

THE ROLE OF MULTIMODAL IMAGING IN A CASE OF INFECTIVE ENDOCARDITIS ... WITH SURPRISES AND HAPPY ENDING

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Abstract

Infective endocarditis, a potentially fatal condition and a serious public health problem can be difficult to diagnose due to non-specific symptoms. Thus, the multidisciplinary approach to this pathology by the Endocarditis Team is essential for optimizing management and reducing mortality. Echocardiography is the main way to diagnose an infective endocarditis. Coronary CT angiogram is an alternative to invasive coronary angiography for the preoperative evaluation of the coronary status in patients with aortic valve affected by the infectious process. We hereby present the case of a 45-year-old patient known with a bicuspid aortic valve, diagnosed with mitral valve and aortic valve infective endocarditis, complicated with valvular ruptures and severe bivalvular regurgitation 5 months after the onset of an intermittent febrile syndrome, identified and treated as bronchopneumonia in another hospital.

Methods: Multimodal imaging helps to confirm the diagnosis. Echocardiography, both transthoracic and transesophageal, is the main diagnostic method. Coronary CT angiogram reveals severe bicoronary lesions with "high risk" atheroma plaques.

Results: After a complex double valve replacement with mechanical prostheses, two aorto-coronary bypass and prosthetic aortic replacement of the ascending thoracic aorta, the result was excellent and the patient was discharged without clinical symptoms of heart failure at rest and during exertion. At the 1-month postoperative follow-up the patient had no symptoms and the transthoracic echocardiography showed the improvement of the systolic dysfunction of the left ventricle.

Conclusions: Multimodal imaging plays an extremely important role in the diagnosis of infective endocarditis and associated pathologies. Although the surgical risk is very high in this type of interventions, the patients can well overcome the operative moment and can be quickly socio-professionally reintegrated. The multidisciplinary evaluation of these complex patients is



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mandatory to find the best management strategy for such cases.

Keywords: infective endocarditis, vegetation, multimodal imaging, endocarditis team, febrile syndrome, cardiac surgery

Rezumat

Endocardita infecțioasă, afecțiune cu potențial fatal și o serioasă problemă de sănătate publică, poate fi uneori greu de diagnosticat din cauza simptomelor nespecifice. Astfel, abordarea multidisciplinară a acestei patologii de către Endocarditis Team este esențială pentru optimizarea managementului și reducerea mortalității. Ecocardiografia este elementul principal din imagistica multimodală pentru diagnosticul endocarditei infecțioase. Angio-CT coronarian reprezintă o alternativă a coronarografiei pentru evaluarea statusului coronarian preoperator la pacienții cu valva aortică afectată de procesul infecțios. Această lucrare prezintă cazul unui barbat în vârstă de 45 de ani, cu valva aortică bicuspidă, care la distanță de 5 luni de la debutul unui sindrom febril intermitent, identificat și tratat ca bronhopneumonie într-un alt spital, este diagnosticat cu endocardită infecțioasă a valvelor mitrală și aortică, complicată cu rupturi valvulare și regurgități bivalvulare severe.

Metode: Imagistica multimodală contribuie la confirmarea diagnosticului. Ecocardiografia, atât transtoracică, cât și cea transesofagiană reprezintă metoda principală de diagnostic. Efectuarea angio-CT coronarian relevă leziuni biconariene severe, cu plăci de aterom "high risk".

Rezultate: După o intervenție chirurgicală complexă de înlocuire bivalvulară cu proteze mecanice, dublu by-pass aorto-coronarian și protezare de aortă ascendentă, rezultatul a fost unul foarte bun, pacientul externându-se fără fenomene clinice de insuficiență cardiacă în repaus și la efort. La controlul cardiologic de la 1 lună postoperator pacientul afirmă dispariția completă a simptomatologiei, iar ecocardiografia transtoracică confirmă ameliorarea funcției sistolice de ventricul stâng.

