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Case report

The role of transesophageal echocardiography in the diagnosis of polymer-associated infective endocarditis (PIE) in the case of a cardiac stimulator device (CRT-D) with septic arthralgia as the initial manifestation

Dan Cristian Briscan¹

¹Oradea University of Medicine and Pharmacy, Doctoral School of Biomedical Sciences, Oradea, Romania

Abstract

Infective endocarditis (IE) represents the microbial colonization of the native structures of the cardiac valve or a heterogeneous intracardiac implanted material, in our case, a probe endocarditis as part of a polymer-associated endocarditis (PIE). Sepsis is the most common syndrome seen in the intensive care unit. An underlying infection of infective endocarditis should be early included in the differential diagnosis, because this can significantly affect the patient's prognosis. Often, fever occurs on multimorbid patients with corresponding predisposing factors, such as patients with prosthetic cardiac implants, with pacemaker implants or with implantable cardioverter defibrillators, patients after a hemodialysis catheter implant or after the placement of the central venous catheter. Infective endocarditis can be easily ignored in case of urosepsis associated with a nephroureteral drain catheter or in case of cholecystitis with cholecystolithiasis. A detailed anamnesis cannot be made on a patient with sepsis, dementia or drug abuse. The anamnesis made by interviewing other persons can also be insufficient if, for example, the patient lives alone or in a nursing home. In case fever of unknown origin appears associated with recurrence or an aggravated heart murmur, dyspnea on exertion or on rest, headache, general fatigue, weight loss, appetite loss, night sweats, myalgia or arthralgia with/without other symptoms such as Janeway lesions, Osler nodes, splinter hemorrhages, the family doctor must refer the patient to the hospital for subsequent explanations, i.e. for diagnosis.

In case of negative results when searching for the so-called infection outbreak, respectively in case of recurrent fever/ sepsis, the differential diagnosis of infective endocarditis in an early stage must be considered. Additionally, an interdisciplinary co-assessment should be made by the dentist, the urologist and the gynecologist. The gold standard of the microbiological diagnosis of sepsis reveals bacteremia in the context of infective endocarditis with typical pathogens in blood cultures. However, in case of suspicion of infective endocarditis or of a genesis associated with a catheter, besides more blood culture pairs drawn through peripheral venepuncture, a blood culture from the central venous catheter (CVC) must be also drawn. Additionally, as part of the gold standard in the diagnosis of infective endocarditis, the detection of a cardiac lesion of the endocardium using transesophageal echocardiography (TEE) as the main method, except involving the tricuspid valve, when using the transthoracic echocardiography (TTE) makes it more obvious. The diagnostic assistance is provided through the Duke criteria.

The gold standard for the treatment of infective endocarditis is 4 weeks of intravenous antibiotic therapy or, if it involves a polymer material or if associated with a catheter, it means 6 weeks of intravenous antibiotic therapy. If making a diagnosis or determining a therapy becomes difficult, one should quickly accept the help given by a higher competence center. According to the indications given by the specialized team, an early surgical intervention for surgical rehabilitation seems to be a favorable prognosis and it can improve both the therapy and the prognosis. In polymer or catheter-associated endocarditis, the immediate and complete removal of the entire polymer material, the entire implant and the catheter, represents a therapeutic standard. By examining the coronary angioplasty, one can additionally distinguish a deposit of contrast media on the infected heart valve prosthesis in case of infective endocarditis. If bacteremia of unknown origin, fever and the joint pain occur, one must take into consideration infective endocarditis as part of the differential diagnosis and make the right diagnosis in order to exclude it.

Keywords

: transesophageal echocardiogram, polymer-associated endocarditis, catheter-associated endocarditis

Highlights

- ✓ Infective endocarditis is a very complex and rare disease, which, if left treated, may become fatal.
- ✓ The gold standard in the microbiological diagnosis of sepsis is a proof of bacteremia in the context of infective endocarditis with typical pathogens in blood cultures.

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*Corresponding author: Oradea University of Medicine and Pharmacy, Doctoral School of Biomedical Sciences, 1 Universității Street, Oradea, Bihor, Romania, 410087

E-mail: briscan.dancristian@yahoo.de

Introduction

Infective endocarditis

Infective endocarditis appears as a microbial endocarditis or an endovascular infection, preferably bacterial of the cardiovascular structures. This is characterized by specific lesions that appear on the inflammation spot, vegetation that consists in the accumulation of platelets, fibrin, micro colonies of microorganisms and inflammatory cells (1). As for the preferable site, the native heart valves prevail because here there is a higher frequency of heterogeneous intracardial implanted materials, such as the infection of the artificial cardiac valves (heart valve prosthesis) or of the cardiac stimulation probes of a Pacemaker. There is a difference between the endocarditis of the native cardiac structures and of a heterogeneous material, for example of the stimulating electrodes or of a prosthetic valve, in case of associated endocarditis. The less frequently affected structures include the endocardium at the ventricular or atrial level, as well as the large blood vessels from near the heart. Infective endocarditis is considered active in case of persistent symptoms of the infection and bacteremia, with the detection of the intraoperative pathogen or with macroscopic/ histologic evidence of the inflammation, before the end of a proper therapy (2).

