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Echocardiographic Aspect of Infectious Aortic Endocarditis: Experience of the Cardiology Department, Mohammed VI University Hospital of Marrakech, Morocco

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Infective Endocarditis (IE) is a serious disease whose prognosis depends on early management. Aortic localization is characterized by its progression to myocardial failure and the high number of complications motivating early recourse to surgery. The diagnosis of AR is based on microbiological and imaging studies. Echocardiography is the recommended imaging modality to make the diagnosis, assess the impact and guide surgery.

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Materials and Methods: This is a retrospective study, including all subjects over 20 years of age who presented with infective endocarditis of the aortic valve, hospitalized between January 2019 and December 2022, in the Department of Cardiology and Vascular Diseases at the ERRAZI-CHU Mohammed VI Hospital in Marrakech. Clinical, paraclinical and therapeutic data were collected for each case using an exploitation form.

Results: During the study period, 26 patients had presented with aortic positional AR, with a sex ratio that was equal to 1.8. The mean age of the patients was 43±12.5 years. A known history of valvular disease was found in 57% of the cases. Among the native valvular diseases, rheumatic origin was found in 85%. The most common valvular lesions were represented by vegetations (88%), which were mobile in 56%, measuring between 10 and 20 mm in half of the cases, their most predominant localization was on the ventricular side with a tilt.IE on severe IAo was found in 90% of cases. The most common associated valvulopathies were MI (53%), RAo (38%) and MR (34%), whose severity was variable. The association of aortic disease with mitral disease was the most frequent association. Echocardiographic complications were presented by fistulas, perforations and peri-aortic abscesses (2 cases each) which were correlated with severe AI. Regarding the impact of the aortic AR on the LV, we noted a marked dilatation in 42% of cases with a preserved ejection fraction in 74%. A quarter of our patients had undergone transesophageal echocardiography in addition to transthoracic echocardiography, with an average time between admission and completion of 3 days. The indication of its realization was posed in front of the doubt of the visualization of an image of vegetations or suspicion of complications not visualized with the TTE. Valvular lesions found on TEE were essentially vegetations in 45% of cases, prolapses in 22% of cases, as well as abscesses, para-prosthetic leaks and prosthesis deinsertion found in 11% of cases.

Conclusion: Aortic AR remains a frequent pathology in our context. Aortic insufficiency is the most predisposing valvulopathy and the most common sonographic appearance is vegetations. The results of our study have shown that complications of AE occur preferentially in patients with severe aortic insufficiency.

Keywords: Aortic endocarditis; thoracic echocardiography; transesophageal echocardiography; vegetation image; complication.

1. INTRODUCTION

Infective endocarditis is defined as infection of a native or prosthetic heart valve, endocardial surface, or cardiac device. The causes and epidemiology of the disease have evolved over the past few decades with a doubling of the average age of patients and an increased prevalence in patients with indwelling intracardiac devices.

The microbiology of the disease has also changed, and Staphylococci, most commonly associated with healthcare provider contact and invasive procedures, have surpassed Streptococci as the most common cause of the disease. Although new diagnostic and therapeutic strategies have emerged, one-year mortality has not improved and remains at 30%, which is worse than for many cancers [1].

Our objective was therefore to describe the echographic aspects of aortic infective endocarditis in adults through a series of 26 cases in the cardiology department, CHU Mohammed VI of Marrakech, in the light of the literature.

2. PATIENTS AND METHODS

This is a retrospective study, including all adolescent and adult patients over 20 years of age who presented with infective endocarditis only of the aortic valve, hospitalized between January 2019 and December 2022, at the Department of Cardiology and Vascular Diseases at ERRAZI Hospital-Mohammed VI University Hospital in Marrakech.

The diagnosis of infective endocarditis was selected according to the Duke criteria modified by the European Society of Cardiology in 2015.

Patients hospitalized with the diagnosis of aortic infective endocarditis isolated or associated with other localizations, were collated from the diagnostic registers and complete records of the service archive. Incomplete records were excluded.

The data studied concerned the demographic profile (age, sex), patient history, bacteriological profile, and echocardiographic aspects of aortic infective endocarditis.

A descriptive analysis of the study population was performed. Quantitative variables were presented as medians and extremes and qualitative variables as numbers and percentages.

3. RESULTS

3.1 Hospital Prevalence

During our study period, infective endocarditis was diagnosed in 47 patients out of a total of 3109 hospitalizations, IE a hospital prevalence of infective endocarditis over the duration of our study was 1.5%.

In our series, 26 patients out of 47 had infective endocarditis in the aortic position, IE 55% of the total number of infective endocarditis.

3.2 Epidemiological Data

3.2.1 Age

The mean age of our patients was 43.0±12.5 years, with extremes ranging from 17 to 63 years. The most prevalent age range was 31 to 40 years with 30%. The distribution of patients according to age range is shown in Fig. 1.

3.2.2 Gender

There was a male predominance with 65% and a sex ratio that was equal to 1.8.

3.2.3 History

A history of infective endocarditis was found in 3 patients on native valve, with a variable delay before the new episode, respectively 20 years, 4 months and 1 month.

The latter was in fact the evolution of an untreated infective endocarditis due to a discharge against medical advice of the patient.

A known and treated history of rheumatic fever was found in 2 patients (7% of cases).

Tuberculous pericarditis was confirmed by biopsy and under anti-bacillary treatment, thus developing tuberculous endocarditis after 3 months of treatment (Fig. 2).

Underlying heart disease was found in 11 patients (57%) (Fig. 3). Endocarditis was grafted on an aortic valve prosthesis in 4 patients (5%) (3 mechanical and 1 biological) and 22 cases (85%) had endocarditis on a native valve. Among the native valve diseases, rheumatic origin was found in 85% (Fig. 4).

