

2023 ESC Guidelines for the management of endocarditis



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European Society
of Cardiology

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ESC GUIDELINES

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2023 ESC Guidelines for the management of endocarditis

Developed by the task force on the management of endocarditis
of the European Society of Cardiology (ESC)

Endorsed by the European Association for Cardio-Thoracic Surgery
(EACTS) and the European Association of Nuclear Medicine (EANM)

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Table 1 Classes of recommendations

	Definition	Wording to use	
Classes of recommendations	Class I	Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective.	Is recommended or is indicated
	Class II	Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.	
	Class IIa	Weight of evidence/opinion is in favour of usefulness/efficacy.	Should be considered
	Class IIb	Usefulness/efficacy is less well established by evidence/opinion.	May be considered
	Class III	Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful.	Is not recommended

Table 2 Levels of evidence

Level of evidence A	Data derived from multiple randomized clinical trials or meta-analyses.
Level of evidence B	Data derived from a single randomized clinical trial or large non-randomized studies.
Level of evidence C	Consensus of opinion of the experts and/or small studies, retrospective studies, registries.

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1. Novetats en profilaxis

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Table 3 Cardiac conditions at highest risk of infective endocarditis for which prophylaxis should be considered when a high-risk procedure is performed

Recommendations	Class ^a	Level ^b
Antibiotic prophylaxis should be considered for patients at highest risk for IE: (1) Patients with any prosthetic valve, including a transcatheter valve, or those in whom any prosthetic material was used for cardiac valve repair. (2) Patients with a previous episode of IE. (3) Patients with CHD: (a) Any type of cyanotic CHD. (b) Any type of CHD repaired with a prosthetic material, whether placed surgically or by percutaneous techniques, up to 6 months after the procedure or lifelong if residual shunt or valvular regurgitation remains.	IIa	C
Antibiotic prophylaxis is not recommended in other forms of valvular or CHD.	III	C

CHD = congenital heart disease; IE = infective endocarditis.

^aClass of recommendation.

^bLevel of evidence.

^cReference(s) supporting recommendations.

2023



General prevention measures are recommended in individuals at <u>high and intermediate</u> risk of IE.	I	C
Antibiotic prophylaxis is recommended in patients with <u>ventricular assist devices</u> .	I	C
Antibiotic prophylaxis may be considered in recipients of <u>heart transplant</u> .	IIb	C
Antibiotic prophylaxis is recommended in patients with <u>surgically implanted prosthetic valves and with any material used for surgical cardiac valve repair</u> .	I	C
Antibiotic prophylaxis is recommended in patients with <u>transcatheter implanted aortic and pulmonary valvular prostheses</u> .	I	C
Antibiotic prophylaxis should be considered in patients with transcatheter mitral and tricuspid valve repair.	IIa	C

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Recommendations	Class ^a	Level ^b
A. Dental procedures		
<ul style="list-style-type: none"> Antibiotic prophylaxis is not recommended for local anaesthetic injections in non-infected tissues, treatment of superficial caries, removal of sutures, dental X-rays, placement or adjustment of removable prosthodontic or orthodontic appliances or braces or following the shedding of deciduous teeth or trauma to the lips and oral mucosa 	III	C
B. Respiratory tract procedures^c		
<ul style="list-style-type: none"> Antibiotic prophylaxis is not recommended for respiratory tract procedures, including bronchoscopy or laryngoscopy, or transnasal or endotracheal intubation 	III	
C. Gastrointestinal or urogenital procedures or TOE^c		
<ul style="list-style-type: none"> Antibiotic prophylaxis is not recommended for gastroscopy, colonoscopy, cystoscopy, vaginal or caesarean delivery or TOE 	III	C
D. Skin and soft tissue procedures^c		
<ul style="list-style-type: none"> Antibiotic prophylaxis is not recommended for any procedure 	III	C

Section 3. Recommendation Table 2 — Recommendations for infective endocarditis prevention in high-risk patients

Systemic antibiotic prophylaxis may be considered for high-risk patients undergoing an invasive diagnostic or therapeutic procedure of the respiratory, gastrointestinal, genitourinary tract, skin, or musculoskeletal systems.

IIb	C
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Table 6 Recommended prophylaxis for high-risk dental procedures in high-risk patients

Situation	Antibiotic	Single-dose 30–60 minutes before procedure	
		Adults	Children
No allergy to penicillin or ampicillin	Amoxicillin or ampicillin ^a	2 g orally or i.v.	50 mg/kg orally or i.v.
Allergy to penicillin or ampicillin	Clindamycin	600 mg orally or i.v.	20 mg/kg orally or i.v.

^aAlternatively, cephalexin 2 g i.v. for adults or 50 mg/kg i.v. for children, cefazolin or ceftriaxone 1 g i.v. for adults or 50 mg/kg i.v. for children.

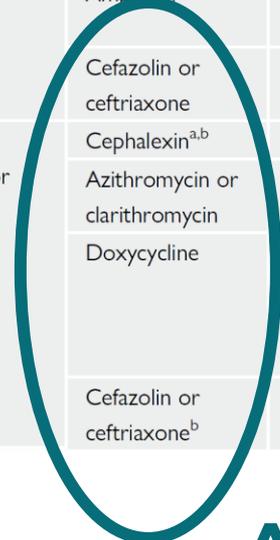
Cephalosporins should not be used in patients with anaphylaxis, angio-oedema, or urticaria after intake of penicillin or ampicillin due to cross-sensitivity.

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Table 6 Prophylactic antibiotic regime for high-risk dental procedures

Situation	Antibiotic	Single-dose 30–60 min before procedure	
		Adults	Children
No allergy to penicillin or ampicillin	Amoxicillin	2 g orally	50 mg/kg orally
	Ampicillin	2 g i.m. or i.v.	50 mg/kg i.v. or i.m.
	Cefazolin or ceftriaxone	1 g i.m. or i.v.	50 mg/kg i.v. or i.m.
Allergy to penicillin or ampicillin	Cephalexin ^{a,b}	2 g orally	50 mg/kg orally
	Azithromycin or clarithromycin	500 mg orally	15 mg/kg orally
	Doxycycline	100 mg orally	<45 kg, 2.2 mg/kg orally >45 kg, 100 mg orally
	Cefazolin or ceftriaxone ^b	1 g i.m. or i.v.	50 mg/kg i.v. or i.m.



Amb



Table 7 Recommendations for antibiotic prophylaxis for the prevention of local and systemic infections before cardiac or vascular interventions

Recommendations	Class ^a	Level ^b	Ref. ^c
Preoperative screening of nasal carriage of <i>Staphylococcus aureus</i> is recommended before elective cardiac surgery in order to treat carriers	I	A	46,47
Perioperative prophylaxis is recommended before placement of a pacemaker or implantable cardioverter defibrillator	I	B	45
Potential sources of sepsis should be eliminated ≥ 2 weeks before implantation of a prosthetic valve or other intracardiac or intravascular foreign material, except in urgent procedures	IIa	C	
Perioperative antibiotic prophylaxis should be considered in patients undergoing surgical or transcatheter implantation of a prosthetic valve, intravascular prosthetic or other foreign material	IIa	C	
Systematic local treatment without screening of <i>S. aureus</i> is not recommended	III	C	

Section 3. Recommendation Table 3 — Recommendations for infective endocarditis prevention in cardiac procedures

Optimal pre-procedural aseptic measures of the site of implantation is recommended to prevent CIED infections.	I	B
Surgical standard aseptic measures are recommended during the insertion and manipulation of catheters in the catheterization laboratory environment.	I	C
Antibiotic prophylaxis covering for common skin flora including <i>Enterococcus</i> spp. and <i>S. aureus</i> should be considered before TAVI and other transcatheter valvular procedures.	IIa	C

