FAKULTNÍ NEMOCNICE® OLOMOUC

Lékařská fakulta
Univerzita Palackého v Olomouci

KOMPLEXNÍ KARDIOVASKULÁRNÍ CENTRUM
FAKULTNÍ NEMOCNICE OLOMOUC

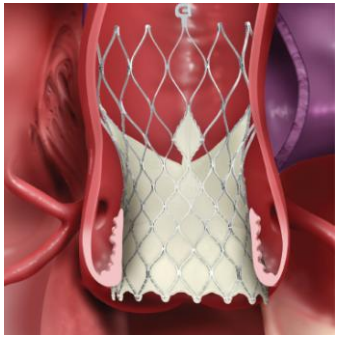
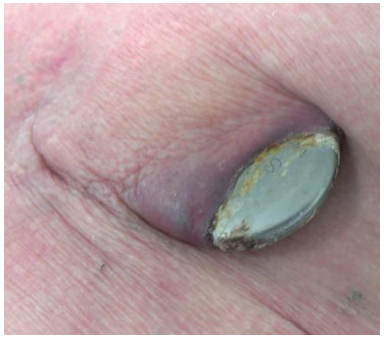
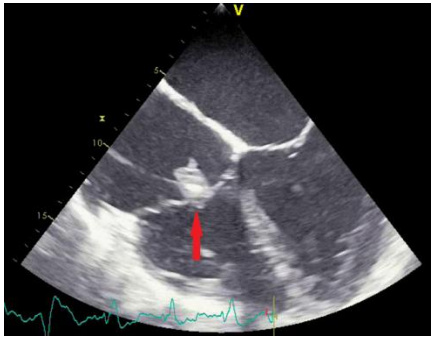
Endokarditida – 2023 ESC guidelines

Martin Hutyra

Definice IE

Zánětlivé onemocnění způsobené infekčním fokusem v oblasti endokardu nebo srdečních chlopní (nativních i protetických), event. nitrosrdečních implantátů



Vegetace: typické léze pro inf. endokarditis (masa trombocytů, fibrinu, mikrokolonií mikroorganismů a zánětlivých buněk)

Incidence: 13/ 100 000/ rok

2015 ESC Guidelines for the management of infective endocarditis: The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). Eur Heart J. 2015 Nov 21;36(44):3075-3128. doi: 10.1093/eurheartj/ehv319. Epub 2015 Aug 29.
Linhartova K., 2015 ESC Guidelines for the management of infective endocarditis. Summary document prepared by the Czech Society of Cardiology, Cor et Vasa 58 (2016) e107–e128.

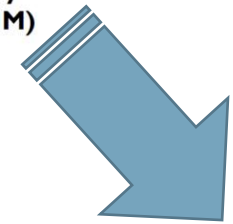
European Heart Journal (2015) **36**, 3075–3123
doi:10.1093/eurheartj/ehv319

ESC GUIDELINES

2015 ESC Guidelines for the management of infective endocarditis

The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC)

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



ESC European Society of Cardiology
European Heart Journal (2023) **00**, 1–95
https://doi.org/10.1093/eurheartj/ehad193

ESC GUIDELINES

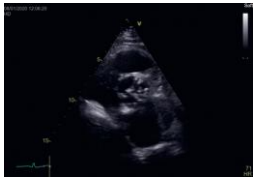
2023 ESC Guidelines for the management of endocarditis

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

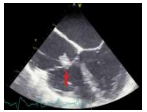
Endorsed by the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association of Nuclear Medicine (EANM)

Patogeneze IE

Dysfunkce endokardu - **predispozice** pro rozvoj IE

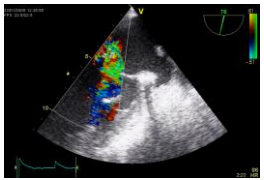


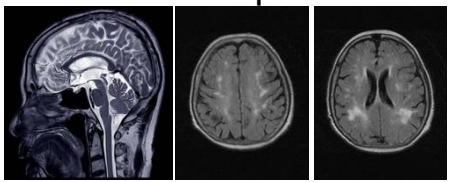
Poškození endokardu turbulentním tokem - vznik depa trombocytů a fibrinů - rozvoj nebakteriální **trombotické endokarditis**, která je náchylná k mikrobiální kolonizaci, než neporušený endokard



Ke kolonizaci dochází během **bakterémie** (intervenční výkony stomatologické, GIT, urologické…)

Poškození srdečních struktur (usurace, perforace, valvulární fistule, destrukce chlopenního aparátu vedoucí k regurgitaci)





Embolizace vegetací – mikroinfarkty, abscesy

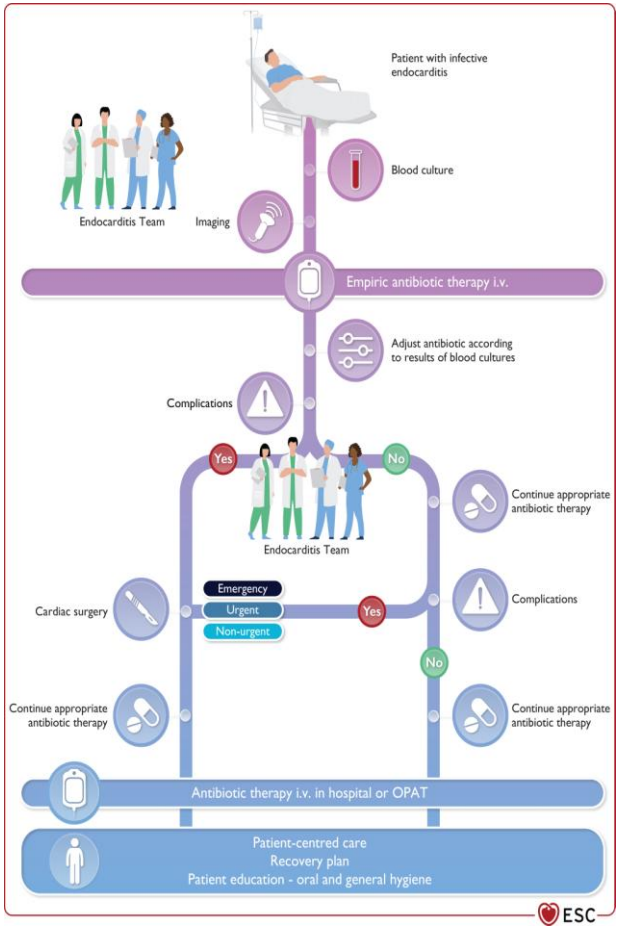
2015 ESC Guidelines for the management of infective endocarditis: The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). Eur Heart J. 2015 Nov 21;36(44):3075-3128. doi: 10.1093/eurheartj/ehv319. Epub 2015 Aug 29.
Linhartova K., 2015 ESC Guidelines for the management of infective endocarditis. Summary document prepared by the Czech Society of Cardiology, Cor et Vasa 58 (2016) e107–e128.