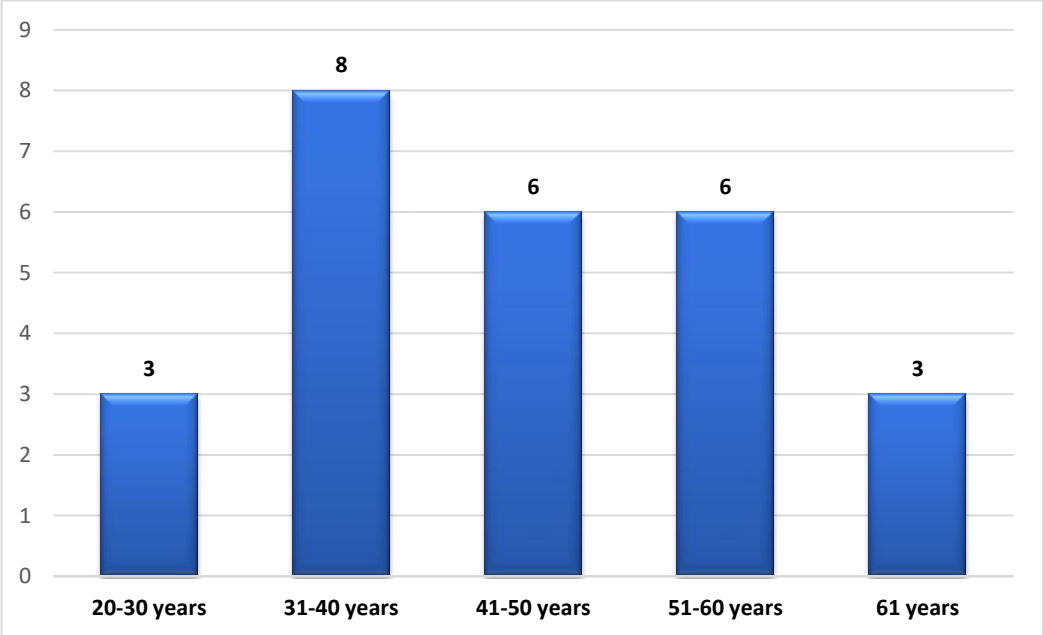

Fig. 1. Distribution of patients by age group

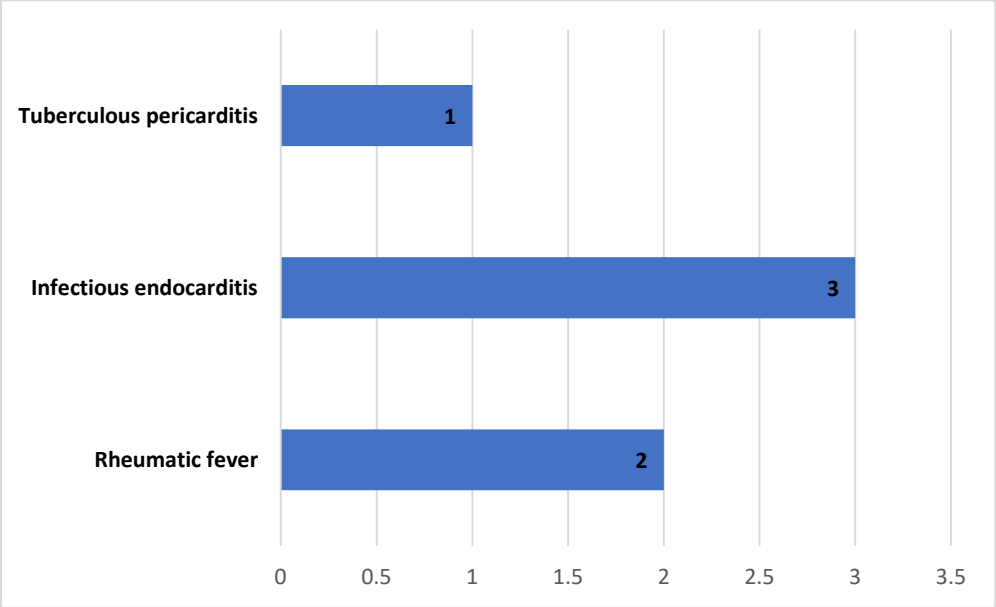

Fig. 2. Distribution according to the history of the patients in our series

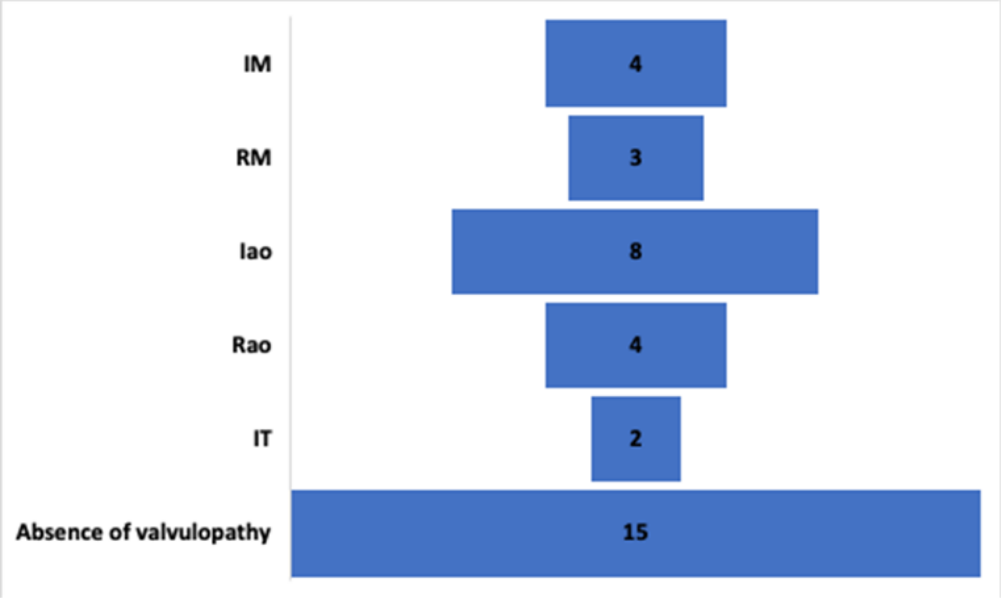

Fig. 3. Distribution according to known history of valvulopathy

The congenital heart diseases found in our series were: a persistent ductus arteriosus, an interventricular communication, a subaortic membrane and 3 cases of bicuspidia.

3.3 Bacteriological Data

3.3.1 Infectious entry point

The presumed portal of entry was cutaneous in 12 patients (45%), oral and ENT in 8 cases (33%), urinary in 4 cases (15%), and digestive in 2 cases (7%).

3.3.2 Inflammatory assessment

In our series, 21 patients (80%) presented a biological inflammatory syndrome.

C-reactive protein (CRP) was performed in all our patients and came back positive in 19 patients (73%).

Procalcitonin was requested in only 10 patients (38%) of our series, coming back positive in 8 patients (80%). While the sedimentation rate (SV) was only requested in 20 patients (76%), coming back positive in 17 patients (65%) (Fig. 5).

3.3.3 Blood cultures

Blood cultures were performed for all patients, with a mean number of 4 (extremes ranged from 2 to 6).

At least one or more blood cultures were positive in 38% of cases (Fig. 6).

Coagulase-negative Staphylococcus was the most common germ in aortic infective endocarditis, with 10 patients (40%) having positive blood cultures (Fig. 7).