Education of high-risk patients to prevent infective endocarditis

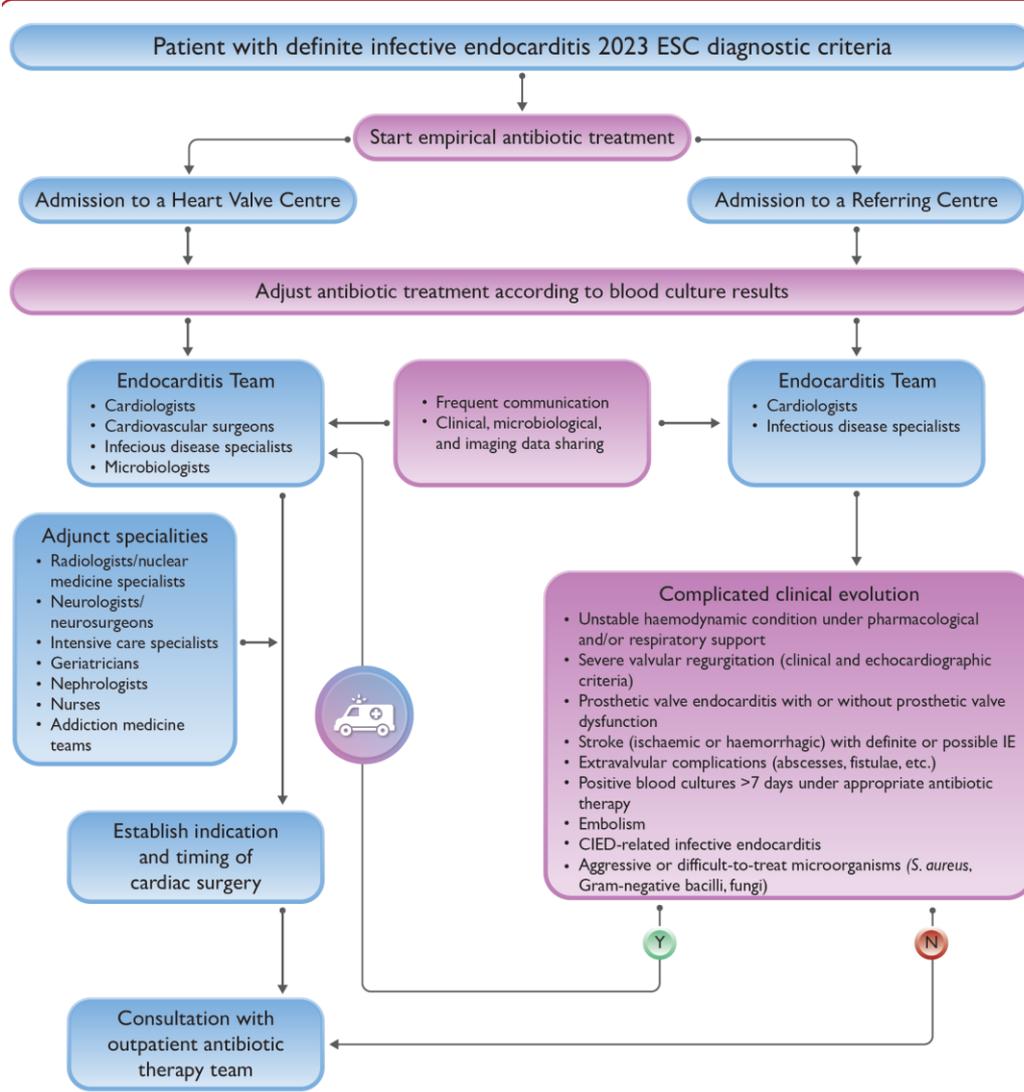


- **Maintain good dental hygiene**
 - Use dental floss daily
 - Brush teeth morning and evening
 - See your dentist for regular check-ups
- **Maintain good skin hygiene**
 - Minimize risk of skin lesions
 - In case of lesions, observe for signs of infection (redness, swelling, tenderness, puss)
 - Avoid tattoos and piercings
- **Be mindful of infections**
 - If experiencing fever for no obvious reason, contact your doctor, and discuss appropriate action based on your risk of endocarditis
- **Do not self prescribe antibiotics**
- **Show this card to your doctors before any interventions**



2.

Novetats en Endocarditis team





3. Novetats en diagnòstic

Table 10 Definitions of the 2023 European Society of Cardiology modified diagnostic criteria of infective endocarditis

Major criteria

(i) Blood cultures positive for IE

- (a) Typical microorganisms consistent with IE from two separate blood cultures:
Oral streptococci, *Streptococcus gallolyticus* (formerly *S. bovis*), HACEK group, *S. aureus*, *E. faecalis*
- (b) Microorganisms consistent with IE from continuously positive blood cultures:
 - ≥ 2 positive blood cultures of blood samples drawn >12 h apart.
 - All of 3 or a majority of ≥ 4 separate cultures of blood (with first and last samples drawn ≥ 1 h apart).
- (c) Single positive blood culture for *C. burnetii* or phase I IgG antibody titre $>1:800$.

(ii) Imaging positive for IE:

- Valvular, perivalvular/periprosthetic and foreign material anatomic and metabolic lesions characteristic of IE detected by any of the following imaging techniques:
- Echocardiography (TTE and TOE).
 - Cardiac CT.
 - [18F]-FDG-PET/CT(A).
 - WBC SPECT/CT.

Minor criteria

(i) Predisposing conditions (i.e. predisposing heart condition at high or intermediate risk of IE or PWIDs)^a

(ii) Fever defined as temperature $>38^{\circ}\text{C}$

(iii) Embolic vascular dissemination (including those asymptomatic detected by imaging only):

- Major systemic and pulmonary emboli/infarcts and abscesses.
- Haematogenous osteoarticular septic complications (i.e. spondylodiscitis).
- Mycotic aneurysms.
- Intracranial ischaemic/haemorrhagic lesions.
- Conjunctival haemorrhages.
- Janeway's lesions.