ESC 2023 guidelines

1. Infective endocarditis (IE) is a major public health challenge. In 2019, the estimated incidence of IE was 13.8 cases per 100 000 subjects per year, and IE accounted for 66 300 deaths worldwide.

2. The population at risk of IE has increased and new data on IE in different clinical scenarios have arisen.

3. The emerging and increasing antibiotic resistance among oral streptococci is of concern.



Prevention

The groups of individuals at high risk of IE in whom antibiotic prophylaxis is recommended or should be considered include the following:

1. Patients with **previous IE**: the highest risk of IE is observed in patients with previous history of IE who have an ominous prognosis during IE-related hospitalization. Patients with recurrent IE more frequently have prosthetic valves.
2. Patients with surgically implanted **prosthetic valves**, with transcatheter implanted prosthetic valves, and with any material used for cardiac valve repair: the increased risk of IE in these patients, combined with the ominous outcomes as compared with patients with native IE (NVE), make antibiotic prophylaxis advisable in this patient group. Mitral and aortic bioprostheses may be associated with increased risk of IE as compared with mechanical prostheses. In terms of transcatheter mitral and tricuspid valve interventions, the data on the risk of IE are limited. Patients with septal defect closure devices, left atrial appendage closure devices, vascular grafts, vena cava filters, and central venous system ventriculo-atrial shunts are considered within this risk category in the first 6 months after implantation.
3. Patients with **congenital heart disease**. The cumulative incidence over time is influenced strongly by the improved long-term survival of children with CHD into adulthood. Indeed, there are now more adults living with CHD than children with CHD. The overall incidence rate of IE among adult patients with CHD is 27–44 times that reported for contemporary adults of the general population (1.33 cases per 1000 persons per year).
4. Patients with **ventricular assist devices** as destination therapy.

Recommendations	Class[a]	Level[b]
General prevention measures are recommended in individuals at high and intermediate risk for IE.	I	C
Antibiotic prophylaxis is recommended in patients with previous IE.[47,84,86]	I	B
Antibiotic prophylaxis is recommended in patients with surgically implanted prosthetic valves and with any material used for surgical cardiac valve repair.[47,87–89]	I	C
Antibiotic prophylaxis is recommended in patients with transcatheter implanted aortic and pulmonary valvular prostheses.[91–94]	I	C
Antibiotic prophylaxis is recommended in patients with untreated cyanotic CHD, and patients treated with surgery or transcatheter procedures with post-operative palliative shunts, conduits, or other prostheses. After surgical repair, in the absence of residual defects or valve prostheses, antibiotic prophylaxis is recommended only for the first 6 months after the procedure.[8,47,97,101]	I	C
Antibiotic prophylaxis is recommended in patients with ventricular assist devices.[102]	I	C
Antibiotic prophylaxis should be considered in patients with transcatheter mitral and tricuspid valve repair.[95]	IIa	C
Antibiotic prophylaxis may be considered in recipients of heart transplant.[105–107]	IIb	C
Antibiotic prophylaxis is not recommended in other patients at low risk for IE.[11,51]	III	C

CHD, congenital heart disease; IE, infective endocarditis.
[a]Class of recommendation.
[b]Level of evidence.

Prevention

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.

Recommendations	Class[a]	Level[b]
Antibiotic prophylaxis is recommended in dental extractions, oral surgery procedures, and procedures requiring manipulation of the gingival or periapical region of the teeth.[11,49,51,108]	I	B
Systemic antibiotic prophylaxis may be considered for high-risk[c] patients undergoing an invasive diagnostic or therapeutic procedure of the respiratory, gastrointestinal, genitourinary tract, skin, or musculoskeletal systems.[6,11]	IIb	C

[a]Class of recommendation.
[b]Level of evidence.
[c]This recommendation does not apply to patients with intermediate risk for IE or to the general population.

Recommendations	Class[a]	Level[b]
Pre-operative screening for nasal carriage of *S. aureus* is recommended before elective cardiac surgery or transcatheter valve implantation to treat carriers.[113,114]	I	A
Peri-operative antibiotic prophylaxis is recommended before placement of a CIED.[116–118]	I	A
Optimal pre-procedural aseptic measures of the site of implantation is recommended to prevent CIED infections.[119]	I	B
Periprocedural antibiotic prophylaxis is recommended in patients undergoing surgical or transcatheter implantation of a prosthetic valve, intravascular prosthetic, or other foreign material.[120]	I	B
Surgical standard aseptic measures are recommended during the insertion and manipulation of catheters in the catheterization laboratory environment.	I	C
Elimination of potential sources of sepsis (including of dental origin) should be considered ≥2 weeks before implantation of a prosthetic valve or other intracardiac or intravascular foreign material, except in urgent procedures.	IIa	C
Antibiotic prophylaxis covering for common skin flora including *Enterococcus* spp. and *S. aureus* should be considered before TAVI and other transcatheter valvular procedures.[121]	IIa	C
Systematic skin or nasal decolonization without screening for *S. aureus* is not recommended.	III	C

CIED, cardiac implantable electronic device; TAVI, transcatheter aortic valve implantation.
[a]Class of recommendation.
[b]Level of evidence.

Endocarditis team

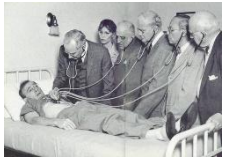
The diagnosis and management of patients with IE should be discussed with the Endocarditis Team.

Core members

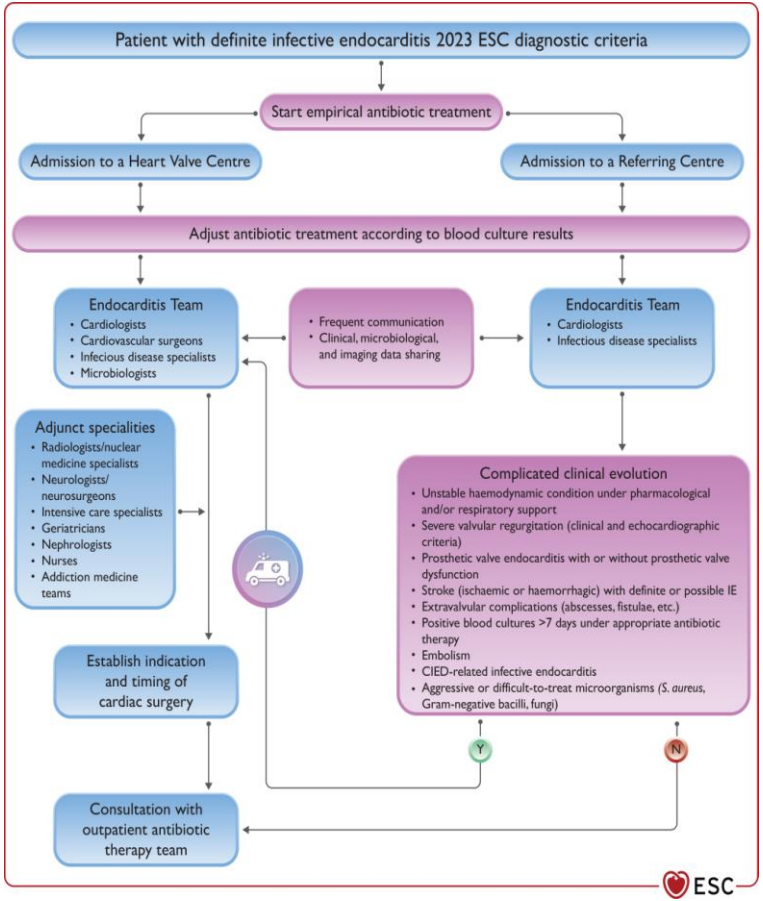
- Cardiologists.
- Cardiac imaging experts.
- Cardiovascular surgeons.
- Infectious disease specialist (or internal medicine specialist with expertise in infecti
- Microbiologist.
- Specialist in outpatient parenteral antibiotic treatment.

