Infections endovasculaires

O. Leroy

Service de Réanimation et Maladies Infectieuses

CH Tourcoing 59

Conflits d'intérêt

- Laboratoires Novartis:
  - Orateur
- Laboratoires Sanofi-Aventis:
  - Orateur, investigateur
- Laboratoires MSD:
  - Orateur, investigateur
- Laboratoires Wyeth:
  - Orateur
- Laboratoire Pfizer:
  - Orateur
- Laboratoire Astellas:
  - Orateur

Cette présentation est de la seule responsabilité de l'orateur

Sommaire

- **Vaste programme…**

Sommaire

- **Infection sur matériel de stimulation**
  - Pacemakers
  - Défibrillateurs
- **Infection sur système d'assistance** cardiaque implantable
- **Infection sur stents** coronaires ou artériels, ombrelles…

Infections sur matériel de stimulation

- **Guidelines récents**
  - 2009: Europe
  - 2010: USA
  - 2015: GB

European Heart Journal (2009) **30**, 2369–2413
doi:10.1093/eurheartj/ehp285

ESC GUIDELINES

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

The Task Force on the Prevention, Diagnosis, and Treatment of Infective Endocarditis of the European Society of Cardiology (ESC)

Endorsed by the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and by the International Society of Chemotherapy (ISC) for Infection and Cancer

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

- **Distinction entre**
  - Infection limitée au boitier
  - Endocardite infectieuse associée aux stimulateurs
    - Extension de l'infection aux électrodes, aux valves ou à l'endocarde

European Heart Journal (2009) **30**, 2369–2413

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

- **Diagnostic de l'endocardite**
  - Echographie
  - Hémocultures
    - Positives dans 77% des cas…
  - Cultures des sondes ??
    - It has recently been proposed that positive lead cultures can be used as a sign of CDRIE only in the absence of pocket infection or when the leads were removed using a remote incision from the pocket or surgical extraction

European Heart Journal (2009) **30**, 2369–2413

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

Cardiac device-related infective endocarditis (CDRIE): treatment and prevention

A - PRINCIPLES OF TREATMENT:		
Prolonged antibiotic therapy and device removal are recommended in definite CDRIE	I	B
Device removal should be considered when CDRIE is suspected on the basis of occult infection without other apparent source of infection	IIa	C
In patients with native or prosthetic valve endocarditis and an intracardiac device with no evidence of associated device infection, device extraction may be considered	IIb	C

European Heart Journal (2009) **30**, 2369–2413

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

Cardiac device-related infective endocarditis (CDRIE): treatment and prevention

B - MODE OF DEVICE REMOVAL:		
Percutaneous extraction is recommended in most patients with CDRIE, even those with large (> 10 mm) vegetations	I	B
Surgical extraction should be considered if percutaneous extraction is incomplete or impossible or when there is associated severe destructive tricuspid IE	IIa	C
Surgical extraction may be considered in patients with very large (> 25 mm) vegetations	IIb	C

European Heart Journal (2009) **30**, 2369–2413

Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009)

Cardiac device-related infective endocarditis (CDRIE): treatment and prevention

C – REIMPLANTATION:		
After device extraction, reassessment of the need for reimplantation is recommended	I	B
When indicated, reimplantation should be postponed if possible to allow a few days or weeks of antibiotic therapy	IIa	B
Temporary pacing is not recommended	III	C

European Heart Journal (2009) **30**, 2369–2413

Endocardite sur matériel du cœur droit: traitement

- **Ablation du matériel**
- **Antibiothérapie**

On enlève le matériel
On attend les cultures de sondes
On met des ATB en attendant
Vancomycine + rifampicine
On adapte aux résultats microbiologiques
On traite quelques semaines
On réimplante
On poursuit l'antibiothérapie quelques semaines

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

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

Larry M. Baddour, Andrew E. Epstein, Christopher C. Erickson, Bradley P. Knight, Matthew E. Levison, Peter B. Lockhart, Frederick A. Masoudi, Eric J. Okum, Walter R. Wilson, Lee B. Beerman, Ann F. Bolger, N.A. Mark Estes III, Michael Gewitz, Jane W. Newburger, Eleanor B. Schron, Kathryn A. Taubert, Council on Cardiovascular Surgery and Anesthesia, Council on Cardiovascular Nursing, Council on Clinical Cardiology and the Interdisciplinary Council on Quality of Care and Outcomes Research

Circulation **January 26, 2010**

Update on Cardiovascular Implantable Electronic Device Infections

Recommendations for Diagnosis of CIED Infection and Associated Complications

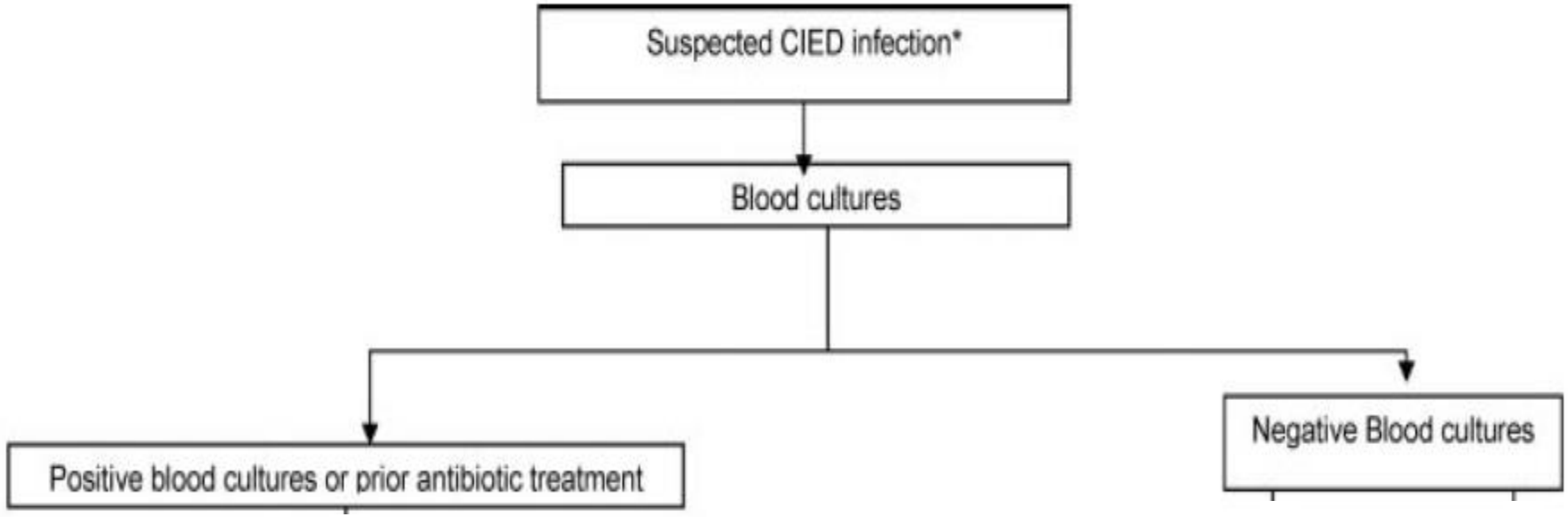
Class I

1. All patients should have at least 2 sets of blood cultures drawn at the initial evaluation before prompt initiation of antimicrobial therapy for CIED infection. (*Level of Evidence: C*)
2. Generator-pocket tissue Gram's stain and culture and lead-tip culture should be obtained when the CIED is explanted. (*Level of Evidence: C*)

Circulation January 26, 2010

Update on Cardiovascular Implantable Electronic Device Infections

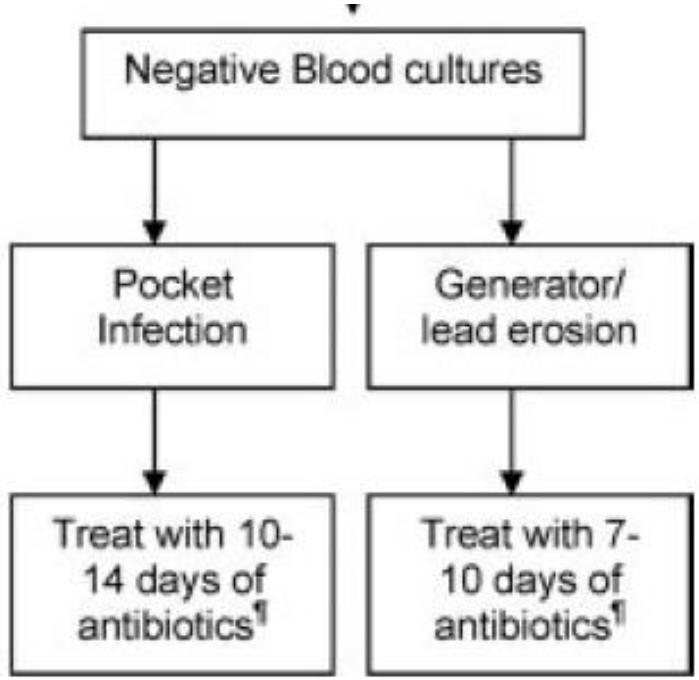
Approach to management of adults with CIED infection.



