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Original Article

Infective Endocarditis in Patients with Congenital Heart Disease: Pediatric and Young Adult Perspectives from a Tertiary Center

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Abstract

Objectives: This study aimed to evaluate the clinical, microbiological, echocardiographic, and surgical characteristics of pediatric and young adult patients diagnosed with definite infective endocarditis (IE) at a tertiary pediatric cardiology center.

Methods: In this retrospective cohort study, we included 21 patients diagnosed with IE between January 2019 and December 2024, according to the Modified Duke Criteria. Demographic, clinical, microbiological, and echocardiographic data were analyzed. Outcomes and complications, including the need for surgery and mortality, were recorded. Patients with complex congenital heart disease were included even beyond 18 years of age due to ongoing pediatric cardiology follow-up.

Results: The median age at diagnosis was 15 years (range: 4 months–35 years), and 85.7% had congenital heart disease. Blood cultures were positive in 61.9% of patients, with *Candida* species being the most common pathogens (33.3%). Vegetations were detected in 85.7% of patients, primarily affecting the pulmonary and aortic valves. Surgical intervention was required in 33.3% of cases. In-hospital mortality was 23.8%, with *Candida*-related IE accounting for 60% of deaths. Culture-negative IE occurred in 38.1% of cases, often associated with prior antibiotic use. One patient experienced a relapse within six months.

Conclusion: Infective endocarditis in children and young adults remains a serious condition with high morbidity and mortality, especially among those with complex congenital heart disease and fungal infections. *Candida*-related IE is associated with particularly poor outcomes, highlighting the need for early diagnosis, aggressive treatment, and vigilant follow-up in high-risk populations.

Keywords: Congenital heart disease; infective endocarditis; pediatrics, young adult.

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Konjenital Kalp Hastalarında Enfektif Endokardit: Üçüncü Basamak Bir Merkezden Pediatrik ve Genç Erişkinlere Yönelik Bulgular

Özet

Amaç: Bu çalışmada, üçüncü basamak bir pediatrik kardiyoloji merkezinde kesin infektif endokardit (İE) tanısı alan pediatrik ve genç erişkin hastaların klinik, mikrobiyolojik, ekokardiyografik ve cerrahi özelliklerinin değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Bu retrospektif kohort çalışmasında, Ocak 2019 – Aralık 2024 tarihleri arasında Modifiye Duke Kriterleri'ne göre enfektif endokardit tanısı alan 21 hasta değerlendirildi. Demografik veriler, klinik bulgular,

mikrobiyolojik ve ekokardiyografik özellikler analiz edildi. Cerrahi müdahale ihtiyacı ve mortalite gibi kısa dönem sonuçlar değerlendirildi. Karmaşık doğumsal kalp hastalığı (DKH) nedeniyle 18 yaş üzeri bazı hastalar da çocuk kardiyoloji izlemi kapsamında dahil edildi.

Bulgular: Tanı anındaki medyan yaş 15 yıl (4 ay–35 yıl) olup, hastaların %85,7'sinde konjenital kalp hastalığı (KKH) mevcuttu. Kan kültürü %61,9 hastada pozitifti ve en sık izole edilen patojen *Candida* türleri (%33,3) oldu. Hastaların %85,7'sinde vejetasyon saptandı; en sık pulmoner ve aort kapaklar etkilenmişti. Hastaların %33,3'üne cerrahi müdahale uygulandı. Hastane içi mortalite oranı %23,8 olup, ölümlerin %60'ı *Candida*-ilişkili İE vakalarına aitti. Kültür negatif İE oranı %38,1 olup, sıklıkla önceki antibiyotik kullanımı ile ilişkiliydi. Bir hastada altı ay içinde relaps gelişti.

Sonuç: Çocuk ve genç erişkinlerde EE, özellikle karmaşık DKH ve fungal enfeksiyon varlığında yüksek morbidite ve mortaliteye yol açmaktadır. *Candida*'ya bağlı EE olgularındaki yüksek ölüm oranı, erken tanı, agresif tedavi ve yüksek riskli gruplarda yakın takibin önemini vurgulamaktadır.

Anahtar sözcükler: Konjenital kalp hastalığı; enfektif endokardit; pediatri; genç erişkin.