Infective endocarditis can be divided into four categories, considering the risk factors depending on the predisposing factors. Thus, one can distinguish between: infective endocarditis of the native valve due to its previous deterioration, infective endocarditis of the prosthetic valve, infective endocarditis in case of drug addicts due to intravenous administration and nosocomial infective endocarditis. Here we can mention a new developmental category, with an increased incidence of endocarditis among hemodialyzed patients (3).

Besides these, the frequent use of intravascular heterogeneous prosthetic materials, such as Pacemakers, implantable defibrillators, chemotherapy port systems with implantable cameras or heart valve prostheses represent another risk factor in the development of infective endocarditis. Moreover, we should also mention that the standard procedures in intensive care place a central venous catheter (CVC) and administer the hemodialysis treatment, as well as a specific local pathogen spectrum with a new important role in the development of "nosocomial" infective endocarditis. In case there is a suspicion that the origin of endocarditis is catheter-related, a blood culture should be drawn from the central venous catheter (CVC) in addition to the blood culture drawn through puncture from a peripheral vein. The catheter

should be immediately removed and its point should be microbiologically examined. The duration of use of a central venous catheter (CVC) has been identified as a risk factor for bacterial colonization (4). Many studies have investigated the fact that a routine replacement of the central venous catheter can reduce the risk of catheter-related infection. To resume, we could say that the change of the catheter or a new central venous catheter should only be made in case of a clinical suspicion of infection (5). The necessity of preserving the central venous access must be revised on a daily basis.

Infective endocarditis is a very complex disease, with a possibly lethal course, whose diagnosis and therapy need the experience of experts in cardiovascular imaging, cardiology, cardiac surgery, infectiology, neurology and other fields, such as nephrology.

Epidemiology

The incidence of infective endocarditis in Europe ranges from 3 to 30/ 100,000 patients per year, with a more frequent incidence in men, with a men: women ratio of 2:1 (6, 7). Infective endocarditis is a severe disease, even fatal if no proper treatment is being initiated. The death rate is 20-25% (8) and it depends on: clinical factors, causing agents, diagnostic time and the onset of the proper therapy (2). The current death rate in Germany is up to 18%, with an average hospitalization time of 42 ± 29 days and diagnostic latency of 29 ± 35 days (9). The surgical intervention during active infective endocarditis occurs in more than 30% of the patients (9). The increased usage of ICD and CRT systems, and the stimulation for cardiac defibrillation respectively, as well as the usage of conventional stimulators that stimulate one chamber of the heart (uni-chamber) or two (bi-chamber), the complications associated with all these become more and more important. In comparison with conventional cardiac stimulation systems and ICD, CRT systems have a higher pre-surgical (13.8%) and post-surgical (10%) complication rate (10, 11). The risk of infection of the cardiac stimulation system (infection at the level of the generator, probe endocarditis) rises to 0.25 – 2.1% (12 - 15).

Case report

Diagnosis

Anamnesis / Clinical Examination

The patient, aged 80 years, was first brought by ambulance to the ambulatory surgery center of our hospital in August 2018 because he complained of severe pain in the left knee after he had fallen on it. The patient had a high fever, over 39^o C, and thus he was admitted to the internal

medicine unit for further examination of his feverishness, after excluding a surgical origin of the knee pain, as well as a fracture at the level of the knee. The patient's fever seemed to have been associated with bilateral knee arthralgia for several days, decreased vigilance and the impossibility of standing and walking. The patient had no dyspnea, thoracic pain, palpitations, heart murmur, skin changes, skin lesions, Osler nodes. The examination of the knee joints did not reveal any bilateral pathology.

The patient is also known for dilative cardiomyopathy with a very restricted systolic function of the left ventricle, coronary artery disease, persistent atrial fibrillation with functional status after the electrical cardioversion in 2012, with oral auto-coagulation with Marcumar with CHA2DS2-VASc high score and drug therapy with amiodarone, left bundle branch block, with an onset of moderate mitral regurgitation, with functional status after the implantation of a cardiac stimulator on DDD mode (series Medtronic DR) because of a third-degree atrioventricular block in 2001, revised in 2013 most probably because a defibrillator device (CRT-D) was implanted. The patient was not able to tell us the history of his own pre-existent diseases. Cardiovascular risk factors: high blood pressure, obesity, hyperlipidemia. The implantation of a cardiac resynchronization device equipped with a defibrillator (CRT-D) and the administration of amiodarone therapy is most probably justified because of the ventricular tachyarrhythmia with/as part of chronic heart failure simultaneous with persistent atrial fibrillation and left bundle branch block.