3.4 Echocardiographic Appearance

3.4.1 Description

All our patients had performed transthoracic echocardiography on admission.

The most common endocardial lesions were represented by vegetations 23 (88%) (Fig. 8). Their size was between 10 and 20 mm.

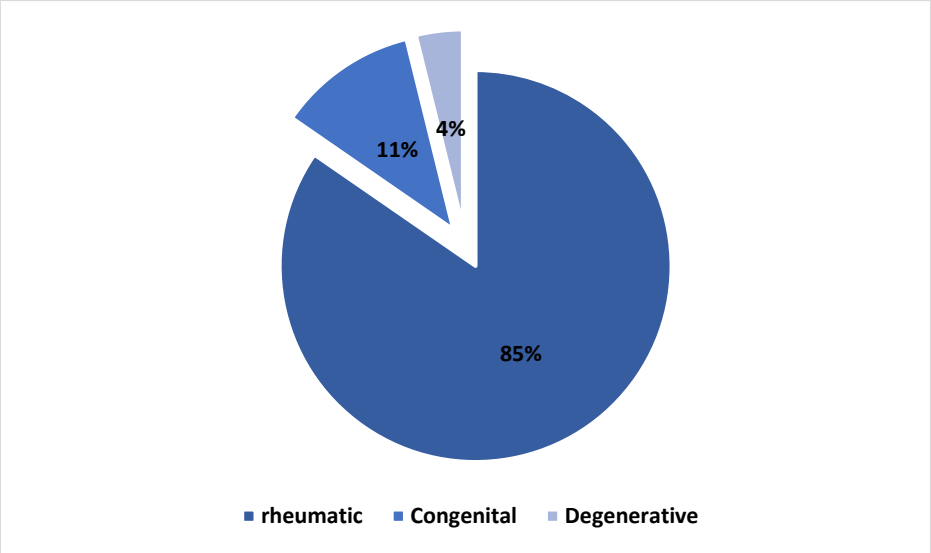

Fig. 4. The distribution of patients according to the nature of the valvulopathy

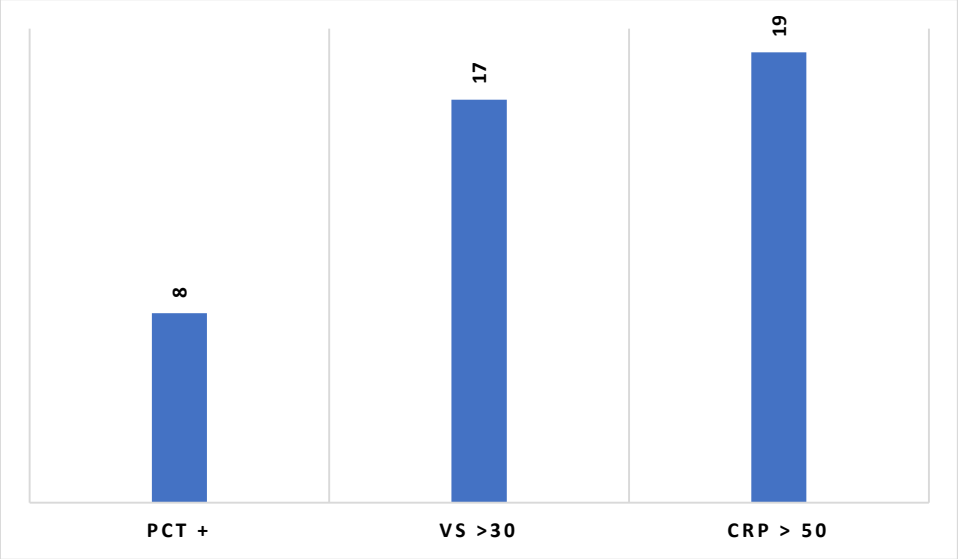

Fig. 5. Distribution of inflammatory findings in our series

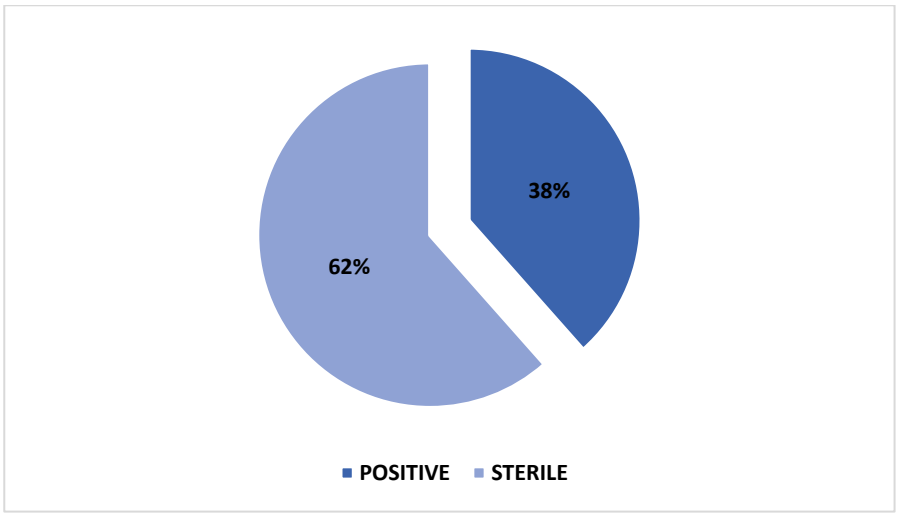

Fig. 6. Distribution of patients according to blood culture results

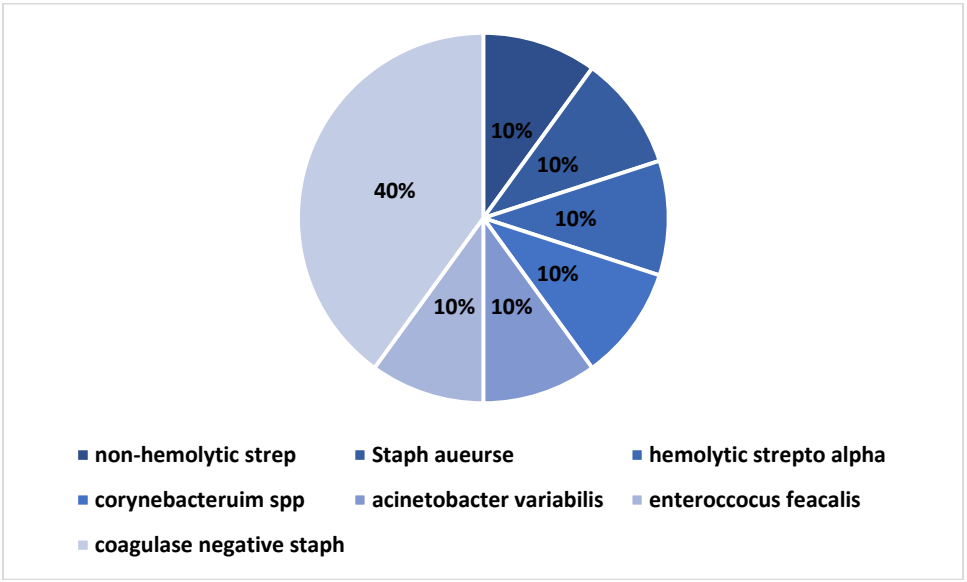

Fig. 7. The distribution of patients according to the incriminated germ

In 13 patients (56%), vegetations were prolapsing on both sides of the valve, those on the aortic side isolated in 5 patients (21%) (Fig. 9).