Introduction

Infective endocarditis (IE) remains a life-threatening disease with considerable morbidity and mortality, despite advances in diagnostic techniques and antimicrobial therapy. Although IE is less common in children than in adults, its incidence has increased in recent years, ranging from 0.43 to 0.84 cases per 100,000 children annually, with higher rates observed in developing countries and tertiary referral centers.[1] This rise is largely attributed to improved survival of children with congenital heart disease (CHD), and the growing use of prosthetic materials, intracardiac devices, and catheter-based interventions.[2,3]

While congenital cardiac anomalies and previous cardiac surgeries constitute the most common predisposing conditions for pediatric IE, it is noteworthy that up to 10% of pediatric cases occur in children without any known structural heart disease.[4] These patients often present with vague and nonspecific symptoms, which may delay diagnosis. Fever is the most frequent clinical feature, but it may be absent in partially treated patients or those receiving immunosuppressive therapy. Other manifestations include fatigue, malaise, arthralgia, new-onset or changing heart murmurs, and embolic events affecting the central nervous system or visceral organs.[5]

In recent years, there has also been an increased recognition of fungal endocarditis, particularly due to *Candida* species, especially among immunocompromised hosts or those with central venous catheters.[6] Fungal IE often exhibits a more aggressive clinical course, higher rates of embolization, and worse outcomes compared to bacterial IE.

In this study, we aimed to present the clinical, microbiological, echocardiographic, and surgical features of pediatric and young adult patients diagnosed with definite infective endocarditis at our tertiary pediatric cardiology center. By highlighting real-world experiences in a population enriched with complex CHD and device-related interventions, we sought to contribute to the limited regional data on pediatric IE.

Materials and Methods

This retrospective cohort study included patients diagnosed with definite infective endocarditis (IE) according to the Modified Duke Criteria between January 2019 and December 2024 at the Pediatric Cardiology Department of a tertiary referral hospital. A total of 21 patients were enrolled. All except two patients were diagnosed and primarily followed at our tertiary pediatric cardiology center. Two patients had been initially diagnosed at external hospitals and were referred to our institution for continuation of their treatment and follow-up.

Although some patients were over 18 years of age at the time of diagnosis, they remained under pediatric cardiology follow-up due to their complex congenital cardiac conditions and prior childhood cardiac surgeries. Complex congenital cardiac conditions were defined as major structural heart defects associated with single-ventricle physiology or requiring staged palliative repair, such as tetralogy of Fallot, pulmonary atresia with intact ventricular septum, and complete or partial atrioventricular septal defect. Their follow-up and management continued in the pediatric setting because of their specialized needs and clinical history.

Data were collected from electronic medical records and the institutional echocardiographic archive. The variables analyzed included demographic characteristics, predisposing risk factors, clinical features, laboratory and microbiological findings, echocardiographic data, treatment approaches (including antimicrobial therapy and surgical interventions), complications, and short-term outcomes. Cardiac involvement was assessed using transthoracic echocardiography (TTE) and, when indicated, transesophageal echocardiography (TEE). Echocardiographic evaluations were performed in the outpatient clinic, inpatient ward, or intensive care unit, depending on the patient's clinical status. All patients were hospitalized at the time of diagnosis and managed as inpatients in the pediatric cardiology ward or intensive care unit.

For patients with multiple IE episodes, only the first episode was included in the analysis. Recurrent IE was defined as an episode occurring more than six months after the initial episode or associated with a different pathogen.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional ethics committee (Approval Date: 01/07/2025; Decision Number: 2025/11/1012).

Statistical analyses were performed using IBM SPSS Statistics version 21.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as median (minimum–maximum), as all continuous data showed non-normal distribution.

Results

Patient Characteristics

A total of 21 patients diagnosed with definite infective endocarditis (IE) according to the Modified Duke Criteria were included in the study between 2019 and 2024. The median age at diagnosis was 15 years (range: 4 months to 35 years), and the male-to-female ratio was 13:8. One patient experienced a relapse within six months, and another had two distinct IE episodes five years apart; only the first episode for each patient was included in the analysis. In several cases, the diagnosis of infective endocarditis was established during an ongoing hospitalization for other indications, such as postoperative care or systemic deterioration; therefore, hospital stay duration was not analyzed as a separate outcome parameter. In this cohort, two patients (Cases 12 and 16) had been initially diagnosed at external hospitals and were subsequently referred to our center for treatment and follow-up.