The first hospitalization of this patient on the intensive care unit of our hospital occurred in 2015. The patient suffered from acute renal failure in the context of pre-renal genesis, concomitant hyperpotassemia, under therapy with spironolactone as well as metabolic acidosis. Moreover, the patient has had episodes of recurrent diarrhea for several months. The echocardiogram reveals the dilation of the left ventricle with a final diastolic diameter of the left ventricle of 69 mm, with a left ventricular ejection fraction globally limited to 30-35%, without hypertrophy, with a slight dilation of the left and right atria, normal right ventricle, with a normal morphological and functional valve apparatus except moderate mitral insufficiency, systolic pulmonary arterial pressure impossible to measure, normal inferior vena cava of 0.8 cm, with collapse during exhalation. The patient had no heart rhythm disorders while he was monitored on the intensive care unit. There were no complications during hospitalization and the patient was discharged after 8 days. He was referred to the nephrologist for further examination, assessment and management of the chronic kidney disease.

On February 2018, the patient was referred to the hospital by his family doctor because his general health status had got worse. He was hospitalized for 3 days. It was impossible for him to stand or walk because of the great pain he experienced on both his knee joints. As for the patient's pre-existent diseases, the replacement of the device for cardiac resynchronization equipped with a defibrillator (CRT-D, Quadraassura cd 3371-40qc, series 12260xx) was considered in 2017, after the cardiac stimulator implant in DDD mode (series Medtronic DR), because of the third degree atrioventricular block in 2001, revised in 2013 most likely because a defibrillator device had been implanted (CRT-D). After the laboratory tests, the diagnosis was made: sepsis with proved infection with gram-positive diplococci in blood cultures, this being the cause for the patient's symptoms. Because of the patient's decreased vigilance, in the context of sepsis with dehydration, a cranial CT scan with neurological co-assessment was performed. Thus, an acute cerebral infarction, i.e. a cerebrovascular accident, was excluded. After 7 days of intravenous antibiotic therapy with Unacid (Unasyn – sulbactam and ampicillin) and the dose adapted to his kidney failure, the patient's general health state improved and, as seen in the laboratory tests, the infection signs had completely disappeared. The knee pain had also disappeared and its origin was set to be part of high degree gonarthrosis and retro patellar arthrosis through proved changes at the level of the respective structures seen on the X-ray. Because of the very high INR parameter associated with sepsis, the treatment with Marcumar has been temporary interrupted. With the aid of the abdominal sonography, a nephroureteral drain catheter was found. The patient declared during anamnesis that it had been implanted more than 8 months before. This nephroureteral drain catheter may be the cause of sepsis. Additionally, cholecystolithiasis without clinical or sonographic signs of cholecystitis was found.

After 8 days, the patient was discharged from the hospital. He was advised to consult a urologist as soon as possible for additional specialized assessment, respectively for changing the nephroureteral drain catheter.

The Results of Laboratory Tests

At that time, lab test results revealed: high level of Procalcitonin (PCT) – over 100, leukocytosis with over 44,000/ μ L white blood cells, significantly increased transaminase and INR level due to sepsis.

Blood Cultures

The blood cultures harvested were positive, showing that the infection was the result of gram-positive diplococci already detected in the patient’s blood culture that was drawn for sepsis in February. When hospitalized, he received an intravenous antibiotic treatment with ceftriaxone and, thus, the infection parameters significantly decreased and there was no other record of fever.

Imaging Diagnosis

On the transthoracic echocardiography (TTE), abdominal sonography and radiological test, no cause or focus of infection was detected.

The assessment of the echocardiographic parameters together with the clinical and microbiological ones, always represents the decisive factor in making the diagnosis. The compulsory assessment of left and right ventricular functions is useful for the early detection of heart overloading or of septic cardiomyopathy.

Duke criteria are widely used in clinical practice in order to diagnose infective endocarditis, based on the clinical, echocardiographic and microbiological results.

Used for the first time in 1994 and then subsequently modified (modified Duke criteria), these criteria are characterized by high sensitivity (> 80%) (16, 20, 22), excellent peculiarity (99%) (17), as well as a high negative predictive value (> 90%) (18).

According to current diagnostic guidelines, an important role in making the tentative diagnosis and in searching the focus of infection is played by both transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE). Since echocardiography provides only morphological and functional information, a common assessment of all clinical information and lab parameters is also important (19).

Indications for transesophageal echocardiography (TEE) (21):

1. On patients with an inadequate quality of the transthoracic echocardiography
2. Special questions
 - Fever of unknown origin / infective endocarditis
 - Prosthetic heart valve malfunctions
 - Severe aortic stenosis, mitral regurgitation

