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Original article

Comparison of the epidemiological, clinical and diagnostic characteristics of infective endocarditis of native and prosthetic valves in a Peruvian reference centre

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ABSTRACT

Objective. To compare the epidemiological, clinical and diagnostic characteristics of patients with native valve infective endocarditis (NVIE) and prosthetic valve infective endocarditis (PVIE) treated in a Peruvian reference center. **Materials and Methods.** A retrospective, descriptive study was conducted on patients diagnosed with NVIE and PVIE at the Instituto Nacional Cardiovascular (INCOR), EsSalud, between 2017 and 2023. **Results.** A total of 65 NVIE and 55 PVIE cases were identified, with community-acquired infections predominating (92.3% in NVIE, 83.6% in PVIE). PVIE patients were older (mean age: 63.7 vs. 46.1 years, p<0.001) and had more comorbidities. The key predisposing factor in PVIE was prior endocarditis (20.0%) and valve repair (14.5%), while congenital heart disease (41.5%) and valvular disease (21.5%) predominated in NVIE. Fever and dyspnea were the most common symptoms in both groups. The aortic valve was the most frequently affected (78.5% in NVIE, 87.3% in PVIE). NVIE was associated with vegetation (92.3%) and leaflet perforations (41.5%), while PVIE showed more abscesses (34.5%) and pseudoaneurysms (36.4%). Cardiac computed tomography identified vegetations and pseudoaneurysms in both groups. Blood cultures were positive in 49.2% of NVIE and 65.5% of PVIE, with Streptococcus species predominant in NVIE and Staphylococcus species in PVIE. Surgical treatment was performed in 96.7% of NVIE and 82.6% of PVIE cases. **Conclusions.** NVIE predominantly affected younger patients with congenital heart disease, while PVIE was more common in older patients with comorbidities. Transesophageal echocardiography and microbiological findings were essential for diagnosis.

Keywords: Endocarditis; Diagnosis; Signs and Symptoms; Peru (Source: MeSH-NLM).

RESUMEN

Comparación de las características epidemiológicas, clínicas y diagnósticas de endocarditis infecciosa de válvula nativa y protésica en un centro de referencia peruano

Objetivo. Comparar las características epidemiológicas, clínicas y diagnósticas de pacientes con endocarditis infecciosa de válvula nativa (EIVN) y protésica (EIVP) en un centro de referencia peruano. **Materiales y métodos**. Estudio retrospectivo de pacientes con diagnóstico de EIVN y EIVP atendidos en el Instituto Nacional Cardiovascular (INCOR), EsSalud, entre 2017 y 2023. Se recolectaron datos clínicos y diagnósticos. **Resultados.** Se incluyeron 65 casos de EIVN y 55 de EIVP, predominando la adquisición comunitaria (92,3 y 83,6%, respectivamente). La edad promedio fue mayor en EIVP (63,7 vs. 46,1 años, p<0,001), al igual que las comorbilidades. En EIVP, el factor predisponente más frecuente fue endocarditis previa (20,0%), mientras que en EIVN destacaron cardiopatías congénitas (41,5%) y valvulopatías (21,5%). Fiebre y disnea fueron síntomas comunes. La válvula aórtica fue la más afectada (78,5% en EIVN y 87,3% en EIVP). En EIVN predominaron vegetaciones (92,3%) y perforaciones (41,5%); en EIVP, abscesos (34,5%) y pseudoaneurismas (36,4%). La tomografía cardíaca permitió identificar vegetaciones y pseudoaneurismas en ambos grupos. Los hemocultivos fueron positivos en 49,2% de EIVN y 65,5% de EIVP, con predominio de estreptococos y estafilococos, respectivamente. El tratamiento quirúrgico se realizó en 96,7% de EIVN y 82,6% de EIVP. **Conclusiones.** La EIVN predominó en jóvenes con cardiopatías congénitas, mientras que la EIVP afectó a pacientes mayores con comorbilidades. Los hallazgos microbiológicos y la ecocardiografía transesofágica fueron fundamentales para el diagnóstico.

Palabras clave: Endocarditis; Diagnóstico; Signos y Síntomas; Perú (Fuente: DeCS-Bireme).