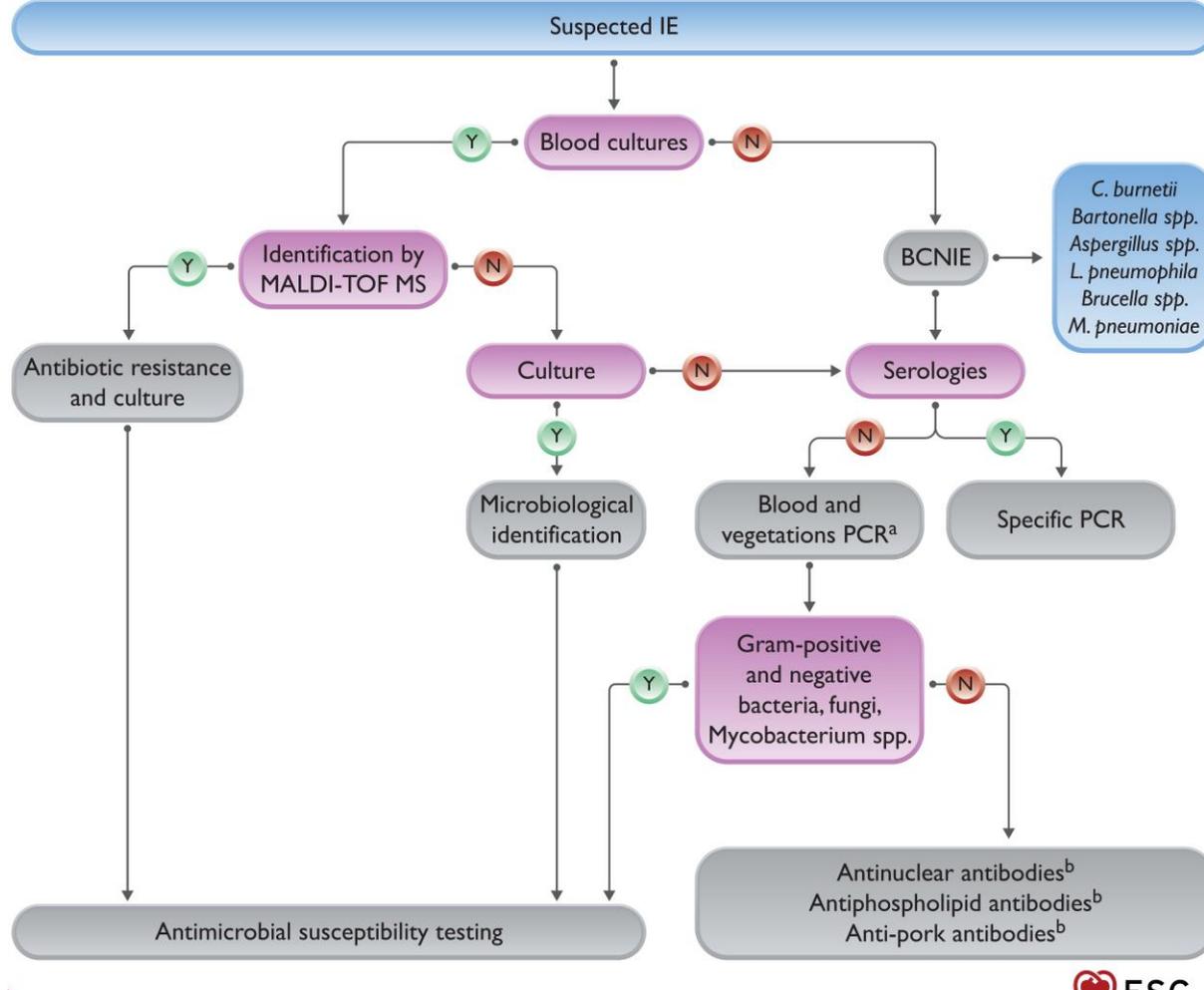
(IV) Immunological phenomena:

- Glomerulonephritis.
- Osler nodes and Roth spots.
- Rheumatoid factor.

(V) Microbiological evidence:

- Positive blood culture but does not meet a major criterion as noted above.
- Serological evidence of active infection with organism consistent with IE.





Diagnòstic



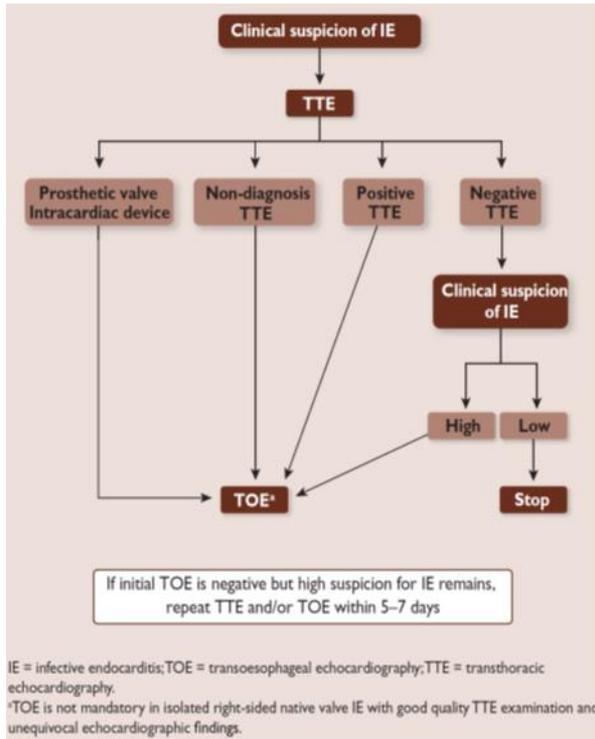
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Nuclear
RMN**

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Recommendations	Class ^a	Level ^b
A. Diagnosis		
<i>Streptococcus</i> spp. bacteraemia.		
B. Follow-up under medical therapy		
Repeating TTE and/or TOE is recommended as soon as a new complication of IE is suspected (new	I	B
D. Following completion of therapy		
TTE and/or TOE are recommended at completion of antibiotic therapy for evaluation of cardiac and valve morphology and function in patients with IE who did not undergo heart valve surgery. ¹⁸²⁻¹⁸⁴	I	C
TOE should be considered to detect new silent complications. The timing of repeat TTE and/or TOE depends on the initial findings, type of microorganism, and initial response to therapy. ^{165,166,179}	Ila	B
right-sided native valve IE with good quality TTE examination and unequivocal echocardiographic findings. ^{165,166,179}	I	C
Performing an echocardiography should be considered in <i>S. aureus</i> , <i>E. faecalis</i> , and some <i>Streptococcus</i> spp. bacteraemia. ^{19,149,174}	Ila	B

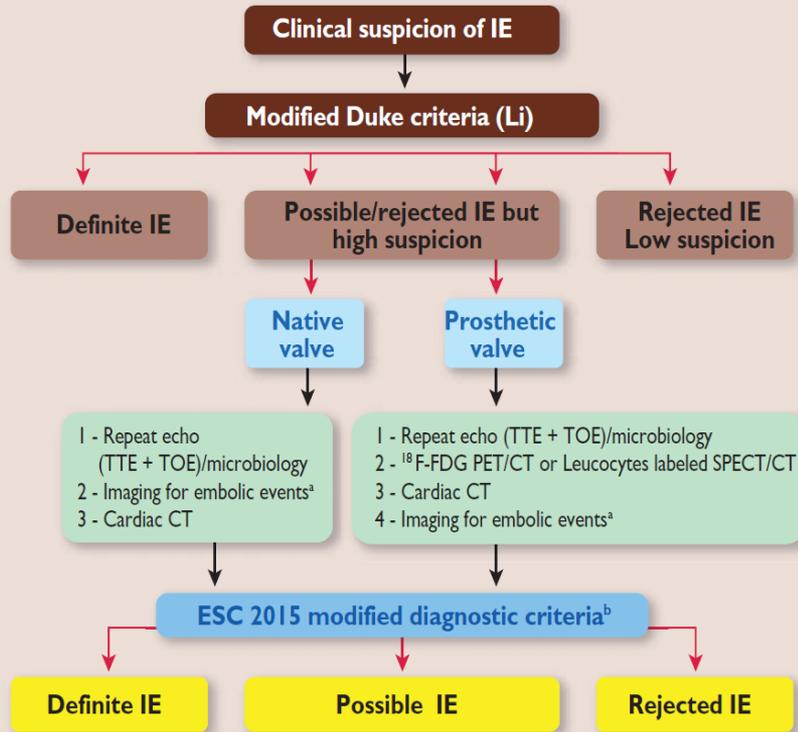
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Recommendations	Class ^a	Level ^b
Cardiac CTA is recommended in patients with possible NVE to detect valvular lesions and confirm the diagnosis of IE. ^{33,168,169}	I	B
[18F]FDG-PET/CT(A) and cardiac CTA are recommended in possible PVE to detect valvular lesions and confirm the diagnosis of IE. ^{22,129,209,210,237–239}	I	B
Cardiac CTA is recommended in NVE and PVE to diagnose paravalvular or periprosthetic complications if echocardiography is inconclusive. ^{20,168,169,185,186}	I	B
Brain and whole-body imaging (CT, [18F]FDG-PET/CT, and/or MRI) are recommended in symptomatic ^c patients with NVE and PVE to detect peripheral lesions or add minor diagnostic criteria. ^{22,197–200,210,213,240,241}	I	B
WBC SPECT/CT should be considered in patients with high clinical suspicion of PVE when echocardiography is negative or inconclusive and when PET/CT is unavailable. ^{213–216}	IIa	C
[18F]FDG-PET/CT(A) may be considered in possible CIED-related IE to confirm the diagnosis of IE. ^{22,129,209,210,237,238}	IIb	B
Brain and whole-body imaging (CT, [18F]FDG-PET/CT, and MRI) in NVE and PVE may be considered for screening of peripheral lesions in asymptomatic patients. ^{188,197–201}	IIb	B