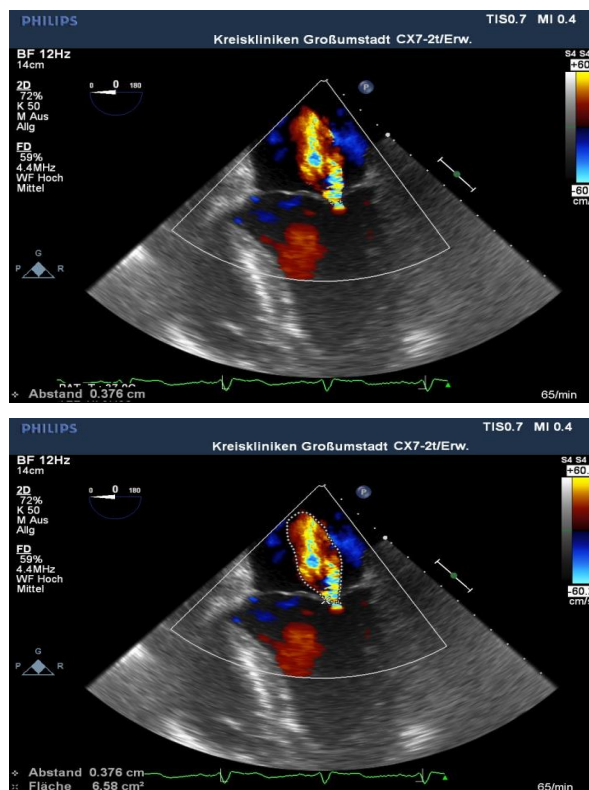


Figure 1. Accurate representation through TEE of a mitral valve moderate insufficiency

- Congenital heart defects (pre- and post-operative)
- Acute thoracic pain / aortic dissection / pulmonary embolism
- Embolism / thrombosis / cardiac tumors

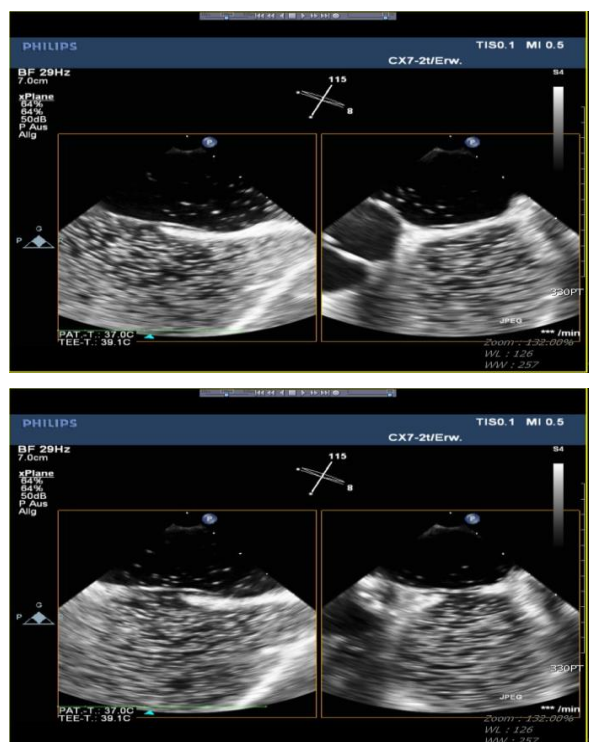


Figure 2. Representation and diagnosis through TEE of patent foramen ovale (PFO)

- Intra-operative monitoring / left ventricular function / post-operative result

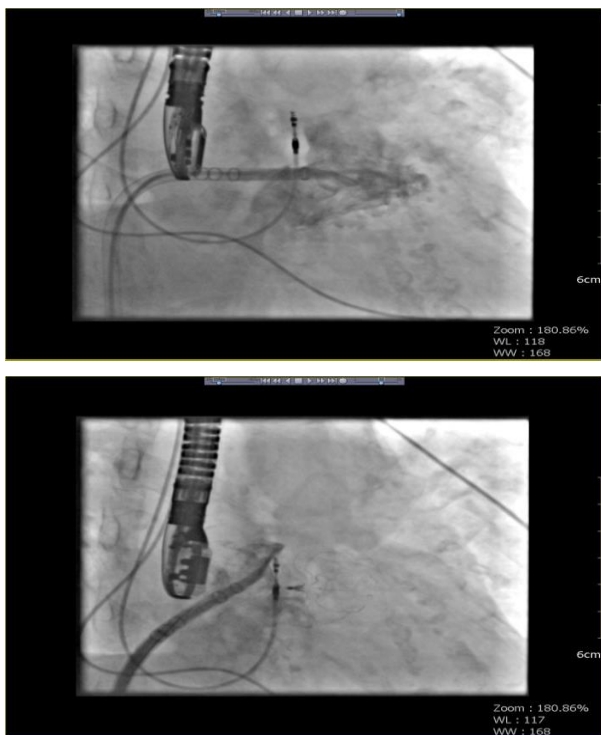


Figure 3. Guidance through TEE for implanting a 27mm Watchman occlusion device

- Explaining hypotension (low blood pressure) / hypoxia in the intensive care unit

