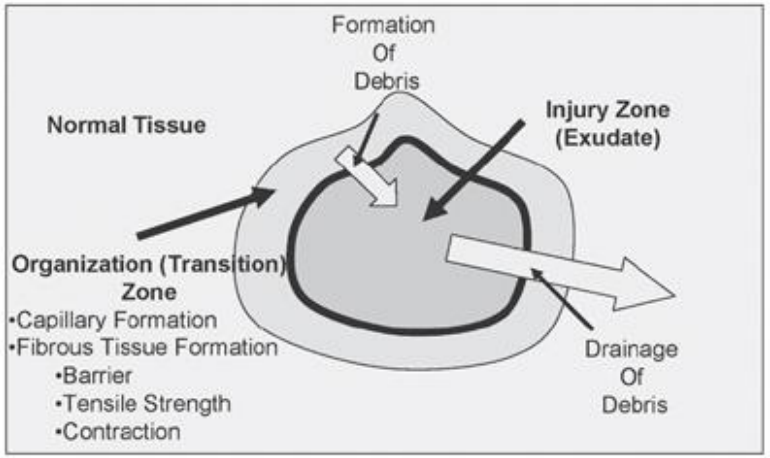



Inflammatory Reaction
Normal Laminar Flow
Blood Vessel
Cellular Zone
Plasmatic Zone
Hydrostatic Pressure
Oncotic Pressure
Transudate
Extravascular Space
A

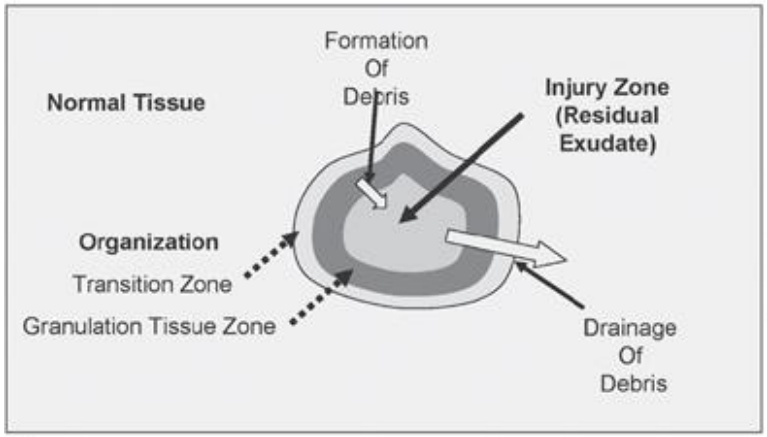

Inflammatory Reaction
Tissue Injury (Transudate Phase)
Vessel Wall
Dilated and Porous
Cellular Zone
Hydrostatic Pressure
Tissue Edema (Transudate)
Oncotic Pressure
Chemical Mediators
Tissue Injury
Direct Injury to Vessel Wall
B


Inflammatory Reaction
Tissue Injury (Exudate Phase)
Vessel Wall
Dilated & Porous
Blood Vessels
•Edematous Wall
• More Porous
• Slow Flow
• Loss of Cellular & Plasmatic Zones
Tissue Injury
Tissue Edema
(Exudate)

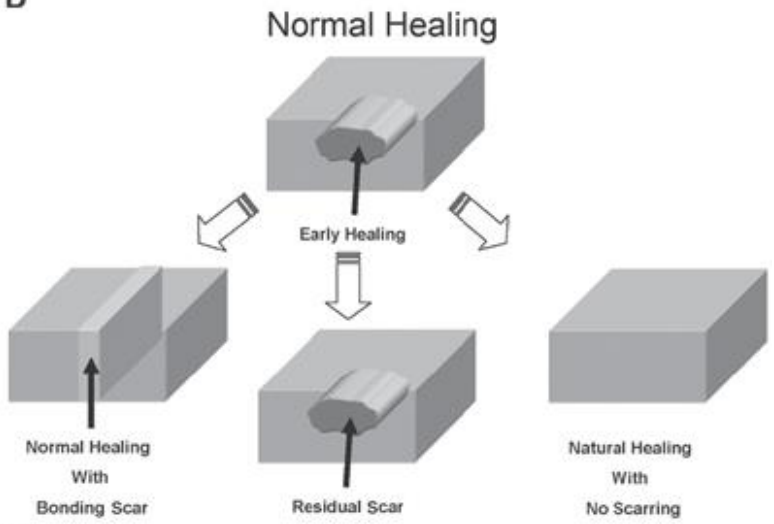
C


Formation
Of
Debris
Normal Tissue
Injury Zone
(Exudate)
Organization (Transition)
Zone
•Capillary Formation
•Fibrous Tissue Formation
•Barrier
•Tensile Strength
•Contraction
Drainage
Of
Debris

D


Normal Tissue
Formation
Of
Debris
Injury Zone
(Residual
Exudate)
Organization
Transition Zone
Granulation Tissue Zone
Drainage
Of
Debris

E


Normal Healing
Early Healing
Normal Healing
With
Bonding Scar
Residual Scar
Natural Healing
With
No Scarring

F

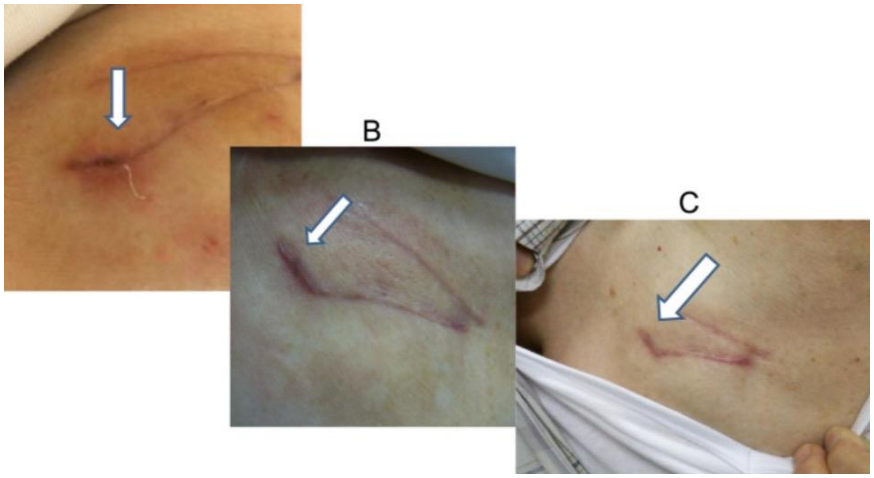
Cep enfeksiyonunda lokal inflamatuar bulgular

- Eritem %41
- Şişlik %38
- Ağrı ve hassasiyet %28
- Isı artışı %18
- Drenaj %38
- Cihazın dışarı çıkması %21

Heart Rhythm 2010;7:1043-1047

Yüzeyel infeksiyon/dikiş apsesi

- Genellikle cihaz çıkarma endikasyonu yok
- İnfeksiyon yüzeyle sınırlı, ancak aşağı inmediğinden emin olmak gerekli
- Oral antibiyotik, yara bakımı ile çoğu sıkıntısız iyileşiyor
- FDG-PET-CT?