- NVE: TC confirmar diagnòstic
- PVE: FDG-PET/TC , TC confirmar diagnòstic
- Metàstasi sèptiques en pacients simptomàtics: FDG-PET/TC , TC , RMN (Ib) (asimptomàtics IIb)
- CIED: FDG-PET/TC



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CT = computed tomography; FDG = fluorodeoxyglucose; IE = infective endocarditis;
PET = positron emission tomography; SPECT = single photon emission computerized tomography;
TOE = transoesophageal echocardiography; TTE = transthoracic echocardiography.

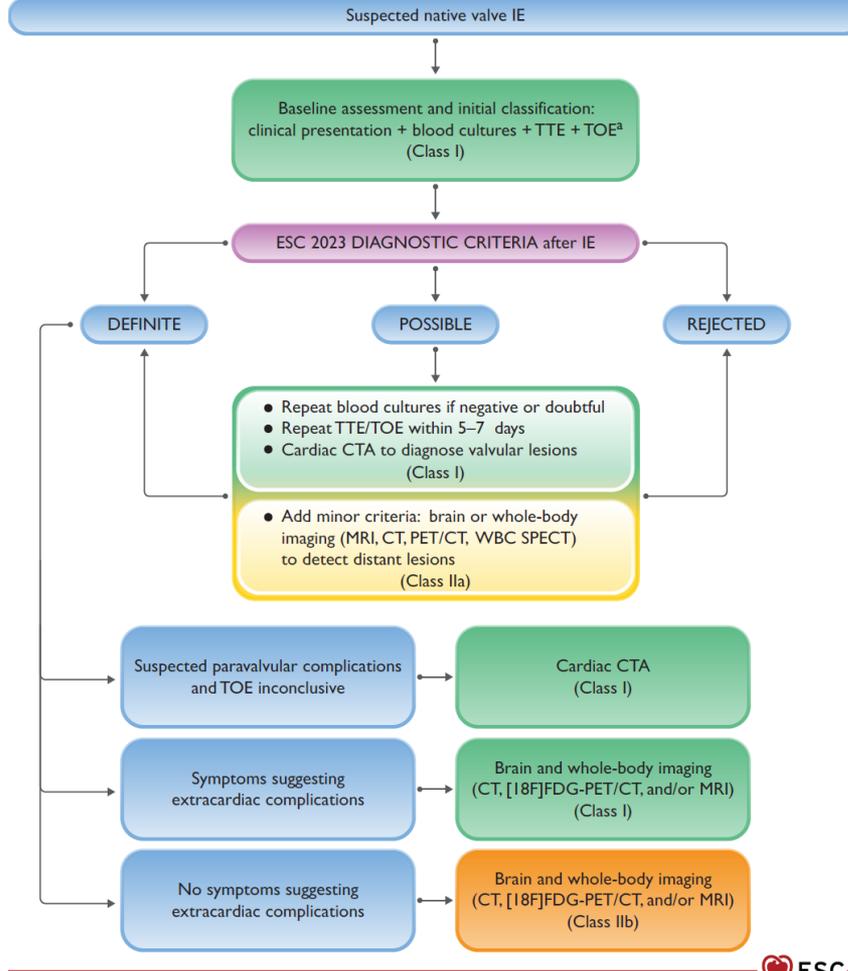
^aMay include cerebral MRI, whole body CT, and/or PET/CT.

^bSee Table 14.

Algorismes



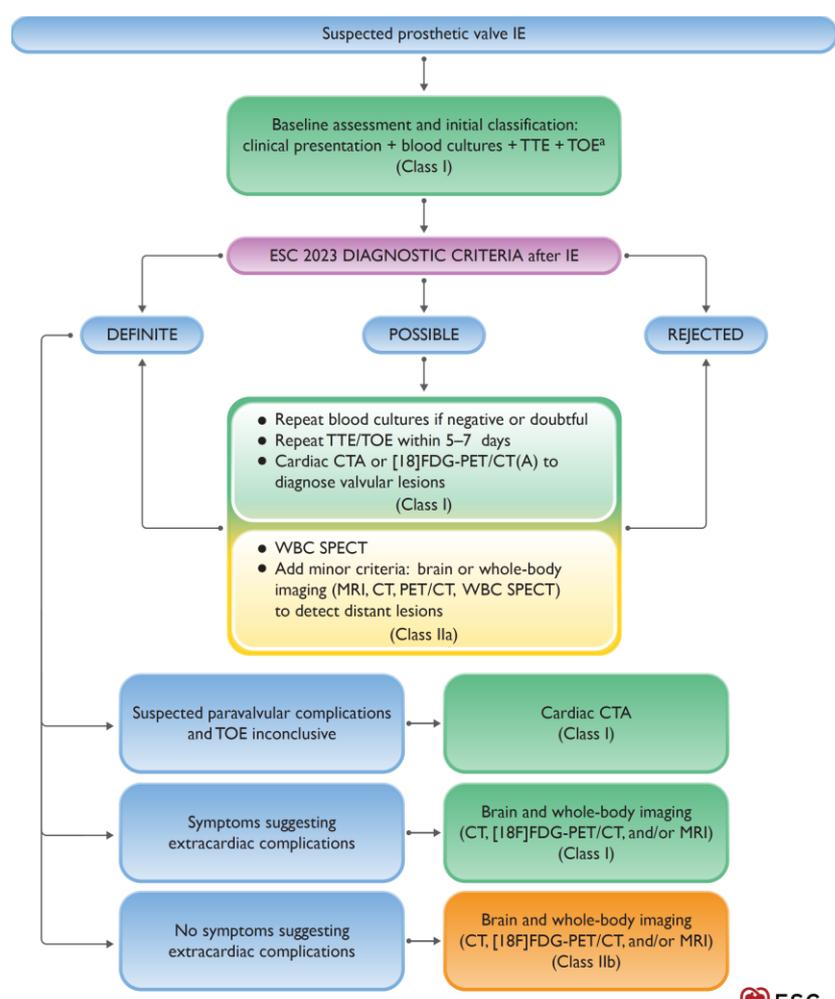
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Algorithmes