All cases met the Modified Duke Criteria for definite infective endocarditis through appropriate combinations of major and minor criteria. A major echocardiographic criterion was present in all patients—either vegetation (n=18, 85.7%) or new valvular regurgitation in the absence of a visible vegetation (n=3, 14.3%). Blood cultures yielded a typical microorganism in 13 patients (61.9%), most commonly *Candida* spp. and *Staphylococcus aureus*. The most frequent minor criteria were predisposing congenital heart disease (n=18, 85.7%), fever ≥38°C (n=17, 81%), and elevated inflammatory markers (n=18, 85.7%); vascular phenomena (e.g., embolic events) were documented in a subset of cases as detailed in the Results.

Risk Factors and Predisposing Conditions

At least one risk factor was identified in 19 out of 21 patients. CHD was the most common underlying condition, present in 18 patients (85.7%). One patient (4.8%) had rheumatic heart disease, while two patients (9.5%) had no identifiable risk factors. Among patients with CHD, infective endocarditis developed after cardiac surgery or transcatheter valve implantation in 17 cases. The onset of IE occurred between 1 month and 5 years post-procedure, with a mean interval of 12±2 months.

Additional predisposing factors included prolonged hospitalization in the intensive care unit, long-term use of broad-spectrum antibiotics, and central venous catheterization—particularly in patients requiring extended postoperative PICU stays, such as Cases 1 and 2. One patient (Case 17) had a history of coronary artery bypass surgery and liver transplantation due to familial hyperlipidemia and was under immunosuppressive treatment at the time of IE diagnosis (Table 1a).

Clinical Presentation

Fever was the most common presenting symptom, observed in 17 patients (81%). Two patients (Cases 14 and 18) presented with chest pain. Neurological manifestations such as altered mental status, encephalitis, or hemiparesis were present at diagnosis in three patients (Cases 11, 12, and 20). Eight patients (38%) had a newly developed or changing heart murmur. In two patients without fever during clinical follow-up, it was noted that they had received antimicrobial therapy prior to admission (Cases 3 and 5).

Among CHD patients, 15 were diagnosed with IE during postoperative follow-up, and two following transcatheter pulmonary valve implantation. Most patients were referred to pediatric cardiology due to unexplained fever, murmur, or signs of sepsis. In patients without known cardiac disease, such as Cases 11, 12, and 20, the diagnosis was prompted by findings including splenomegaly, neurological symptoms, and pansystolic murmur. Related surgical interventions and risk factors are presented in Table 1b.

Laboratory and Microbiological Findings

Leukocytosis was present in 18 patients (85.7%), and acute phase reactants were elevated in the same number of cases at the time of diagnosis. The median white blood cell count was 15,170/μL (range: 8,000–37,600), the median C-reactive protein (CRP) level was 86 mg/L (range: 1–209), and the median erythrocyte sedimentation rate (ESR) was 43 mm/h (range: 12–86) (Table 1a). In two patients who presented with chest pain (Cases 14 and 18), elevated troponin levels were observed.

Blood cultures were positive in 13 patients (61.9%). The most frequently isolated microorganisms were *Candida* species (33.3%), *Staphylococcus aureus* (14.2%), and coagulase-negative *Staphylococci* (14.2%). In Case 17, both *Candida* spp. and coagulase-negative *Staphylococcus* were isolated in repeated cultures. *Burkholderia cepacia* was detected in Case 16, who had a relapsing IE episode. Three patients (Cases 11, 12, and 20) had *S. aureus* growth despite having no history of cardiac surgery or intervention. In eight patients (38.1%) with negative cultures, prior antibiotic therapy was identified as a probable cause of culture negativity.

Echocardiographic Characteristics

Vegetations were identified in 18 out of 21 patients (85.7%) using transthoracic or transesophageal echocardiography. Severe mitral regurgitation was observed in two patients, and one patient had severe aortic regurgitation. In three patients, TTE did not reveal any vegetation, but TEE confirmed the presence of vegetations.