Echocardiography showed a leak considered severe in 19 patients (90%), of which 2 (10%) were related to valve perforation, moderate to moderate in 2 cases (5%).

The distribution of patients with pre-existing valve disease other than IAo are presented as follows (Table 1).

Fig. 10 shows the distribution of patients according to the combination of valvulopathies.

Table 1. Distribution of patients according to the frequency of other valvulopathies associated with IAo

	Number of patients	Percentage
Mitral insufficiency	14/26	53%
Aortic Stenosis	10/26	38%
Mitral stenosis	09/26	34%
Tricuspid insufficiency	07/26	26%

The severity of the mitral valve disease was variable, the association with severe mitral insufficiency was frequently found (10 cases), tight mitral stenosis was very rarely encountered (1 case).

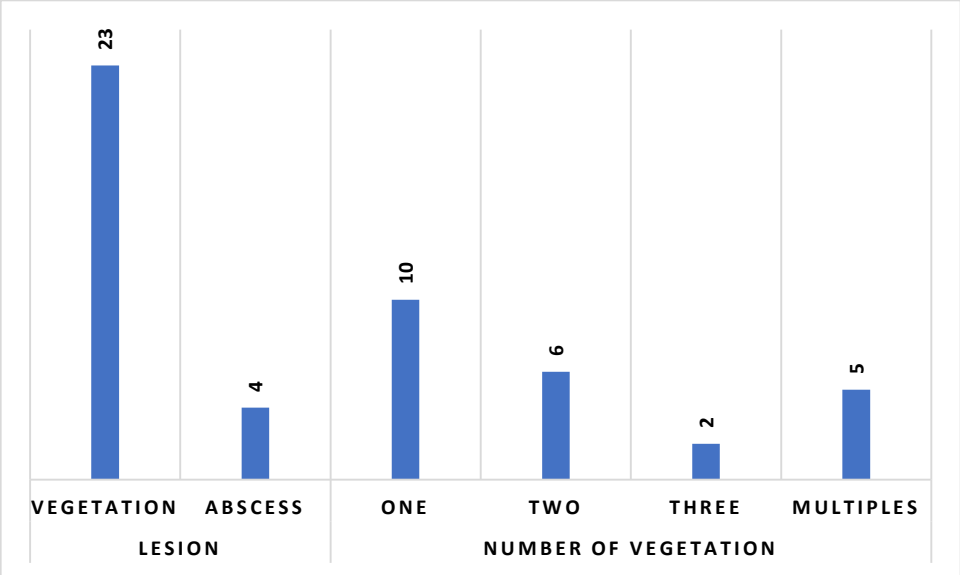

Fig. 8. The description of aortic infective endocarditis lesions

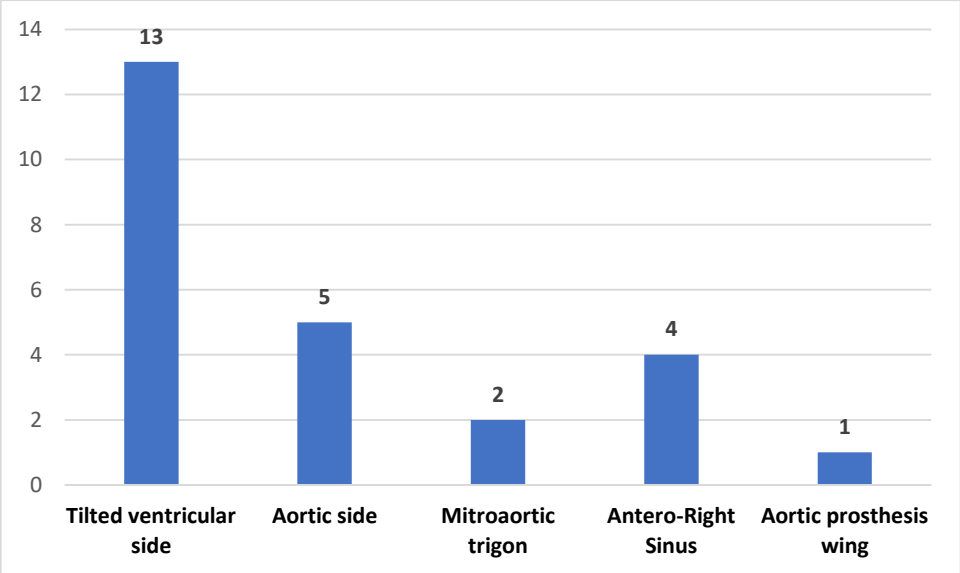

Fig. 9. The distribution of patients according to the location of aortic vegetation

Abscesses were seen in 4 patients (15%), two of them with fistulization to the adjacent cavities (VD and VG).

3.4.2 Impact

Marked LV dilatation in association with a pre-existing leak was seen in 11 patients (42%). Left ventricular ejection fraction was preserved (LVEF>55%) in 74%.

Other echocardiographic abnormalities that are the consequence of valvulopathies were observed, in particular the consequence of their valvulopathies: PH in 76%, biatrial dilatation in 46%, aneurysmal dilatation of the aorta in 11%.

3.4.3 Transesophageal echocardiography

Transesophageal echocardiography was performed in 6 patients (25%) in addition to transthoracic echocardiography, with an average time between admission and completion of 3 days.

Valvular lesions found on TEE were mainly vegetations in 45% of cases, perforation in 22% of cases (Fig. 11).