Cep incelmesi ve impending perforasyon

- Risk faktörleri:
  - Primer: ince subkutan doku, kilo vermek, travma, migrasyon, büyük cihaz, uygunsuz cep, yüzeyel yerleşim
  - Sekonder: Okült infeksiyon, Özellikle tethering varsa
- Cep incelmesi infeksiyöz olsun olmasın önemli sayıda hastada ilerleyici ve cep perforasyonu ile sonuçlanmakta

Figure 1: Images of Pocket Infection Over Two Years

Source: Tarakji and Wilkoff, 2013.[35]

Cep infeksiyonu vs inflamasyon vs yüzey infeksiyon?- FDG-PET-CT

- Ahmed et al.: FDG PET/CT infeksiyonu olanlar ve olmayanları (inflamasyon) ve infeksiyonu yüzeyel olanlar ile jeneratör ve leadlere ulaşmış olanları ayırd edebiliyor (AUC=0.98)

- Cautela et al. Cep infeksiyonu olanlarda FDG PET/CT'nin duyarlılık ve özgüllüğü % 86.7 ve %100. Bu çalışmada yüzeyel infeksiyonu olan tek hasta da FDG PET/CT tarafından doğru tanınmış

- Benhimson et al. cep infeksiyonunda duyarlılık, özgüllük, pozitif öngördürücü değer ve negatif öngördürücü değerler %100, %100, %100 ve %100 ,lead infeksiyonunda daha düşük.

- Sarrazin et al. erken infeksiyonu post-implantasyon inflamatuar değişikliklerden ayırd edebiliyor

Eur Heart J Cardiovasc Imaging 2015 (May);**16**:521–530.
Europace 2013; **15**:252–257.
Clin Microbiol Infect. 2011;17(6):836–44.
J Am Coll Cardiol. 2012;59(18):1616–25.

Clinical Predictors of Cardiovascular Implantable Electronic Device-Related Infective Endocarditis

- Kronik immunmodülatör tedavi (steroid dışı) (OR 3.79)
- Kronik kortikosteroid tedavi (OR 2.15)
- Hemodiyaliz (OR 3.24)
- Uzak enfeksiyon (OR 1.77)
- Ateş (OR 3.78)
- Halsizlik (OR 1.87)
- Lökositoz (OR 3.61)
- Cep enfeksiyonu bulguları (OR 0.19)

PACE 2011; 34:450–459

Tanı için görüntüleme

- Tüm hastalara göğüs filmi ve gerekirse CT çekilmelidir
  - Multifokal konsolidasyon
  - Plevral effüzyon
  - Jeneratör pozisyonu (migrasyon kronik cep enfeksiyonu bulgusu olabilir)
  - Lead sayısı
- **TEE TTE'den lead infeksiyonu/IE tanısı için daha daha duyarlıdır**
- Rutin FDG PET/CT önerilmez
  - PET/CT cep infeksiyonu için klinik bulgular varlığında tanıyı destekler (ek katkı az)
  - Lead infeksiyonu/IE tanısında yeterince duyarlı değil

Tanı için örnek

- Kan kültürü
  - Antibiyotik başlamadan önce
  - Kronik/subakut enfeksiyonlarda 6 saat ara ile farklı bölgelerden, septik şok varsa 1 saat içinde 2 set
  - İnfekte CIED çıkarıldıktan 48-72 saat sonra tekrar kan kültürü
- Lead kültürü (proksimal ve distal uç)
- Vejetasyon kültürü
- Cep dokusu kültürü
- Akıntı kültürü
  - Sürüntü yerine örnek, kültür ve Gram boyama

  - *CONS türleri ciltten kontaminasyon olabilir*

2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction

COR	LOE	Recommendations	References
I	C-LD	**If antibiotics are going to be prescribed, drawing at least two sets of blood cultures before starting antibiotic therapy is recommended for all patients with suspected CIED infection to improve the precision and minimize the duration of antibiotic therapy.**	116

Microbial growth can be suppressed by antibiotics and can mislead or mask CIED-related bloodstream infection. Early identification of the pathogen will guide appropriate selection and duration of antimicrobial therapy. Blood culture should include two sets of aerobic and anaerobic bacterial cultures. Multiple positive blood cultures might be needed to distinguish bloodstream infection vs contamination in cases of infection due to skin flora, in particular, coagulase-negative staphylococci.[116]

COR	LOE	Recommendations	References
I	C-LD	**Gram stain and culture of generator pocket tissue and the explanted lead(s) are recommended at the time of CIED removal to improve the precision and minimize the duration of antibiotic therapy.**	117

Collecting device pocket tissue for Gram stain and culture at the time of device removal is useful for identifying the causative organism. The sensitivity of tissue culture (69%) is higher than that of the swab culture (31%) of the pocket.[117] The entire explanted leads or lead tips should also be sent for culture, although lead contamination can occur when leads are extracted through the generator pocket. Pathogen-guided therapy enhances antimicrobial drug selection by targeting the causal microbe, guiding appropriate treatment duration to minimize recurrent infection, and identifying potential drug resistance.

COR	LOE	Recommendations	References
I	B-NR	**Preprocedural transesophageal echocardiography (TEE) is recommended for patients with suspected systemic CIED infection to evaluate the absence or size, character, and potential embolic risk of identified vegetations.**	118–122

TEE is a useful imaging modality for establishing the diagnosis of CIED-related endocarditis and/or lead infection. The sensitivity of TEE for endocarditis and perivalvular extension of infection is superior to that of transthoracic echocardiography (TTE). The sensitivity of TTE for detecting endocarditis was only 32%, and the specificity was 100% when compared with TEE.[118] TEE benefits include the confirmation of native or prosthetic valve endocarditis and identifying the presence and the size of vegetation(s) on the valve or lead(s), valvular malfunction, and perivalvular abscess. This information can help guide antibiotic therapy and provide additional information on the risk of CIED removal.[119–122]

Heart Rhythm 2017;14:e503-e551

2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction

I	C-EO	**Evaluation by physicians with specific expertise in CIED infection and lead extraction is recommended for patients with documented CIED infection.**	

When the diagnosis of CIED infection is documented, consulting physicians who have the expertise in CIED infection (including infectious disease specialists, cardiologists, and surgeons who specialize in managing device-related infection and/or performing lead extraction) is beneficial. Delayed, inappropriate, or incomplete therapy can result in significant morbidity and mortality for patients with CIED infection.

IIa	B-NR	**TEE can be useful for patients with CIED pocket infection with and without positive blood cultures to evaluate the absence or size, character, and potential embolic risk of identified vegetations.**	[123]

Device pocket infection might or might not be accompanied by bloodstream infection. In one study, intravascular lead involvement was present in 88% of patients presenting with pocket infection despite lack of symptoms of systemic infection.[123]

IIa	C-EO	**Evaluation by physicians with specific expertise in CIED infection and lead extraction can be useful for patients with suspected CIED infection.**	

When CIED infection is suspected, consulting physicians who have expertise in CIED infection (including infectious disease specialists, cardiologists, and surgeons who specialize in managing device-related infection and/or performing lead extraction) can be useful for facilitating the diagnosis and further management.