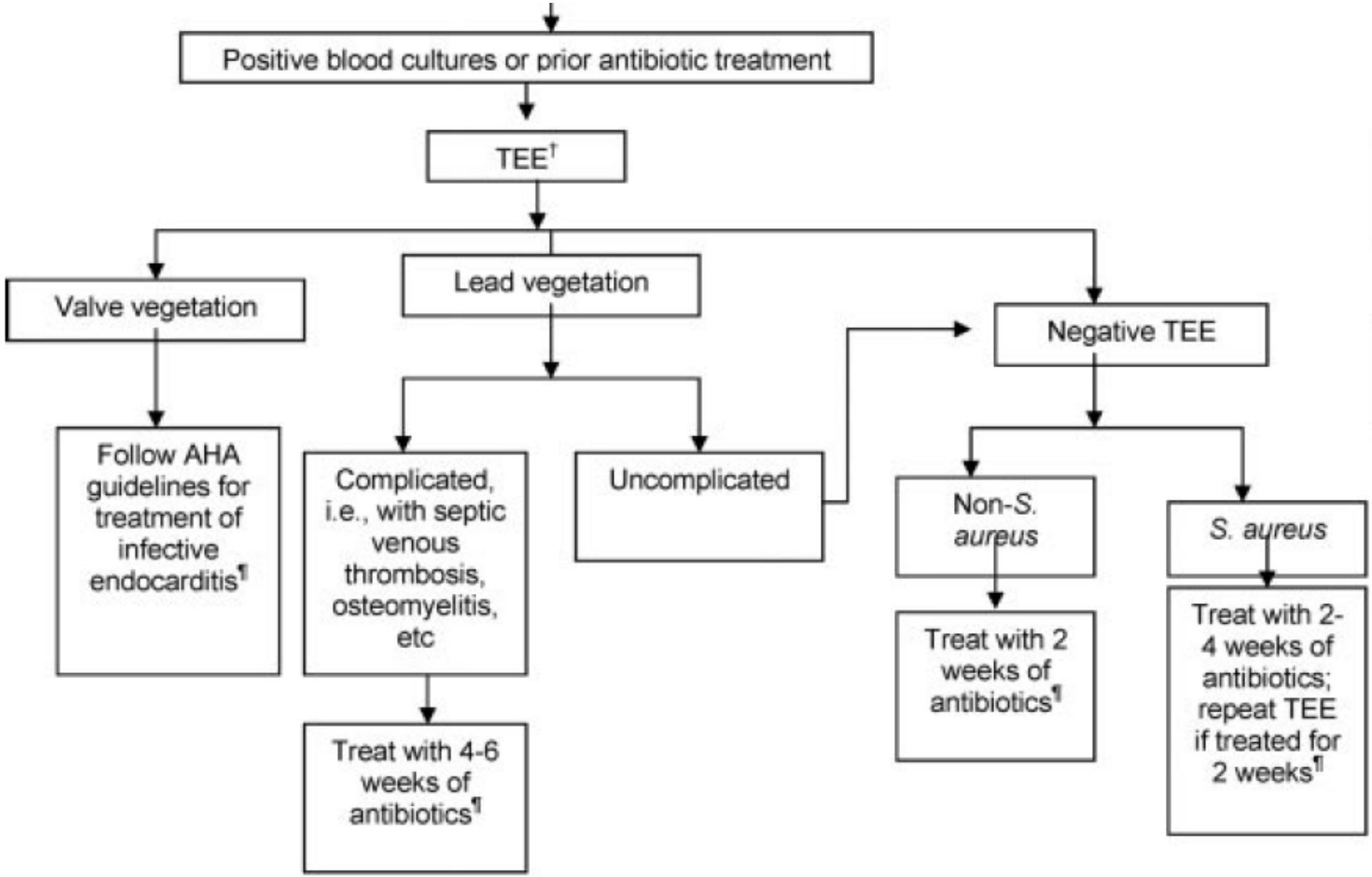
Circulation January 26, 2010

Update on Cardiovascular Implantable Electronic Device Infections

Approach to management of adults with CIED infection.



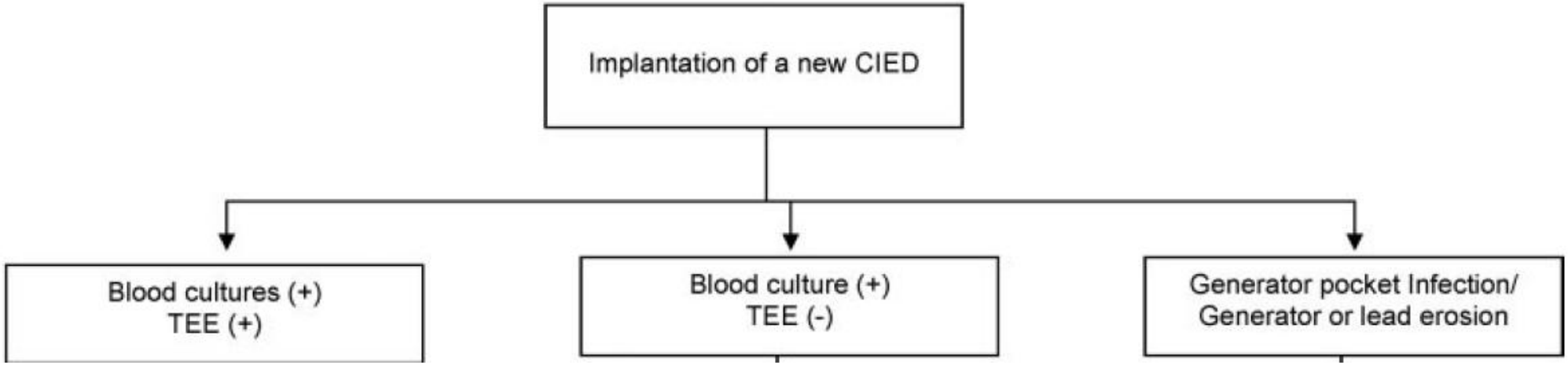
Circulation January 26, 2010



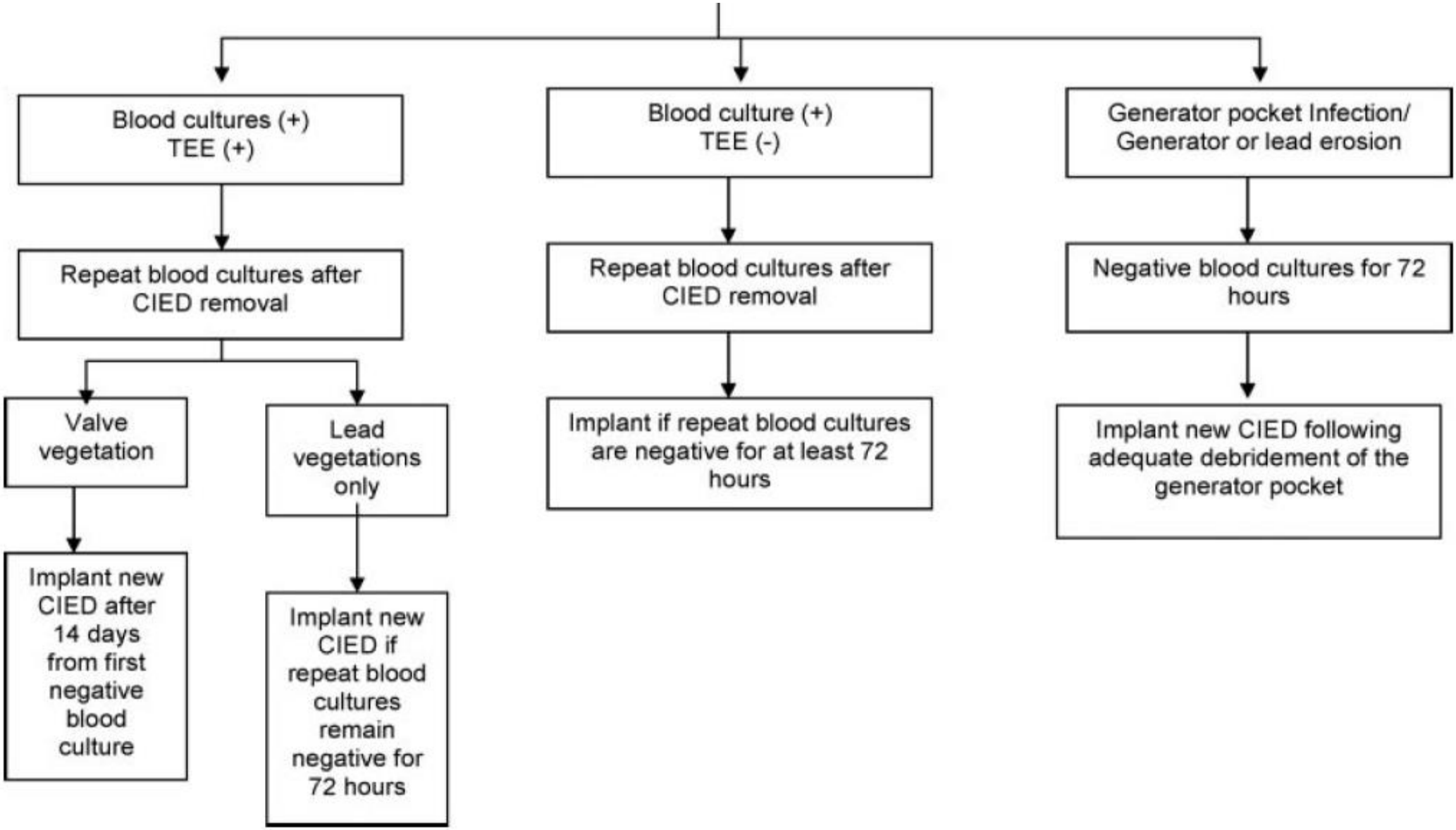
¶Duration of antibiotics should be counted from the day of device explantation.