Concluzii: Imagistica multimodală joacă un rol extrem de important în diagnosticarea endocarditei infecțioase și a patologiilor asociate. Deși riscul chirurgical este foarte ridicat în cazul intervențiilor de asemenea amploare, pacienții adecvat selectați pot depăși cu bine momentul operator și se pot reintegra socio-profesional în foarte scurt timp. Evaluarea multidisciplinară a acestor pacienți complecși este obligatorie pentru a găsi cea mai bună strategie de gestionare a unor astfel de cazuri.

Cuvinte cheie: endocardită infecțioasă, vegetație, imagistică multimodală, sindrom febril, chirurgie cardiacă.

Introduction

Infective endocarditis is a life-threatening condition and a major public health problem⁽¹⁾. It is a challenging diagnosis due to various clinical presentation that can be confusing. Diagnosing and treating this condition can be more difficult as the complications are numerous. Thus, we need a multidisciplinary team, the Endocarditis Team, to cooperate for optimization of the management of these patients and to reduce mortality⁽²⁾.

Multimodal imaging has spread nowadays and became essential for patients suspected of infective endocarditis. The positive diagnostic is based on the Duke criteria that position echocardiography as the first line of imaging investigations. 3D echocardiography allows the accurate measurement of large vegetations, but the detection of small and highly mobile ones is limited by the reduced spatial and temporal resolution⁽³⁾.

According to European guidelines, invasive coronary angiography is recommended as part of the preoperative protocol in cardiac surgery, but in patients with aortic valve infective endocarditis it is necessary to perform other imaging techniques to evaluate the coronary status due to the increased risk of embolization of the vegetations⁽⁴⁾.

CT coronary angiogram is a radiological investigation that can provide details about the status of the coronary arteries and the great vessels, as well as about the valves and cardiac cavities⁽⁵⁾.

Case description

We present the case of a 45-year-old patient with preexisting cardiovascular risk factors (hypertension, dyslipidemia) known with bicuspid aortic valve, mild aortic regurgitation and ascending aortic aneurysm since 2017.

Initially he was admitted in another hospital in April 2024 for an intermittent febrile syndrome accompanied by cough, asthenia and myalgias and diagnosed with bronchopneumonia for which he was treated with intravenous empirical antibiotherapy (ceftriaxone + gentamicin + metronidazole) for 2 weeks and then he was discharged.

Five months after his initial admission the symptoms did not improve and the patient presented in our Department of Internal Medicine with dyspnea, asthenia, fatigue, sweating and weight loss.

At admission, BP and HR were within normal limits. Physical examination reveals a diastolic murmur grade V/VI in the aortic area, systolic murmur grade IV/VI in the mitral area and turgid jugular veins.

Laboratory tests showed a markedly increased NT-proBNP (4435 pg/mL), high level of high sensitive troponin I (14 pg/mL), mild hypercholesterolemia (LDL-cholesterol 108 mg/dl). The ECG shows sinus rhythm, 1st degree atrio-ventricular block, amputated R waves in V1-V2 and negative, large T waves in the antero-lateral territory (Figure 1). Cardio-pulmonary radiography showed an enlarged heart transverse diameter and bilateral apical and basal pachypleuritis (Figure 2). Transthoracic echocardiography detects severely dilated LV with mild systolic dysfunction through diffuse hypokinesia, severe organic aortic regurgitation through rupture and flail of the posterior cusp, bicuspid aortic valve with raphe between RCC-LCC, a mass attached to the posterior cusp suggestive of vegetation, severe organic mitral regurgitation possibly due to perforation of the AMV (Figure 3) and ascending aorta aneurysm (53 mm, respectively 29 mm/m²).

Transesophageal echocardiography confirms the data obtained from transthoracic echocardiography (Figure 4 and Figure 5).



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Considering high embolic risk of invasive coronary angiography due to the presence of vegetation attached to aortic valve, we decided according to the recommendations of the European guidelines to perform a CT coronary angiogram which confirms the dilation of the ascending aorta, perforated anterior mitral leaflet, bicuspid aortic valve type I with RCC+LCC fusion, the presence of filiform vegetation at the LVOT level and mildly reduced LVEF (48%) (Figure 6).