IIb	C-LD	**Additional imaging may be considered to facilitate the diagnosis of CIED pocket or lead infection when it cannot be confirmed by other methods.**	[124–129]

18-Fluorodeoxyglucose (^{18}F-FDG) positron emission tomography (PET)/computed tomography (CT) scanning might provide helpful evidence when diagnosis of CIED pocket or lead infection is doubtful.[124–126] One study showed that PET/CT had a high sensitivity of 87% and a specificity of 100% for device pocket infection but a low sensitivity of 31% and a specificity of 62% for endocarditis.[127] In another single-center, prospective, controlled study of 86 patients, patients with suspected generator pocket infection requiring CIED extraction had significantly higher ^{18}F-FDG activity (4.80 [3.18–7.05]) compared with those who did not have the infection (1.40 [0.88–1.73]) and compared with controls (1.10 [0.98–1.40]).[128] The diagnostic performance of ^{99m}Tc-hexamethypropylene amine oxime–labeled autologous white blood cell (^{99m}Tc-HMPAO-WBC) scintigraphy had a sensitivity of 94% for both detection and localization of CIED-associated infection.[129]

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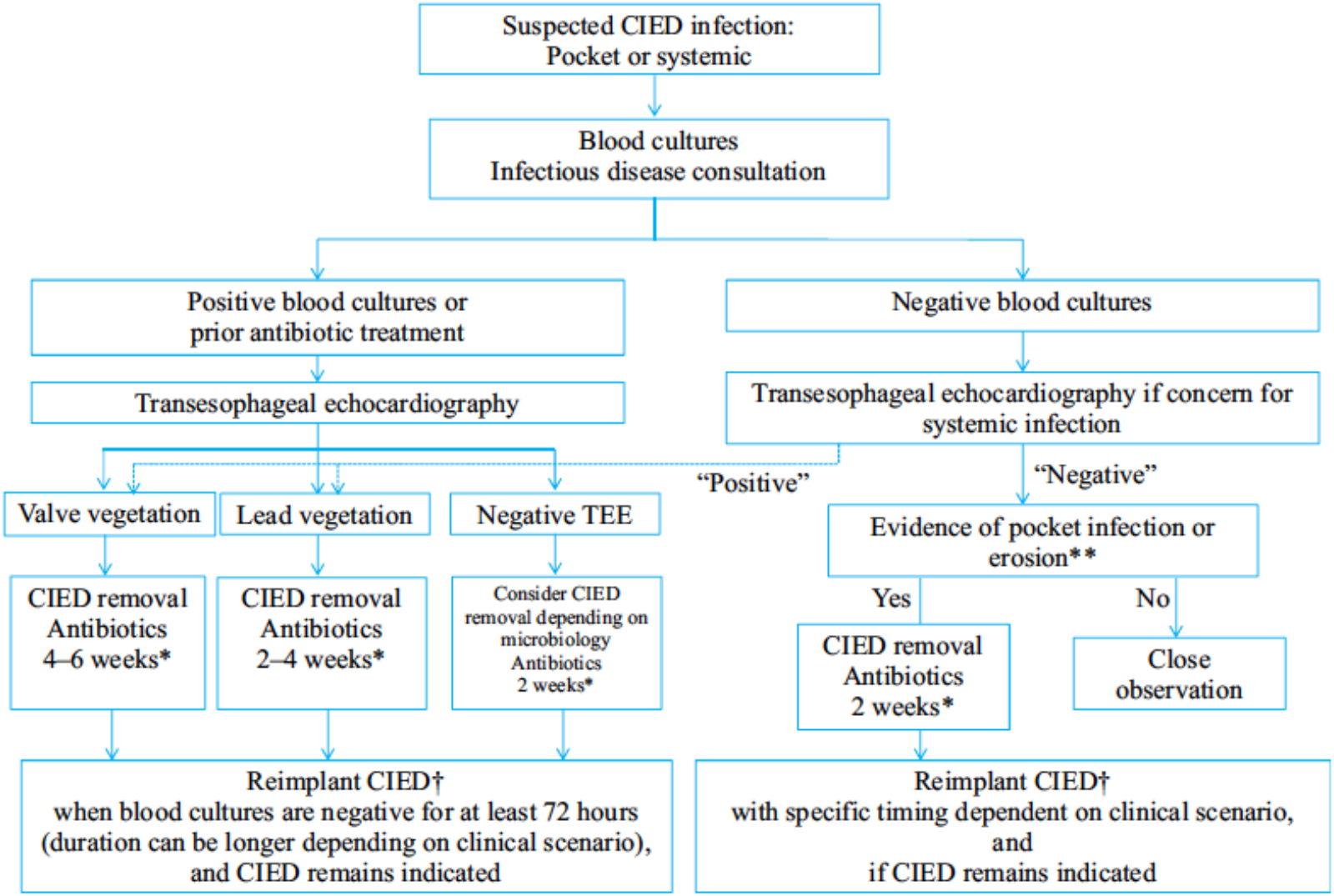

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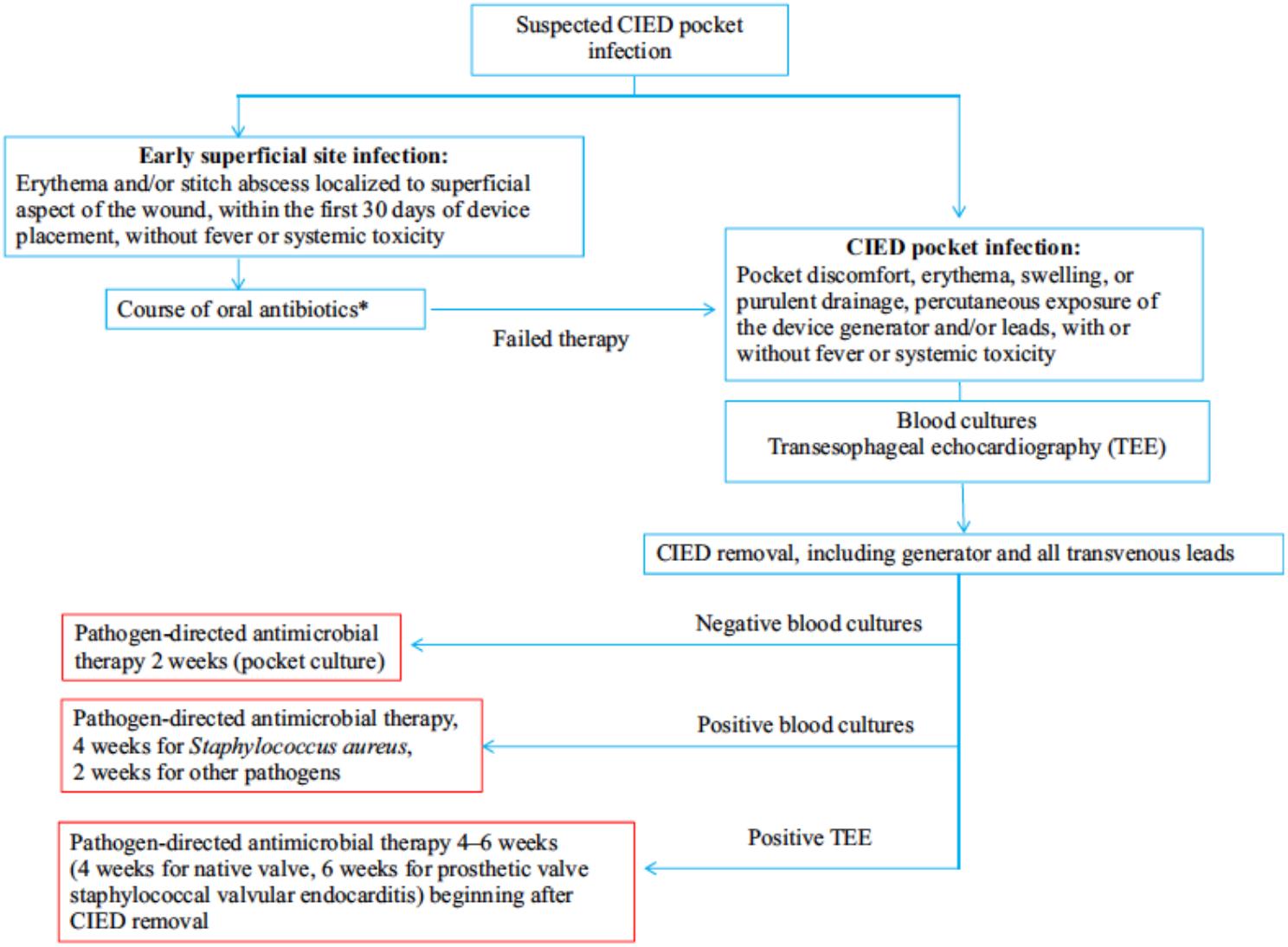