Update on Cardiovascular Implantable Electronic Device Infections

Approach to implantation of a new device in patients after removal



Circulation January 26, 2010



Circulation January 26, 2010

Update on Cardiovascular Implantable Electronic Device Infections

- **Points positifs**
  - Une durée d'antibiothérapie est proposée
  - Le timing de la réimplantation est clair
- **Points négatifs**
  - Il n'est pas évoqué l'apport des cultures de sondes
  - Que faire si HC négatives et ETO + ?
  - Quels antibiotiques ?

Circulation January 26, 2010

Update on Cardiovascular Implantable Electronic Device Infections

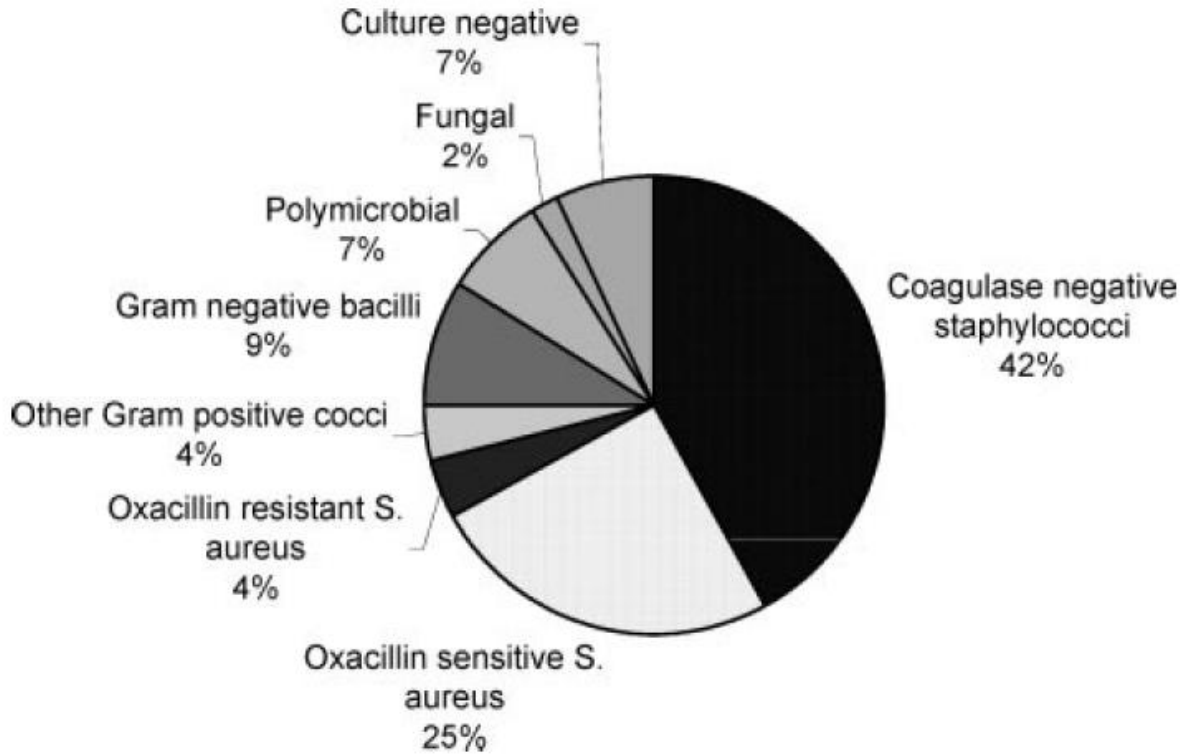


Figure 1. Microbiology of PPM/ICD infections (n=189). From Sohail et al,[38] with permission.

Circulation January 26, 2010

Update on Cardiovascular Implantable Electronic Device Infections

- Antimicrobial therapy is **adjunctive** in patients with CIED infection
- Selection of the **appropriate antimicrobial agent** should be based on **identification and in vitro susceptibility** testing results.
- **Vancomycin** should be administered initially as **empirical antibiotic coverage** until microbiological results are known.

Place de la vancomycine ?

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Oct. 2007, p. 3731–3733 Vol. 51, No. 10
0066-4804/07/$08.00+0 doi:10.1128/AAC.00101-07
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NOTES

Impact of Empirical-Therapy Selection on Outcomes of Intravenous Drug Users with Infective Endocarditis Caused by Methicillin-Susceptible *Staphylococcus aureus*▽

Thomas P. Lodise, Jr.,[1]* Peggy S. McKinnon,[2] Donald P. Levine,[3,4] and Michael J. Rybak[3,4,5]

Place de la vancomycine ?

TABLE 1. Comparison of baseline clinical characteristics and outcomes for patients with MSSA IE who received empirical beta-lactam therapy and for those who received empirical vancomycin therapy

Baseline clinical feature or overall outcome	Result for[a]: Beta-lactam (n = 44)	Result for[a]: Vancomycin (n = 28)	P value
Overall outcome (infection-related mortality) for indicated patient group			
All	5 (11.4)	11 (39.3)	0.005
Left-side/bilateral involvement	3 (27.3)	6 (66.7)	0.08
Right-side involvement	2 (6.1)	5 (26.3)	0.04
Definite IE by Duke criteria (%)	5 (13.9)	11 (40.7)	0.02

Patients traités initialement par vancomycine n=28

- 21 patients avec changement pour pénicilline
- Mortalité = 33%

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)

Jonathan A. T. Sandoe[1]*, Gavin Barlow[2], John B. Chambers[3], Michael Gammage[4], Achyut Guleri[5], Philip Howard[1], Ewan Olson[6], John D. Perry[7], Bernard D. Prendergast[8], Michael J. Spry[9], Richard P. Steeds[10], Muzahir H. Tayebjee[1] and Richard Watkin[11]

J Antimicrob Chemother 2015; **70**: 325–359

Guidelines for the diagnosis, management and prevention of implantable cardiac electronic device infection

ICED infection definitions, treatment and empirical antibiotic regimens

	Definition
Early postimplantation inflammation	Erythema affecting the box implantation incision site, without purulent exudate, dehiscence, fluctuance or systemic signs of infection and occurring within 30 days of implantation. Includes a small, localised area (<1 cm) of erythema and/or purulence associated with a suture ('stitch abscess')

Guidelines for the diagnosis, management and prevention of implantable cardiac electronic device infection

ICED infection definitions, treatment and empirical antibiotic regimens

	Definition
Uncomplicated generator pocket infection	Any one of: 1. Spreading cellulitis affecting the generator site 2. Incision site purulent exudate (excluding simple stitch abscess) 3. Wound dehiscence 4. Erosion through skin with exposure of the generator or leads 5. Fluctuance (abscess) or fistula formation AND no systemic symptoms or signs of infection AND negative blood cultures

Guidelines for the diagnosis, management and prevention of implantable cardiac electronic device infection

ICED infection definitions, treatment and empirical antibiotic regimens

	Definition
Complicated generator pocket infection	As for uncomplicated generator pocket infection but with any one of: 1. Evidence of lead or endocardial involvement 2. Systemic signs or symptoms of infection 3. Positive blood cultures