Introduction

Infective endocarditis (IE) is a complex disease characterised by infection of the endocardial surface and cardiac valves [1,2]. Its pathophysiology involves several processes, beginning with endothelial damage caused by turbulent blood flow secondary to underlying structural heart disease, leading to the formation of sterile thrombi. During episodes of transient bacteraemia, microorganisms may adhere, either directly or indirectly, to these sites, initiating infection [1,2]. Risk factors for developing IE include cardiac factors such as a prior episode of IE, the presence of prosthetic valves or intracardiac devices, congenital heart disease, and valvular disease. Non-cardiac risk factors include advanced age, male sex, intravenous drug use, recent dental procedures, immunosuppression, and haemodialysis [3,4].

IE may affect native valves (native valve infective endocarditis, NVIE), prosthetic valves (prosthetic valve infective endocarditis, PVIE), and cardiac implantable electronic devices (CIEDs), accounting for approximately 92%, 4%, and 4% of affected individuals, respectively [5,6]. Diagnosis relies on the combination of microbiological, imaging, surgical, and clinical criteria. The 2023 Duke-ISCVID criteria have demonstrated, in external validation studies, comparable sensitivity but improved specificity relative to previous diagnostic frameworks [6,7].

The epidemiology of IE has undergone considerable changes in recent decades, with a global increase in incidence from 478,002 cases in 1990 to 1,090,526 in 2019. However, no significant differences have been observed in mortality or disease burden over this period [8]. Early identification and appropriate treatment, whether medical or surgical, are therefore essential to prevent severe complications such as micro- and macrovascular embolisation, conduction abnormalities, heart failure, cardiogenic shock, and death [3,8]. Given the limited availability of data on the characteristics and trends of IE in Latin America and the Caribbean, it is crucial to characterise and compare patients with NVIE and PVIE to gain a better understanding of its clinical heterogeneity. In this context, the present study aimed to analyse the epidemiological, clinical, and diagnostic differences between these two forms of IE at a Peruvian referral centre, to identify predisposing factors, clinical manifestations, microbiological profiles, and imaging findings that may help optimise diagnosis and treatment.

Materials and methods

Study design

Observational, descriptive, and retrospective study conducted at the National Cardiovascular Institute (INCOR-EsSalud), Lima, Peru, from January 1, 2017, to December 31, 2023.

Population

All patients referred to our centre with a diagnosis of IE were included. They were classified into two groups according to the type of valve involved: native or prosthetic (mechanical or biological). The modified Duke-ISCVID 2023 [9] diagnostic criteria were used, comprising: (I) pathological criteria; and (II) clinical criteria, which include major (microbiological, imaging, and surgical) and minor criteria (predisposition, fever, vascular phenomena, immunological phenomena, microbiological, imaging, and physical examination findings). A definitive diagnosis of IE was established if the patient met one of the following: a) one pathological criterion; b) two major clinical criteria; c) one major clinical criterion plus three or four minor criteria; or d) five minor criteria. A possible diagnosis was established if the patient met: a) one major and one or two minor criteria; or b) three or four minor clinical criteria.

Variables

The two groups were compared in terms of cardiovascular risk factors (age, sex, hypertension, type 2 diabetes mellitus, smoking, dyslipidaemia); medical history (chronic kidney disease, stroke, atrial fibrillation, ischaemic heart disease, immunosuppression); predisposing factors; clinical manifestations; echocardiographic and cardiac computed tomography (CT) findings; blood cultures; isolated microorganisms; analysis of the affected valve; histopathological results; and surgical findings.

Procedures or interventions

Medical records were reviewed for data collection, and corresponding data collection forms were completed. Cases with incomplete medical records or those considered relapses of endocarditis (an episode of IE within the previous six months) were excluded.

Ethical aspects

The study was approved by the institutional ethics committee (047/2023 CEI). Due to its retrospective design, informed consent from patients was not required, as data were collected from medical records without direct contact with participants. Confidentiality was strictly maintained, ensuring compliance with the ethical principles outlined in the Declaration of Helsinki and local health research regulations. No interventions were performed that could compromise the integrity or safety of the patients included in the study.