Heart Rhythm 2017;14:e503-e551

CIED Çıkarma önerileri

COR	LOE	Recommendations	References
I	B-NR	**A complete course of antibiotics based on identification and in vitro susceptibility testing results after CIED removal is recommended for all patients with definite CIED system infection.**	1,140,153,166–168

A complete course of antibiotics is recommended to treat device pocket and/or bloodstream infection and/or valvular endocarditis.[1,140,153,166–168] After device and lead removal, antibiotics are more effective for eradicating the infection. Selection of the appropriate antimicrobial agent should be based on identification and in vitro susceptibility testing results. Patients with infections due to methicillin-susceptible staphylococcal strains can be administered cefazolin or nafcillin. Vancomycin should be administered to patients with infection due to methicillin-resistant staphylococci. Although there are no clinical trials that have tested the minimum duration of antibiotic therapy, in general, a 2-week antibiotic therapy after lead extraction is recommended for CIED pocket infection and 10 days for pocket erosion.[153] For patients with bloodstream infection without valvular involvement, a minimum 2-week course of antimicrobial therapy is recommended after extraction of the infected CIED. Antimicrobial therapy should be at least 4–6 weeks for complicated infection including endocarditis. The duration of antimicrobial therapy should be calculated from the day of completion of the lead extraction or negative blood cultures (whichever occurred last).

COR	LOE	Recommendations	References
I	B-NR	**Complete device and lead removal is recommended for all patients with definite CIED system infection.**	169–171

Early diagnosis of CIED infection and performing lead extraction within 3 days of diagnosis is associated with lower in-hospital mortality.[169] A multivariate analysis found a 7-fold increase in 30-day mortality if the CIED was not removed. Although CIED removal resulted in fatal complications, the mortality associated with a delay in removal was even higher.[170] Therefore, CIED-associated infections are the strongest indication for complete CIED system removal and should not be delayed, regardless of the timing of the start of antimicrobial therapy.[1,171]

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I	C-EO	**Complete removal of epicardial leads and patches is recommended for all patients with confirmed infected fluid (purulence) surrounding the intrathoracic portion of the lead.**

Infection can occur in patients with surgical epicardial leads and/or patches that are connected to a pectoral or abdominal generator. Complete removal of infected portions of epicardial leads and patches is recommended to eradicate the infection after weighing the risk of surgery and mortality from infection.[172]

I	B-NR	**Complete device and lead removal is recommended for all patients with valvular endocarditis without definite involvement of the lead(s) and/or device.** [153,169]

Complete CIED removal should be performed when patients undergo valve replacement or repair for infective endocarditis, because the CIED could serve as a nidus for relapsing infection and subsequent seeding of the surgically treated heart valve.[153]
A recent study has shown that complete CIED removal appears curative for patients with CIED infection in the presence of prosthetic heart valves and thus might prevent repeat valve surgery.[169]

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I	B-NR	**Complete device and lead removal is recommended for patients with persistent or recurrent bacteremia or fungemia, despite appropriate antibiotic therapy and no other identifiable source for relapse or continued infection.**	[153,165]

Persistent or relapsing bacteremia or fungemia after a course of appropriate antibiotic therapy when there is no other identified source for bacteremia or fungemia suggests CIED and lead infection. In this scenario, the retained intravascular leads are very likely to be the source of infection. Complete removal of hardware is recommended to eradicate the infection.[153,165]

I	C-EO	**Careful consideration of the implications of other implanted devices and hardware is recommended when deciding on the appropriateness of CIED removal and for planning treatment strategy and goals.**	

Patients who have received a CIED might have other implanted devices and hardware. For example, left ventricular assist device (LVAD) recipients often have a CIED in place (up to 87%). In a large series of 247 LVAD patients, 2.8% had CIED infection. Patients with an LVAD and CIED infection should undergo CIED removal to eliminate a potential source of microbial seeding and infection. Chronic suppressive antibiotic therapy is warranted in concomitant LVAD infection.[173]