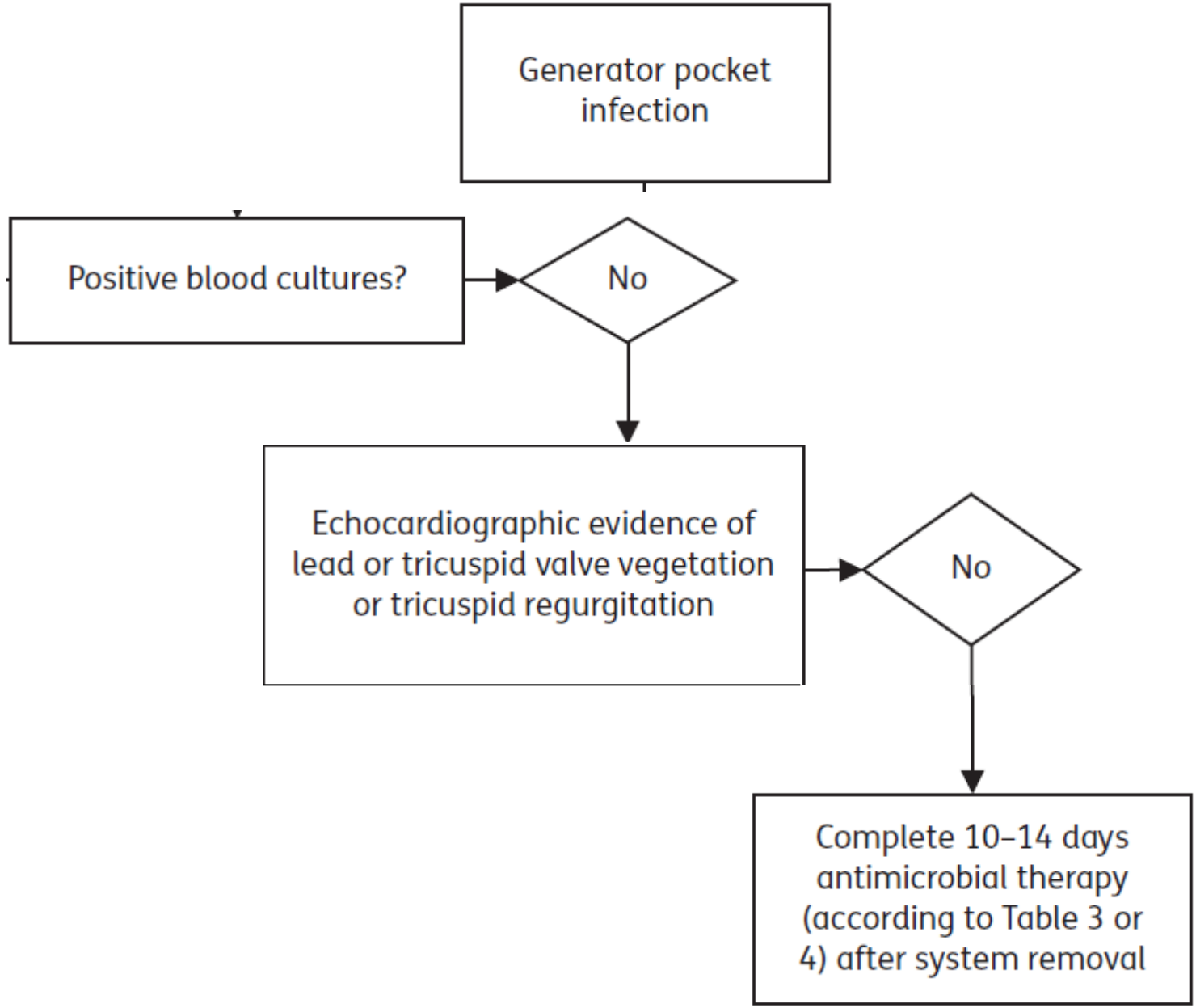
ICED infection definitions, treatment and empirical antibiotic regimens

	Definition
ICED-lead infection (ICED-LI)	Symptoms and signs of systemic infection without signs of generator pocket infection, but with:Definite ICED-LI—either: 1. Echocardiography consistent with vegetation(s) attached to lead(s) and major modified Duke microbiological criteria or 2. Culture, histology or molecular evidence of infection on explanted lead Possible ICED-LI—either: 1. Echocardiography consistent with vegetation(s) attached to lead(s) but no major modified Duke microbiological criteria or 2. Major modified Duke microbiological criteria but no echocardiographic evidence of lead vegetation(s)

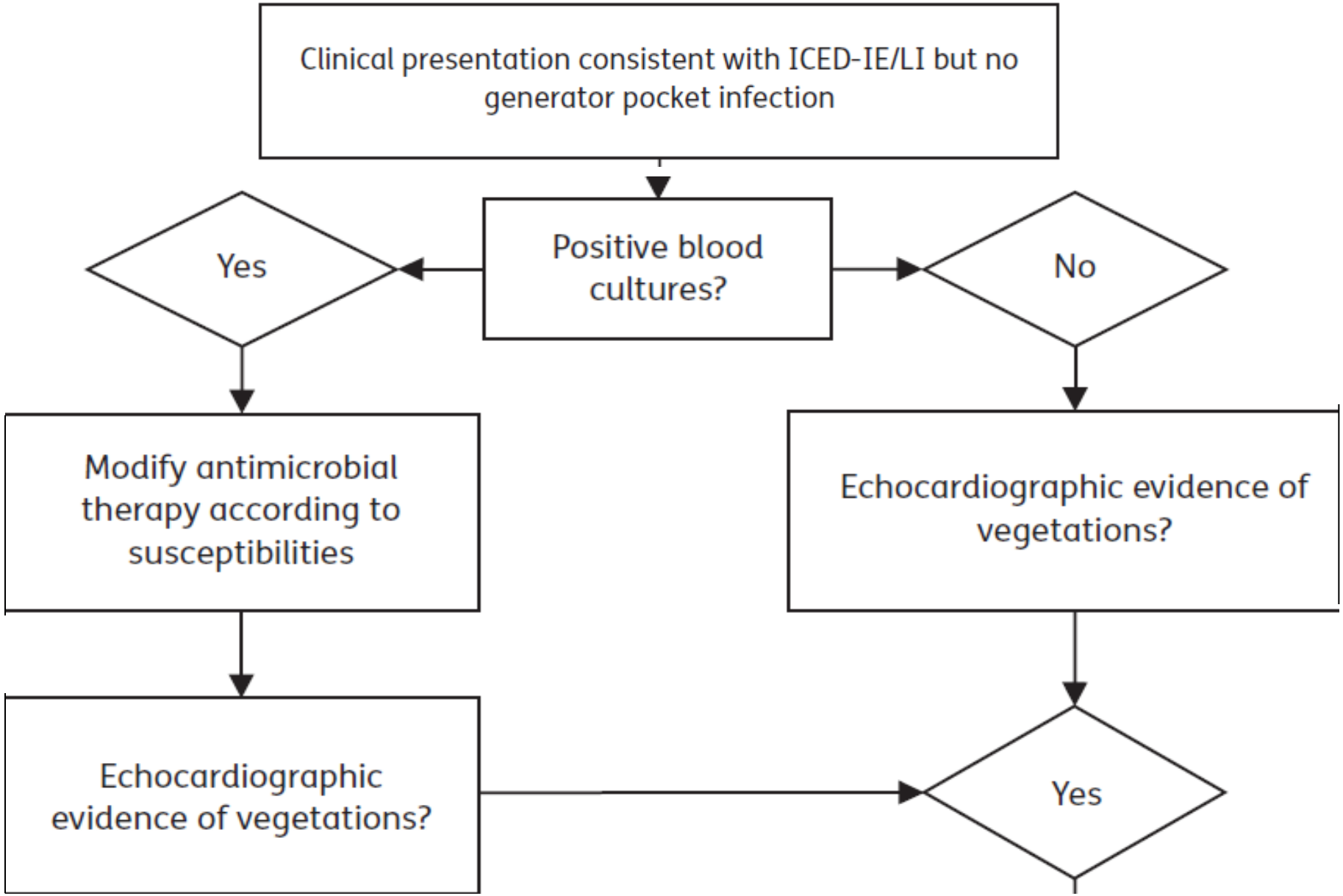
Guidelines for the diagnosis, management and prevention of implantable cardiac electronic device infection