Data analysis

Data were processed using Jamovi statistical software, version 2.3.28.0. Categorical variables were expressed as frequencies and compared using the chi-square test or Fisher's exact test. For quantitative variables, the median or mean was calculated according to their distribution, and comparisons were made using the Student's t-test or the Mann–Whitney U test. A p-value < 0.05 was considered statistically significant.

Results

A total of 131 medical records were reviewed, but only 120 patients were included in the study, 65 with NVIE and 55 with PVIE. Community-acquired infection was observed in 60 cases (92.3%) of NVIE and in 46 cases (83.6%) of PVIE, while healthcare-associated infection was identified in 5 cases (7.7%) of NVIE and 9 cases (16.4%) of PVIE.

Patients with PVIE were older on average and had a higher number of comorbidities compared to those with NVIE **(Table 1)**. Regarding predisposing factors for IE, a history of previous IE was more frequently observed in PVIE cases (20.0%), whereas congenital heart disease (41.5%) and valvular heart disease (21.5%) were more common among patients with NVIE. The most frequently identified congenital heart defects in NVIE included bicuspid aortic valve (19 cases), ventricular septal defect (3 cases), patent ductus arteriosus (3 cases), tetralogy of Fallot (1 case), and subaortic membrane (1 case). The presence of a predisposing factor, as a minor Duke criterion, was documented in 100% of PVIE cases and 53.8% of NVIE cases **(Table 1)**.

The most common symptom in both groups was fever, although dyspnoea was more frequent in NVIE (58.5%). Vascular phenomena served as a minor diagnostic criterion in 36.9% of NVIE cases and 32.7% of PVIE cases, with arterial embolism being the most common manifestation. Immunological phenomena were infrequent in both groups **(Table 2)**.

At least one echocardiographic study was performed on all patients, with a higher frequency of transesophageal echocardiography (TEE) in PVIE cases (98.2%). The most affected valve in both groups was the aortic valve; however, the mitral valve showed greater involvement in NVIE compared to PVIE. Multivalvular involvement occurred in 33.8% of NVIE and 14.5% of PVIE cases. In the PVIE group, the biological prosthesis was the most affected (74.5%). Regarding echocardiographic findings, vegetations (92.3%), leaflet perforations (41.5%), and new valvular insufficiency (87.7%) were more frequently observed in NVIE. Abscesses (34.5%), pseudoaneurysms (36.4%), and partial

Table 1. Cardiovascular risk factors, medical history, and predisposing factors in cases of infective endocarditis in native and prosthetic valves.

	Native (%)	Prosthetic (%)	p-value
Cardiovascular risk factors			
Mean age in years (SD)	46.1 (±17.8)	63.7 (±15.6)	<0.001
Male sex	50 (76.9%)	37 (67.3%)	0.238
Hypertension	24 (36.9%)	30 (54.5%)	0.053
Diabetes	8 (12.3%	10 (18.2%)	0.369
Smoking	12 (18.5%)	11 (20.0%)	0.831
Dyslipidemia	6 (9.2%)	10 (18.2%)	0.151
Medical history			
Chronic kidney disease	6 (9.2%)	7 (12.7%)	0.539
Hemodialysis	5 (7.7)	0 (0.0%)	0.062
Previous stroke	3 (4.6%)	9 (16.4%)	0.063
Ischemic heart disease	1 (1.5%)	10 (18.2%)	0.003
Atrial fibrillation	2 (3.1%)	13 (23.6%)	<0.001
Immunosuppression	4 (6.2%)	1 (1.8%)	0.373
Previous invasive procedure	8 (12.3%)	6 (10.9%)	0.812
Predisposing factors			
Previous infective endocarditis	0 (0.0%)	11 (20.0%)	<0.001
Valve prosthesis carrier (surgical or percutaneous)	1 (1.5%)	54 (98.2%)	<0.001
Valve repair (surgical or percutaneous)	0 (0.0%)	8 (14.5%)	0.001
Congenital heart disease	27 (41.5%)	2 (3.6%)	<0.001
Valvulopathy	14 (21.5%)	0 (0.0%)	<0.001
Cardiac electronic device carrier	0 (0.0%)	1 (1.8%)	0.458
Hypertrophic cardiomyopathy	2 (3.1%)	0 (0.0%)	0.499
Intravenous drug use	1 (1.5%)	0 (0.0%)	1.000
Minor criterion by predisposing factor	35 (53.8%)	55 (100%)	<0.001

SD: standard deviation.