Adjunct specialities

- Radiologist and nuclear medicine specialist.
- Pharmacologist.
- Neurologist and neurosurgeon.
- Nephrologist.
- Anaesthesiologists.
- Critical care.
- Multidisciplinary addiction medicine teams.
- Geriatricians.
- Social worker.
- Nurses.
- Pathologist.



Uncomplicated IE can be managed in a Referring Centre that remains in early and regular communication with the Endocarditis Team of the Heart Valve Centre.
Patients with **complicated IE** should be treated in the Heart Valve Centre, which must offer a wide range of ancillary specialty support including onsite cardiac surgery expertise.



Diagnosis

The diagnosis of IE is based on major criteria, which include positive **blood cultures** and valvular and perivalvular/periprosthetic anatomic and metabolic lesions detected on **imaging**, and on minor criteria which have been updated to include frequent embolic vascular dissemination including asymptomatic lesions detected by imaging only.

Section 5. Recommendation Table 5 — Recommendations for the role of echocardiography in infective endocarditis					
TOE should be considered in patients with suspected IE, even in cases with positive TTE, except in isolated right-sided native valve IE with good quality TTE examination and unequivocal echocardiographic finding.	IIa	C	TOE is recommended in patients with suspected IE, even in cases with positive TTE, except in isolated right-sided native valve IE with good quality TTE examination and unequivocal echocardiographic findings.	I	C

Positive blood cultures remain the cornerstone of IE diagnosis and provide live bacteria for both identification and susceptibility testing. At least **three sets** of blood cultures should be obtained at **30-minute intervals prior to antibiotic therapy**, each containing 10 mL of blood, and should be incubated in **both aerobic and anaerobic** atmospheres. Sampling should be obtained from a **peripheral vein** rather than from a central venous catheter (because of the risk of contamination and misleading interpretation), using a meticulous sterile technique. In the absence of previous antimicrobial therapy, this is virtually always sufficient to identify the usual causative microorganisms. In IE, bacteraemia is almost constant and has two implications: (i) there is no rationale for delaying blood sampling to coincide with peaks of fever; (ii) nearly all blood cultures are positive during bacteraemia.

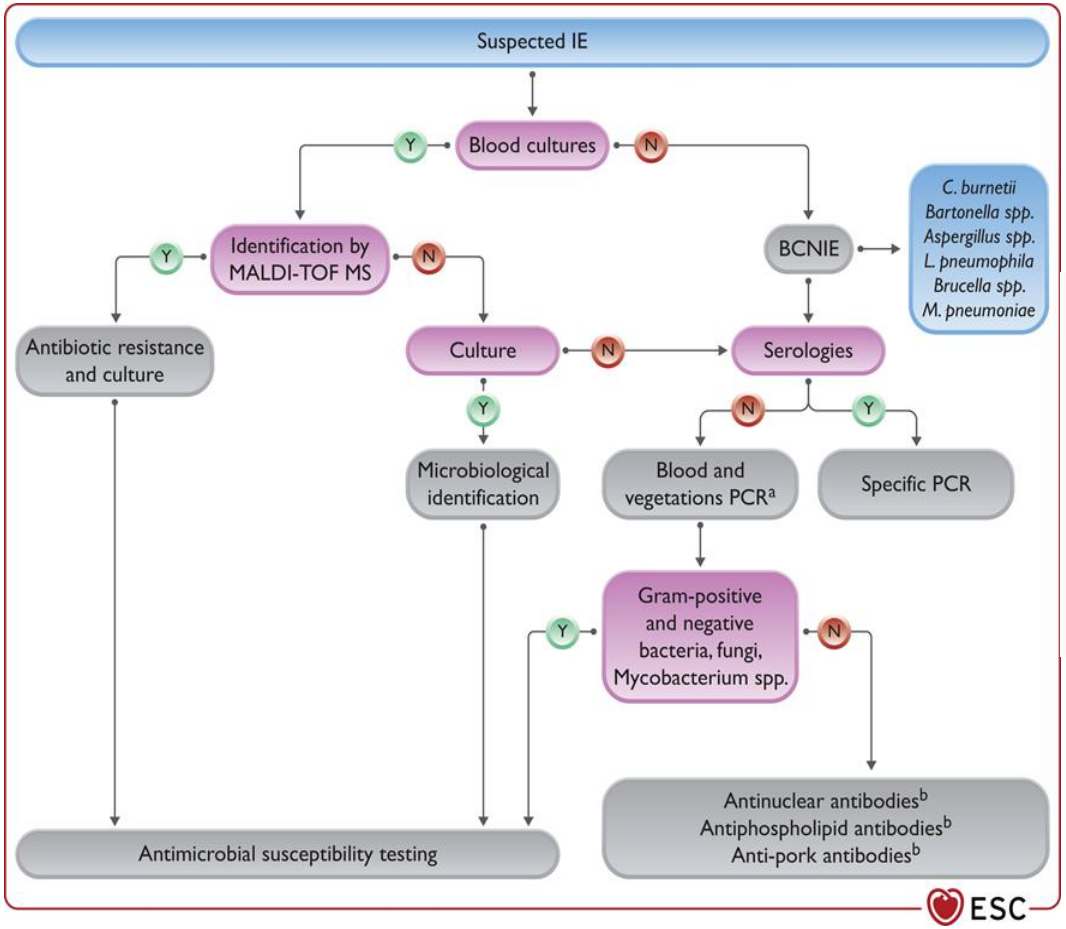
IE etiologie

Streptococcus: 30-40 % (spíše snížení incidence)
Staphylococcus: 30 % (zvýšení frekvence – používání implantátů)
Enterococcus, G- bakterie: 10 %
Vzácné patogeny: 10 % (tahomae.g. Coxiella burnetti, Chlamydia, Mycoplasma, Legionellae, skupina HACEK – Haemophilus influenzae, Actinobacillus, Cardiobacterium, Eikenella, Kingella)
Fungi: 1 %
5-10 % nelze izolovat patogen (negativní hemokultury)