It also detects a moderate-increased coronary calcium score (136 HU), with atheroma plaques and severe stenoses at the level of LAD I-II and RCA I-II (Figure 7). According to all the clinical, paraclinical and imaging data, the diagnosis of infective endocarditis with bivalvular involvement is outlined and the patient is referred to the cardiovascular surgery department.

The intraoperative aspect highlights ascending aorta aneurysm and important changes following the infectious process involving the bicuspid aortic valve and the mitral valve, with rupture of the posterior aortic cusp and vegetations attached to both cusps, respectively an opening on the atrial side of the anterior mitral leaflet which bifurcates towards the ventricular side (Figure 13). Surgical intervention of mechanical aortic valve replacement (Medtronic Open Pivot 27) and mechanical mitral valve replacement (Medtronic Open Pivot 31), prosthetic replacement of the

ascending thoracic aorta (Gelweave 32) and double coronary artery bypass graft with LIMA-LAD and Ao-SVG-RCA is performed. The microbiological tests of the resected valves were negative to microbial flora.

The postoperative recovery of the patient was slowly favorable, being discharged on the 12th postoperative day with normo-functioning prostheses, RV with preserved longitudinal function and LV with severe systolic dysfunction (Figure 14) in the context of a complete left bundle branch block (Figure 15) with asynchronous contraction, but without clinical phenomena of heart failure at rest or during mobilization. Pharmacological treatment was recommended according to the current guidelines (acenocoumarol 4 mg depending on the INR, sacubitril/valsartan 24/26 mg twice a day, dapagliflozin 10 mg per day, bisoprolol 2.5 mg per day, furosemide 40 mg per day, spironolactone 25 mg per day, aspirin 75 mg per day, atorvastatin 40 mg per day and pantoprazole 40 mg per day). Considering the absence of fever, the negative blood cultures and no inflammatory syndrome, antibiotic treatment was not considered necessary.

At the 1-month postoperative follow-up the patient had no symptoms and good exercise tolerance. Transthoracic echocardiography showed the improvement of the systolic function of the left ventricle (calculated LVEF 42%), without other significant changes.



Figure 1. Preoperative ECG



Figure 2. Cardio-pulmonary radiography

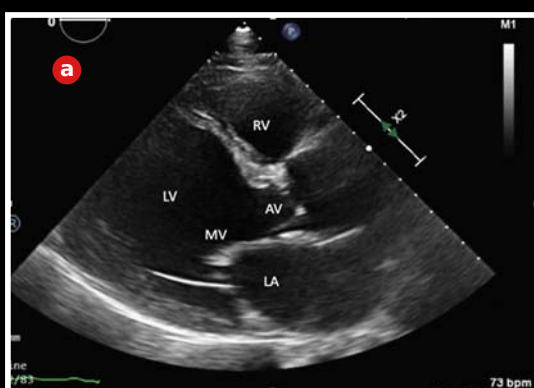


Figure 3. Transthoracic echocardiography (TTE), parasternal long axis (PLAX) - dilated LV (a); severe aortic regurgitation with eccentric jet occupying the entire LVOT (b); severe mitral regurgitation with jet through the body of the anterior mitral cusp (c).