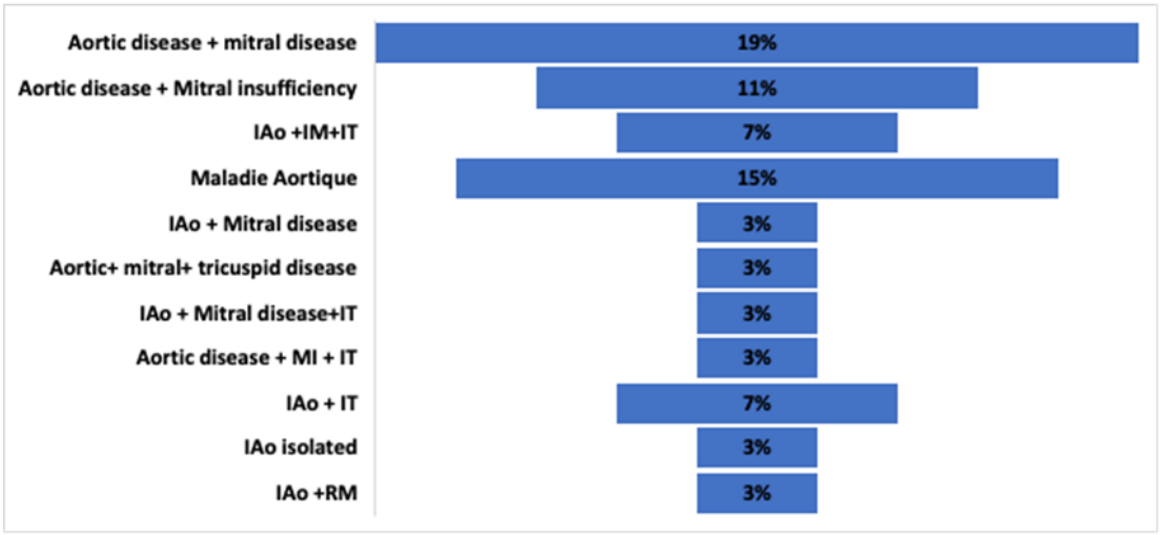

Fig. 10. Distribution of patients according to the combination of valvulopathies

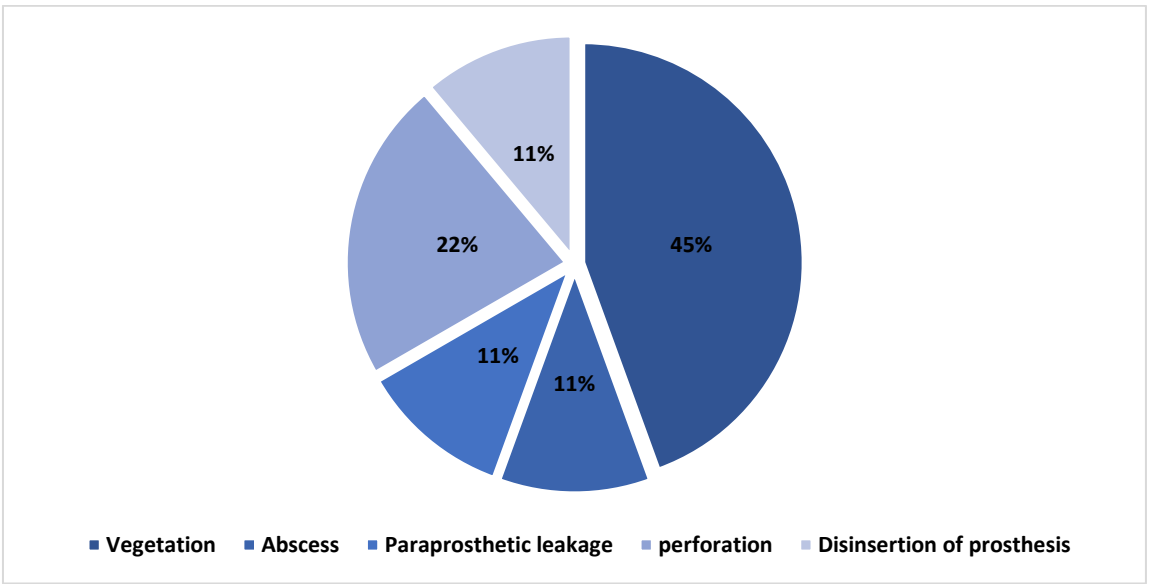

Fig. 11. The results of the lesions found on TEE in our series

3.5 Correlation between the Severity of IAo and Echocardiographic Abnormalities in Aortic IE

Table 2 compares complications with the severity of AIo.

3.6 Classification of Endocarditis

According to the Duke criteria modified by the European Society of Cardiology in 2015, definite infective endocarditis was found in 12 patients (46%) by the demonstration of 2 major clinical criteria (positive specific germ blood culture + presence of endocardial lesions on echocardium), or 1 major criteria with 3 minor criteria (Fig. 12).

Half of the patients (50%) had presented with possible endocarditis, based on the association of 1 major criterion with 1 or 2 minor criteria (preexisting heart disease and prolonged fever above 38.8C°).

Endocarditis was ruled out when a transesophageal echocardiography was performed, confirming the absence of vegetation of the aortic prosthesis with resolution of the endocarditis symptomatology at H72 of antibiotic treatment.

Table 2. Correlation between the severity of AIo and cardiographic echo abnormalities

		Total	IAo severe	IAo not severe (moderate to medium)
Vegetation		17	15	2
Abscess		1	1	0
Association Vegetation + Abcess		6	6	0
Complications	Fistula	2	2	0
	Perforation	2	2	0
	Detergent abscess	2	2	0

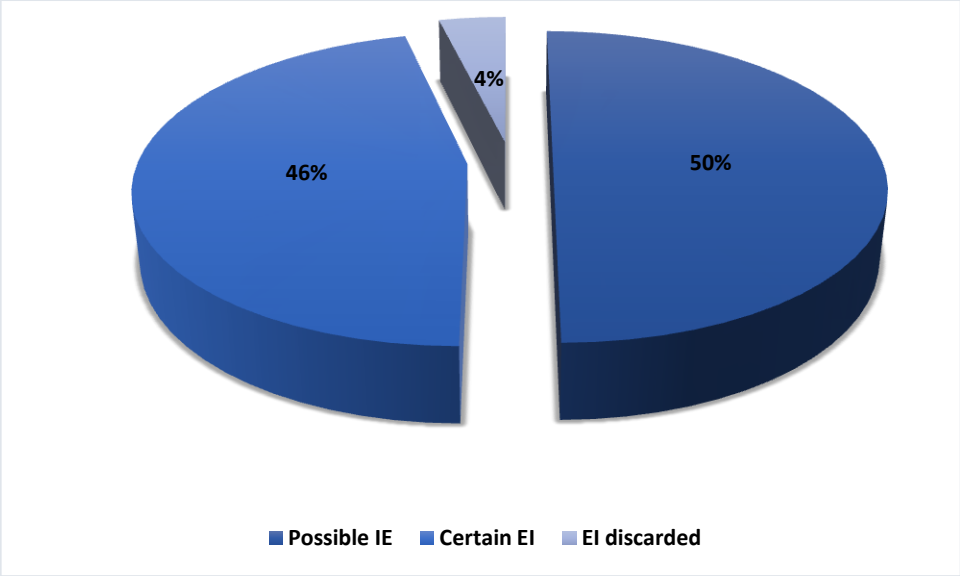

Fig. 12. Infective endocarditis according to the modified DUkE criteria

3.7 Therapeutic Management

All patients in our series had received a combination of broad-spectrum intravenous antibiotic therapy. A probabilistic antibiotic therapy had been prescribed initially; taking into consideration the cases where the entrance door was found or suspected.