	Beneš et al.[8, 9]	Pazderník et al.[10, 11]	Registr EURO-ENDO[12, 13]
Země (místo realizace)	ČR – 29 nemocnic	ČR – 1 centrum (FN Hradec Králové)	40 zemí (156 nemocnic) (27 zemí ESC, 13 zemí mimo ESC)
Doba realizace	02/2007–01/2008 (12 měsíců)	11/1998–11/2006 (8 let)	01/2016–03/2018
Počet pacientů	132	106	3116
Počet případů IE	134	117	3116
Incidence IE	3,4/100 000 obyv./rok	-	-
Medián věku pacientů (roky)	63	59,6	63,0
Muži (%)	60,6	80,2	68,9
IE nativních chlopní (%)	-	-	56,6
Protézová endokarditida (%)	17,2	17,9	30,1
IE spojená se srdečními implantabilními elektronickými přístroji (%)	8,2	6,0	9,9
Kardiochirurgický výkon (%)	26,9	30,7	51,2
Nemocniční mortalita (%)	26,9	21	17,1
Etiologie:			
Streptokoky (%)	15,6	13,7	19,0
viridující streptokoky (%)	13,4	9	12,4
Stafylokoky (%)	38,1	45	44,1
Staph. aureus (%)	29,9	30,8	31,4
Enterokoky (%)	8,2	12,8	15,8
Jiné grampozitivní bakterie (%)	2,2	1	-
Gramnegativní bakterie (%)	2	4,3	3,5
HACEK (%)	-	-	-
Polymikrobiální etiologie (%)	-	4,3	-
Houby (%)	-	-	-
Etiologie nezjištěna (%)	33,6	17,9	21,0

HACEK – rody bakterií *Haemophillus, Actinobacillus, Cardiobacterium, Eikenella, Kingella*

2015 ESC Guidelines for the management of infective endocarditis: The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). Eur Heart J. 2015 Nov 21;36(44):3075-3128. doi: 10.1093/eurheartj/ehv319. Epub 2015 Aug 29.
Linhartova K., 2015 ESC Guidelines for the management of infective endocarditis. Summary document prepared by the Czech Society of Cardiology, Cor et Vasa 58 (2016) e107–e128.



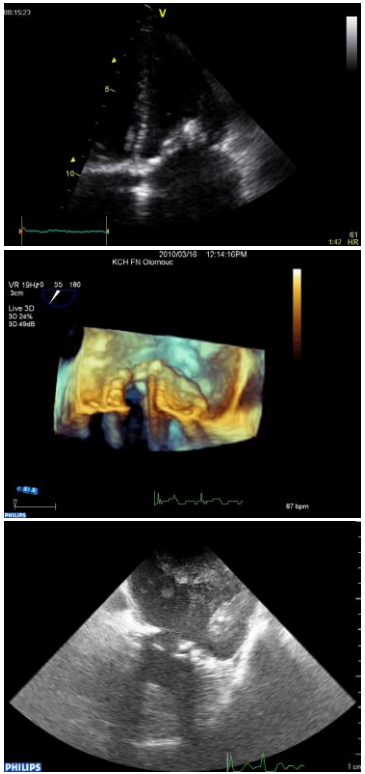
Investigation of rare causes of blood culture-negative infective endocarditis

Pathogen	Diagnostic procedures
Brucella spp.	Serology, blood cultures, tissue culture, immunohistology, and 16S rRNA sequencing of tissue
C. burnetii	Serology (IgG phase I >1:800), tissue culture, immunohistology, and 16S rRNA sequencing of tissue
Bartonella spp.	Serology (IgG phase I >1:800), blood cultures, tissue culture, immunohistology, and 16S rRNA sequencing of tissue
T. whipplei	Histology and 16S rRNA sequencing of tissue
Mycoplasma spp.	Serology, tissue culture, immunohistology, and 16S rRNA sequencing of tissue
Legionella spp.	Serology, blood cultures, tissue culture, immunohistology, and 16S rRNA sequencing of tissue
Fungi	Serology, blood cultures, 18S rRNA sequencing of tissue
Mycobacteria (including *Mycobacterium chimaera*)	Specific blood cultures, 16S rRNA sequencing of tissue

Ig, immunoglobulin; rRNA, ribosomal ribonucleic acid.

Echokardiografie

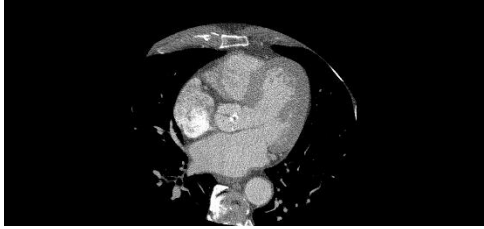
Recommendations	Class[a]	Level[b]
A. Diagnosis		
TTE is recommended as the first-line imaging modality in suspected IE.[166,179]	I	B
TOE is recommended in all patients with clinical suspicion of IE and a negative or non-diagnostic TTE.[166,178,179]	I	B
TOE is recommended in patients with clinical suspicion of IE, when a prosthetic heart valve or an intracardiac device is present.[166,178,179]	I	B
Repeating TTE and/or TOE within 5–7 days is recommended in cases of initially negative or inconclusive examination when clinical suspicion of IE remains high.[178]	I	C
TOE is recommended in patients with suspected IE, even in cases with positive TTE, except in isolated 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 *S. aureus*, *E. faecalis*, and some *Streptococcus* spp. bacteraemia.[19,149,174]	IIa	B



B. Follow-up under medical therapy		
Repeating TTE and/or TOE is recommended as soon as a new complication of IE is suspected (new murmur, embolism, persisting fever and bacteraemia, HF, abscess, AVB).[165,166,179]	I	B
TOE is recommended when patient is stable before switching from intravenous to oral antibiotic therapy.[43,180]	I	B
During follow-up of uncomplicated IE, repeat TTE and/or 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]	IIa	B
C. Intra-operative echocardiography		
Intra-operative echocardiography is recommended in all cases of IE requiring surgery.[181]	I	C
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

AVB, atrioventricular block; HF, heart failure; IE, infective endocarditis; PVE, prosthetic valve endocarditis; TOE, transoesophageal echocardiography; TTE, transthoracic echocardiography.
[a]Class of recommendation.
[b]Level of evidence.

CT



1. Diagnosis of IE and cardiac complications.

Cardiac CT is more accurate than TOE for diagnosing perivalvular and periprosthetic complications of IE (abscesses, pseudoaneurysms, and fistulae) and is recommended in both NVE and PVE if TOE is not conclusive or not feasible. In addition, cardiac CT can significantly influence subsequent surgical decision-making. Echocardiography continues to be superior for detecting valvular lesions, particularly small vegetations (<10 mm) which remain underdiagnosed by CT, but also leaflet perforations and fistulae. Cardiac CT should be acquired according to the recommendations of cardiac CT guidelines to ensure high diagnostic accuracy, and can be performed alone or in combination with PET.

