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INFECTIVE ENDOCARDITIS IN PEDIATRIC AGE GROUP: A SINGLE CENTER EXPERIENCE

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ABSTRACT

Background: Complications of structural heart disease, such as infectious endocarditis, are a major cause of death and disability. Prolonged and frequently intensive medical and surgical treatments continue to impose a heavy financial and overall morbidity burden. **Aim of study:** to evaluate clinical, laboratory presentations and in-hospital outcomes of IE. **Patients and methods:** This was a prospective descriptive study which included 30 patients aged < 18 years old and diagnosed with Infective Endocarditis for a period of one year from December 2024 to December 2025. A detailed history was taken, clinical examination was done, laboratory tests including blood culture were sent and serial transthoracic echocardiography was done. **Results:** In this study, congenital heart disease was the underlying factor in 90% of patients and VSD accounts for the vast majority patients (40%). Fever was the most presenting symptom of 76%. Twelve patients (40%) had a negative blood culture. Among patients with positive blood culture; Staphylococcus aureus was the most common causative microorganism in this study with 37% patients followed by Viridans-group streptococci in 16.7% of patients. Complications had occurred in 16.7% of patients, 10% of them developed thromboembolic events and 6.7% developed acute renal injury. The mortality rate in our study was 10%. **Conclusion:** IE is not uncommon disease in Iraq; CHD is the main underlying cause. Frequent use of antibiotics leads to increase the percentage of culture negative IE. Staphylococcus aureus is the most common causative microorganism due to the rise in survival, surgical intervention, and invasive procedures of children with CHD.

KEYWORDS: Endocarditis, pediatric, infective, morbidity, complication.

INTRODUCTION

When bacteria infect the heart's endocardial surface, it can affect either natural or artificial valves, endocardial structures, or intracardiac devices or leads. This condition is known as infectious endocarditis (IE).[1] With an annual prevalence of 1%, pediatric IE is still a very rare and serious cardiovascular infection in children. 1/100,000 instances.[2] It has a lower incidence and better outcomes than IE in adults.[3] Even though Staphylococcus aureus and viridans streptococci continue to be the most common microorganisms in pediatric IE.[4] other, less common microbes such coagulase-negative staphylococci, Gram-negative bacteria, and fungi have been responsible for an upsurge in cases recently.[5] Patients with congenital heart disorders (CHDs) are living longer and using central catheters more often, which has led to an increase in the frequency of IE and changes in predisposing factors.[6] Recent developments in the pediatric population also include an increased number of interventional cardiac catheterization procedures, intracardiac prosthesis, residual cardiac shunts, and underlying CH.[7] On the other hand, IE can manifest in infants who do not have cardiac illness. Central catheters and immunosuppressive medications are common among young children, according to reports.[8] Because of the wide variety and lack of specificity in the clinical presentation of IE in children, prompt diagnosis can be challenging.

Symptoms of systemic embolization may include fever, petechiae, focal neurologic impairments, or organ infarctions; however, fever is the most prevalent symptom.[9] Delays in diagnosis and the high incidence of complications mean that pediatric IE remains a leading cause of morbidity and mortality, even if surgical therapies and diagnostic methods have advanced.[10] More than 50% of adults with IE will experience neurologic complications, including ischemic stroke, infectious intracranial aneurysms, intracranial hemorrhage, and intracerebral abscesses. These complications are most likely caused by septic material embolizing to the intracranial vasculature.[11] There is a lack of data on the prevalence and risk factors of IE's neurologic consequences in children, and these may vary from adult populations.[12] In Iraq, heart problems, such as rheumatic heart disease, which puts people at risk for IE, have been on the rise in recent years. It is critical to know how common IE is in the local population.[13] There is a lack of thorough data on the prevalence and clinical characteristics of IE due to the significant surveillance gaps in the Iraqi healthcare system. The aim of this study is to evaluate clinical, laboratory presentations and in-hospital outcomes of IE. Public health policies and clinical practices in an era of rising cardiovascular problems can be informed by this study, which will also add to our knowledge of IE on a global scale.

Patients and Methods

Study design and setting

This is a prospective descriptive study which was conducted at Ibn Al-Bitar center for cardiac surgery in Baghdad / Iraq for a period of one year from December 2024 to December 2025.

Study patients

The study included 30 patients aged < 18 years admitted to hospital and diagnosed as IE. Patients who refused to participate in this study were excluded. Diagnosis of IE was confirmed according to the Duke criteria and the requirement is two major criteria or one major and three minor criteria or five minor criteria. The major criteria included the following.[14]

- ✓ Positive blood cultures for IE.
- ✓ From two separate blood cultures, typical microorganism for IE.
- Viridans streptococci, Streptococcus bovis, and HACEK group or,
- Community-acquired Staphylococcus aureus or enterococci in the absence of a primary focus or
- If two blood cultures are taken 12 hours apart or three or more cultures are taken separately, with the first and final taken at least one hour apart, consistently revealing a microbe compatible with infectious endocarditis, then the results are considered persistently positive.