In 92% of cases, third generation cephalosporins (C3G) at a dose of 2g/d for 6 weeks + Gentamycin at a dose of 5mg/kg/d for 2 weeks were prescribed (Fig. 13).

In each case, after obtaining the results of blood cultures, the curative antibiotic therapy was adapted to the germs:

The distribution of patients according to the duration of antibiotic treatment was variable: 8 patients (30%) having completed their duration of treatment, the rest not having exceeded 6 weeks of treatment due to deterioration of their clinical condition and death.

3.8 Evolution

The evolution during the hospitalization, preoperatively, was marked by an improvement of the clinical state in only 12%, a perioperative death in 38%, and a worsening of the clinical state in 50%, with an average hospitalization duration of 14 days.

Emergency surgery was indicated in 77% of the cases in front of the deterioration of the clinical state of the patients, and in front of the aggravation of the lesions, on the other hand 23% of the cases a valve replacement surgery was indicated after cooling of the lesions, according to the severity of the IAO as well as of the associated valvulopathies.

4. DISCUSSION

Infective endocarditis (IE) is a rare (3-10 cases/100,000 population/year) but serious disease, a septicemic condition, secondary to transplantation of a pathogen, to a healthy or

previously injured endocardium or valve prosthesis. IE is associated with a high risk of complications and high mortality (20-40%) [1-2]. The incidence of IE remains stable at monde [3].

Its epidemiological profile varies according to the level of development of countries. The underlying valvulopathy is mostly of rheumatic origin in developing countries as it is the case in our series with 85%. This observation is generally noted in most of the series africaines [4]. While in developed countries, it is mainly of origin degenerative [5]. The high frequency of rheumatic valvulopathy in the history confirms the persistence of this condition in Africa, contrary to the new trends concerning endocarditis on pacemaker, prosthetic valves particularly [6]. The emphasis must be placed on its prevention.

The predominance of males in our series is consistent with the literature [7]. IE occurs preferentially in young people with an average age of 43 years, which corroborates the data of some auteurs [7], but differs from Western data with an advanced age [6].

The clinical manifestations of endocarditis are multiple and differ according to the etiological agent and underlying risk factors, but none of them is sufficiently specific and sensitive to allow the diagnosis diagnostic [8].

The diagnosis of IE relies on microbiologic testing and imaging. Echocardiography is the recommended imaging modality for visualization of manifestations of IE, such as vegetations, morphologic valve/dehiscence abnormalities, septal defects, or fistula formation, and for evaluation of hemodynamic consequences [9].

The study by C. Selton-Suty et al reported two important results which are that S. aureus has become the predominant causative species of AEs in France and healthcare-associated AEs now represent 0.25% of all AE cases [10].

Overall, S. aureus was the predominant species among causative pathogens, accounting for 0.25% of cases, far ahead of the number of cases caused by oral streptococci. This is particularly striking among healthcare-associated IE cases, but even among community-acquired IE cases, staphylococci are as common as oral streptococci. Coagulase-negative staphylococci also appeared to be frequently responsible for IE, not only in the prosthetic IE valve but also in the native IE valve, although this was significantly more the case in the subgroup of healthcare-associated IE. Overall, streptococci were more frequently responsible for community than healthcare-associated origin, but the once predominant oral streptococci accounted for 20% of IE cases overall. In addition, group D streptococci accounted for 12.5% of all organisms. Although this percentage is much higher than that found in the International Project Collaboration on Endocarditis (ICE), it is also much lower than the 25% observed in the French survey. These figures illustrate the dramatic paradigm shift in IE from a primarily dental infectious disease to a primarily healthcare-associated infection in a few years, as previously highlighted by other studies [10].

Duke University incorporates echocardiographic findings as one of the primary diagnostic criteria for infective endocarditis. If infective endocarditis is suspected, echocardiography is used to detect and characterize endocardial vegetations; complications; and follow-up after treatment.

TTE and TEE are useful for assessing the size, mobility, and evolution of vegetation under antibiotics. However, atypical findings are common, and echocardiography may be falsely negative in 15% of AR cases, especially in cases of severe lesions (degenerative lesions and prosthetic valves). Therefore, TTE/ETO should be repeated at 7/10 days after the first examination, when the level of clinical suspicion is still high. Conversely, it is sometimes difficult to differentiate between vegetations and thrombi, cusp prolapse, cardiac tumors, myxomatous changes or non-infectious vegetations [11].

The sensitivity for detection of vegetations in native valve endocarditis is <65% by transthoracic echocardiography, whereas it is 82-100% by transesophageal echocardiography; in infective endocarditis on prosthetic valves, the sensitivity is 16-36 and 82-96%, respectively.

The sensitivity of transthoracic echocardiography for detection of periannular abscess is 28%, whereas that of transesophageal echocardiography is 87%.

Echocardiographic studies have shown that highly mobile aortic vegetations with a diameter >10 mm are more likely to cause complications (embolism, heart failure, need for surgical intervention, and death).