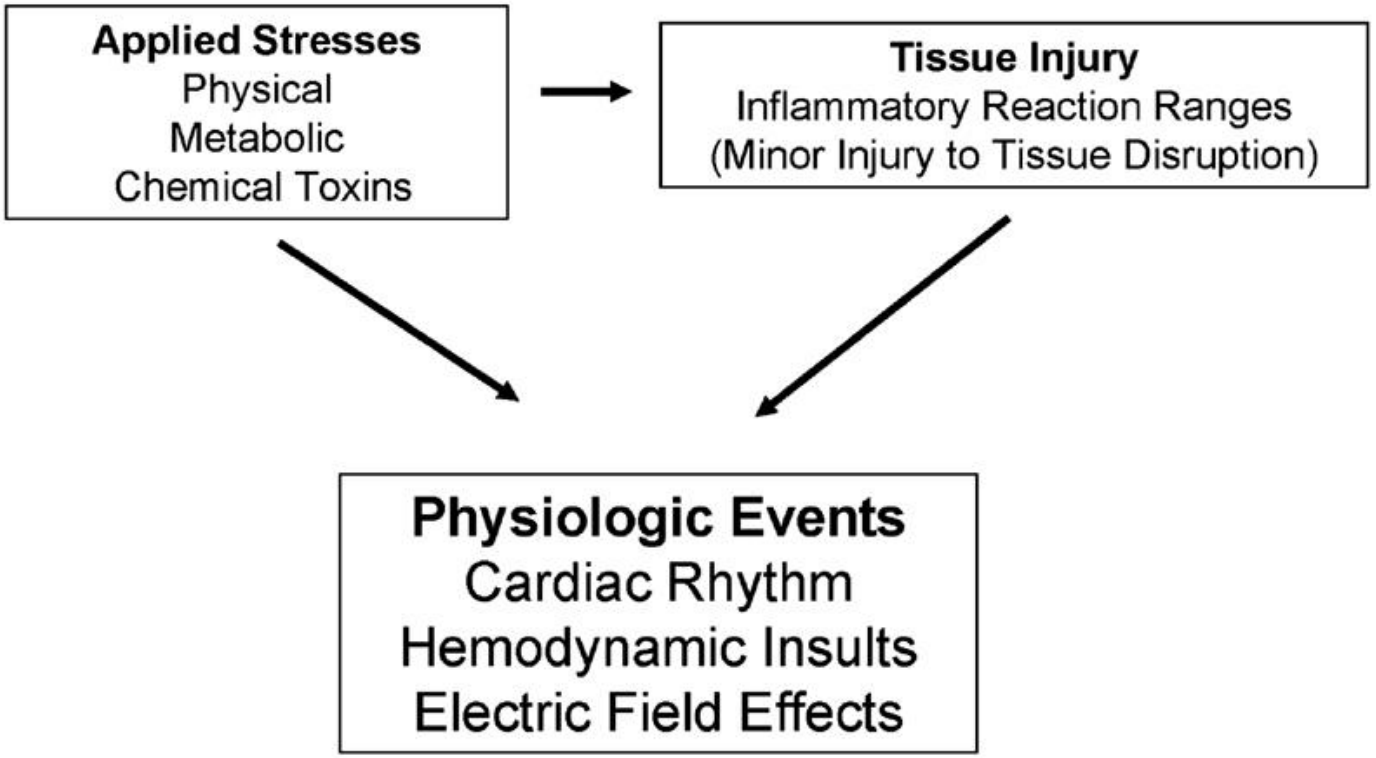
Heart Rhythm 2017;14:e503-e551

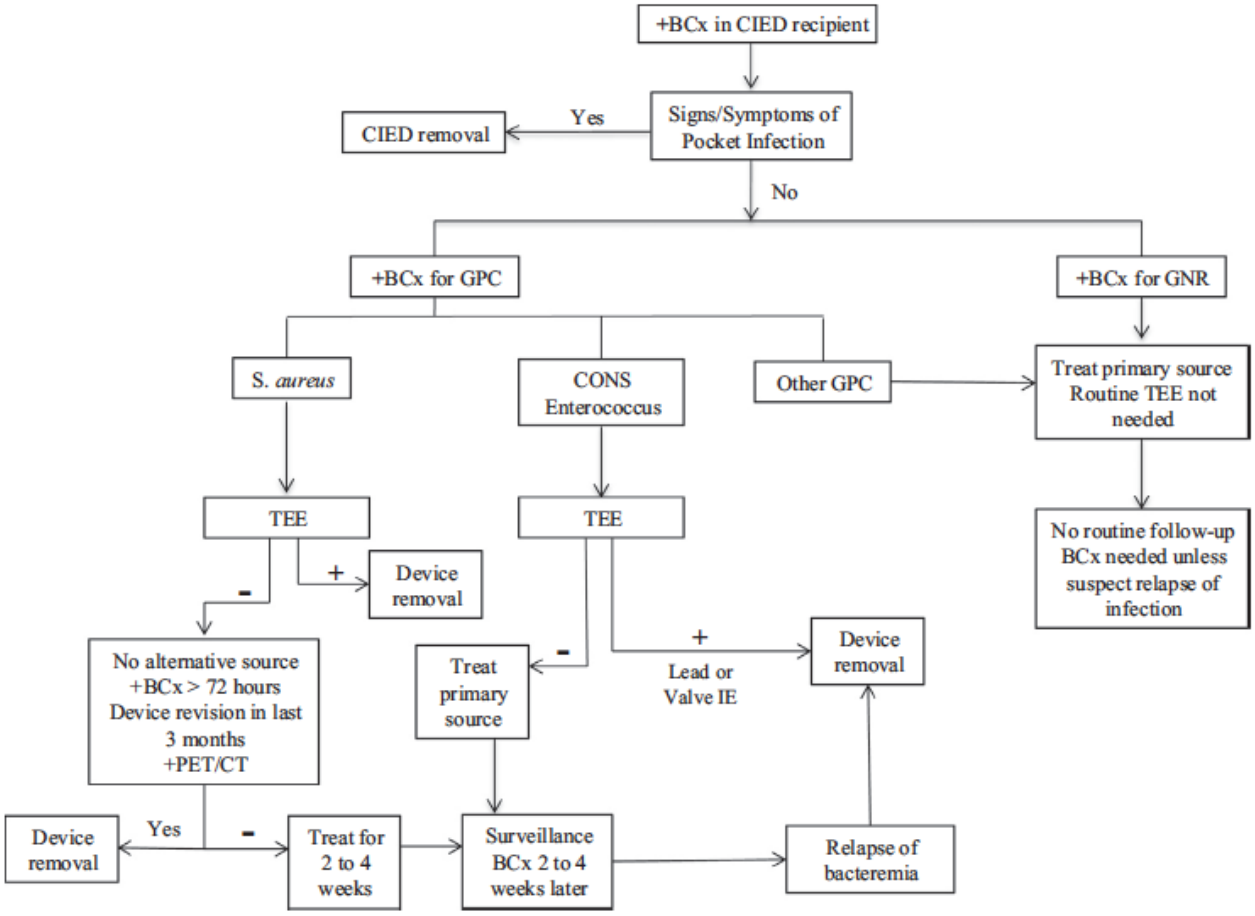
CİHAZA YÖNELİK STRATEJİLER

Tanı/senaryo	Öneri	Antimikrobiyal strateji	Yorum
Erken post-implantasyon inflamasyon	Cihazı yerinde bırak	Vaka bazlı, izlem ya da 7–10 gün oral tedavi	Erken infeksiyonu da gösterebilir, başka senaryolar da olası olabilir
Komplike olmamış cep infeksiyonu cihaz çıkarılabilir cihaza mutlak gereksinim yok	Cihazı tamamen çıkar Yeni cihaz takma	10-14 gün IV/PO antimikrobiyal	En yüksek kür olsılığı ile tercih edilen yaklaşım
Komplike olmamış cep infeksiyonu Cihaz çıkarılabilir cihaza mutlak gereksinim var	Cihazı tamamen çıkar Geçici pace et İnfeksiyon bulguları yatışınca yeni cihaz tak	10–14 gün IV antimikrobiyal.	Geçici ve sonraki kalıcı sistemi infekte etme riski
Cep infeksiyonu Lead çıkarılması riskli /hasta kabul etmiyor Cihaza mutlak gereksinim yok	Jeneratörü çıkar, Leadler kalsın, Yeni cihaz takma	6 hafta IV tedavi	Rezidüel lead infeksiyonu eradikasyon riski düşük
Cep infeksiyonu Lead çıkarılması riskli /hasta kabul etmiyor cihaza mutlak gereksinim var	Jeneratörü çıkar, Leadler kalsın, Erken/aynı seansta yeni cihaz tak	6 hafta IV tedavi	Rezidüel lead infeksiyonu eradikasyon riski düşük Yeni sistemi infekte etme riski yüksek İnfeksiyon riski geçici pacing süresini aşar