2. Detection of distant lesions and sources of bacteraemia.

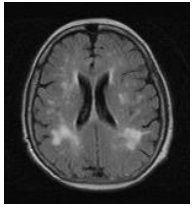
Whole-body and brain CT are useful for assessing IE systemic complications, including septic emboli. The detection of distant lesions adds a minor diagnostic criterion leading to a more conclusive diagnosis of definite or rejected IE, and can be relevant for decision-making. CT angiography can detect mycotic arterial aneurysms complicating IE in almost any site of the vascular tree, including the central nervous system (CNS). Although MRI is superior to CT for diagnosing neurological complications, CT may be more feasible in an emergency setting and is an acceptable alternative for the detection of neurological complications, with a sensitivity of 90% and specificity of 86% in the detection of ischaemic and haemorrhagic lesions. Finally, CT can also detect the extracardiac sources of the bacteraemia, including early neoplastic lesions, that may be important for patient management, and which need to be ideally addressed prior to undergoing heart valve surgery.

3. Pre-operative assessment.

Cardiac CT is a valuable alternative for non-invasive assessment of coronary artery disease (CAD) before cardiac surgery in patients with IE.

4. Alternative diagnosis.

MRI



1. Diagnosis of IE and cardiac complications.

The role of cardiac MRI to diagnose IE is limited by the low spatial resolution (as compared with cardiac CT) and the signal void generated by some prostheses impairing the assessment of prosthetic valve anatomy and function.

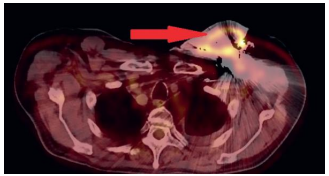
2. Diagnosis of neurological IE-related complications.

MRI has higher sensitivity than CT for the diagnosis of neurological lesions and, hence, increases the likelihood of detecting neurological complications in patients with IE. Patients with IE might present CNS lesions in up to 60–80% of cases, most of them corresponding to ischaemic lesions (50–80% of patients) that are often small and asymptomatic and do not impact on the decision-making. Other lesions that may influence the decision-making, such as parenchymal or subarachnoid haemorrhages, abscesses, or mycotic aneurysms, are found in <10% of patients. The systematic performance of brain MRI has shown to directly impact the diagnosis of IE, as it can add a minor diagnostic criterion in patients without neurological symptoms with non-definitive IE diagnosis. Brain MRI can reclassify 25% of patients with an initially inconclusive diagnosis for IE to a more conclusive diagnosis, thereby leading to an earlier diagnosis. Cerebral microbleeds, found in 50–60% of patients with IE, are detected at gradient echo T2* sequences. Cerebral microbleeds should not be considered a minor criterion because there is no concordance with ischaemic lesions.

3. Diagnosis of spine lesions.

MRI is the diagnostic modality of choice of spondylodiscitis and vertebral osteomyelitis with a diagnostic accuracy of 89–94%. MRI findings include vertebrae and disc oedema, paravertebral/epidural inflammation or abscess, bone erosion, and gadolinium enhancement of vertebrae and discs. It should be acknowledged that when MRI is performed too early, the rate of false-negative increases.

Nuclear imaging



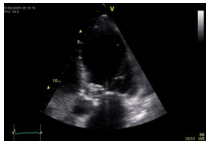
[18F]FDG-PET/CT and white blood cell (WBC) single photon emission computed tomography (SPECT)/CT are recommended in suspected PVE in cases of inconclusive echocardiography. The most recent meta-analysis showed 86% sensitivity and 84% specificity for [18F]FDG-PET/CT in PVE.

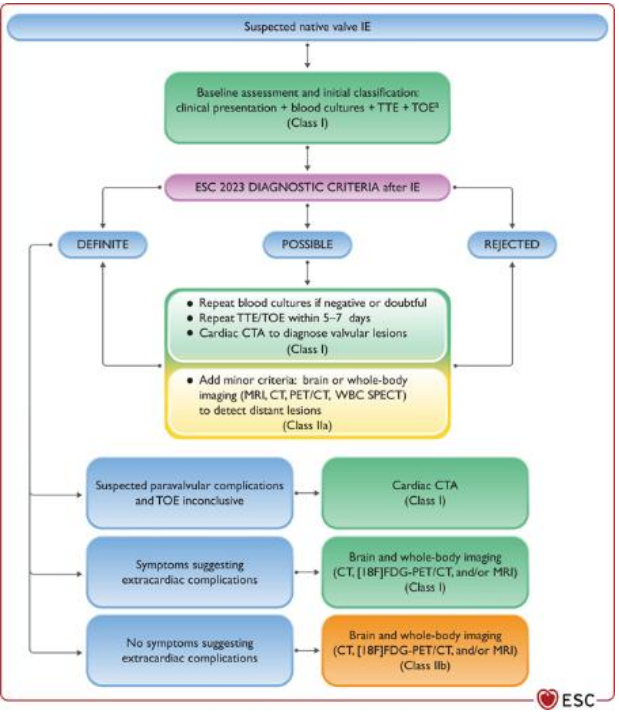
White blood cell SPECT/CT is an alternative nuclear imaging technique for the diagnosis of IE, when PET/CT is unavailable and inexperienced centres. The sensitivity of WBC SPECT/CT has been reported as 64–90% and the specificity as 36–100%; diagnostic ability significantly increases with the presence of periprosthetic abscesses.

In cases of NVE, the sensitivity of PET/CT and SPECT/CT is low (about 31%) but with a higher specificity (around 98%). In NVE, the diagnosis of IE cannot be excluded in the absence of abnormal [18F]FDG uptake

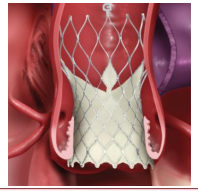
Recommendations	Class[a]	Level[b]
Cardiac CTA is recommended in patients with possible NVE to detect valvular lesions and confirm the diagnosis of IE.[33,168,169]	I	B
[18F]FDG-PET/CT(A) and cardiac CTA are recommended in possible PVE to detect valvular lesions and confirm the diagnosis of IE.[22,129,209,210,237–239]	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