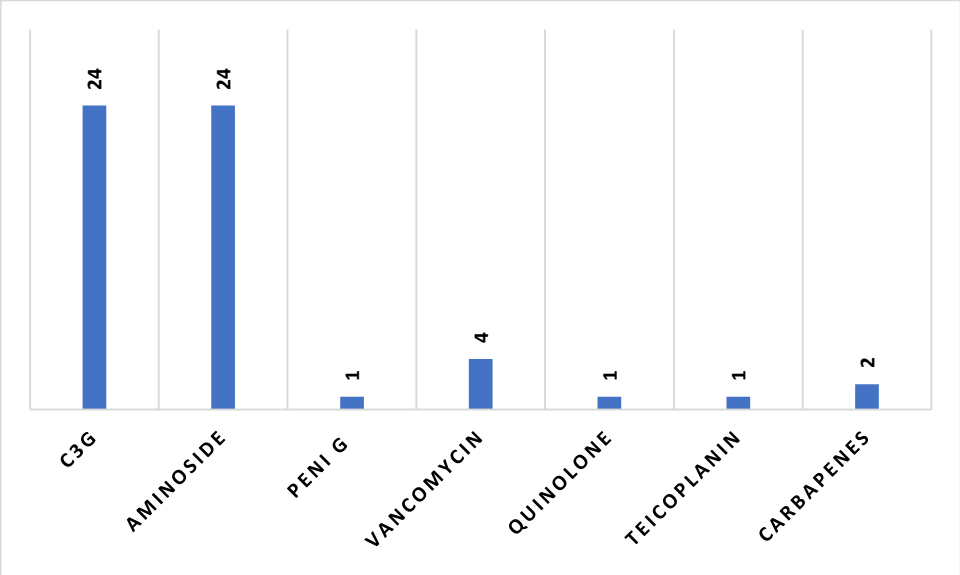

Fig. 13. The therapeutic classes of antibiotic therapy prescribed in our series

The results of our study identified the trend that complications of AR occur preferentially in patients with severe AI.

The World Heart Federation (WHF) has proposed echocardiographic criteria for the diagnosis of rheumatic valve disease to allow standardization and better reproducibility of epidemiological investigations [13].

The application of the criteria should not preclude the search for a congenital cause such as aortic bicuspidism, endocarditis, or degenerative valve damage. Since rheumatic valve disease almost always affects the valves of the left heart (100% according to autopsy series, 99.3% according to echographic studies), the diagnostic criteria concern only mitral valve damage and aortic [13].

Another important advantage of echocardiography is its ability to accurately detect cardiac complications of infective endocarditis: valve regurgitation, valve rupture, peri-annular abscess, prosthetic dehiscence, cardiac fibrosis rupture, septal abscess, hemopericardium, and myocardial infarction.

Valvular vegetations present as an abnormal, echogenic mass attached to the leaflet of the valve with independent motion [7] Aortic valve vegetations usually present as an echogenic mass attached to the ventricular side of the leaflet with independent motion and extending into the outflow tract during diastole (Fig. 14).

The second major echocardiographic criterion for endocarditis is the presence of a perivalvular abscess, which on echocardiography may be either echolucent or echodense [12]. Most commonly, abscesses occur in the valvular annulus adjacent to the infected leaflet tissue and in the case of endocarditis of the aortic valve [14].

Echocardiographic findings include increased echogenicity, an echolucent area at the base of the septum, or increased thickness of the posterior aortic root [15] (Fig. 15).

Diagnosis of paravalvular abscess by TTE has lower sensitivity and specificity than TEE because of poor ultrasound penetration into the tissue. TEE imaging is particularly important in patients with valve prosthesis endocarditis because paravalvular abscesses are common and shadowing and reverberations from the valve prosthesis compromise examen [11]. In cases where a paravalvular abscess is suspected with equivocal findings on TEE, cardiac CT may be a useful tool for diagnostic [14].

In the evaluation of abscess, CT has higher sensitivity and specificity in patients with mechanical aortic valves, whereas TEE has higher sensitivity and specificity in patients with bioprosthetic aortic valves. These results may be attributable to the fact that CT artifacts are less troublesome than ultrasound artifacts associated with mechanical valves [16].

Other perivalvular complications include fistulation and pseudoaneurysm. Fistula is defined by a communication between two adjacent cavities and sonographically by a color Doppler communication between two adjacent cavities. The pseudoaneurysm is characterized by a perivalvular cavity communicating with the cardiovascular lumen. Sonographically, it appears as a pulsatile perivalvular space without echo with color Doppler flow within (Fig. 16) [16].

In this setting, 3D TEE allows for better assessment of perivalvular complication because multiple reconstructions allow for better definition of anatomic relationships with adjacent structures.

Evaluation of prosthetic valves in cases of suspected endocarditis may be more difficult because the infection often involves the area around the prosthetic valve annulus and for reverberations and shadowing by prosthesis [17].

For these reasons, TEE imaging should be strongly considered for suspected prosthetic valve endocarditis (Figs. 17, 18) [18]. In fact, this technique has high sensitivity and specificity for the detection of prosthetic valve endocarditis, paravalvular abscess, and prosthetic mitral regurgitation.

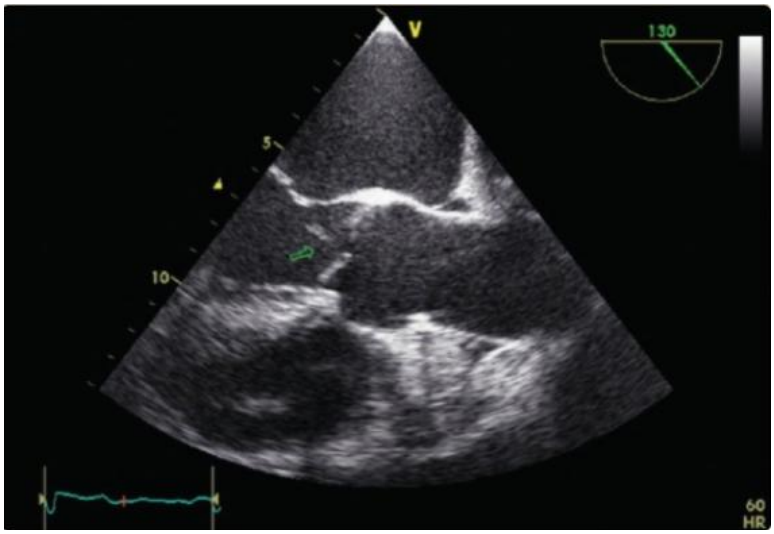

Fig. 14. Transesophageal echocardiography, long axis section: Echogenic mobile vegetation of the aortic valve on the ventricular side of the posterior cusp (length 9mm, thickness 3mm) [5]