Sabrınız İçin Teşekkürler…

Biophysical Interface



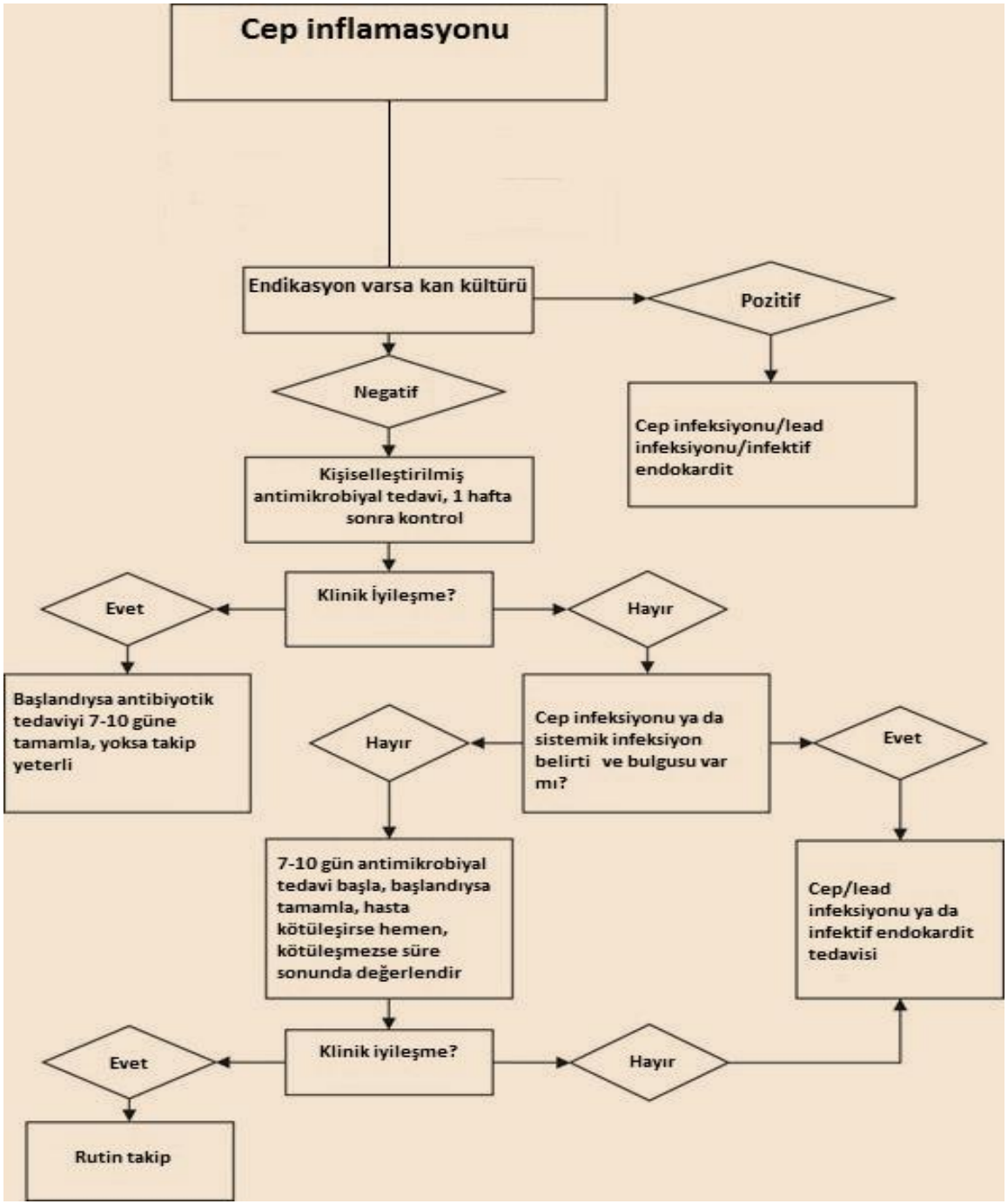

+BCx in CIED recipient
Signs/Symptoms of Pocket Infection
Yes
CIED removal
No
+BCx for GPC
+BCx for GNR
S. aureus
CONS Enterococcus
Other GPC
Treat primary source Routine TEE not needed
No routine follow-up BCx needed unless suspect relapse of infection
TEE
TEE
+
Device removal
-
No alternative source +BCx > 72 hours Device revision in last 3 months +PET/CT
-
Treat primary source
+
Lead or Valve IE
Device removal
Device removal
Yes
-
Treat for 2 to 4 weeks
Surveillance BCx 2 to 4 weeks later
Relapse of bacteremia

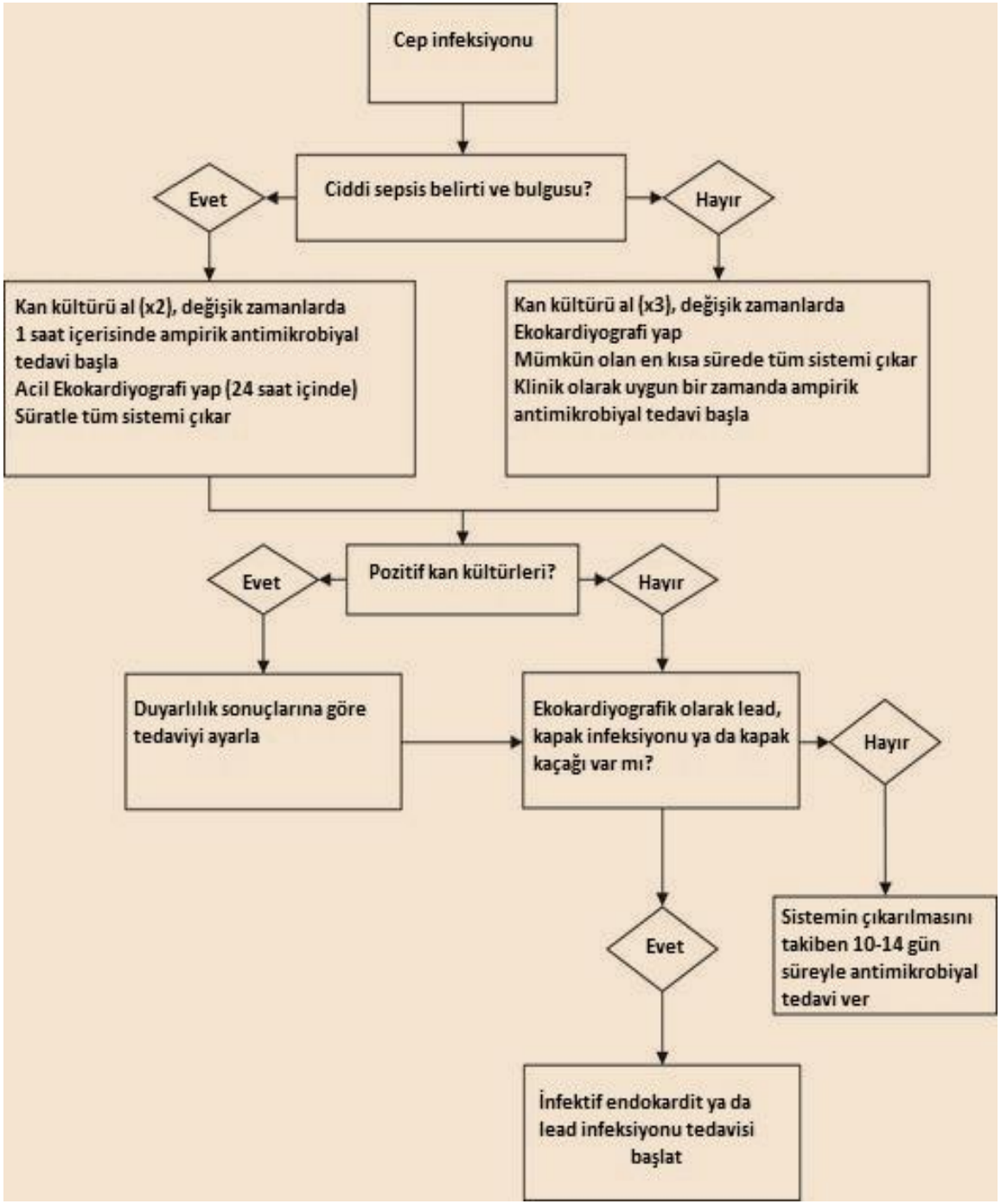
Risk faktörü	Risk faktörünü belirleyen çalışma sayısı
Prosedürle ilişkili risk faktörleri	
Antimikrobiyal profilaksi yapılmaması	4
Cihaz tipi (CRT> ICD> PPM)	4
Taburculuk öncesi girişim gereksinimi	2
Epikardiyal ya da transvenöz/rpikardiyal lead (erken infeksiyon)	1
Prosedür süresi	1
Potoperatif hematom	1
Post-operatif yara infeksiyonu (erken infeksiyon)	1
Geçici pil takılması	1
Hasta Özellikleri	
Önceki girişim sayısı	5
Antikoagülasyon	2
KOAH	2
Erkek cinsiyet	2
Renal hasar	2
Genç yaş	2
Azotemi	1
Kronik kortikosteroid tedavi	1
Hastanede yatış süresi (geç infeksiyon)	1
Kalp yetersizliği	1
Eski cihaz (1985 öncesi)	1
İşlemden önceki son 24 saatte ateş	1
Hemodializ	1
İmplantasyondan sonra geçen sürenin kısalığı (<1 yıl)	1