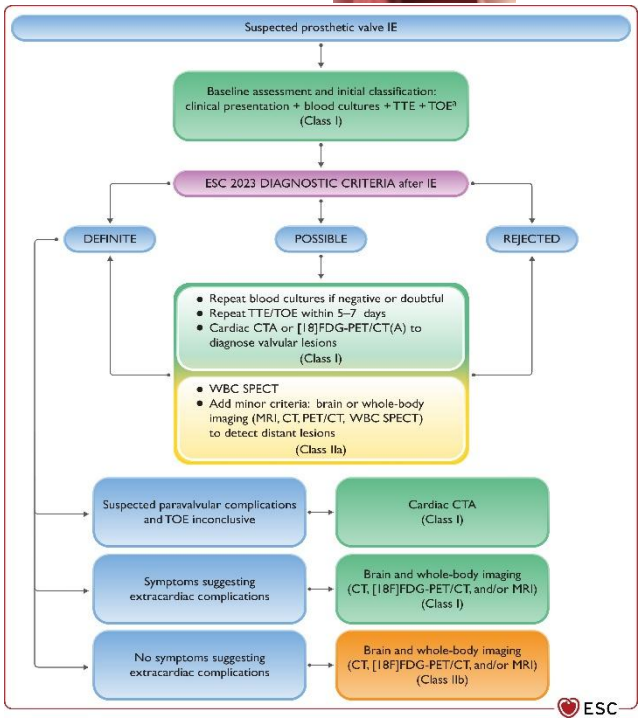
NVE



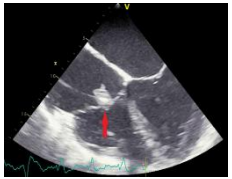


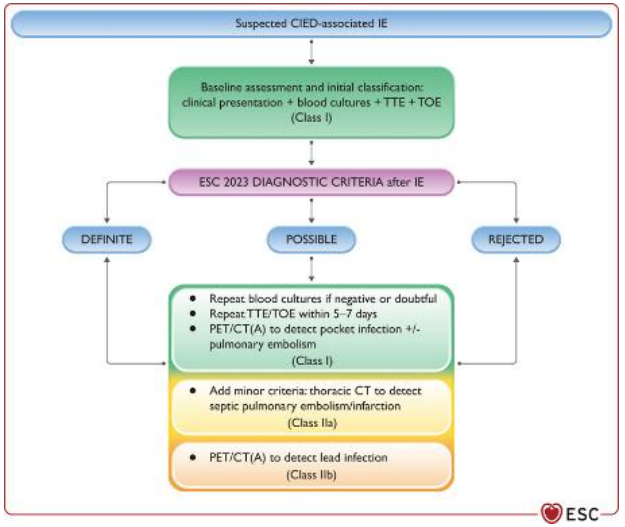
PVE





CDRIE





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°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

IE Classification (at admission and during follow-up)

Definite:

- 2 major criteria.
- 1 major criterion and at least 3 minor criteria.
- 5 minor criteria.

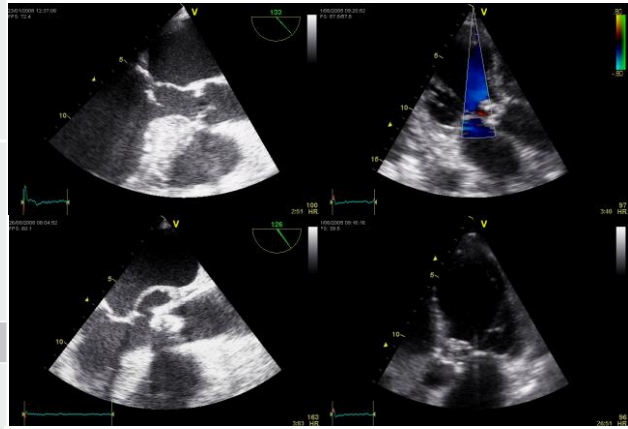
Possible:

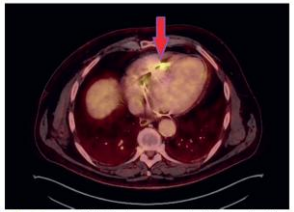
- 1 major criterion and 1 or 2 minor criteria.
- 3–4 minor criteria.

Rejected:

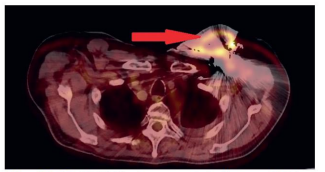
- Does not meet criteria for definite or possible at admission with or without a firm alternative diagnosis.

[18F]-FDG-PET/CT, ^{18}F-fluorodeoxyglucose positron emission tomography; CT(A), computed tomography (angiography); HACEK, *Haemophilus, Aggregatibacter, Cardiobacterium, Eikenella,* and *Kingella*; IE, infective endocarditis; Ig, immunoglobulin; PWID, people who inject drugs; TOE, transoesophageal echocardiography; TTE, transthoracic echocardiography; WBC SPECT/CT, white blood cell single photon emission tomography/computed tomography.
[a]For detailed explanation of predisposing conditions, please see *Section 3*.





Obr. 52.14 PET/CT – hypermetabolismus glukózy na elektrodě v pravé komoře, potvrzená vegetace



Obr. 52.13 PET/CT – hypermetabolismus glukózy při infekci kapsy

The new 2023 ESC diagnostic algorithms

The diagnosis of IE is based on clinical suspicion, blood cultures, and imaging findings. Echocardiography is usually the first imaging technique to diagnose IE, although the use of other techniques, either for the diagnosis of cardiac involvement (cardiac CT, [18F]FDG-PET/CT, or WBC SPECT/CT), or for the diagnosis of distant lesions (cerebral MRI, whole-body CT, and/or PET/CT), is encouraged. In the presence of prosthetic valves and CIED, echocardiography is particularly limited and the aforementioned imaging techniques are strongly recommended.

Major criteria

Enteroccus faecalis should be acknowledged as a typical endocarditis bacterium, regardless of the place of acquisition or the source of infection.
Diagnosis based on the presence of lesions characteristics of IE. Anatomic lesions and increased [18F]FDG uptake or WBC accumulation can be depicted by nuclear imaging techniques and add a major diagnostic criterion.
Abnormal prosthetic or periprosthetic uptake (intense focal or heterogeneous) detected by [18F]FDG-PET/CT or WBC SPECT/CT should be considered a major criterion for PVE, irrespective of the interval from surgery.

Minor criteria

Distant IE-related lesions include all lesions that can result from embolic events and from haematogenous seeding of bacteria. These lesions can be suspected due to specific symptoms or can be incidentally detected on imaging techniques. Spondylodiscitis is the most frequent osteoarticular infective complication in patients with IE.
Molecular biology (16S/18S rRNA PCR sequencing) in cardiac tissue or embolic material has increased the diagnostic performance of IE with negative blood culture.
Infective endocarditis classification has been added to the 2023 ESC criteria. Possible IE cases include the combination of 1 major and 1 or 2 minor criteria. Infective endocarditis classification should be applied by the Endocarditis Team at admission and later at follow-up.