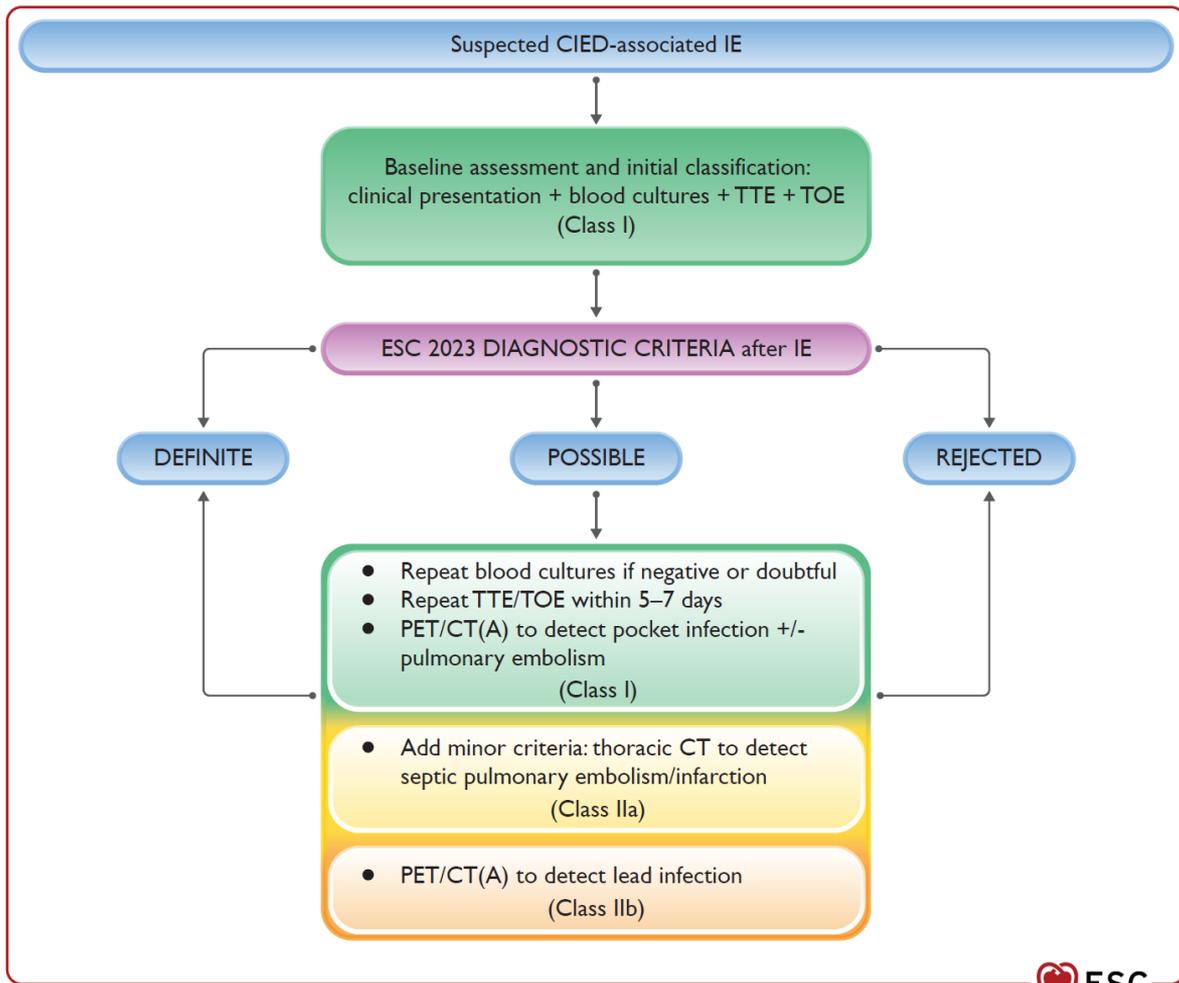


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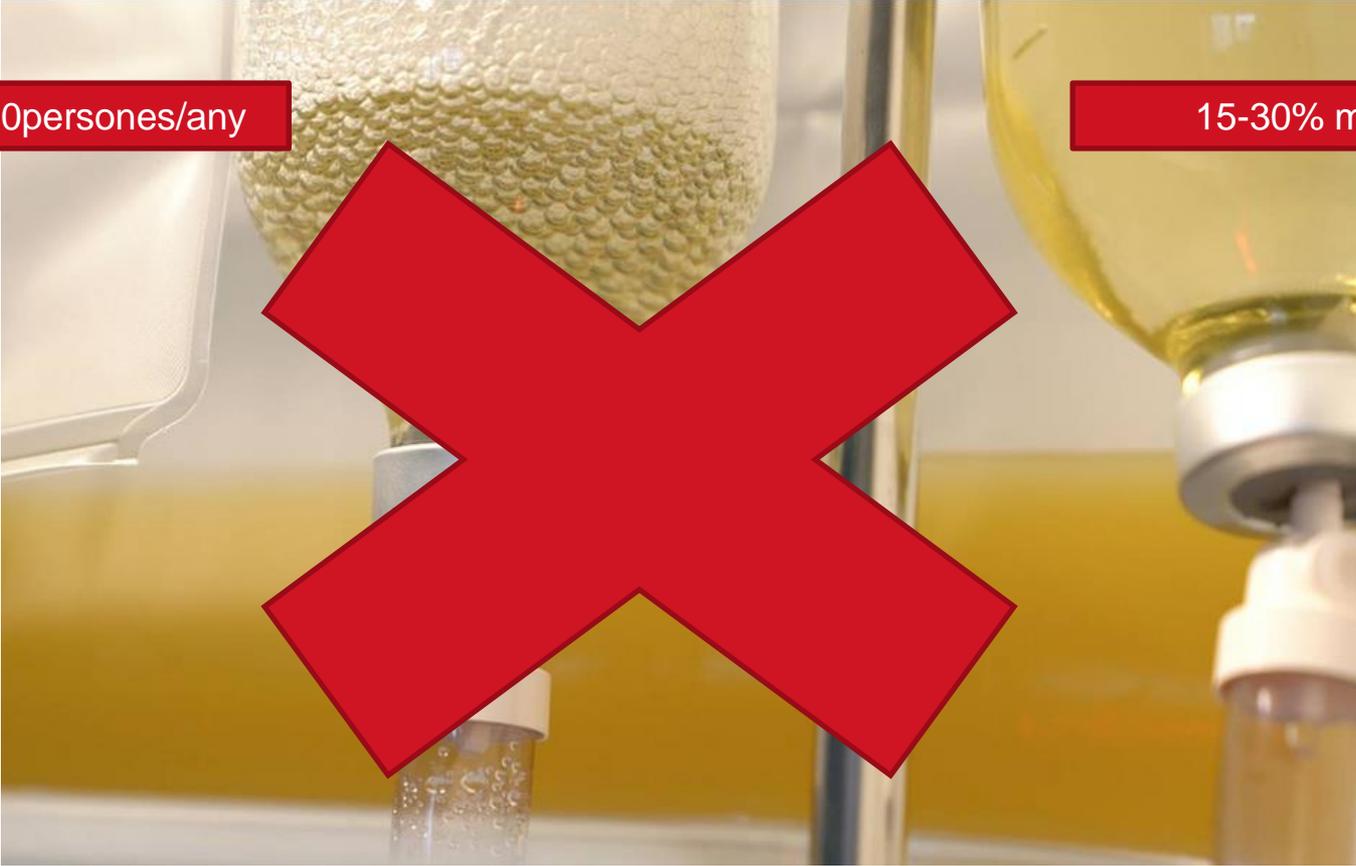
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4.