ICED infection definitions, treatment and empirical antibiotic regimens

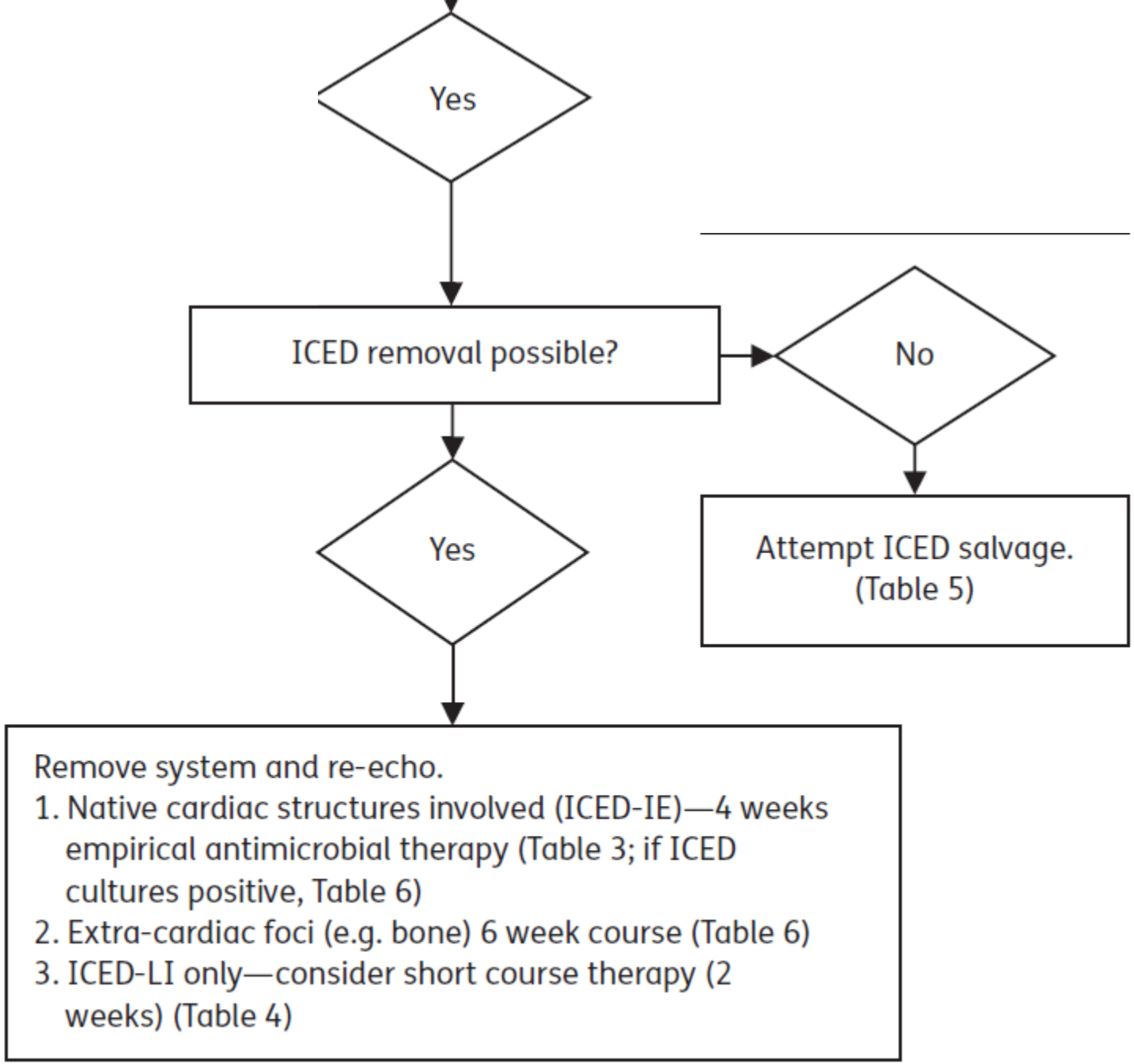
	Definition
ICED-associated infective endocarditis (ICED-IE)	All of: 1. ICED in situ 2. Modified Duke criteria for definite infective endocarditis 3. Echocardiographic evidence of valve involvement



J Antimicrob Chemother 2015; **70**: 325–359



J Antimicrob Chemother 2015; **70**: 325–359


Yes
ICED removal possible?
No
Attempt ICED salvage.
(Table 5)
Yes
Remove system and re-echo.
1. Native cardiac structures involved (ICED-IE)—4 weeks empirical antimicrobial therapy (Table 3; if ICED cultures positive, Table 6)
2. Extra-cardiac foci (e.g. bone) 6 week course (Table 6)
3. ICED-LI only—consider short course therapy (2 weeks) (Table 4)

Empirical treatment regimens for ICED infection

Diagnosis/scenario	Antimicrobial	Dose/route[a]
Uncomplicated generator pocket infection	vancomycin	1 g q12h[b] iv
	OR	
	daptomycin	4 mg/kg q24h iv
	OR	
	teicoplanin	6 mg/kg to a maximum of 1 given at 0, 12 and 24 h ar then q24h[183]
ICED-LI or ICED-IE or complicated generator pocket infection pending blood cultures, e.g. in severe sepsis	vancomycin	1 g q12h[b] iv
	AND	
	meropenem	1 g q8h iv
	OR	
	daptomycin	8–10 mg/kg q24h iv
	AND	
	meropenem	1 g q8h iv
ICED-LI or ICED-IE or generator pocket infection with negative blood cultures	vancomycin	1 g q12h[b] iv
	AND	
	gentamicin[c]	1 mg/kg q12h iv
	OR	
	daptomycin	8–10 mg/kg q24h iv
	AND	
	gentamicin[c]	1 mg/kg q12h iv

Guidelines for the diagnosis, management and prevention of implantable cardiac electronic device infection

- **Comme pour les recommandations US, l'intérêt des cultures de sonde est évoqué mais jamais pris en compte (tout est basé sur les résultats des HC) … sauf**

ICED-lead infection (ICED-LI)	Symptoms and signs of systemic infection without signs of generator pocket infection, but with:Definite ICED-LI—either: 1. Echocardiography consistent with vegetation(s) attached to lead(s) and major modified Duke microbiological criteria or 2. Culture, histology or molecular evidence of infection on explanted lead

Intérêt des cultures de sonde

	Inflammation (n = 8)	Impending ext (n = 16)	Exteriorisation (n = 31)	Local infection (n = 50)	p Value
Positive blood culture (by Duke criteria)	1 (12.5%)	1 (6.2%)	1 (3.2%)	2 (4%)	NS
Positive extravascular lead cultures	8/8 (100%)	13/14 (92.8%)	25/26 (96.1%)	41/47 (87.2%)	NS
Positive intravascular lead cultures	5/6 (83.3%)	10/13 (76.9%)	22/27 (77.7%)	36/46 (78.3%)	NS
S epidermidis	5 (100%)	8 (80.0%)	16 (76.1%)	22 (61.1%)	NS
Other coagulase negative staphylococcus	1 (20%)	2 (20.0%)	4 (19.0%)	10 (27.8%)	NS
S aureus or other microorganism	0	1 (10.0%)	6 (28.6%)	13 (36.1%)	NS
>1 microorganism	2 (40%)	3 (30.0%)	2 (9.5%)	5 (13.9%)	NS

Local complications at the site of pacemaker implantation are usually associated with infection of the intravascular part of the leads, with a risk of progressing to systemic infection.

Klug D et al. *Heart* 2004;90:882–886.

Intérêt des cultures de sonde

Characteristics	Infectious manifestation				P
	Systematic (n = 92)	Local (n = 60)	Erosion (n = 39)	Other (n = 33)	
Positive blood culture (Duke criteria)	18 (19.5)	6 (10)	5 (12.8)	4 (12.1)	NS
Positive wound swab culture	20 (21)	21 (35)	13 (33.3)	9 (45.4)	NS
Positive extravascular lead cultures	57/68 (83.8)	46/52 (88.4)	30/34 (88.2)	22/24 (91.6)	NS
Positive intravascular lead cultures	56/68 (82.3)	44/52 (84.6)	26/34 (76.4)	18/24 (75.0)	NS
Same microorganism on both lead segments	50	44	26	18	
Different microorganisms on each lead segment	8	2	4	4	

Klug D et al. *Am Heart J* 2005;149:322-8.

Intérêt des cultures de sonde

	Blood culture		Leads					
			1			2		
PT	+ (n)	ORG	EV	IV1	IV2	EV	IV1	IV2
1	0	0	NA	MSSE	MSSE	–		–
2	1	MSSE	NA	MSSE	MSSE	–		–
				Staphylococcus hominis				
3	0	0	MSSE	MSSE	MSSE	–	–	–
4	0	0	MSSE	MSSE	MSSE	–	–	–
5	6	MSSE	MSSE	MSSE	MSSE	–	–	–
6	0	0	*Staphylococcus lugdunensis*	*S lugdunensis*	*S lugdunensis*	*S hominis*	0	0
7	0	0	MRSE	MRSE	MRSE	MRSE	MRSE	MRSE
8	0	0	MSSE	MSSE	MSSE	MSSE	0	0
			(2 strains)					
9	0	0	*Staphylococcus warneri*	MSSE	*S warneri*	*S warneri*	MSSE	MSSE
10	0	0	*Staphylococcus schleiferi*	*S schleiferi*	*S schleiferi*	*S schleiferi*	*S schleiferi*	*S schleiferi*
11	2		MSSE	MRSE	*Staphylococcus haemolyticus*	MRSE	MRSE	MSSE
		Gemella	*Gemella*	*Gemella*				
12	0	0	*Staphylococcus capitis*	*S capitis*	MSSE	NA	MSSE	*S hominis*
13	0	0	*S capitis*	*S capitis*	MSSE	*Citrobacter*	0	0
14	0	0	*Citrobacter* MSSE	MRSE	MSSE	MSSE	MSSE	MSSE
			S hominis		*S hominis*			
15	0	0	*S capitis*	*S capitis*	*S capitis*	*S capitis*	*S capitis*	*S capitis*

Klug D et al. *Am Heart J* 2005;149:322-8.