The most common localization of vegetation was the pulmonary valve position (33%) (Fig. 1). Right-sided infective endocarditis was detected in nine patients, while eleven patients had left-sided involvement. Among them, five of the right-sided IE patients and seven of the left-sided IE patients had central venous catheters. In three patients, the diagnosis of IE was established based on the appearance of new-onset or increased valvular regurgitation compared to preoperative findings, despite the absence of visible vegetations. Echocardiographic findings for each case are summarized in Table 1a.

Complications and Outcomes

IE-related complications developed in several patients. Neurological manifestations such as encephalitis, seizure, or hemiparesis were observed in Cases 11, 12, and 20. Septic embolism occurred in Cases 12 and 20. Case 12 experienced multiple systemic complications, including cerebral, splenic, and renal embolism, as well as heart failure.

Table 1a. Demographic, clinical, microbiological, and echocardiographic characteristics of patients with infective endocarditis

Case	Age at IE diagnosis	Underlying disease	Intervention / risk factor	Microorganism	Echo findings	WBC (cells/μL)	CRP (mg/L)	ESR (mm/h)
1	4 months	IVS + PA	Postoperative 4th month, central venous catheter (CVC)	Burkholderia cepacia	Vegetation on tricuspid valve	25250	77	NA
2	4 months	VSD	Postoperative 1st month, central venous catheter (CVC)	*Klebsiella spp.*, *Candida parapsilosis*	Mitral valve perforation with severe regurgitation	11250	198	NA
3	7 months	VSD	Postoperative 5th month	*Candida parapsilosis*	No vegetation detected	10000	36	NA
4	9 months	Tetralogy of Fallot	Postoperative 1st month, symptoms started after 1 week	*Candida spp.*	Pulmonary valve vegetation	17000	86	12
5	18 months	Complete AVSD	Postoperative 18th month	Candida albicans	Pulmonary valve vegetation	23700	1	NA
6	32 months	VSD	Postoperative 1st year	No growth	Severe mitral regurgitation	8490	15	NA
7	6 years	Bicuspid aortic valve	Postoperative 1st month	*Candida spp.*	Intracardiac abscess	10400	45	NA
8	11.5 years	Significant aortic regurgitation	Unknown interval	No growth	Aortic regurgitation	23500	15	NA
9	12 years	Tetralogy of Fallot	Postoperative 6th month	No growth	Endocarditis on Melody valve	37600	7.4	43
10	13 years	ASD	Postoperative 1st month	Staphylococcus hominis (CoNS)	No vegetation detected	14300	110	NA
11	15 years	Prolonged fever (no structural heart disease)	No prior surgery	Staphylococcus aureus	Aortic regurgitation	25000	149	40
12	15 years	History of tooth extraction (no structural heart disease)	No prior surgery	Staphylococcus aureus	Mitral vegetation with perforation	20140	200	69
13	16 years	Dysplastic aortic valve with aortic dilatation	Postoperative 5th year	No growth	Vegetation on prosthetic aortic and pulmonary valves	15700	131	NA
14	18 years	Bicuspid aortic valve	Postoperative 5th year	No growth	Fibrinous thrombus on aortic valve prosthesis	11440	1.84	NA
15	18 years	VSD, Bicuspid aortic valve	Postoperative 3rd month	*Candida parapsilosis*, *Staphylococcus epidermidis* (CoNS)	Aortic root abscess with vegetation on Prosthetic aortic valve	26690	209	NA
16	18 years	Tetralogy of Fallot	Postoperative 2nd month	Burkholderia cepacia	Vegetation on Myvall pulmonary valve	15170	139	NA
17	20 years	Bicuspid aortic valve	Postoperative 5th month, immunosuppressed (liver transplant)	*Candida spp.*, *Staphylococcus lentus* (CoNS), ESBL-Klebsiella	Vegetation on mitral and prosthetic aortic valve	13700	131	NA
18	20 years	Parsiyel AVSD	Postoperative 6th month	*Staphylococcus epidermidis* (CoNS)	Vegetation on mitral valve leaflets	12300	27.5	NA
19	21 years	VSD, AVP	Postoperative 1st month, residual VSD	No growth	Residual VSD and new defects around patch area	8000	30	30
20	25 years	VSD, ASD	Amputation 5 months prior, recent cannabis use (20 days ago)	*Staphylococcus aureus*	Vegetation on tricuspid valve	22000	138	86
21	35 years	Repaired Tetralogy of Fallot	Postoperative 1st year	No growth	Bioprosthetic Pulmonary valve vegetation	8000	107	43