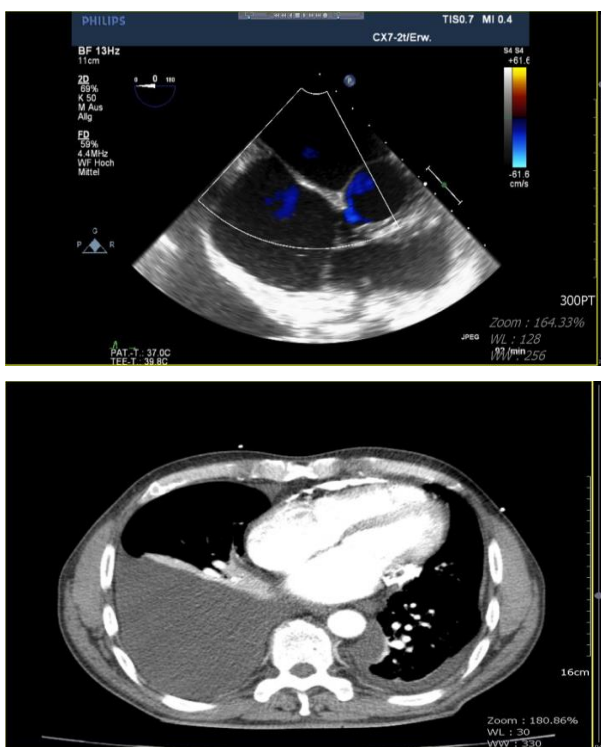


Figure 4. Representation of constrictive pericarditis, of pericardial calcification through TEE and of strong pericardial calcification through thoracic computed tomography

- “TEE guided cardioversion” of atrial fibrillation
- Before / during interventions: mitral valve valvuloplasty procedure (MVP), patent foramen ovale (PFO)

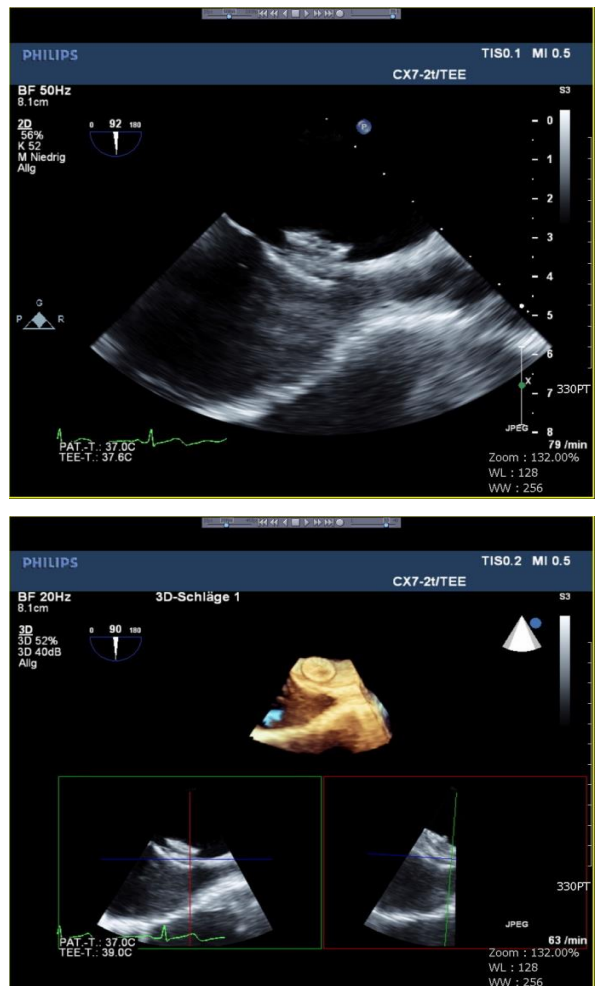


Figure 5. PFO closing with a PFO-Amplatzer occlusion device (25 mm), TEE controlled

The most frequent signs are fever of unknown origin, the functional assessment of the artificial heart valve and cardioembolism suspicion. In the operating room, the function of the ventricle is being monitored on patients at high cardiac risk or who undergo certain special surgical techniques, thus leading to surgical success (including the mitral valve reconstruction and the complex correction of cardiac vices). The transesophageal echocardiography (TEE) is used in the intensive care unit to assess patients with mechanical ventilation and to explain hypotonia or hypoxia or indefinite thoracic pain (aortic dissection, pulmonary embolism) (23).

As a rule, the transesophageal echocardiography (TEE) should be used for a complementary examination – and not as an alternative technique – to the conventional transthoracic echocardiography. It should be dedicated to patients whose transthoracic echocardiogram has an improper image quality or for specific questions. The

transesophageal echocardiography (TEE) should be done to all patients in case the transthoracic echocardiography is not possible or its quality is inadequate.

Resolution and image quality are often greater than those of conventional transthoracic echocardiography, especially on obese patients or those with pulmonary emphysema, patients on mechanical ventilation present in intensive care unit or patients with functional status after thoracic surgery. Moreover, it facilitates the representation of the esophagus on certain plans and structures that are usually transthoracically limited or barely visible, such as: the left atrial appendage, the superior vena cava, the pulmonary artery bifurcation and the thoracic aorta (except when passing from the ascending aorta of the aortic arch) (24).