Table 2. Clinical manifestations, vascular phenomena, and immunological phenomena in cases of infective endocarditis of native and prosthetic valves.

	Native (%)	Prosthetic (%)	p-value
Clinical manifestations			
Fever	52 (80.0%)	40 (72.7%)	0.348
Dyspnoea	38 (58.5%)	20 (36.4%)	0.016
Syncope	3 (4.6%)	3 (5.5%)	1.000
Neurological focus	10 (15.4%)	9 (16.4%)	0.884
Vascular phenomena			
Arterial embolism	21 (32.3%)	16 (29.1%)	0.704
Septic pulmonary infarction	3 (4.6%)	0 (0.0%)	0.249
Cerebral or splenic abscess	1 (1.5%)	2 (3.6%)	0.593
Intracranial hemorrhage	2 (3.1%)	2 (3.6%)	1.000
Mycotic aneurysm	0 (0.0%)	0 (0.0%)	
Conjunctival hemorrhage	0 (0.0%)	0 (0.0%)	
Janeway lesions	2 (3.1%)	2 (3.6%)	1.000
Purulent purpura	0 (0.0%)	0 (0.0%)	
Splinter hemorrhages	0 (0.0%)	0 (0.0%)	
Minor vascular phenomenon criterion	24 (36.9%)	18 (32.7%)	0.631
Immunological phenomena			
Rheumatoid factor	6 (9.2%)	5 (9.1%)	1.000
Roth spots	0 (0.0%)	2 (3.6%)	0.208
Osler nodes	2 (3.1%)	1 (1.8%)	1.000
Immune complex-mediated glomerulonephritis	1 (1.5%)	0 (0.0%)	1.000
Minor immunological phenomenon criterion	9 (13.8%)	7 (12.7%)	0.857

prosthesis dehiscence (21.8%) were more common in PVIE. Echocardiography served as a major criterion in 100% of NVIE cases and 96.4% of PVIE cases **(Table 3)**.

The use of cardiac CT as a diagnostic tool was more frequent in PVIE (36.4%) than in NVIE (18.5%). In the 12 patients with NVIE who were evaluated with CT, vegetation was the most frequent finding (18.5%). In the 20 patients with PVIE, the predominant findings were abscesses (25.0%) and pseudoaneurysms (60%). The aortic valve was the most affected in the tomographic studies in both groups, with a prevalence of 58.3% in NVIE and 75.0% in PVIE **(Table 3)**.

Positron emission tomography (PET) was used in only three patients with PVIE, where the indication was a high clinical suspicion with inconclusive findings on echocardiography or cardiac CT.

Blood cultures were taken from all patients in the study, with positive results in 49.2% of NVIE cases and 65.5% of PVIE cases. However, most patients had received antibiotic therapy prior to admission and before blood cultures were taken. In NVIE, the most frequently isolated microorganisms were streptococci (24.6%), whereas staphylococci predominated in PVIE. The microbiological major criterion was more frequent in PVIE (43.6%) **(Table 4)**.

Only 79 patients in the study had valve, prosthetic valve, or prosthetic material cultures, with positive results in 10.4% of the 48 NVIE cases and 25.8% of the 31 PVIE cases **(Table 5)**. Histopathological studies were conducted in 53 NVIE patients (58.9%) and 28 PVIE patients (60.9%), with active endocarditis and fulfillment of the pathological diagnostic criterion being more frequent in NVIE **(Table 5)**.

Regarding surgical treatment, 61 patients with NVIE underwent surgery, with intraoperative findings fulfilling the major diagnostic criterion in 96.7% of cases. In the PVIE group, 46 patients received surgical treatment, with 82.6% meeting the major surgical diagnostic criterion **(Table 5)**.

Discussion

In the present study, 120 cases of IE were analysed, classifying them into NVIE and PVIE. Patients with PVIE were older, had more comorbidities, and a history of endocarditis, whereas congenital heart disease predominated in NVIE cases. Although community-acquired infections were common, PVIE was more strongly associated with healthcare-associated infections.