Table 1b. Surgical interventions, complications, and outcomes of patients with infective endocarditis

Case	Surgical intervention notes	Complication notes	Outcome at discharge
1	Atrial septectomy, PDA ligation, and central shunt at day 12; Glenn procedure at 4 months	None	Survived
2	IE onset in postoperative 1st month; patient died in postoperative 3rd month	None	Deceased
3	Vegetation/thrombus in right pulmonary artery and at left bifurcation	None	Survived
4	Total repair of Tetralogy of Fallot, IE onset in 2nd postoperative week following surgery at 9 months	None	Survived
5	Complete AVSD repair; IE with pulmonary artery involvement	None	Survived
6	Multiple operations: VSD closure (14 mo), RVOT relief (21 mo), mitral valve replacement (22 mo)	Underwent mitral valve replacement	Survived
7	Neonatal balloon valvuloplasty for bicuspid valve; Konno (6 mo); subaortic ridge resection and valve repair (2 yrs); LVOT reconstruction and pulmonary conduit replacement (6 yrs); IE onset 21 days post-op	None	Deceased
8	MVR due to rheumatic heart disease (11 yrs), IE onset 6. month postop	underwent aortic valve replacement	Survived
9	Total repair of Tetralogy of Fallot, Bioprosthetic pulmonary valve replacement (5 yrs); Transcatheter Melody valve implantation (12yrs); IE onset 6 month; Transcatheter Melody valve in valve implantation (14 yrs)	None	Survived

Table 1b. Cont.

Case	Surgical intervention notes	Complication notes	Outcome at discharge
10	ASD repair (13 yrs)	None	Survived
11	No structural heart disease	Neurological: encephalitis	Survived
12	No structural heart disease	Systemic embolism: cerebral, splenic, renal; heart failure	Survived
13	Konno-Rastan AVR, RCA-RİMA Bypass (12 yrs),	underwent aortic valve replacement	Deceased
14	AVR(14 yrs)	None	Survived
15	VSD repair (8 yrs), Nicks procedure with aortic valve replacement (mechanical, 23 mm; IE onset 3. month post-op	None	Deceased
16	Total repair of Tetralogy of Fallot (10 mo); transcatheter Melody valve implantation (11 yrs); transcatheter Myvall pulmonary valve implantation (18 yrs)	Underwent pulmonary valve replacement	Survived
17	Coronary bypass and liver transplant (6 yrs) due to familial hyperlipidemia; Konno-Rastan, AVR (20 yrs)	None	Survived
18	AVSD repair	None	Deceased
19	Surgical VSD closure; IE onset 1month post-op	None	Survived
20	VSD without surgical intervention	Septic embolism	Survived
21	Total repair of Tetralogy of Fallot, Bioprosthetic pulmonary valve replacement (34 yrs); IE onset 1year post-op (First IE); Transcatheter Melody valve implantation (35yrs); Transcatheter Myvall valve implantation (41 yrs); Second IE onset 8 months post-catheter	None	Survived

IE: Infective endocarditis; AVSD: Atrioventricular septal defect; VSD: Ventricular septal defect; ASD: Atrial septal defect; PA: Pulmonary atresia; AVP: Aortic valve prolapse; CoNS: Coagulase-negative staphylococci; ESBL: Extended-spectrum beta-lactamase; CVC: Central venous catheter; NA: Not available; LVOT: Left ventricular outflow tract; mo: Months; PDA: Patent ductus arteriosus; RVOT: Right ventricular outflow tract; CHD: Congenital heart disease.

Early surgical intervention was required in 33.3% of the patients, including a case of prosthetic aortic valve endocarditis due to *Candida parapsilosis* (Fig. 2). The overall mortality rate was 23.8% (5 out of 21 patients). Among patients with *Candida*-related IE, the mortality rate was markedly higher at 42.9%. Notably, although *Candida* infections represented one-third of all cases, they accounted for 60% of the total deaths in the cohort.

In patients with *Staphylococcus aureus* endocarditis without a history of cardiac surgery (Cases 11, 12, and 20), clinical deterioration and systemic embolism were common. All three required surgical treatment after antimicrobial therapy and were discharged without sequelae.