Novetats en tractament



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Table 20 Proposed antibiotic regimens for initial empirical treatment of infective endocarditis in acute severely ill patients (before pathogen identification)^a

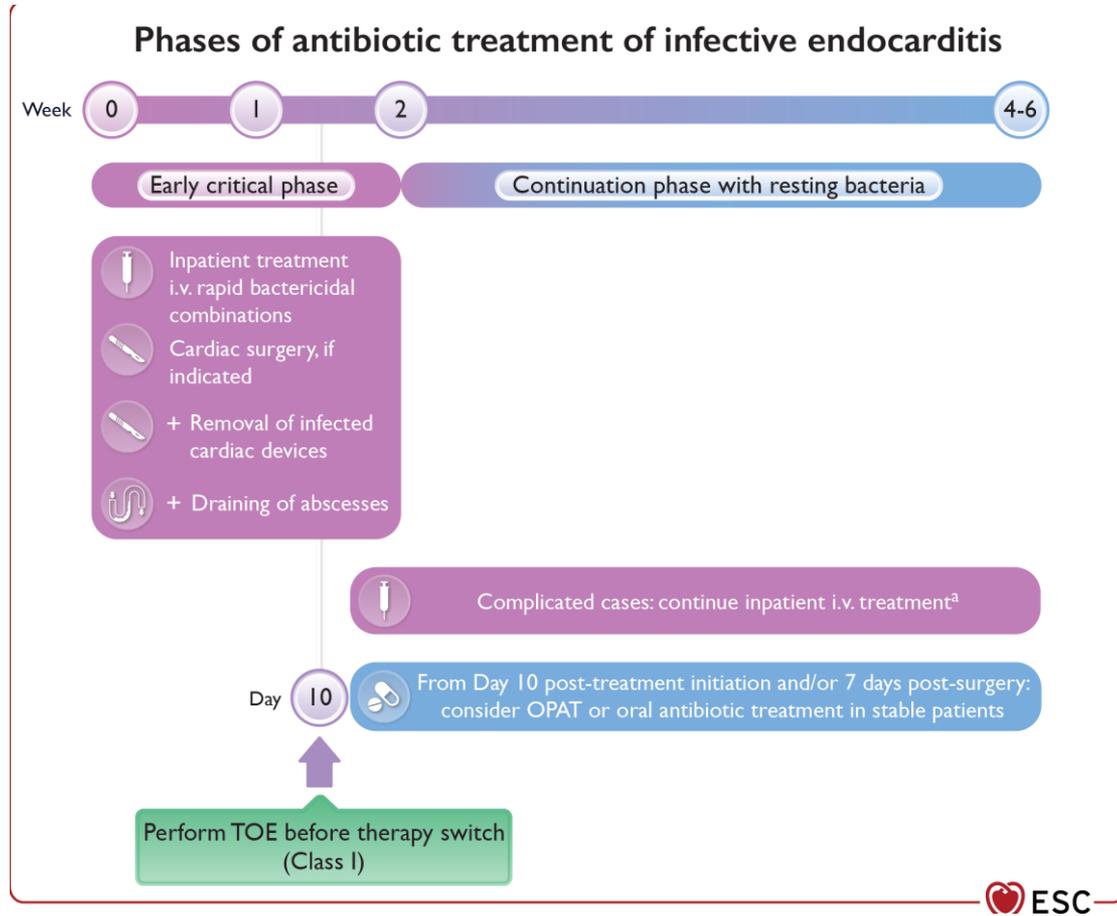
Antibiotic	Dosage and route	Class ^b	Level ^c	Comments
Community-acquired native valves or late prosthetic valves (≥ 12 months post surgery) endocarditis				
Ampicillin with (Flu)cloxacillin or oxacillin with Gentamicin ^d	12 g/day i.v. in 4–6 doses 12 g/day i.v. in 4–6 doses 3 mg/kg/day i.v. or i.m. in 1 dose	IIa	C	Patients with BCNIE should be treated in consultation with an ID specialist.
Vancomycin ^d with Gentamicin ^d	30–60 mg/kg/day i.v. in 2–3 doses 3 mg/kg/day i.v. or i.m. in 1 dose			
Early PVE (<12 months post surgery) or nosocomial and non-nosocomial healthcare associated endocarditis				
Vancomycin ^d with Gentamicin ^d with Rifampin	30 mg/kg/day i.v. in 2 doses 3 mg/kg/day i.v. or i.m. in 1 dose 900–1200 mg i.v. or orally in 2 or 3 divided doses	IIb	C	Rifampin is only recommended for PVE and it should be started 3–5 days later than vancomycin and gentamicin has been suggested by some experts. In healthcare associated native valve endocarditis, some experts recommend in settings with a prevalence of MRSA infections >5% the combination of cloxacillin plus vancomycin until they have the final <i>S. aureus</i> identification



Recommendations	Class ^b	Level ^c
In patients with community-acquired NVE or late PVE (≥12 months post-surgery), ampicillin in combination with ceftriaxone or with (flu)cloxacillin and gentamicin should be considered using the following doses: ³⁵³	IIa	C
<i>Adult antibiotic dosage and route</i>		
Ampicillin 12 g/day i.v. in 4–6 doses		
Ceftriaxone 4 g/day i.v. or i.m. in 2 doses		
(Flu)cloxacillin 12 g/day i.v. in 4–6 doses		
Gentamicin ^d 3 mg/kg/day i.v. or i.m. in 1 dose		
<i>Paediatric antibiotic dosage and route</i>		
Ampicillin 300 mg/kg/day i.v. in 4–6 equally divided doses		
Ceftriaxone 100 mg/kg i.v. or i.m. in 1 dose		
(Flu)cloxacillin 200–300 mg/kg/day i.v. in 4–6 equally divided doses		
Gentamicin ^d 3 mg/kg/day i.v. or i.m. in 3 equally divided doses		
In patients with early PVE (<12 months post-surgery) or nosocomial and non-nosocomial healthcare-associated IE, vancomycin or daptomycin combined with gentamicin and rifampin may be considered using the following doses: ³⁹⁵	IIb	C
<i>Adult antibiotic dosage and route</i>		
Vancomycin ^e 30 mg/kg/day i.v. in 2 doses		
Daptomycin 10 mg/kg/day i.v. in 1 dose		
Gentamicin ^d 3 mg/kg/day i.v. or i.m. in 1 dose		
Rifampin 900–1200 mg i.v. or orally in 2 or 3 doses		
<i>Paediatric antibiotic dosage and route</i>		
Vancomycin ^e 40 mg/kg/day i.v. in 2–3 equally divided doses		
Gentamicin ^d 3 mg/kg/day i.v. or i.m. in 3 equally divided doses		
Rifampin 20 mg/kg/day i.v. or orally in 3 equally divided doses		
Allergy to beta-lactams	IIb	C
In patients with community-acquired NVE or late PVE (≥12 months post-surgery) who are allergic to penicillin, ceftazolin, or vancomycin in combination with gentamicin may be considered using the following doses:		
<i>Adult antibiotic dosage and route</i>		
Ceftazolin 6 g/day i.v. in 3 doses		
Vancomycin ^e 30 mg/kg/day i.v. in 2 doses		
Gentamicin ^d 3 mg/kg/day i.v. or i.m. in 1 dose		