Table 3. Cardiac imaging studies in cases of infective endocarditis of native and prosthetic valves.

	Native (%)	Prosthetic (%)	p-value
Echocardiogram	65 (100.0%)	55 (100.0%)	
Transthoracic echocardiography	63 (96.9%)	55 (100.0%)	0.190
Transesophageal echocardiogram	58 (89.2%)	54 (98.2%)	0.05
Median LVEF % (IQR)	60 (51-66)	60 (52-67)	0.825
Right ventricular systolic dysfunction	8 (12.3%)	6 (10.9%)	0.812
Aortic valve affected	51 (78.5%)	48 (87.3%)	0.206
Mitral valve affected	30 (46.2%)	11 (20.0%)	0.003
Tricuspid valve affected	5 (7.7%)	2 (3.6%)	0.451
Pulmonary valve affected	4 (6.2%)	1 (1.8%)	0.373
Congenital defect affected	4 (6.2%)	0 (0.0%)	0.124
Vegetación	60 (92.3%)	35 (63.6%)	<0.001
Leaflet perforation	27 (41.5%)	2 (3.6%)	<0.001
Valve aneurysm	4 (6.2%)	0 (0.0%)	0.124
Abscess	7 (10.8%)	19 (34.5%)	0.002
Pseudoaneurysm	12 (18.5%)	20 (36.4%)	0.027
Fistula	9 (13.8%)	7 (12.7%)	1.000
New valve insufficiency	57 (87.7%)	17 (30.9%)	<0.001
Partial prosthetic dehiscence	0 (0.0%)	12 (21.8%)	<0.001
Major echocardiographic criterion	65 (100.0%)	53 (96.4%)	0.208
Cardiac tomography	12 (18.5%)	20 (36.4%)	0.027
Vegetation	7 (58.3%)	4 (20.0%)	0.053
Perforation	1 (8.3%)	0 (0.0%)	0.375
Valve aneurysm	1 (8.3%)	2 (10.0%)	1.000
Abscess	1 (8.3%)	5 (25.0%)	0.370
Pseudoaneurysm	2 (16.7%)	12 (60.0%)	0.028
Fistula	1 (8.3%)	2 (10.0%)	1.000
Prosthetic dehiscence	0 (0.0%)	3 (15.0%)	0.274
Major tomographic criterion	9 (75.0%)	16 (80.0%)	1.000
18-FDG PET CT	0 (0.0%)	3 (5.5%)	0.093
Major criterion by 18-FDG PET CT	0 (0.0%)	2 (66.7%)	
Minor criterion by 18-FDG PET CT	0 (0.0%)	1 (33.3%)	

LVEF: left ventricular ejection fraction; 18-FDG PET CT: positron emission tomography with 18F-fluoro-2-deoxy-D-glucose.

Fever was the most common symptom, with dyspnoea predominating in NVIE. Echocardiographically, NVIE presented more vegetations and perforations, whereas PVIE showed abscesses, pseudoaneurysms, and prosthetic dehiscences. Positive blood cultures were more frequent in PVIE, with staphylococci predominating, while in NVIE, streptococci were more common.

Histopathological and surgical diagnostic confirmations were more frequent in NVIE; meanwhile, cardiac CT and PET, although less commonly employed, were instrumental in identifying pseudoaneurysms in PVIE. These differences reflect distinct patterns of epidemiology, clinical presentation, and diagnosis.

Our findings show that patients with PVIE had a mean age of 63.7 years, significantly higher than the 46.1 years in NVIE [10,11]. A previous study in Peru reported a median age of 50 years, lower than what we observed in our analysis [12], which may reflect the global trend of increasing age at disease onset in recent years. This phenomenon is associated with a higher burden of

Table 4. Blood culture results in cases of infective endocarditis of native and prosthetic valves.