Therefore, echocardiography and especially the transesophageal echocardiography (TEE) are not suitable for screening, but they are important for the diagnosis only if the endocarditis suspicion is well-grounded. Transesophageal echocardiography (TEE) is considerably superior to transthoracic echocardiography (TTE) from the sensitivity point of view, especially when assessing cardiac prosthetic devices (1). The sensitivity of transesophageal echocardiography (TEE) in comparison with transthoracic echocardiography (TTE) is represented with over 90% in comparison with less than 70% in case of native valves and with over 80% in comparison with less than 30% in case of cardiac prosthetic devices (25). The representation of the transcupid valve that refers to the transthoracic approach is an exception (26).

The transesophageal echocardiography (TEE) is a semi-invasive technique, which causes discomfort to conscious patients. The general risk of complications associated with the transesophageal echocardiography (TEE) decreases under 1% (27), the most frequent ones being reversible heart arrhythmia, low or high blood pressure, vasovagal reactions, bronchospasm, angina pectoris or hypoxia and, in some isolated cases, esophageal perforations. They have been described as perforations that can endanger someone's life. For patients with acute aortic dissection there is an additional risk of aortic rupture or pericardial tamponade due to the sudden increase in blood pressure, thus the examination should be done under sedation and blood pressure must be measured. If necessary, a medication treatment should follow. The risk of bacteremia associated with TEE is negligible (28).

The gold standard in the diagnosis of infective endocarditis is bacteremia determination with typical pathogen agents through blood cultures, as well as through the echocardiographic detection of vegetation on the

internal cardiac structures. Sepsis represents the most common disease in the intensive care unit. Underlying infective endocarditis should be early included in the differential diagnosis, because this can significantly affect the patient's prognosis. Echocardiography must be only done for patients with intermediate or high clinical suspicion of infective endocarditis (29). The chosen medical imaging technique is transesophageal echocardiography (TEE). On qualified hands, the detection of vegetation and even some small abscesses is possible in a very high percentages (30, 31, 32). The echocardiographic signs of endocarditis are represented by additional structures that are mobile and adherent on cardiac valves, other are endocardially or intracardially implanted, valvular or paravalvular abscess formation, as well as pseudo aneurysm or new dehiscence of prosthetic valves with paravalvular leakage. Complementary to the established methods, a 3D echocardiography can provide additional information in real time images about the size of vegetation, abscess extent and chordal rupture (33, 34). This information can be important for the surgical planning and it can allow the assessment of the risk of embolism occurrence. Moreover, a 3D echocardiography is suitable to locate paravalvular leaks. Infective endocarditis leads to characteristic changes in the native or prosthetic cardiac valves in about 95% of the cases (35).

In case of initial negative results, but with continuous clinical suspicion of infective endocarditis, the transesophageal echocardiography must be done again. Current proceedings mention a period of 5 to 7 days until the transesophageal echocardiography should be done again. Thus, the comparative period of previous proceedings has decreased (36). Even in the case of positive transesophageal echocardiography, a repeated examination could be useful in order to assess the vegetation size during its evolution. The sensitivity of transesophageal echocardiography in vegetation determination is so high that it actually excludes the diagnosis of infective endocarditis if we were to exclude the vegetation through transesophageal echocardiography. It should be stated that an echocardiographic examination done very early in case of endocarditis can provide false negative results due to the vegetation's insufficient size. However, if a second transesophageal echocardiographic exam continues to provide "negative" results, endocarditis is unlikely to be present (37, 38). Taking into consideration the fact that most of the examinations were done on a small number of patients with endocarditis, it can explain a great number of false positive or false negative results. In case of doubt, a center with greater experience must be consulted in order to co-assess the results of echographic imaging.

If echocardiography does not give enough certainty in making the diagnosis, other imaging methods can help. The evolution of nuclear medicine techniques is of great importance: white blood cell radioactive marking in single-photon emission computed tomography (SPECT) or in fluorine 18 fludeoxyglucose positron emission tomography (18F-FDG-PET). Each one of these, merging with conventional imaging from computed tomography make the detection of intra- or extra-cardiac inflammatory outbreaks possible (39). Thus, as a result, diagnostic sensitivity can be higher especially on prosthetic valve endocarditis (40, 41). However, we should remember the fact that the result of the examination has a very limited significance on the first three months after the surgical intervention for valve replacement, because of the nonspecific perivalvular inflammatory reactions.

In the cardiac catheterization laboratory, interventions cannot be put into practice without concomitant TEE in mitral valvuloplasty to exclude intra-atrial thrombus (42) or an open foramen ovale closure. On patients with atrial fibrillation and without previous anticoagulation disorders, the concept of “TEE guided” cardioversion can be used in order to exclude the widespread intra-atrial thrombus (43).

TEE and TTE are complementary examinations that are part of the clinical examination, thus being diagnostic measures with a high sensitivity and which must be done in case of typical symptoms or in case of septicemia of uncertain etiology in order to find the infection outbreak (44).

The results of the examination through TEE when searching for the infection outbreak have demonstrated the strong existence of fluoride endocarditis at the level of the cardiac stimulator probes, therefore, the antibiotic treatment has been supplemented with gentamicin, the dose being adjusted for renal failure. Later, because of an acute delirium, the patient has been transferred to a cardiac center specialized in removing units and probes when diagnosed with probe endocarditis.