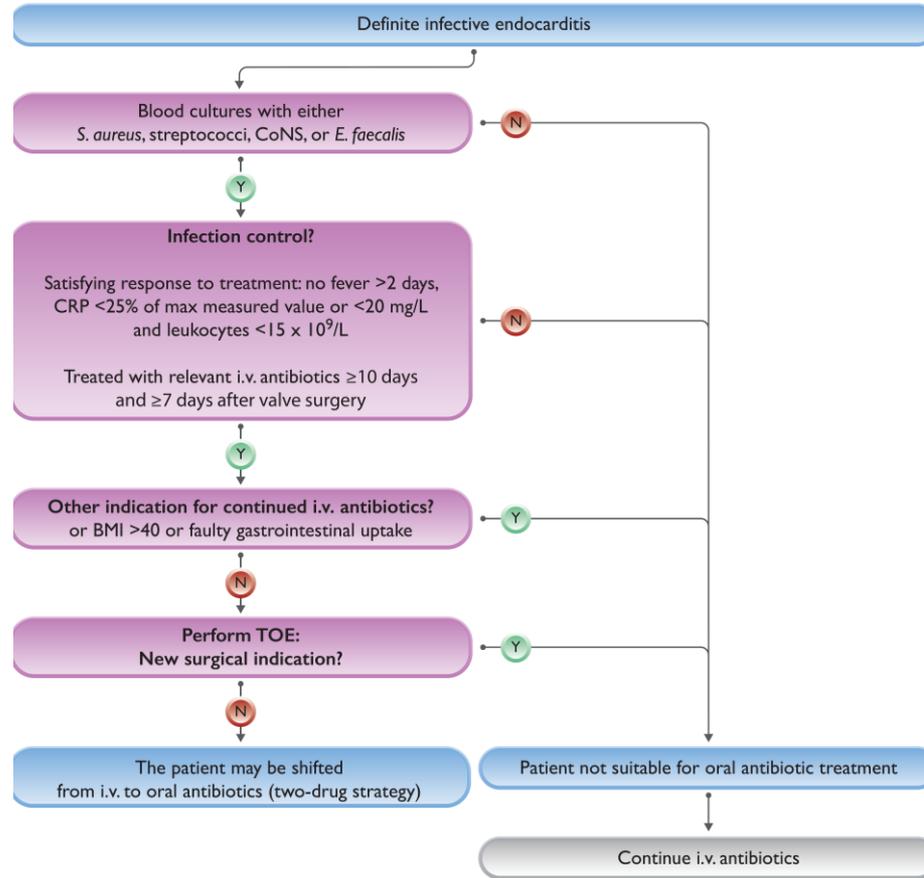


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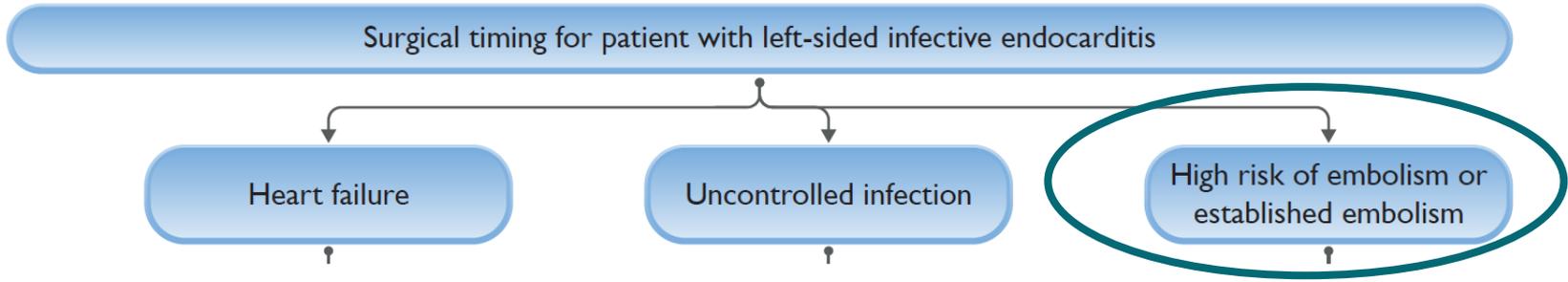


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Table S9 Combinations of antibiotics for oral step-down treatment

Penicillin-and methicillin-susceptible <i>S. aureus</i> & CoNS	Methicillin-susceptible <i>S. aureus</i> & CoNS	Methicillin-resistant CoNS	<i>E. faecalis</i>	Penicillin-susceptible streptococci	Penicillin-resistant streptococci
Amoxicillin 1 g × 4 Rifampin 600 mg × 2	Dicloxacillin 1 g × 4 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Fusidic acid 750 mg × 2	Amoxicillin 1 g × 4 Moxifloxacin 400 mg × 1	Amoxicillin 1 g × 4 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Rifampin 600 mg × 2
Amoxicillin 1 g × 4 Fusidic acid 750 mg × 2	Dicloxacillin 1 g × 4 Fusidic acid 750 mg × 2	Linezolid 600 mg × 2 Rifampin 600 mg × 2	Amoxicillin 1 g × 4 Linezolid 600 mg × 2	Amoxicillin 1 g × 4 Moxifloxacin 400 mg × 1	Moxifloxacin 400 mg × 1 Rifampin 600 mg × 2
Moxifloxacin 400 mg × 1 Rifampin 600 mg × 2	Moxifloxacin 400 mg × 1 Rifampin 600 mg × 2		Amoxicillin 1 g × 4 Rifampin 600 mg × 2	Amoxicillin 1 g × 4 Linezolid 600 mg × 2	Linezolid 600 mg × 2 Moxifloxacin 400 mg × 1
Linezolid 600 mg × 2 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Rifampin 600 mg × 2		Linezolid 600 mg × 2 Moxifloxacin 400 mg × 1	Linezolid 600 mg × 2 Rifampin 600 mg × 2	
Linezolid 600 mg × 2 Fusidic acid 750 mg × 2	Linezolid 600 mg × 2 Fusidic acid 750 mg × 2		Linezolid 600 mg × 2 Rifampin 600 mg × 2	Linezolid 600 mg × 2 Moxifloxacin 400 mg × 1	

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Emergent 24h

Urgent 3-5 days

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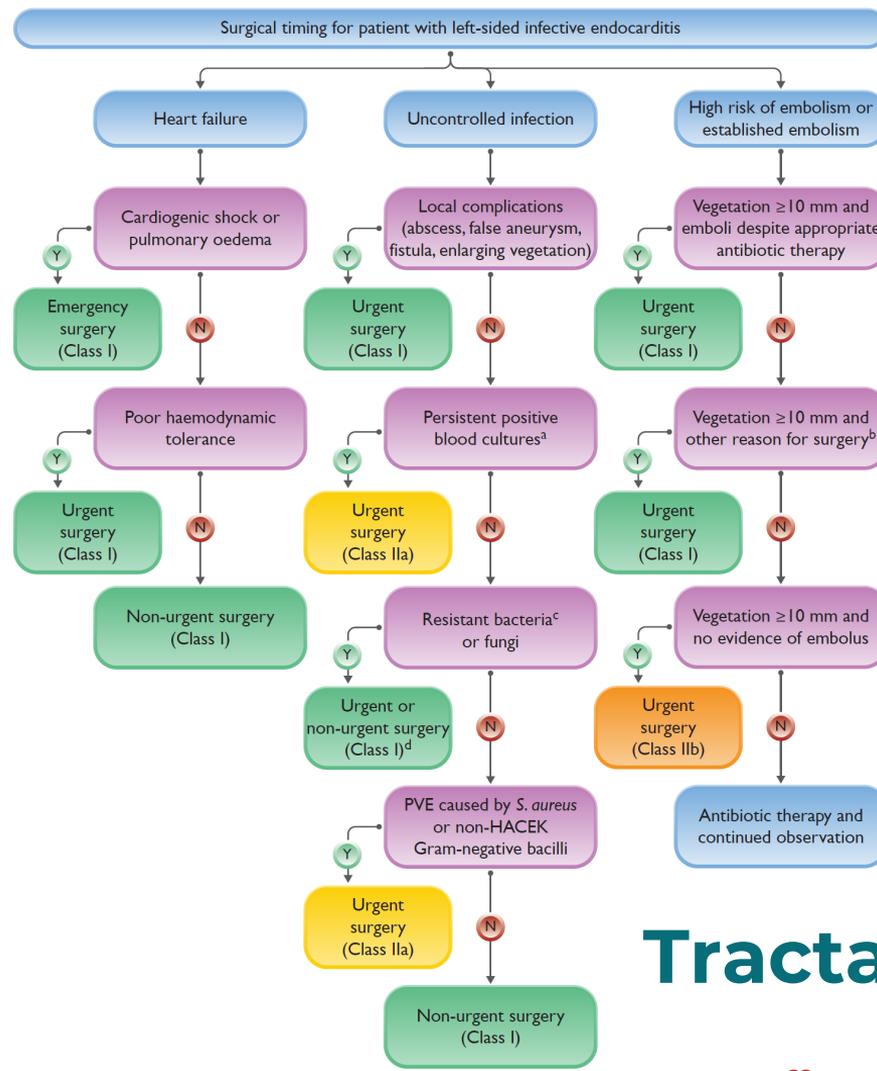