	Native (%)	Prosthetic (%)	p-value
Blood cultures	65 (100.0%)	55 (100.0%)	
Positive	32 (49.2%)	36 (65.5%)	0.074
Microbiological major criterion	9 (13.8%)	24 (43.6%)	<0.001
Microbiological minor criterion	23 (35.4%)	12 (21.8%)	0.103
Isolated microorganism			
Staphylococcus aureus and coagulase-negative staphylococci	6 (9.2%)	17 (30.9%)	
Streptococcus species and *Streptococcus gallolyticus*	16 (24.6%)	8 (14.5%)	
Enterococcus	2 (3.1%)	8 (14.5%)	
Gram-negative bacteria	1 (1.5%)	5 (9.1%)	
Candida	1 (1.5%)	0 (0.0%)	
Other	1 (1.5%)	0 (0.0%)	

comorbidities in older adults, such as chronic kidney disease, diabetes, and hypertension, factors that contribute to worse prognosis and higher mortality [12–14]. Additionally, the atypical clinical presentation and lower frequency of fever complicate diagnosis, increasing the risk of complications [16].

Etiologically, enterococcus and Streptococcus gallolyticus were notably prevalent, with the latter linked to colorectal neoplasms [10]. Although surgery is the only curative option in many cases, its use in older adults is limited by high surgical risk. However, in selected patients, surgery improves long-term survival despite higher postoperative complications [13,14]. These findings highlight the need for a multidisciplinary approach to optimise management and improve clinical outcomes [10].

Regarding sex, our results show a slight male predominance in both groups, consistent with reports from Europe and Latin America, such as those from Spain and Argentina. In these countries, IE is more common in men, with a male-to-female ratio ranging from 2:1 to 3:1, regardless of whether it is NVIE or PVIE [17–19]. This global trend could be explained by differences in predisposing risk factors and exposure to medical procedures between genders. According to the analysis by Slouha et al., the incidence of IE is higher in men, particularly in native valves, while women tend to develop the disease at older ages, with a predominance of mitral valve involvement and a higher risk of complications, such as vegetation on intracardiac devices and prosthetic valves [20]. Moreover, women often receive more conservative management, which may contribute to the higher mortality observed at 30 days and one year compared to men, who have greater access to surgical interventions [21]. In the United States, data suggest a sustained increase in both the incidence and mortality of IE, with a 41.2% rise in age-standardized incidence rates between 1990 and 2019. This increase was more pronounced in men (45.8%) than in women (34.1%) and primarily affected those over 55 years old, likely due to population aging

Table 5. Valve, prosthesis, and prosthetic material culture results, histopathological studies, and surgical findings in cases of infective endocarditis of native and prosthetic valves.

	Native (%)	Prosthetic (%)	p-value
Valve, prosthesis, or prosthetic material culture	48 (73.8%)	31 (56.4%)	0.044
Positive	5 (10.4%)	8 (25.8%)	0.118
Histopathological study	53 (86.9%)	28 (60.9%)	0.002
Microorganism identified	27 (50.9%)	12 (42.9%)	0.488
Active endocarditis	48 (90.6%)	15 (53.6%)	<0.001
Pathological diagnostic criterion	50 (94.3%)	20 (71.4%)	0.007
Surgical treatment	61 (93.8%)	46 (83.6%)	0.085
Major criterion by surgical finding	59 (96.7%)	38 (82.6%)	0.018

and increased use of intracardiac devices and procedures such as valve replacement [22]. These findings underscore the importance of addressing regional, age-related, and sex-based disparities in the management of IE, adapting diagnostic and treatment strategies to different global contexts.

Our results show that patients with PVIE had more cardiovascular comorbidities, such as atrial fibrillation (23.6% vs. 3.1%, p<0.001) and ischaemic heart disease (18.2% vs. 1.5%, p=0.003), compared to NVIE. This is consistent with the European EURO-ENDO registry, which highlights the influence of these comorbidities on prognosis and management [3].

On the other hand, NVIE was primarily associated with congenital heart disease, reflecting patterns described in Europe and Latin America [3]. In adults with congenital heart disease, the risk of developing NVIE is up to 44 times higher than in the general population, due to factors such as intracardiac shunts, haemodynamic disturbances, and prosthetic materials, even after surgical corrections [23,24]. Conditions such as bicuspid aortic valves, ventricular septal defects, and tetralogy of Fallot are especially predisposed, particularly after surgical procedures or the use of intracardiac devices. Although in-hospital mortality is relatively low (4-9%), severe complications are common, underscoring the importance of preventive strategies and multidisciplinary management to optimise prognosis in this population [24,25].