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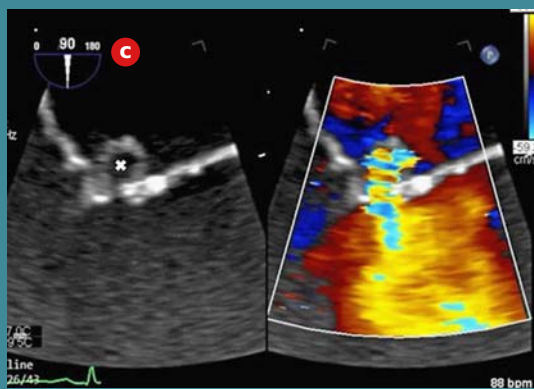
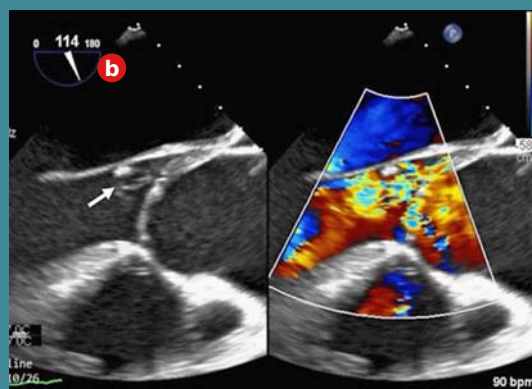


Figure 4. Transoesophageal echocardiography (TEE) - dilated aortic annulus, bicuspid aortic valve, fusion of RCC and LCC cusps and raphe at 2 o'clock (a); mobile mass visible in LVOT with an echostructure similar to that of the cusp, possible ruptured cusp aneurysm with attached vegetation (arrow) and severe aortic regurgitation with eccentric jet (b); ruptured aneurysm of anterior mitral leaflet (x) and severe mitral regurgitation with a thick jet through the aneurysm (c).

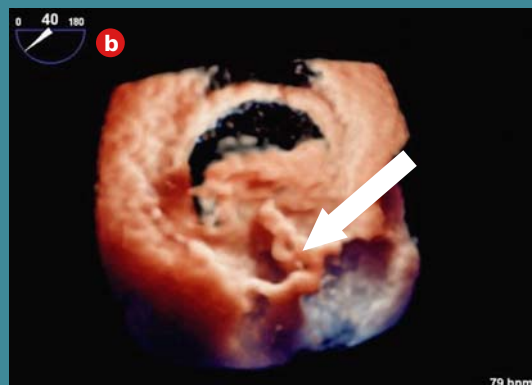
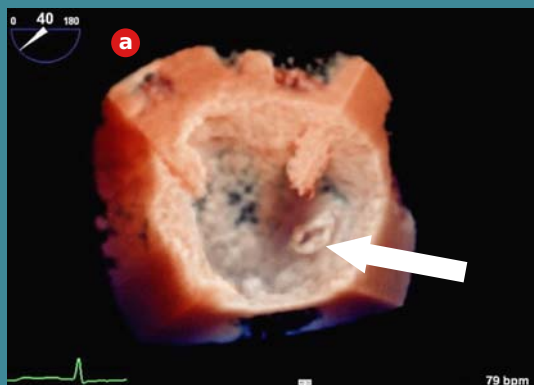


Figure 5. TEE 3D True View mode - an opening of the mitral valve atrial side (arrow) (a); 2 openings of the mitral valve ventricular side (arrow) (b).