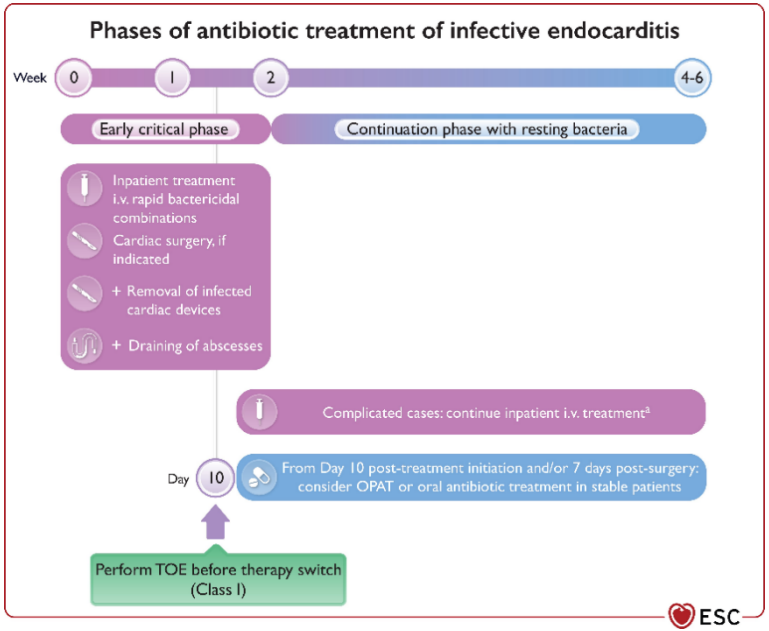
Treatment

Successful treatment of IE relies on microbial eradication by antimicrobial drugs. Surgery contributes by removing infected material and draining abscesses.

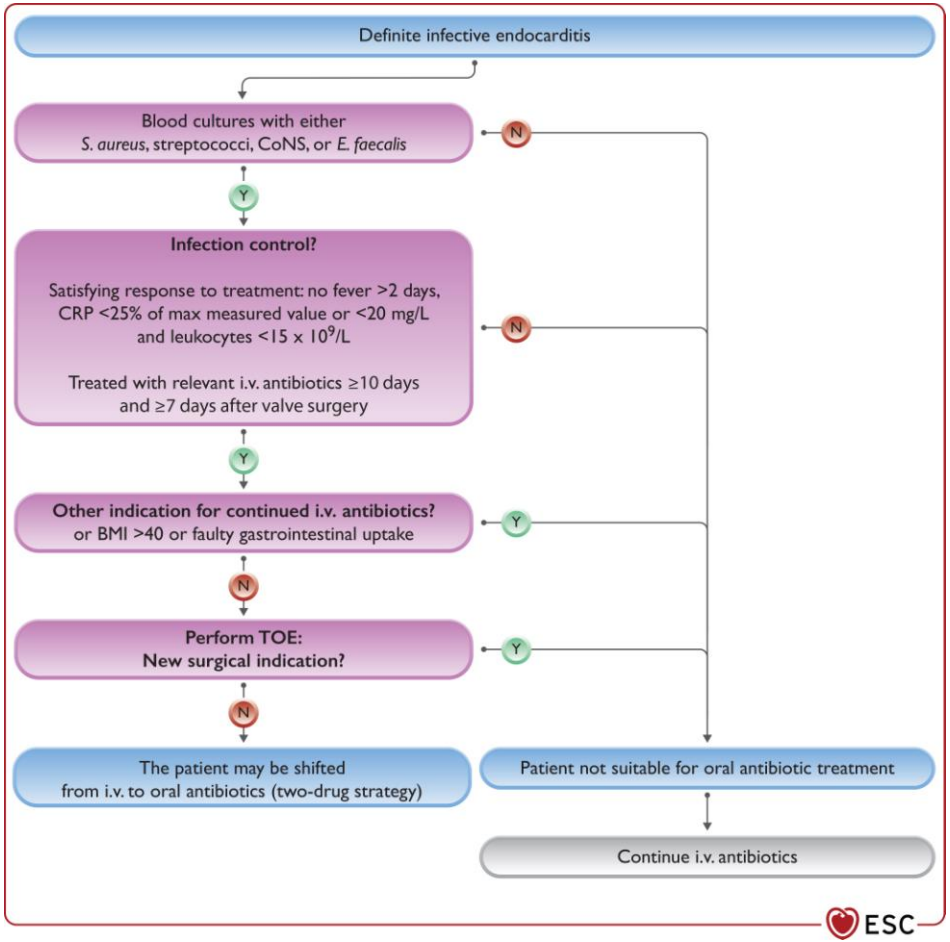
Antibiotic treatment of PVE should last longer (≥6 weeks) than that of NVE (2–6 weeks).

In both NVE and PVE, the **duration of treatment** is based on the first day of effective antibiotic therapy (negative blood culture in the case of initial positive blood culture), not on the day of surgery.

The initial choice of **empirical treatment** depends on the use of previous antibiotic therapy, whether IE is NVE or PVE (and if so, when surgery was performed [early vs. late PVE]), the place where the infection took place (community, nosocomial, or non-nosocomial healthcare-associated IE), and knowledge of the local epidemiology.



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:[255]		IIa	C
Adult antibiotic dosage and route			
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		
Paediatric antibiotic dosage and route			
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
Adult antibiotic dosage and route			
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		

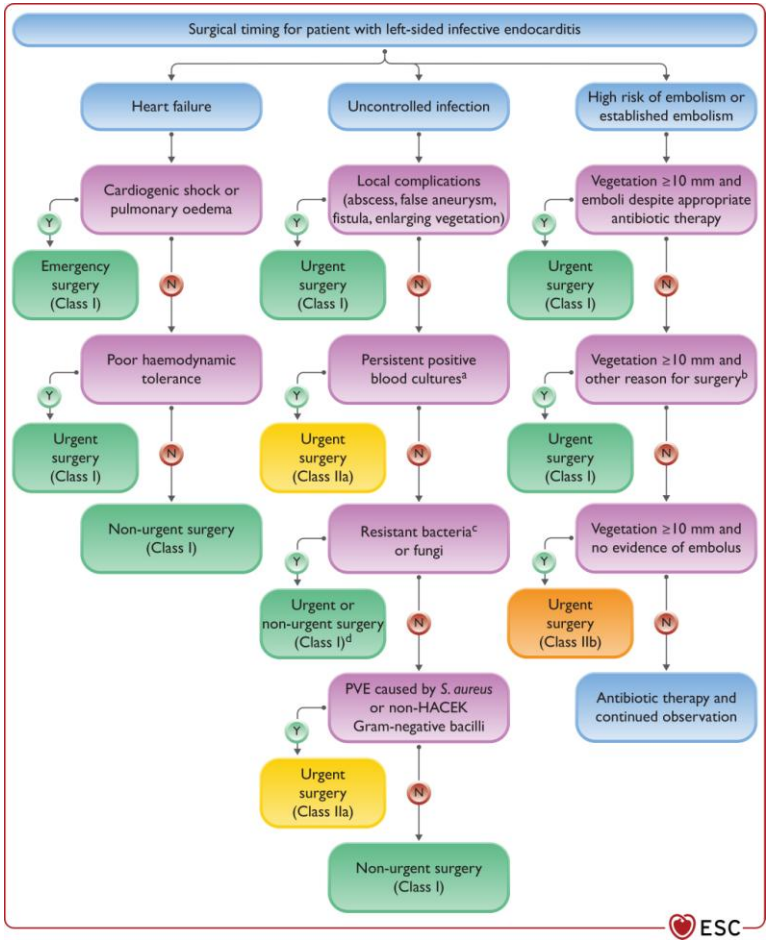


Surgery

The indication to perform invasive coronary angiography or CTA prior to surgery for IE should be based on the presence of cardiovascular risk factors in patients with aortic valve IE.