Detailed outcomes and complication notes are provided in Table 1b.

Treatment and Follow-up

All patients received intravenous antimicrobial therapy, typically lasting six weeks. The most used empirical regimens included combinations of vancomycin, meropenem, and gentamicin. In patients with confirmed fungal infections (Cases 1, 3, 7, 8, 15, and 17), antifungal agents such as amphotericin B (Ambisome®) and fluconazole were administered, either alone or in combination with antibacterial agents. Case 17, who had a history of coronary artery bypass and liver transplantation, received immunosuppressive therapy at the time of IE diagnosis and required broad-spectrum antimicrobial and antifungal treatment.

Early surgical intervention was performed in 7 patients (33.3%) due to indications such as persistent vegetation, severe valvular insufficiency, or embolic complications. Of the 5 patients who died, 3 had *Candida*-related IE and had received antifungal therapy during hospitalization. The remaining patients were discharged following clinical and echocardiographic improvement, with no documented relapses during follow-up except for one patient (Case 16), who experienced a recurrence within six months, requiring excision of the infected prosthetic pulmonary valve (Fig. 3).

Surgical interventions and discharge outcomes are presented in Table 1b.

Discussion

In this study, we analyzed the clinical, microbiological, echocardiographic, and surgical features of 21 pediatric and young adult patients diagnosed with definite infective endocarditis (IE) at a tertiary pediatric cardiology center. CHD was the most common predisposing factor, identified in over 85% of the cohort. Blood cultures were positive in approximately two-thirds of the cases, with *Candida* species being the most frequently isolated pathogens. Notably, *Candida*-related IE was associated with a markedly higher mortality rate (42.9%), accounting for 60% of total deaths. Echocardiographic evidence of vegetation was present in most of the patients, predominantly on the pulmonary and aortic valves. One-third of the patients required early surgical intervention due to severe valvular insufficiency or embolic complications.

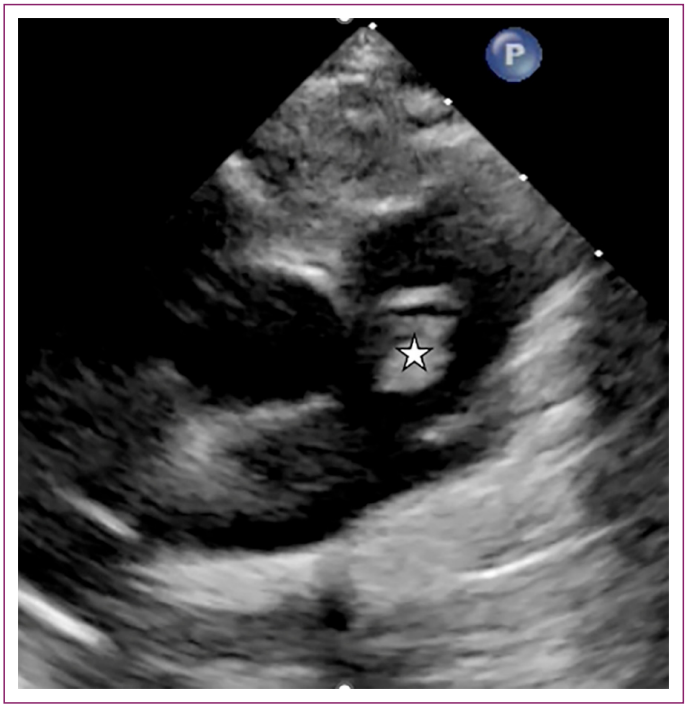

Figure 1. Parasternal short-axis view demonstrating vegetation on the pulmonary valve in Case 5, consistent with infective endocarditis due to *Candida*.