Intérêt des cultures de sonde

- 122 patients avec changement de boitier
- **Aucun signe infectieux**
- Culture du boitier et/ou sonde positive
  - dans 33% des cas
  - staphylocoques à coagulase négative dans 68% des cas

Kleemann T et al. *Europace* 2010; 12:58-63

Intérêt des cultures de sonde

EUROPEAN SOCIETY OF CARDIOLOGY®

Europace (2010) **12**, 5–6
doi:10.1093/europace/eup402

EDITORIAL

Positive cultures in asymptomatic patients during elective device replacement: a murderer hides in the darkness or an innocent person on the crime scene?

Didier Klug[1]*, Frederic Wallet[2], Salem Kacet[1], and René Courcol[2]

[1]Department of cardiology, University of Lille, CHRU Lille, France; and [2]Laboratory of Bacteriology, University of Lille, CHRU Lille, France

Infections sur matériel de stimulation

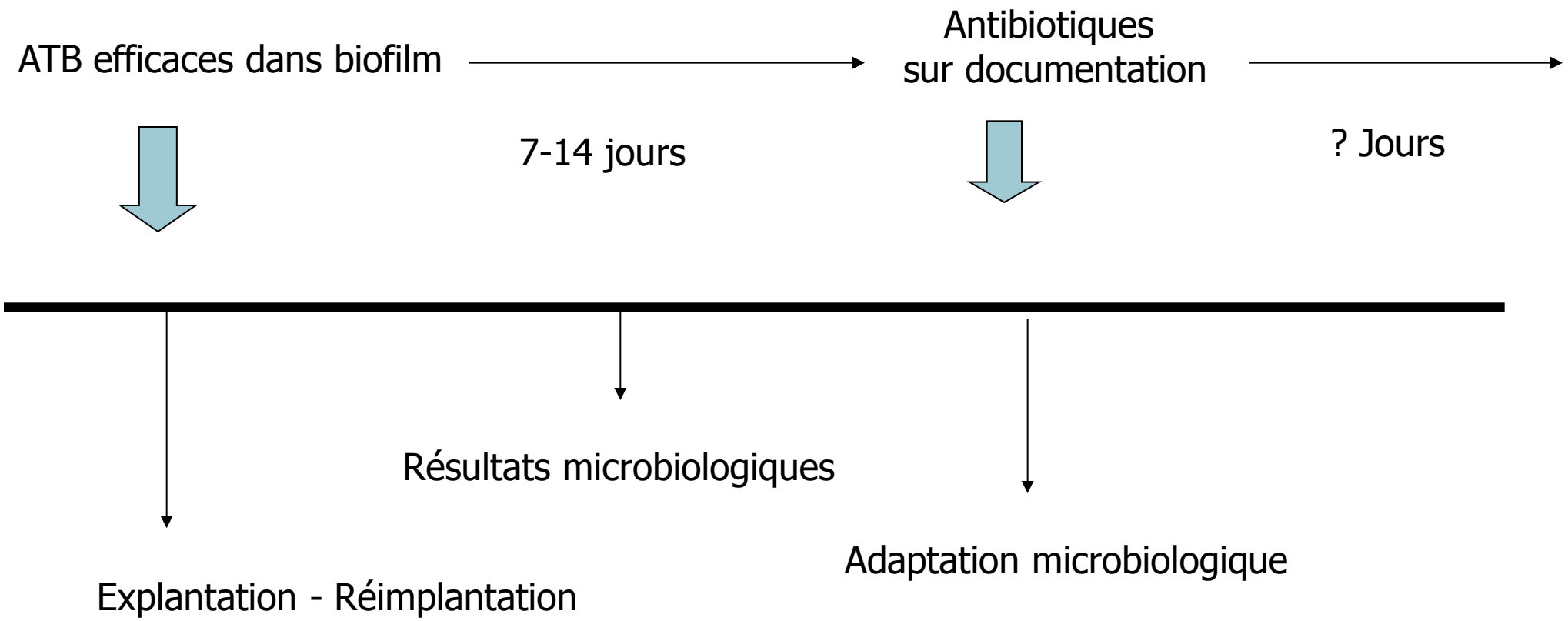
- **Progrès certains**
  - Définition
  - Durée du traitement antibiotique
  - Timing de la réimplantation
- **Incertitudes à propos**
  - Intégration des résultats des cultures de sonde dans le diagnostic +++

Néanmoins, pourquoi ne pas rêver…

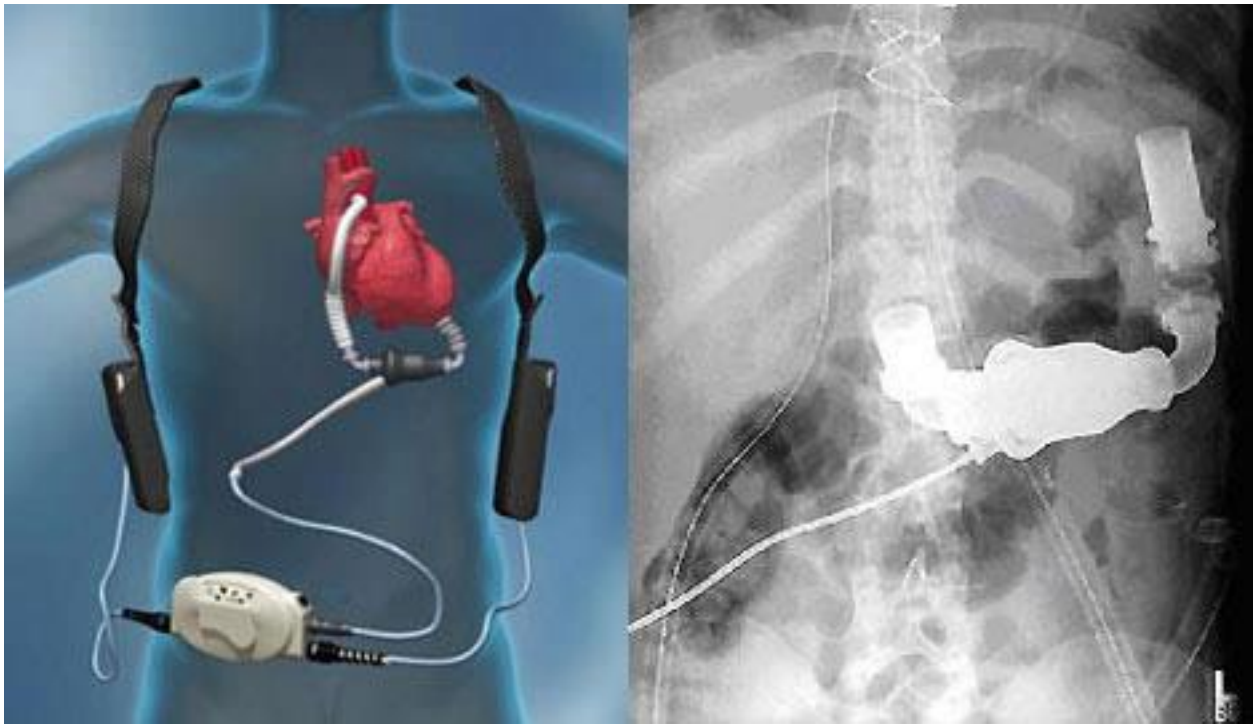
Les chirurgiens orthopédiques et cardio-vasculaires le font bien !

Dès lors que l’extraction est décidée, pourquoi pas du 1 temps

Le rêve


ATB efficaces dans biofilm
Antibiotiques
sur documentation
7-14 jours
? Jours
Résultats microbiologiques
Adaptation microbiologique
Explantation - Réimplantation

Infection sur système d'assistance cardiaque implantable



?

Clinical Manifestations and Management of Left Ventricular Assist Device–Associated Infections

Juhsien Jodi C. Nienaber,[1] Shimon Kusne,[5] Talha Riaz,[1] Randall C. Walker,[1] Larry M. Baddour,[1] Alan J. Wright,[1] Soon J. Park,[2] Holenarasipur R. Vikram,[5] Michael R. Keating,[6] Francisco A. Arabia,[7] Brian D. Lahr,[3] and M. Rizwan Sohail;[1,4] for the Mayo Cardiovascular Infections Study Group

We retrospectively reviewed 247 patients who underwent CF LVAD implantation at Mayo Clinic campuses in Minnesota, Arizona, and Florida between January 2005 and December 2011. These devices included Heartmate II (Thoratec), Jarvik 2000 (Jarvik Heart), and VentrAssist (Ventracor).