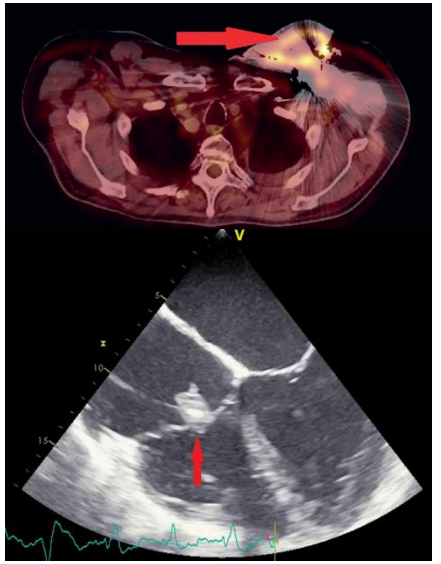
Surgery should not be delayed in patients with non-haemorrhagic stroke and clear indications for surgery. In patients with significant pre-operative haemorrhagic stroke, a delay in operative management (≥4 weeks) is generally recommended.

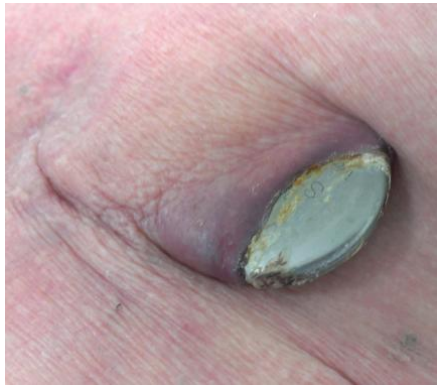
The decision of not offering surgery when indicated should be made in the setting of an Endocarditis Team.

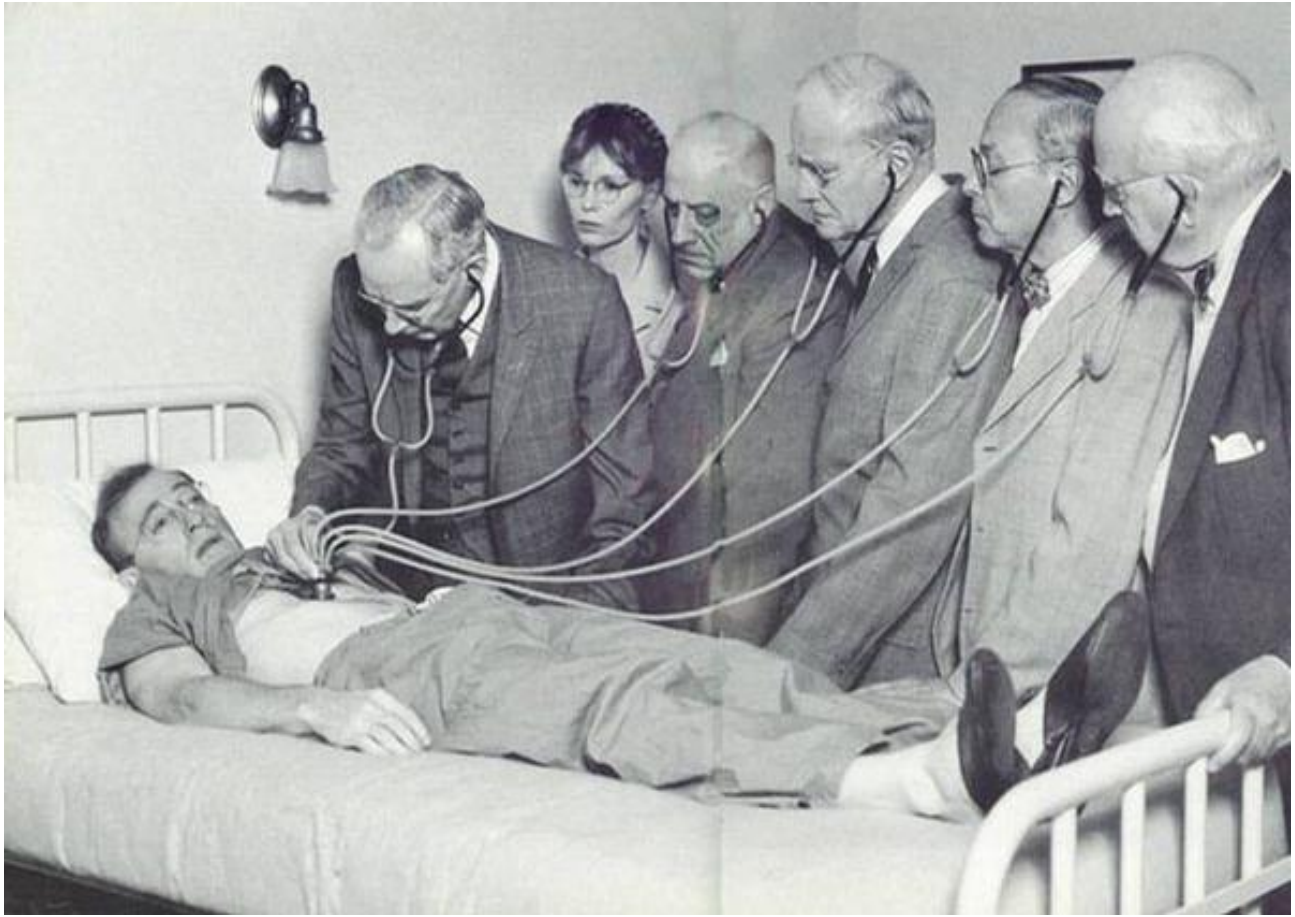


CIED-related IE

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 *S. aureus* 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
Complete hardware removal should be considered on the basis of occult infection without another apparent source of infection.	IIa	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.	IIa	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.	IIb	C
When indicated, definite reimplantation should be postponed if possible, to allow a few days or weeks of antibiotic therapy.	IIa	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







DĚKUJEME ZA POZORNOST

FAKULTNÍ NEMOCNICE OLOMOUC

KOMPLEXNÍ
KARDIOVASKULÁRNÍ CENTRUM
FAKULTNÍ NEMOCNICE OLOMOUC