TEE representation of two echodense mobile vegetations sized 20x11 mm and 13x9 mm as part of endocarditis associated with cardiac stimulator probes.



Figure 6. Excluding intra-atrial thrombus at the left atrial appendage level





Figure 7. Endocarditis associated with heterogeneous intracardiac implanted materials

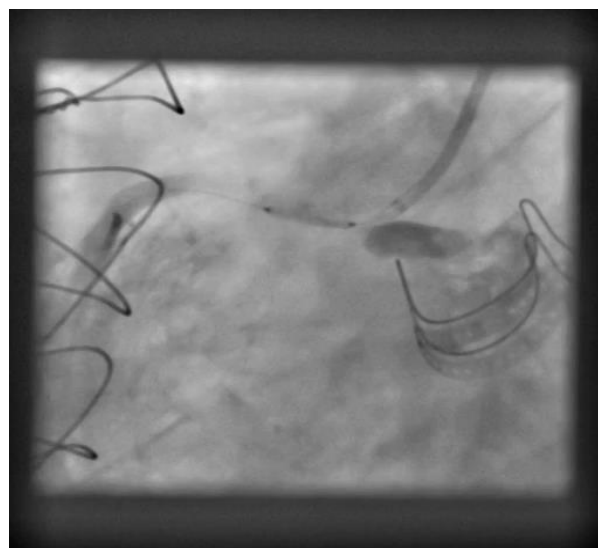
Infection at the level of intracardiac implanted polymers (PIE) - for example, at the level of the prosthetic valve (PVE) or at the level of intracardiac segments of the cardiac stimulator probes – are predisposed to complications. They usually have an unfavorable prognosis in comparison with the ones at the level of native valves caused by identical pathogen species.

On completion of the antimicrobial therapy for infection at the level of intracardiac implanted polymers (PIE), some problems may appear due to the interaction of polymer materials, biofilms and bacterial adhesion surfaces (45).

Particularly, coagulase negative staphylococci produce an extracellular mucous membrane (glycocalyx), with a conditioned resistance to antibiotics, thus, in order to pass its diffusion barrier, one needs serum levels of in vivo antibiotics that cannot be obtained (46). Therefore, the standard therapy is the immediate and complete removal of all polymeric materials, that is of the whole implant (in case of endovascular infections, the implanted electrodes and the unit). TEE becomes compulsory in case of a possible involvement of the polymeric material in the infection process, as well as in the case of native valve acute endocarditis, which becomes an urgent surgery.

Representation through coronary angiography

Percutaneous coronary angiography with direct implant of a stent into the ostial right coronary artery, due to ostial thromboembolic subtotal occlusion, is mandatory in case of acute coronary syndrome without ST segment elevation. An additional mobile structure becomes obvious. It deposits the contrast media in prosthetic valve infective endocarditis (PVE).



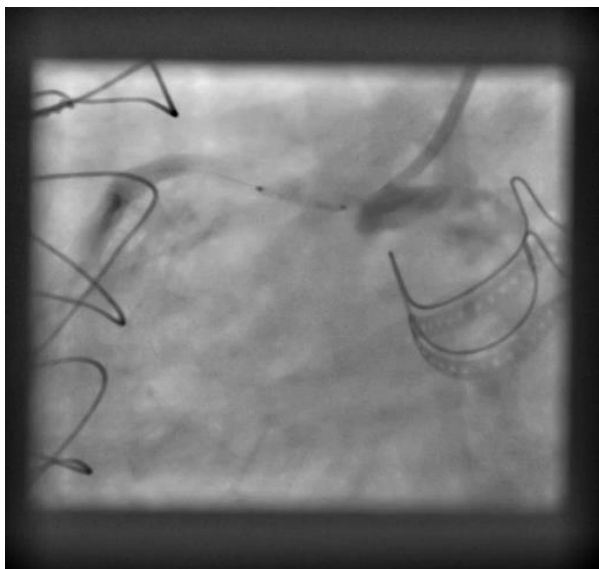


Figure 7. Prosthetic valve infective endocarditis (PVE) represented through coronary angiography

Imaging diagnosis, especially echocardiography, has an essential role in diagnosis, in antibiotic therapy assessment and after the surgical treatment (47, 48).

Acute central embolism represents a severe complication during infective endocarditis and it is correlated with increased morbidity and mortality (49).

A frequent complication of IE is systemic embolism (in 20-50% of all cases of endocarditis). The brain and the spleen are the most affected organs in left heart endocarditis. Right heart endocarditis first embolizes into the lungs. There are only few examples in the specialized literature about the phenomenon of paradoxical systemic septic embolism of the right heart, i.e. endocarditis with patent foramen ovale (50).

Besides the embolic events and the diffuse glomerulonephritis, acute renal failure may occur during IE caused by a prerenal or toxic mechanism, the therapy with antibiotics being a cofactor. Continuous hemofiltration (CVVH) is the treatment of choice. No matter the etiology, the occurrence of acute renal failure indicates a dramatic deterioration of the prognosis, and that is why the early surgical intervention becomes very important (51).