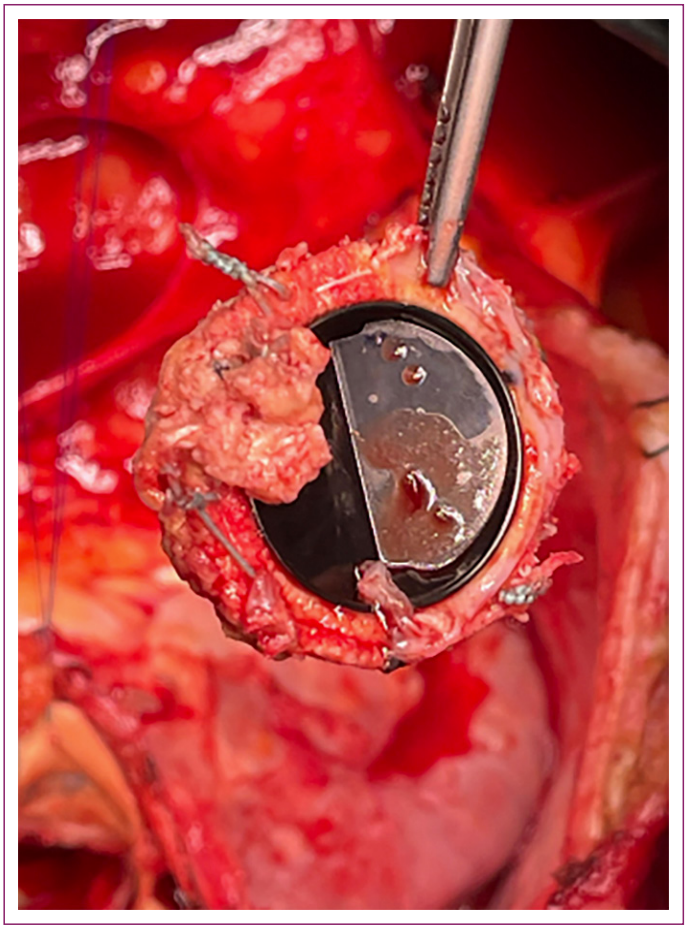

Figure 2. Surgical view of prosthetic aortic valve endocarditis due to *Candida* parapsilosis in Case 15.

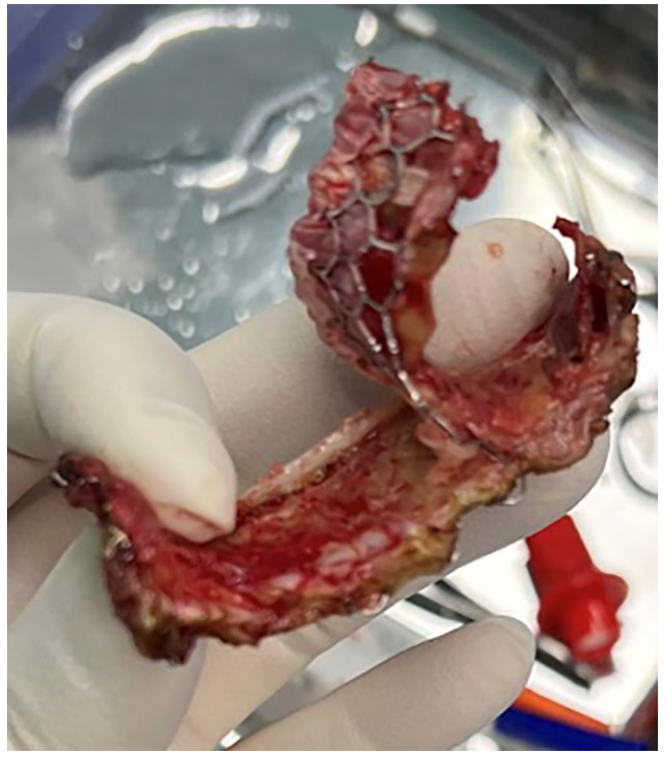

Figure 3. Excised Myval pulmonary valve specimen from Case 16, demonstrating infective endocarditis caused by *Burkholderia cepacia*.

Despite aggressive medical and surgical treatment, the overall mortality rate remained high at 23.8%.

The predominance of CHD as a major predisposing factor in our cohort is consistent with previous pediatric series, which have reported CHD in up to 75–85% of IE cases.[7,8] Our findings further support the vulnerability of patients with repaired or palliated CHD, particularly those with prosthetic material or residual defects, to endocardial infection.