Regarding clinical manifestations, fever was the most common symptom in both groups, while dyspnoea predominated in NVIE (58.5% vs. 36.4%, p=0.016), likely associated with heart failure secondary to congenital heart disease, as reported in Brazil [26]. Furthermore, clinical and demographic differences between NVIE and PVIE highlight the need for a personalised diagnostic and therapeutic approach, considering age, comorbidities, and etiology, as suggested by a recent review [27]. These observations underscore the importance of differentiated management strategies to optimise outcomes.

The findings of this study align with those reported in international registries and highlight clinical and diagnostic differences between NVIE and PVIE. In NVIE, the prevalence of vegetations and valve perforations observed in this study is similar to that described in research conducted in Spain and Colombia, where these lesions, characteristic of previously healthy valves, are associated with a higher risk of embolism and haemodynamic deterioration [18,28]. On the other hand, perivalvular complications, such as abscesses and pseudoaneurysms, predominate in PVIE and reflect the impact of infection on prosthetic valves, consistent with European registries that highlight their predominantly healthcare-associated acquisition, as well as the greater complexity and severity of this clinical entity [3,18].

In our study, positive blood cultures were more frequent in PVIE (65.5%), with *Staphylococcus aureus* and coagulase-negative staphylococci predominating, a finding consistent with registries such as EURO-ENDO and the Spanish registry, which associate these pathogens with healthcare-associated infections and intravascular devices [3,18]. In contrast, in NVIE, streptococci were identified in 24.6% of cases, reflecting a trend similar to that described in Spanish, Danish, and Italian registries, where streptococci are linked to community-acquired infections in previously healthy valves [17,18,29]. These microbiological differences underscore the need to adapt the antimicrobial approach based on the type of valve affected and the context of infection acquisition. Furthermore, the predominance of Staphylococcus aureus in PVIE reflects global changes in predisposing factors, such as the increased implantation of prosthetic valves and the emergence of antimicrobial resistance, which complicates clinical management [30].

The widespread use of TEE in 98.2% of PVIE cases in this study underscores its essential role in identifying complications such as abscesses, pseudoaneurysms, and prosthetic dehiscence, in line with international recommendations [1]. Its high sensitivity (90%-100%) compared to transthoracic echocardiography enables the precise detection of severe lesions that other methods might miss [5]. Complementarily, CT proved crucial in complex cases, particularly for identifying abscesses, pseudoaneurysms, and septic emboli, and was predominantly used in PVIE [1,6]. Furthermore, the combination of PET-CT allowed for the detection of inflammatory activity in prosthetic valves, establishing it as an invaluable tool in high-specialty centres [30]. These advanced techniques strengthen the comprehensive diagnosis of IE, particularly in complex or difficult-to-assess scenarios.

This study has limitations due to its retrospective design and sample size, which may underestimate certain findings. However, the inclusion of a comprehensive analysis of clinical, microbiological, and imaging factors provides valuable insight into IE in a developing country, allowing for meaningful comparisons with international registries.

This study reinforces the need for differentiated strategies for the diagnosis and management of NVIE and PVIE, highlighting the importance of microbiological surveillance and the early use of advanced imaging modalities. Future research should focus on the impact of surgical interventions and the role of diagnostic tools such as PET-CT in resource-limited settings.

In conclusion, this study provides valuable information on the clinical, microbiological, and management differences between NVIE and PVIE at a referral centre in Peru, highlighting epidemiological patterns consistent with international registries. PVIE was associated with older age, comorbidities, and healthcare-associated acquisition, whereas NVIE predominated in younger patients with congenital heart disease. TEE proved crucial in diagnosis, especially in PVIE cases, while blood cultures and histopathological analysis highlighted the microbiological differences between both groups. These findings underscore the need for a multidisciplinary approach to optimise early diagnosis,

timely treatment, and preventive strategies, particularly in resource-limited settings. Furthermore, they reinforce the importance of future studies exploring surgical interventions and advanced imaging tools in this context.

Authors` contributions

DEA: Conceptualisation, Methodology, Formal Analysis, Investigation, Data curation, Writing – Original Draft, Writing – Review and Editing. **RMS, AMH, and DDF:** Investigation, Data curation, Writing – Original Draft, Writing – Review and Editing.

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