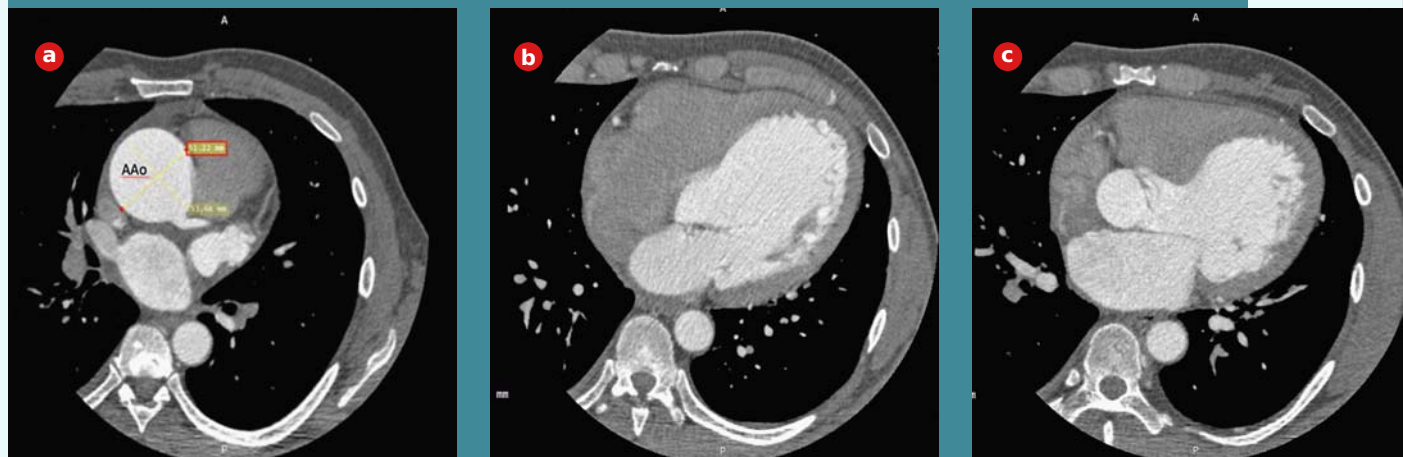


Figure 6. CT coronary angiogram – ascending aorta aneurysm (a); anterior mitral valve perforation (b); type I bicuspid aortic valve and filiform vegetation protruding into LVOT (c).