Fever was the most frequent clinical manifestation, present in 81% of our cases, aligning with literature where fever remains the hallmark of pediatric IE.[5,9] However, the absence of fever in some patients—likely due to prior antimicrobial use—emphasizes the diagnostic challenge, especially in immunosuppressed or postoperative individuals. This diagnostic uncertainty is well recognized in international guidelines, especially in cases of culture-negative endocarditis, where prior antibiotic use or atypical presentations may delay definitive diagnosis.[10,11] In culture-negative cases, especially when conventional diagnostics are inconclusive, molecular methods such as broad-range PCR may aid in pathogen identification; however, their use remains restricted to selected indications.[12,13]

In contrast to adult populations, where *Staphylococcus aureus* is the leading cause of IE, our study identified *Candida* species as the most isolated pathogens, accounting for one-third of culture-positive cases. This notable fungal predominance is consistent with previous reports indicating an increased incidence of fungal IE in immunocompromised children and those with indwelling central venous catheters.[14,15] *Candida* IE has been

associated with a particularly poor prognosis and high mortality, frequently requiring a combination of medical and surgical treatment.[16] In our cohort, *Candida*-related IE was associated with a significantly higher mortality rate (42.9%), reinforcing its aggressive nature and clinical importance.

Echocardiographic evidence of vegetation was detected in 85.7% of our patients, which is comparable to detection rates reported in other pediatric cohorts.[5] In our cohort, the pulmonary valve was the most common site of vegetation (33%). While this differs from the left-sided predominance typically observed in adult IE, it aligns with findings from multicenter pediatric registries that reported increased right-sided and pulmonary valve involvement among children with congenital heart disease and prior right-sided interventions.[17]

The in-hospital mortality rate of 23.8% observed in our cohort is slightly higher than the rates typically reported in pediatric IE series (10–20%).[9] However, studies from resource-limited settings have documented even higher mortality rates exceeding 30%.[18] This variation underscores the impact of factors such as patient complexity, timing of diagnosis, and pathogen profile on clinical outcomes.

Surgical intervention was required in approximately one-third of the patients (33.3%), consistent with prior reports indicating that surgery is frequently needed in complicated pediatric IE cases.[12,19] Indications included persistent vegetations, severe valvular insufficiency, and embolic phenomena. Notably, one patient (Case 16) experienced a relapse within six months of the initial episode. This case illustrates the critical need for vigilant long-term surveillance, especially in individuals with prosthetic valves or complex congenital heart disease.[8] Furthermore, recurrent IE has been shown to carry similar mortality and complication rates as first-episode IE, as demonstrated by the EURO-ENDO registry,[20] emphasizing the importance of timely intervention and sustained follow-up.

This study provides a comprehensive real-world analysis of infective endocarditis (IE) in pediatric and young adult patients followed at a tertiary congenital heart disease center. One of its primary strengths lies in the inclusion of complex congenital heart disease cases extending into adulthood, a population often underrepresented in pediatric IE literature. The detailed integration of clinical, microbiological, and echocardiographic data enhances the clinical value of this work. The notably high proportion of culture-positive fungal endocarditis and its association with increased mortality underscore an important and emerging trend in pediatric IE, particularly relevant for high-risk and immunocompromised populations.

Nevertheless, certain limitations must be acknowledged. The retrospective and single-center nature of the study may limit the generalizability of the findings. Additionally, the relatively small sample size precluded robust statistical comparisons across pathogen subgroups and intervention types. Despite these limitations, the study offers valuable insights for clinicians managing IE in children and young adults with complex congenital heart disease or device-related infections.

Conclusion

IE continues to pose significant diagnostic and therapeutic challenges in pediatric and young adult populations, particularly in those with complex congenital heart disease and device-related interventions. This study highlights the predominance of CHD as a predisposing factor, the notable frequency of fungal pathogens—especially *Candida* species—and the relatively high in-hospital mortality rate associated with such infections. The findings emphasize the importance of heightened clinical suspicion, timely microbiological diagnosis, and individualized management strategies in high-risk patients. Moreover, in patients with CHD under follow-up—particularly those presenting with fever and a history of cardiac surgery with prosthetic device implantation—IE should be considered and investigated.

Given the evolving epidemiology of pediatric IE, multidisciplinary care, early surgical consultation, and vigilant long-term follow-up remain essential for improving patient outcomes. Further multicenter, prospective studies are warranted to validate these findings and guide future clinical practice.

Disclosures

Ethics Committee Approval: The study was approved by the Koşuyolu Hospital Ethics Committee (no: 2025/11/1012, date: 01/07/2025).

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