CIED ile ilişkili enfeksiyonlar

- I- Endokardit
  - I-A Enfekte kardiyak doku
  - I-B Enfekte vejetasyon
  - I-C Enfekte yabancı cisim
- II- Endokardit olmaksızın septisemi
- III- Subkütan doku enfeksiyonu
- IV- Kronik stabil dışa açılmış cep
  - IV-A Kontamine kronik cep dokusu
  - IV-B Kronik granülasyon doku bariyeri

Charles L. Byrd. Managing device-related complications and transvenous lead extraction. Ellenbogen, Kay, Lau, Wilkoff.Clinical Cardiac Pacing Defibrillation,and Resychronization Therapy. Saunders/Elsevier


Cep inflamasyonu
Endikasyon varsa kan kültürü
Pozitif
Negatif
Cep infeksiyonu/lead infeksiyonu/infektif endokardit
Kişiselleştirilmiş antimikrobiyal tedavi, 1 hafta sonra kontrol
Klinik İyileşme?
Evet
Hayır
Başlandıysa antibiyotik tedaviyi 7-10 güne tamamla, yoksa takip yeterli
Hayır
Cep infeksiyonu ya da sistemik infeksiyon belirti ve bulgusu var mı?
Evet
7-10 gün antimikrobiyal tedavi başla, başlandıysa tamamla, hasta kötüleşirse hemen, kötüleşmezse süre sonunda değerlendir
Cep/lead infeksiyonu ya da infektif endokardit tedavisi
Klinik iyileşme?
Evet
Hayır
Rutin takip


Cep infeksiyonu
Ciddi sepsis belirti ve bulgusu?
Evet
Hayır
Kan kültürü al (x2), değişik zamanlarda
1 saat içerisinde ampirik antimikrobiyal tedavi başla
Acil Ekokardiyografi yap (24 saat içinde)
Süratle tüm sistemi çıkar
Kan kültürü al (x3), değişik zamanlarda
Ekokardiyografi yap
Mümkün olan en kısa sürede tüm sistemi çıkar
Klinik olarak uygun bir zamanda ampirik antimikrobiyal tedavi başla
Pozitif kan kültürleri?
Evet
Hayır
Duyarlılık sonuçlarına göre tedaviyi ayarla
Ekokardiyografik olarak lead, kapak infeksiyonu ya da kapak kaçağı var mı?
Hayır
Evet
Sistemin çıkarılmasını takiben 10-14 gün süreyle antimikrobiyal tedavi ver
İnfektif endokardit ya da lead infeksiyonu tedavisi başlat

Tanı-görüntüleme

Posteroanterior akciğer filmi

➢ Jeneratör ve lead'lerin yerleşimi ve akciğer parenkimi

Toraks BT

➢ Şüpheli septik pulmoner emboliler ve pulmoner infeskiyon odakları

En kısa sürede	Gerektiğinde
İE/LE için düşük duyarlılık	İE/LE için yüksek duyarlılık (%96-99)
Tüm hastalar	✓Kan kültürü pozitif ya da önceden Ab almış ✓Sistemik belirti ve bulgular ✓Sonuçsuz TTE ve yüksek şüphe ✓Yeni gelişen kalp yetersizliği, kapak yetersizliği ✓Pulmoner emboli

AMPİRİK ANTİMİKROBİYAL TEDAVİ

Tanı/senaryo	Antimikrobiyal
Erken post-implantasyon inflamasyon Penisilin alerjik/MRSA kolonize hasta	Fluoksasilin 4 x 0.5-1 g PO Doksisiklin 2x100 mg PO/Linezolid 2x600 mg PO/ Klindamisin 4x450 mg PO
Komplike olmamış cep infeksiyonu	Vankomisin 2x1 gr IV/ Daptomisin 1x8-10 mg/kg IV/ Teikoplanin 6 mg/kg (0,12,24. saat), sonra 1x 6 mg/kg
Komplike cep infeksiyonu (örneğin ciddi sepsis)	Vankomisin 2x1 gr IIV ve Meropenem 3x1 gr IV YA DA Daptomisin 1x8-10 mg/kg IV ve Meropenem 3x1 gr IV
Komplike cep infeksiyonu ancak kan kültürleri negatif	Vankomisin 2x1 gr IV veGentamisin 2x1mg/kg YA DA Daptomisin 1x8-10 mg/kg IV ve Gentamisin 2x1mg/kg

Patojen	İlk seçenek (iv) (duyarlılığa göre)	Orale çevirme (genellikle cihaz çıkarımını takiben)
Staphylococcus spp. (metisilin-duyarlı izolat)	fluoksasilin 4x2 gr	Fluoksasilin 4x1 g
Staphylococcus spp. (metisilin - dirençli izolat ya da penisilin alerjisi)	vankomisin 2x1 gr/ teikoplanin 6 mg/kg 0, 12. ve 24. Saat, daha sonra 1x6 mg/kg/ daptomisin 1x4 mg/kg	linezolid 2x600 mg /klindamisin 4x450 mg/ doksisiklin 2x100 mg
Streptococcus spp. (penisilin-duyarlı izolat)	benzil penisilin 6x1.2 gr	Amoksisilin 4x 1 g
Streptococcus spp. (penisilin - dirençli izolat ya da penisilin alerjisi)	Vankomisin 2x1 gr/ teikoplanin 6 mg/kg 0, 12. ve 24. Saat, daha sonra 1x6 mg/kg	linezolid 2x600 mg
Enterococcus spp. (amoksisilin duyarlı)	Amoksisilin 4x2 gr	Amoksisilin 4x 1 g
Enterococcus (amoksisilin dirençli, vankomisin duyarlı ya da penilin alerjisi)	Vankomisin 2x1 gr/ teikoplanin 6 mg/kg 0, 12. ve 24. Saat, daha sonra 1x 6 mg/kg	linezolid 2x600 mg
Enterococcus spp. (amoksisilin- ve vankomisin-dirençli, daptomisin-duyarlı izolat)	daptomisin 1x4 mg/kg / linezolid 2x600 mg	linezolid 2x600 mg
Enterobacteriaceae (‘koliformlar’)	Vaka bazında ve duyarlılığa göre	Duyarlılığa göre vaka bazında karar, monoterapi önerilir