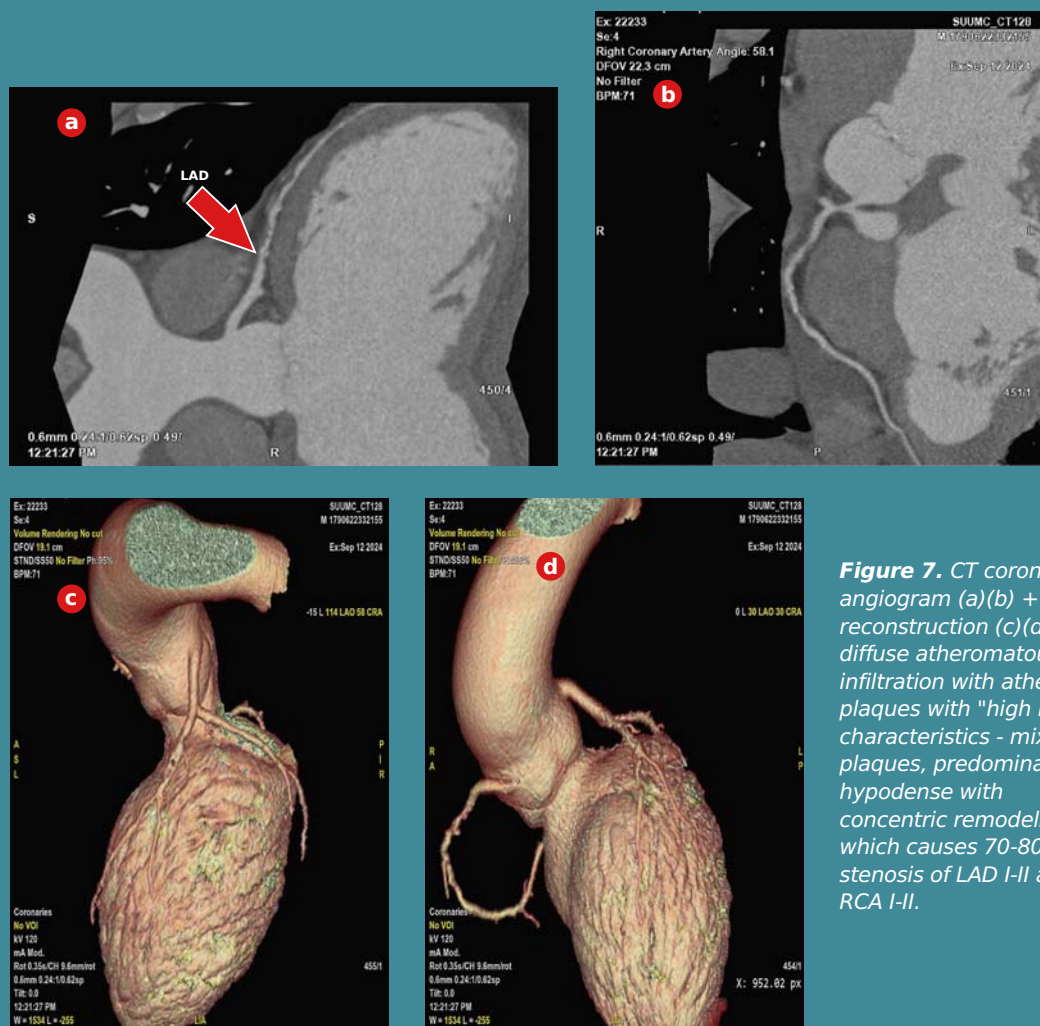


Figure 7. CT coronary angiogram (a)(b) + 3D reconstruction (c)(d)-diffuse atheromatous infiltration with atheroma plaques with "high risk" characteristics - mixed plaques, predominantly hypodense with concentric remodeling which causes 70-80% stenosis of LAD I-II and RCA I-II.



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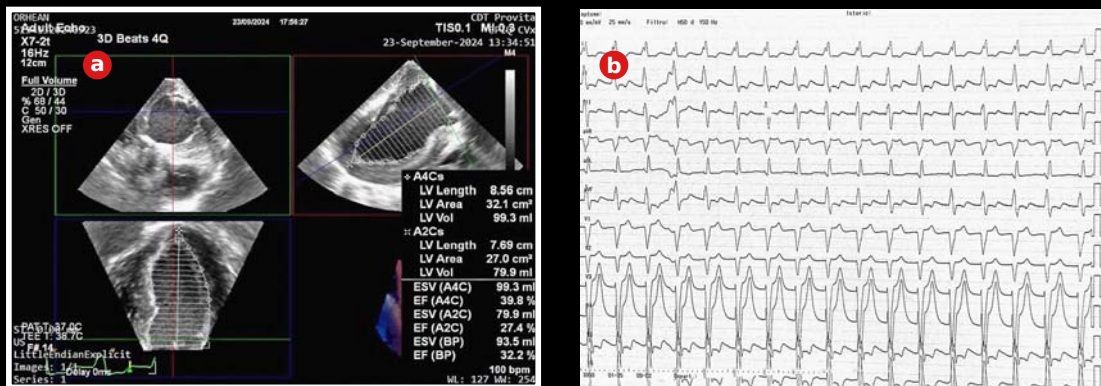


Figure 9. Postoperative TEE, full volume – LVEF 32% (a) and postoperative ECG (b).