Microbiological results. Therapy. Antibiotic therapy.

The antibiotic treatment with clindamycin was administered for 7 days and ampicillin/sulbactam for 6 weeks according to the antibiogram for probe endocarditis of the system CRT-D and for the microbiological determination of *Streptococcus sanguis*, after the complete removal of the unit and the probes.

Polymicrobial endocarditis

A microbial etiology is found in 3-4% of the cases of endocarditis. The risk factors include intravenous drug

abuse and prosthetic valves (52). The therapy is according to the resistance results and it will especially include a combination of bactericidal antibiotics. An early surgical intervention must be taken into consideration. The histopathological evaluation of the cardiac valves in order to determine vegetations, inflammatory reactions and microorganisms continues to be very important in the diagnosis of endocarditis (53).

We discussed in detail with the patient and his relatives about the need of a new defibrillator implant.

Discussions and Conclusions

Infective endocarditis is a very complex and rare disease, which, if left treated, may become fatal.

In order to prevent the morbidity and lethality of infective endocarditis, a diagnosis made in time becomes necessary, as well as a rapid and oriented therapy. Diagnostic assistance is possible due to Duke criteria.

Multidisciplinary. Thus, the experts' experience in cardiovascular imaging, cardiology, cardiac surgery, infectiology, neurology and other fields such as nephrology, becomes necessary in diagnosing and treating infective endocarditis.

From the point of view of the risk and predisposing factors, infective endocarditis can be divided into four categories. Thus, we can distinguish between:

- Infective endocarditis of previous deteriorated native valves

- Infective endocarditis due to a heterogeneous intracardial implanted material, such as artificial prosthetic valves or cardiac stimulation probes, in case of associated infective endocarditis

- Infective endocarditis occurring in case of drug addicts who use intravenous administration

- Nosocomial endocarditis occurring during the intensive care standard procedures, such as the use of central venous catheter (CVC) and during the hemodialysis treatment when endocarditis is associated with a catheter.

In case of fever of unknown origin associated with recurrence or an aggravated heart murmur, dyspnea on rest or on exertion, headaches, general tiredness, weight loss, appetite loss, night sweats, myalgia and arthralgia with/without other signs such as Janeway lesions, Osler nodes, splinter hemorrhages, the patient must be referred to the hospital by the family doctor for further explanation, i.e. for diagnosis.

The results of laboratory tests for patients on the geriatric unit reveal leukocytosis, increased values of BSG and CRP with clinical symptoms such as night sweats. That is why additional examinations are necessary, for example,

extended laboratory and imaging diagnosis as part of the differential diagnosis.

A detailed anamnesis is usually not possible in case of a patient with sepsis, dementia or drug abuse. Anamnesis made by interviewing other persons can also be insufficient if, for example, the patient lives alone or in a nursing home.

In case of negative results when searching for the so-called infection outbreak, respectively in case of fever of unknown origin, recurrent fever / sepsis, the differential diagnosis of infective endocarditis must be early considered. Additionally, an interdisciplinary co-assessment should be made by the dentist, the urologist and the gynecologist.

The gold standard in the microbiological diagnosis of sepsis is a proof of bacteremia in the context of infective endocarditis with typical pathogens in blood cultures.

Additionally, as part of the gold standard in the diagnosis of infective endocarditis, the detection of a cardiac lesion of the endocardium using transesophageal echocardiography (TEE) as the main method, except involving the tricuspid valve, can be better done by means of transthoracic echocardiography (TTE).

The gold standard in the treatment of infective endocarditis or in catheter-related endocarditis is intravenous antibiotic therapy for 4 weeks and for 6 weeks for the one caused by polymeric material.

Sepsis represents one of the most common problems in the intensive care unit. Endocarditis should be early included in the differential diagnosis, because this can significantly affect the patient's prognosis.

If it becomes difficult to make the diagnosis or to decide the proper therapy, one must quickly ask for help at a higher competence center.

According to the indications given by the specialized team, an early surgical intervention for surgical rehabilitation seems to be a favorable prognosis and can improve both the therapy and the prognosis.

An emergency surgical intervention is necessary if some complications appear in infective endocarditis.

In polymer or catheter associated endocarditis, a therapeutic standard is represented by the immediate and complete removal of the entire polymer material, the whole implant, i.e. the catheter.

If bacteremia of unknown etiology, fever and joint pain are present, one should take into consideration the presence of infective endocarditis as part of the differential diagnosis and should make the right diagnosis in order to exclude it.

Probe endocarditis represents a complication, part of the late postoperative complications after the cardiac stimulator implant with an infection rate of 0.5%, a

complication rate at the level of the probe of 5%, with an overall complication rate of 5-10% out of the total number of 9,077 new implants, 2,685 unit changes and 1,532 cardiac stimulator revisions made in the federal state of Bavaria in 2016.

By examining the coronary angioplasty, an increased deposit of contrast media can be additionally distinguished on the infected prosthetic valve in case of infective endocarditis.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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