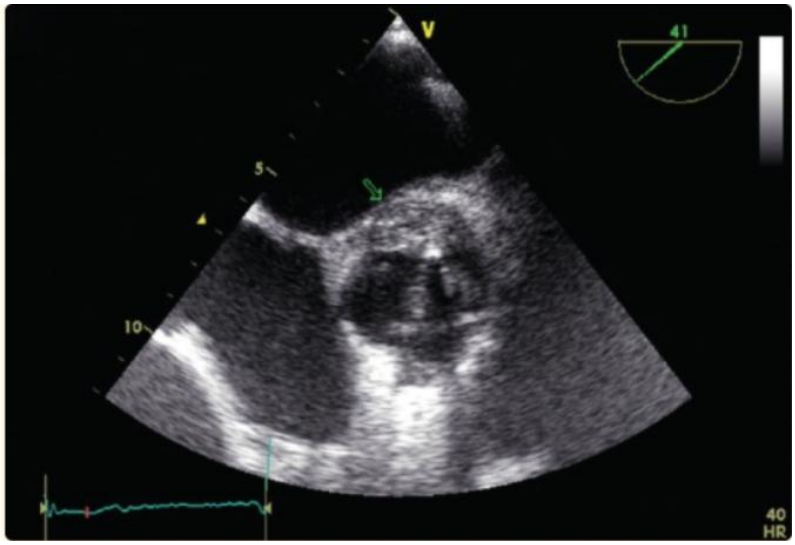

Fig. 15. Transesophageal echocardiography, short-axis section: Dense posterior aortic abscess on ultrasound (length 33 mm, thickness 15 mm) [12]

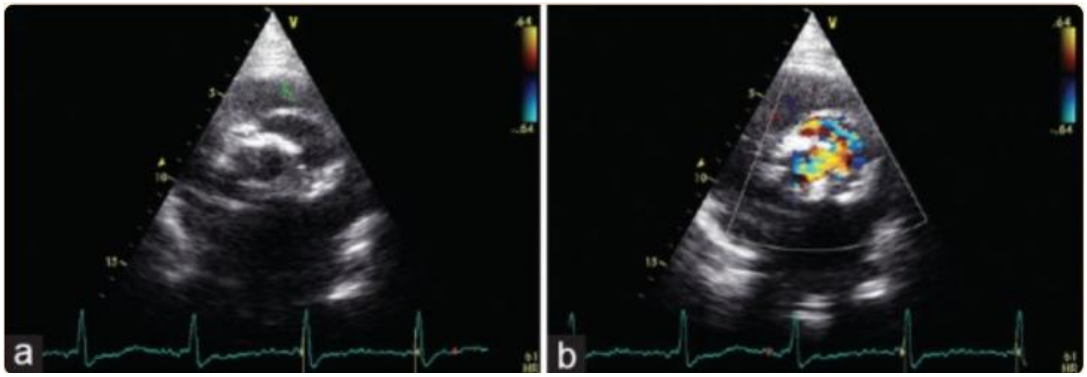

Fig. 16(a and b). Transesophageal echocardiography showing an anterolateral aortic pseudoaneurysm, with perivalvular flow on color Doppler inside with a diameter of 40mmx18mm [15]

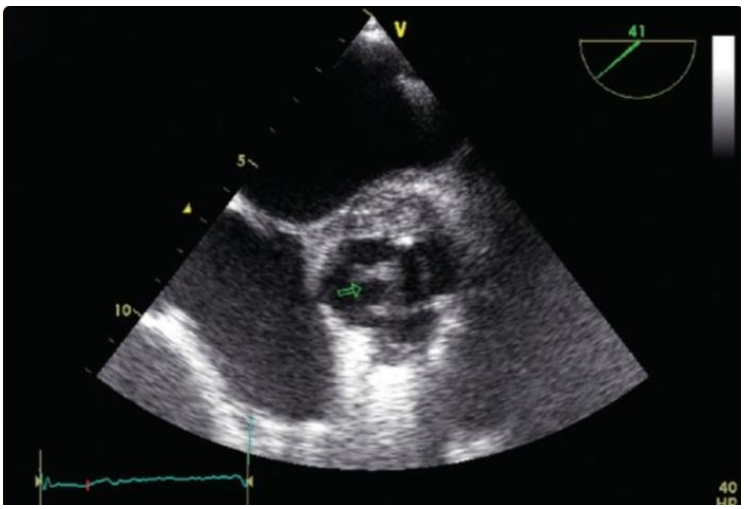

Fig. 17. Transesophageal echocardiography showing a small echogenic vegetation (length 5 mm, thickness 3 mm) on the cusp of the bioprosthetic aortic valve associated with a posterior abscess [17]

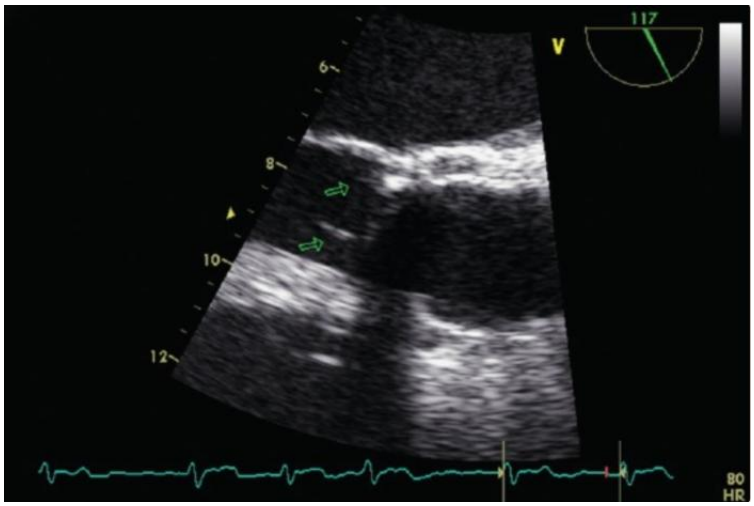

Fig. 18. Transesophageal echocardiography of two small, mobile and echogenic filamentous vegetations (length 8mm, thickness 3mm) on the ventricular side of the aortic valve (Bentall surgery) [17]

TEE is also superior for localization of paravalvular leaks, assessment of prosthetic leaflet mobility/deficiency, and prosthetic dehiscence. Endocarditis can rarely lead to prosthetic valve stenosis because of encroachment of the infected mass on the leaflet opening or an infected pannus on the upstream side of the valve.

Echocardiography remains a simple but valuable diagnostic test, not only for its ability to delineate heart valve morphology and surrounding cardiac anatomy and function, but also for its crucial role in the management of AR.

5. CONCLUSION

Aortic AR is a frequent pathology, which is formidable because of its complications, in particular the rapid evolution towards heart failure, mechanical and thromboembolic complications. Early medical and surgical management can lead to satisfactory results in terms of morbidity and mortality in the short and medium term.

AR occurs predominantly in rheumatic heart disease. Rheumatic fever is still a reality in our regions. The prevention of AR is therefore linked to the prevention of rheumatic heart disease and the screening of congenital heart disease. The results of our study showed that complications of AR occur preferentially in patients with severe OI.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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