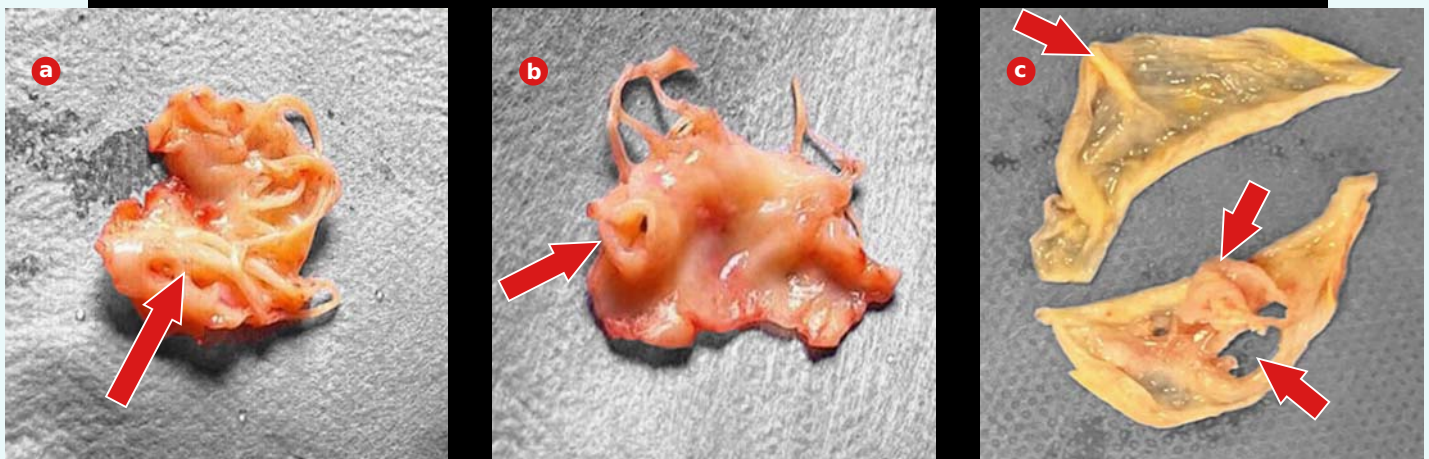


Figure 8. Intraoperative resected parts – 2 openings of the mitral valve ventricular side (a) - arrow; 1 opening of the mitral valve atrial side (b) - arrow; anterior and posterior aortic cusps; the anterior cusp has a raphe between the LCC-RCC; a rupture and a vegetation seen on the posterior cusp (c).

Discussion

A study that aimed to evaluate risk factors for coronary heart disease in patients under 45-year-old, demonstrated that family history, smoking, hypertension, dyslipidemia, high body mass index and diabetes are the main factors involved⁽⁶⁾. The first particularity of our case is the identification of two cardiovascular risk factors for coronary artery disease (arterial hypertension well controlled with only one antihypertensive medication and dyslipidemia, with an LDL-cholesterol value of only 108 mg/dL). In contrast to the low number of cardiovascular risk factors in a young patient, severe bicoronary lesions classified in CAD-RADS 4A/HRP/P2 were identified by CT coronary angiogram.

The second particularity of this case is the association of coronary artery disease with aortic infective endocarditis. The European guideline since 2023 recommend to do an CT coronary angiogram to investigate the coronary arteries as a step of preoperative protocol. According to the CADIE study that analyzed the incidence and prognostic impact of CAD in patients with infective endocarditis, CAD is frequently found in these patients and also it is associated with in-hospital mortality, myocardial infarction, renal failure and heart failure. Also, the study mentioned that screening for coronary atherosclerotic disease was performed less frequently in the case of aortic valve involvement in the infectious process⁽⁷⁾.

Endocarditis team, an entity still not well known in many countries of the world, can be quite difficult to achieve, because it requires a very good collaboration between many departments⁽⁸⁾. Although the concept of Endocarditis team was introduced quite recently in the 2023 European guideline⁽⁹⁾, clinicians did not receive many directions to

help them in the creation and proper functioning of this group⁽⁸⁾.

In the first systematic review and meta-analysis published in 2023 and evaluating the impact of the multidisciplinary team in the management of infective endocarditis, it was demonstrated the existence of a significant association between the Endocarditis team and the improvement of short-term mortality of these patients⁽¹⁰⁾. Regarding the case we presented, we believe that we managed to collaborate with all departments in a short period of time and obtained the best result for our patient.

Conclusion

Infective endocarditis, a real public health problem worldwide, is a condition with high morbidity and mortality, which can produce multisystemic complications and even death. Therefore, the crucial role of multimodal imaging in the evaluation and management of these patients is outlined, with the aim of reducing mortality.

Our case demonstrated once again that the use of multiple imaging techniques is essential both in formulation of the diagnosis of infective endocarditis, and for the evaluation of the coronary arteries by CT coronary angiogram, when the benefits of performing invasive coronary angiography exceed the risks. Although at the first view the cardiovascular risks of some patients seem to be reduced, we may have surprises following the investigations.