Section 8. Recommendation Table 12 — Recommendations for the main indications of surgery in infective endocarditis (native valve endocarditis and prosthetic valve endocarditis)

Aortic or mitral NVE with vegetations >10 mm, associated with severe valve stenosis or regurgitation, and low operative risk (urgent surgery should be considered).	IIa	B	Urgent surgery is recommended in IE with vegetation ≥ 10 mm and other indications for surgery.	I	C
Aortic or mitral NVE or PVE with isolated large vegetations (>15 mm) and no other indication for surgery (urgent surgery may be considered).	IIb	C	Urgent surgery may be considered in aortic or mitral IE with vegetation ≥ 10 mm and without severe valve dysfunction or without clinical evidence of embolism and low surgical risk.	IIb	B



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Tractament quirúrg



5.

Novetats en CIED-IE



Section 12. Recommendation Table 20 — Recommendations for cardiovascular implanted electronic device-related infective endocarditis

Routine antibiotic prophylaxis is recommended before device implantation.	I	B	Antibiotic prophylaxis covering <i>S. aureus</i> is recommended for CIED implantation.	I	A
TOE is recommended in patients with suspected cardiac device-related infective endocarditis with positive or negative blood cultures, independent of the results of TTE, to evaluate lead-related endocarditis and heart valve infection.	I	C	TTE and TOE are both recommended in case of suspected CIED-related IE to identify vegetations.	I	B
In patients with NVE or PVE and an intracardiac device with no evidence of associated device infection, complete hardware extraction may be considered.	IIb	C	Complete CIED extraction should be considered in case of valvular IE, even without definite lead involvement, taking into account the identified pathogen and requirement for valve surgery.	IIa	C

CIED related IE

2015

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Complete hardware removal should be considered on the basis of occult infection without another apparent source of infection.	Ila	C	In cases of possible CIED-related IE or occult Gram-positive bacteraemia or fungaemia, complete system removal should be considered in case bacteraemia/fungaemia persists after a course of antimicrobial therapy.	Ila	C
			In cases of possible CIED-related IE with occult Gram-negative bacteraemia, complete system removal may be considered in case of persistent/relapsing bacteraemia after a course of antimicrobial therapy.	Ilb	C
When indicated, definite reimplantation should be postponed if possible, to allow a few days or weeks of antibiotic therapy.	Ila	C	If CIED reimplantation is indicated after extraction for CIED-related IE, it is recommended to be performed at a site distant from the previous generator, as late as possible, once signs and symptoms of infection have abated and until blood cultures are negative for at least 72 h in the absence of vegetations, and negative for at least 2 weeks if vegetations were visualized.	I	C

CIED related IE



6.

Novetats en El dreta



Section 12. Recommendation Table 21 — Recommendations for the surgical treatment of right-sided infective endocarditis

Surgical treatment should be considered in the following scenarios:

- Microorganisms difficult to eradicate (e.g. persistent fungi) or bacteraemia for >7 days (e.g. *S. aureus*, *P. aeruginosa*) despite adequate antimicrobial therapy; or
- Persistent tricuspid valve vegetations >20 mm after recurrent pulmonary emboli with or without concomitant right HF; or
- Right HF secondary to severe tricuspid regurgitation with poor response to diuretic therapy.

IIa

C

Surgery is recommended in patients with right-sided IE who are receiving appropriate antibiotic therapy for the following scenarios:

Right ventricular dysfunction secondary to acute severe tricuspid regurgitation non-responsive to diuretics.

I

B

Persistent vegetation with respiratory insufficiency requiring ventilatory support after recurrent pulmonary emboli.

I

B

Large residual tricuspid vegetations (>20 mm) after recurrent septic pulmonary emboli.

I

C

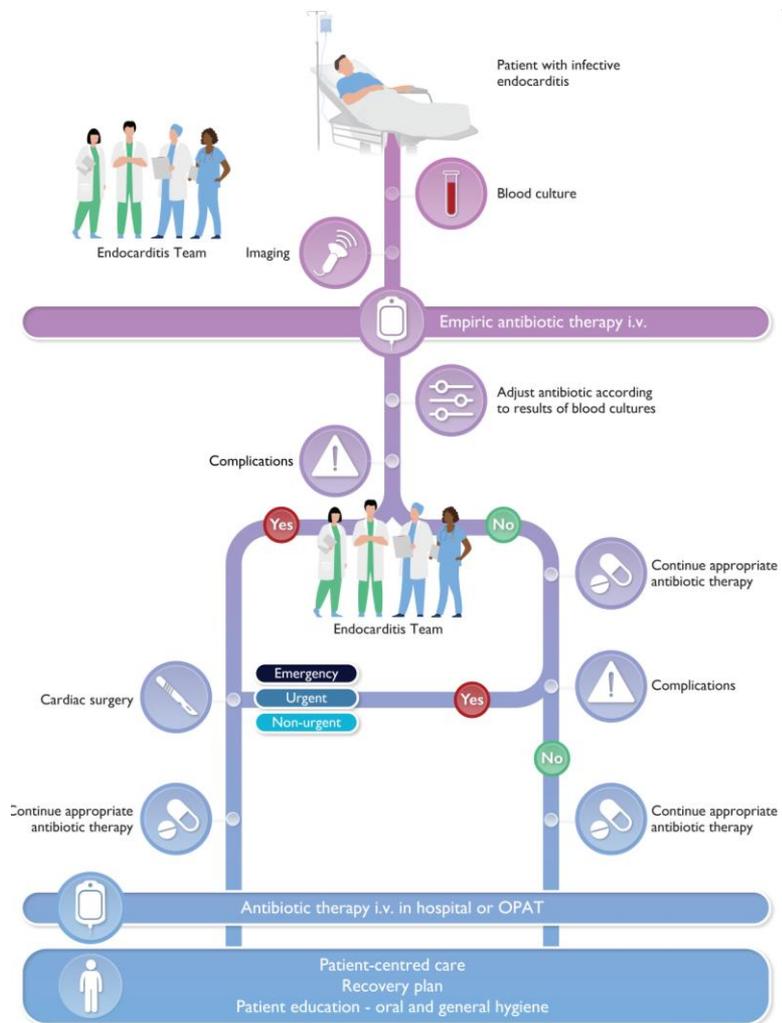
Patients with simultaneous involvement of left-heart structures.

I

C

Right-sided IE





| Gràcies