Cep infeksiyonu-sorulması gereken sorular

- Cep infeksiyonuna lead/infektif endokardit eşlik ediyor mu?
  - ➢Antibiyotik süresi ve verilme yolu değişebilir
  - ➢Hospitalizasyon süresi değişir
  - ➢Yeniden cihaz takma zamanlaması değişir
- İmplantasyondan bu yana geçen süre (>1-2 yıl)
- Cihaz tipi (ICD vs PPM)
- Hastanın genel durumu, komorbiditeleri
- Hastanın cihaz çıkarılmasına yaklaşımı
- Lokal imkanlar

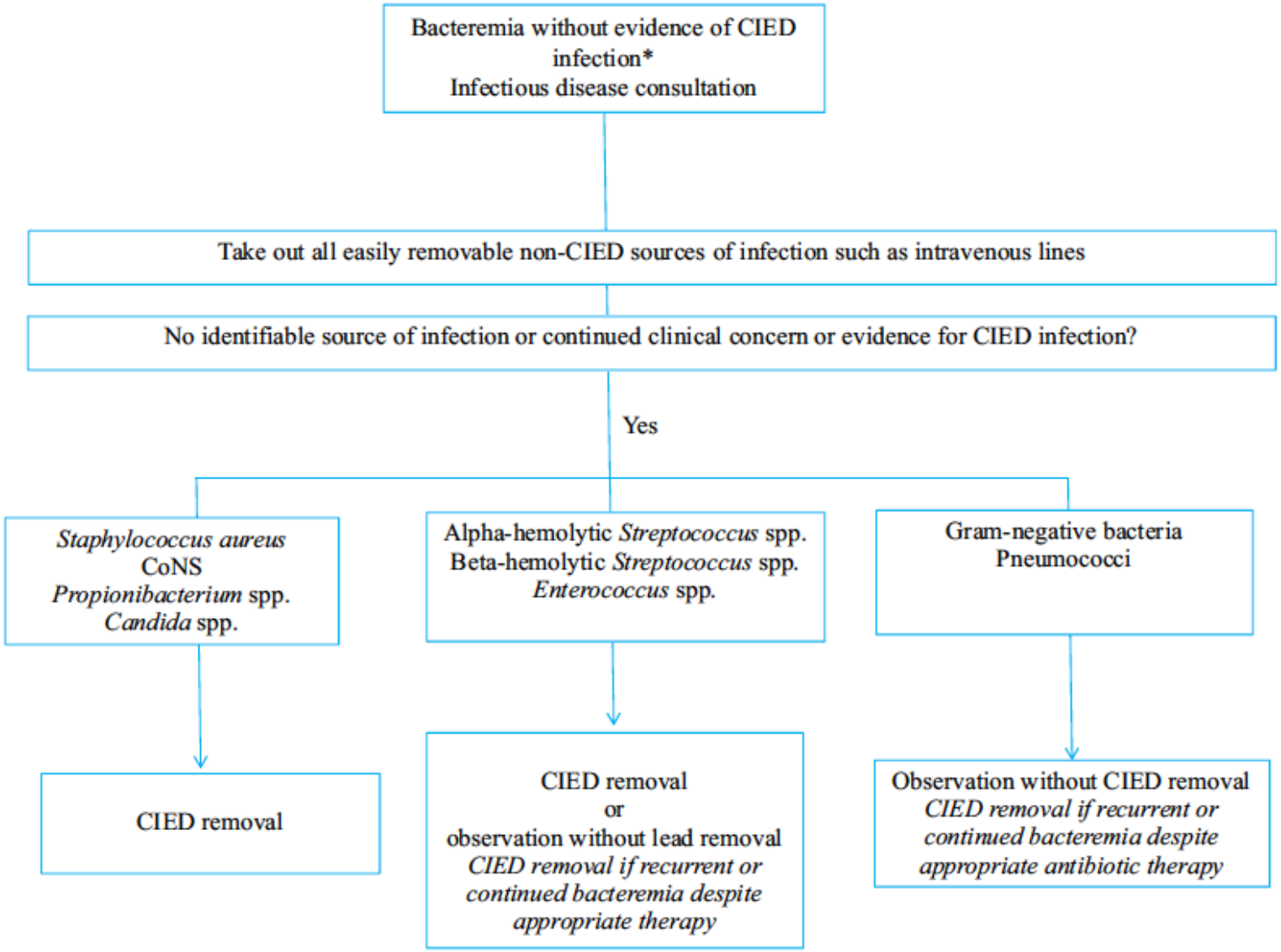
Cardiac implantable electronic device infections: Presentation, management, and patient outcomes

Table 3 Comparison of clinical characteristics between patients presenting with localized pocket infection and patients presenting with endovascular infection and intact device pocket

	Group 1: localized pocket infection/erosion (n = 241)	Group 2: endovascular infection with intact pocket (n = 171)	*P* value
Age	69 ± 15	67 ± 14	.05
New York Heart Association functional class (mean)	1.7	1.8	.186
Coronary artery disease	138 (57%)	93 (54%)	.56
Prior coronary artery bypass surgery	79 (33%)	46 (27%)	.2
Congestive heart failure	109 (45%)	79 (46%)	.85
Prior valve surgery	15 (6.2%)	27 (16%)	.002
Diabetes mellitus	56 (23%)	68 (40%)	<.001
Rheumatic heart disease	1 (0.4%)	10 (6%)	.001
Chronic renal insufficiency (creatinine >1.7 or history of renal insufficiency)	36 (15%)	44 (26%)	<.001
End-stage renal disease	4 (1.7%)	18 (11%)	<.001
Chronic obstructive pulmonary disease	36 (15%)	33 (19%)	.24
Chronic steroid use	3 (1.2%)	8 (4.7%)	.06
History of endocarditis	5 (2.1%)	16 (9.4%)	.001
Infection within first year of implant	124 (52%)	53 (31%)	<.001
Positive blood cultures	51 (21%)	161 (94%)	<.001
Reimplantation during same hospitalization	155 (64%)	80 (47%)	.001
Intensive care unit stay	24 (10%)	46 (27%)	<.001
Time interval between extraction and reimplantation	8.8	9.7	.004
Disposition to home	199 (83%)	109 (64%)	<.001
In-hospital death	4 (1.7%)	15 (9%)	.001
Aspergillus		1	
Other			
Mycobacterium species		2	

Total number of pathogens isolated = 414.

Heart Rhythm 2010;7:1043-1047



Heart Rhythm 2017;14:e503-e551