However, with a multidisciplinary team made up by cardiologist, internist, radiologist, infectious disease specialist, we can diagnose complex pathologies and with the help of very experienced cardiovascular surgeons we can treat extremely difficult cases, so that there is a happy ending for the team, but especially



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for the patients. In conclusion, the patient we presented underwent a complex and high risk surgical intervention, but was discharged and recovered in a relatively short time, so that socio-professional reintegration was achieved very quickly.

References:

1. Global Burden of Disease Metrics. Institute for Health Metrics Evaluation. University of Washington, Seattle. Available at: <https://vizhub.healthdata.org/gbd-compare/> (accessed October 2021).
2. Botelho-Nevers E., Thuny F., Casalta J.P., et al. "Dramatic reduction in infective endocarditis-related mortality with a management-based approach". *Arch Intern Med*. 2009;169:1290-1298.
3. Horgan SJ, Mediratta A, Gillam LD: Cardiovascular imaging in infective endocarditis: a multimodality approach. *Circ Cardiovasc Imaging*. 2020, 13:e008956. 10.1161/CIRCIMAGING.120.008956
4. C. Laperche, O. Lairez, J. Ferrieres, G. Robin, M. Gautier, Y.L. Badie, et al. Coronary angiography in the setting of acute infective endocarditis requiring surgical treatment *Arch Cardiovasc Dis*, 113 (2020), pp. 50-58
5. Ramjattan NA, Lala V, Kousa O, et al. Coronary CT Angiography. [Updated 2024 Jan 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470279/>
6. Nadeem M, Ahmed SS, Mansoor S, Farooq S. Risk factors for coronary heart disease in patients below 45 years of age. *Pak J Med Sci*. 2013 Jan;29(1):91-6. doi: 10.12669/pjms.291.2828. PMID: 24353515; PMCID: PMC3809218.
7. M. Giraud, F. Delahaye, J. Berthiller, P. Lantelme, B. Harbaoui, Prognosis implication of Coronary Artery Disease in Infective Endocarditis, the CADIE study, *Archives of Cardiovascular Diseases Supplements*, Volume 15, Issue 1, 2023, Pages 14-15, ISSN 1878-6480, <https://doi.org/10.1016/j.acvdsp.2022.10.018>.
8. El-Dalati S, Cronin D, Riddell J 4th, Shea M, Weinberg RL, Stoneman E, Patel T, Ressler K, Deeb GM. A step-by-step guide to implementing a multidisciplinary endocarditis team. *Ther Adv Infect Dis*. 2021 Dec 16;8:20499361211065596. doi: 10.1177/ 20499361211065596.PMID: 34950478; PMCID: PMC8689603.
9. Victoria Delgado, Nina Ajmone Marsan, Suzanne de Waha, Nikolaos Bonaros, Margarita Brida, Haran Burri, Stefano Caselli, Torsten Doenst, Stephane Ederhy, Paola Anna Erba, Dan Foldager, Emil L Fosbøl, Jan Kovac, Carlos A Mestres, Owen I Miller, Jose M Miro, Michal Pazdernik, Maria Nazarena Pizzi, Eduard Quintana, Trine Bernholdt Rasmussen, Arsen D Ristić, Josep Rodés-Cabau, Alessandro Sionis, Liesl Joanna Zühlke, Michael A Borger, ESC Scientific Document Group , 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), *European Heart Journal*, Volume 44, Issue 39, 14 October 2023, Pages 3948-4042, <https://doi.org/10.1093/eurheartj/ehad193>
10. Anne-Sophie Roy, Hamila Hagh-Doust, Ahmed Abdul Azim, Juan Caceres, Justin T Denholm, Mei Qin (Denise) Dong, Madeline King, Christina F Yen, Todd C Lee, Emily G McDonald, Multidisciplinary Teams for the Management of Infective Endocarditis: A Systematic Review and Meta-analysis, *Open Forum Infectious Diseases*, Volume 10, Issue 9, September 2023, ofad444, <https://doi.org/10.1093/ofid/ofad444>