Clinical Infectious Diseases 2013;57(10):1438–48

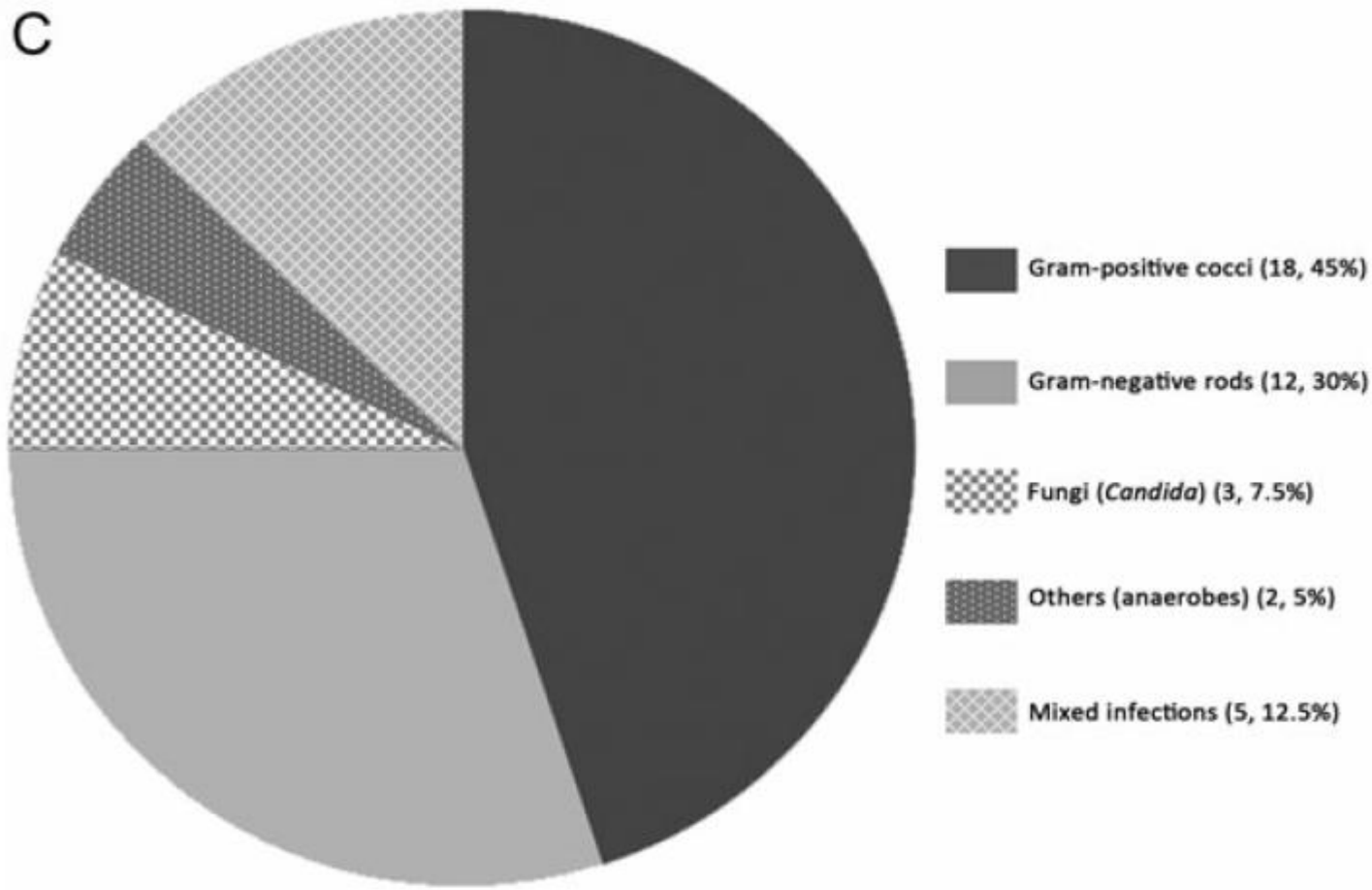
Infection sur système d'assistance cardiaque implantable

Table 1. Incidence of Left Ventricular Assist Device–Associated Infection, by Infection Type

Infection Type	Cases per 100 Person-Years of LVAD Support (95% CI)
All	32.8 (26.7–39.9)
Endocarditis	1.6 (.5–3.8)
Pump and/or cannula infection	4.9 (2.7–8.0)
Bloodstream infection	
VAD related	7.5 (4.7–11.2)
Non–VAD related	6.8 (4.2–10.4)
CVC related	3.3 (1.6–6.0)
CVC associated	1.6 (.5–3.8)
Pocket infection	2.3 (.9–4.7)
Driveline infection	15.0 (10.9–20.0)
CIED infection	1.6 (.5–3.8)
Mediastinitis, VAD related	2.0 (.7–4.2)

Clinical Infectious Diseases 2013;57(10):1438–48

Infection sur système d'assistance cardiaque implantable

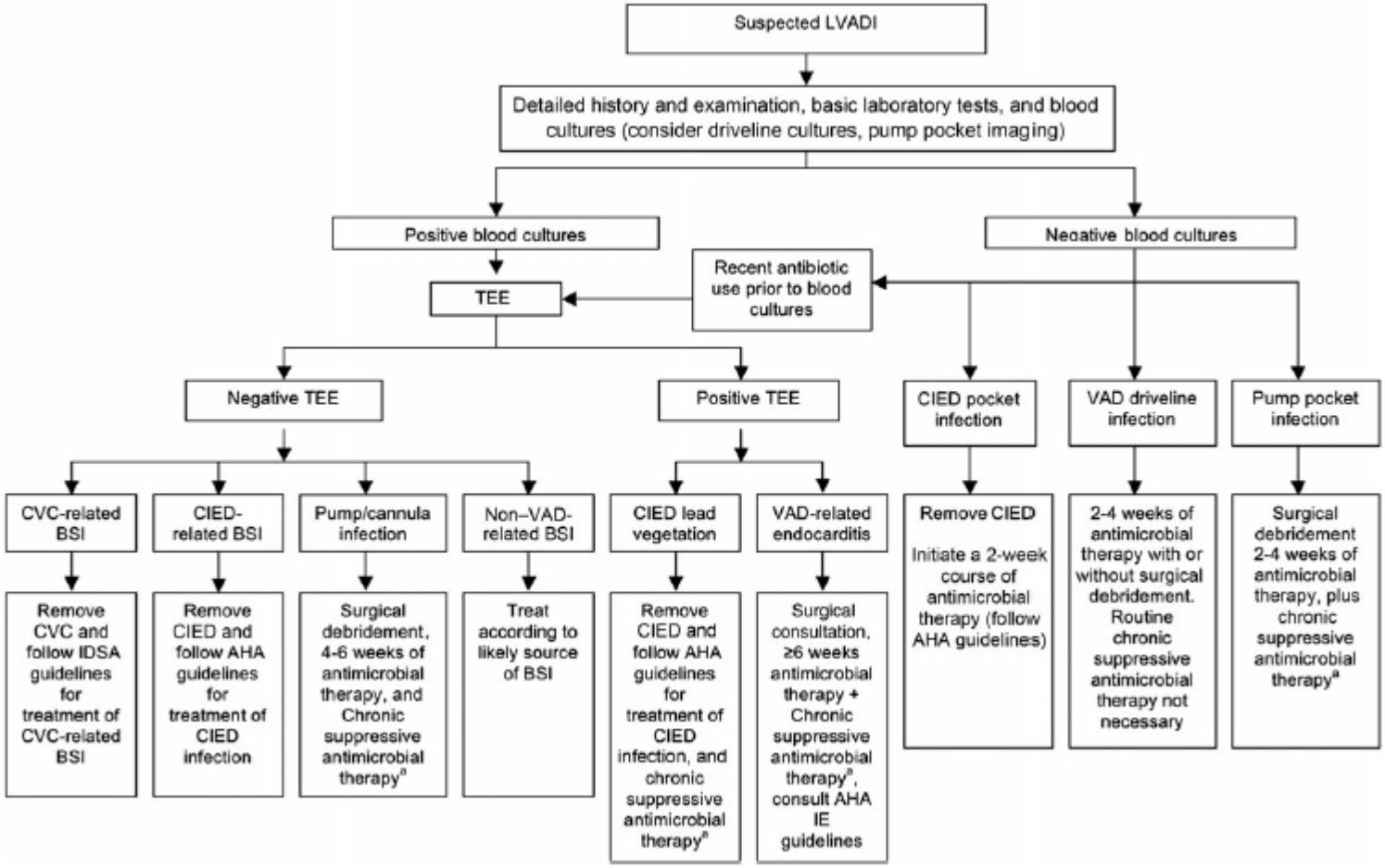


Clinical Infectious Diseases 2013;57(10):1438–48

Management and Outcome of Left Ventricular Assist Device–Associated Infections

Variable	Endovascular (n = 41)
Antibiotic therapy duration, d[a]	
Overall	33.0 (15.5–42.5)
Parenteral antibiotics (primarily)[a]	34.5 (16.0–43.0)
Oral antibiotics (primarily)[a]	15.5 (14.0–17.0)
Receipt of suppressive oral antimicrobials	16 (39)
Receipt of suppressive parenteral antimicrobials[b]	2 (5)
Surgical management	
None	33 (80)
Bedside debridement	1 (2)
Intraoperative debridement with device retention	4 (10)
LVAD removal	1 (2)
Other[c]	2 (5)
Duration of LVAD support follow-up, y	1.3 ± 0.8
Death at 2-y follow-up[d]	19 (53)
Heart transplantation at 2-y follow-up (among bridge-to-transplant patients[d]	5 (40)

Infection sur système d'assistance cardiaque implantable



Clinical Infectious Diseases 2013;57(10):1438–48

Infections de pontage

Nombre de pontages en France

Tableau 4. Nombre d'implants de pontage posés en 2010 dans les établissements publics et privés

Longueur de l'implant droit	Non imprégnés de dérivés d'origine animale				Imprégnés de dérivés d'origine animale	
	Textile		Non textile			
	Privé	Public	Privé	Public	Privé	Public
< 30 cm	0	19	241	729	226	1 222
30 – 70 cm	7	138	1 724	1 554	2 661	3 842
> 70 cm	5	32	4 282	2 874	2 755	1 714
Bimultifurqué	14	102	61	174	2 645	3 239
Total	26	291	6 307	5 331	8 287	10 017

HAS / Service Évaluation des Dispositifs / 2013

30 000/an

Le futur

Stent aortique, rénal, iliaque ou fémoral	2011	2012	2013
n	78035	82852	88276

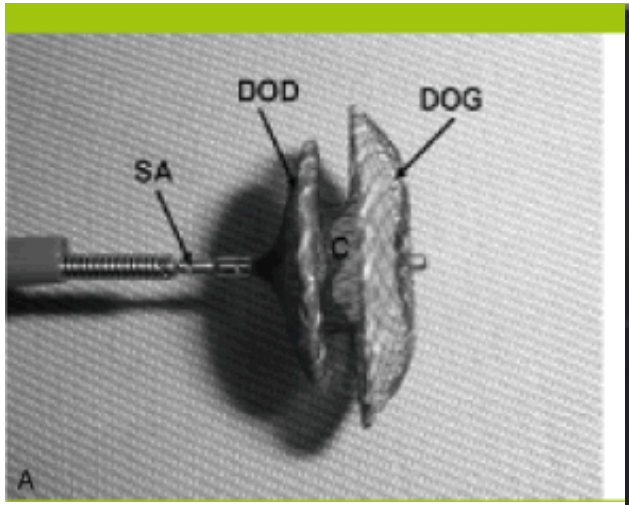
3 fois plus de stents que de ponts

Il faut s'intéresser d'urgence aux infections de stent

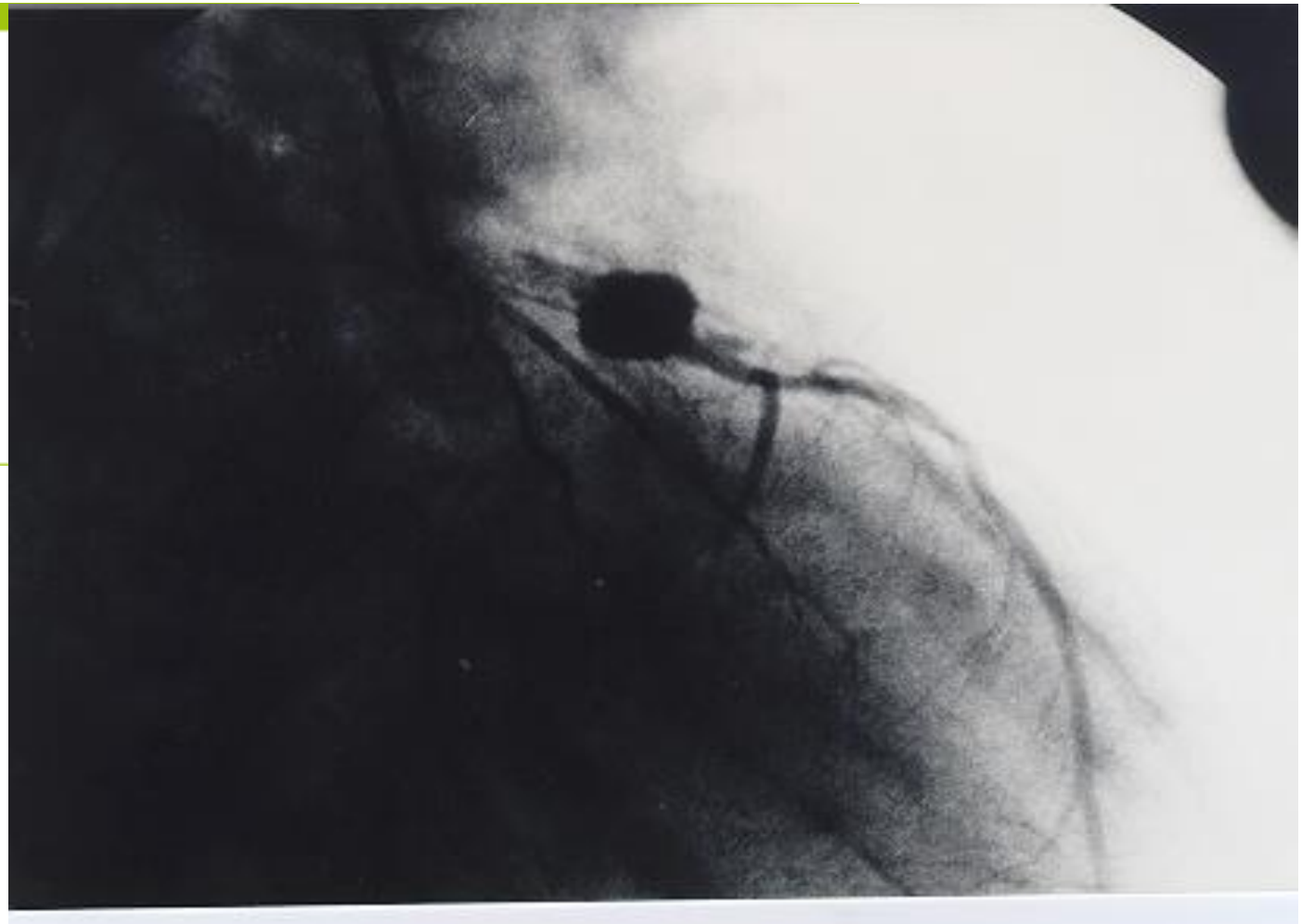
- Diagnostic
- Prise en charge chirurgicale
- Antibiothérapie, matériel en place…

HAS 2015

Infections sur stents coronaires, ombrelles, TAVI…



?



Valvular Heart Disease

Infective Endocarditis After Transcatheter Aortic Valve Implantation

Results From a Large Multicenter Registry

Circulation. 2015;131:1566-1574.

Main Baseline and Periprocedural Characteristics According to the Occurrence of IE

Variables	Global TAVI Population (n=7891)	TAVI-IE Population (n=53)	*P* Value
Type of valve, n (%)			
Self-expandable CoreValve	1562/7891 (19.8)	19 (35.8)	0.003
Balloon-expandable Edwards valve	6329/7891 (80.2)	34 (64.2)	
Orotracheal intubation, n (%)	3528/5054 (69.8)	44 (83.0)	0.037

Circulation. 2015;131:1566-1574.

Table 2. Main Clinical Characteristics, Management, and Outcomes of IE After TAVI (n=53)

Variables	
Time from TAVI, mo	6 (1–14)
Microorganisms, n (%)	
Coagulase-negative Staphylococci	13 (24.5)
Staphylococcus aureus	11 (20.8)
Enterococci	11 (20.8)
Streptococcus viridans	3 (5.7)
Unknown (negative cultures)	2 (3.8)
Other	13 (24.5)
Management and outcomes, n (%)	
Valve intervention	6 (11.3)
Surgical valve explantation	4 (7.5)
Valve-in-valve procedure	2 (3.8)
In-hospital death	25 (47.2)
Death at follow-up	13 (24.5)
Cumulative death	38 (71.7)

Table 3. Baseline Characteristics and IE Features According to the Occurrence of In-Hospital Death

Variables	Absence of In-Hospital Death (n=28)	In-Hospital Death (n=25)	*P* Value
Baseline characteristics			
Previous valve surgery, %	2 (7.1)	8 (32.0)	0.034
Complications, n (%)			
Septic shock	1 (3.6)	10 (40)	0.002
Heart failure	11 (39.3)	17 (68.0)	0.037

Circulation. 2015;131:1566-1574.

Conclusion

- **Infections sur matériel de stimulation**
  - Progrès en cours
- **A éclaircir d'urgence**
  - Infections sur stents artériels
  - Infections et TAVI
- **L'avenir (ou l'exception ?)**
  - Infections sur assistance cardiaque…