- ✓ Evidence of endocardial involvement
- o Positive Echo for IE.
  - Without a different anatomical explanation, an oscillating intracardiac mass on a valve, its supporting structures, a regurgitant jet's route, or implanted material or,
  - Abscess or,
  - New partial dehiscence of prosthetic valve or
- o New valvular regurgitation.

The minor criteria included:

- ➢ Predisposing heart condition or intravenous drug use.
- ➢ Fever: 38°C
- ➢ Emboli, septic pulmonary infarcts, mycotic aneurysms, cerebral hemorrhages, conjunctival hemorrhages, and Janeway lesions are all examples of vascular phenomena.

- ➢ **Immunologic phenomena:**
  - Glomerulonephritis.
  - Osler nodes.
  - Roth spots.
  - RF
- ➢ Serologic evidence of active infection with an organism consistent with IE or a positive blood culture that does not match the primary criteria mentioned above constitute microbiologic evidence.
- ➢ Consistent with IE, the echo results do not fulfil the major requirements mentioned before.

Ethical consideration

For an ethically sound research project like this one, it's important to follow the guidelines provided by the Declaration of Helsinki. The cardiac surgery ethics committee at Ibn Al-Bitar center gave its stamp of approval. A signed informed permission was obtained from each patient or surrogate once they were approved of the study's goals. The use of identifying coding and the storage of data in a password-protected environment ensured data security.

Data collection and workup

- A well-designed questionnaire was used to collect the needed information.

- A detailed history was taken including the age, gender, residency, past medical and surgical history, presenting symptoms, background cardiac disorders, the time interval between symptoms onset and the final diagnosis and any history of antibiotic use before diagnosis were confirmed.

- A thorough physical examination was done including general examination, vital signs especially temperature charts, cardiac examination including any new murmur or change in previous murmur and if present; any vascular or immunologic phenomena (Roth spots, splinter hemorrhages, Janeway lesions, Osler nodes).

- Focal or nonspecific neurologic symptoms and signs were taken in consideration and further management with brain CT or MRI were sent accordingly.
- Laboratory tests such as Complete Blood Cell (CBC), Erythrocyte Sedimentation Rate (ESR), C-reactive Protein (CRP) and Rheumatoid factor (RF) were performed. Blood Culture was sent at least in three samples at admission and frequent sampling during hospitalization and in stable patients with suspected history of antibiotic use blood culture was delayed for few days before it was sent to ensure a proper result of the causative microorganism.
- Any complication during hospitalization was monitored as relapsing disease, increased renal indices, heart failure, pericardial effusion and embolic events.
- A serial transthoracic Echo study was done at time of admission and during treatment and at discharge.
- During hospitalization, patient response to treatment was monitored with changing antibiotic according to result of blood culture in critically ill patients who started empirical treatment with frequent monitoring of renal function CBC and inflammatory markers.

Follow up

After discharge, patients were asked to follow up closely, especially for the first six months. Some stable patients who are stable hemodynamically and afebrile finished their antibiotic course at home after educating the family about the disease, its complication and when they should ask for medical help.

Statistical analysis

We used SPSS, a statistical tool for the social sciences (version 28.0 for windows, SPSS, Chicago, IL, USA), to conduct our numerical analyses. Numbers with percentages are used to represent qualitative data, while quantitative variables are shown as mean ± SD.

RESULTS

Among 30 studied patients, the mean age was 8.2 ± 3.6 years (range: 3.3 – 16.6), with 15 (50%) males. This study showed that acyanotic congenital heart disease accounts for 19 (70.4%) patients; the most common predisposing factor was VSD (40%); and the most common symptom was fever (76.7%) (Table 1).

Table 1: Patients' Characteristics (n=30).

Patients' Characteristics	No. (n= 30)	Percentage (%)
Age (Year)		
< 5	5	16.7
5 – 9	16	53.3
≥ 10	9	30.0
Gender		
Male	15	50.0
Female	15	50.0
CHD		**n= 27**
Acyanotic	19	70.4
Cyanotic	8	29.6
Predisposing factor		
VSD	12	40.0
TOF	4	13.3
PDA	3	10.0
DORV	3	10.0
Central Venous Line	3	10.0
MS, MR	2	6.7
Other	3	10.0
Symptoms		
Fever	23	76.7
Malaise	4	13.3
Pallor	4	13.3
Dyspnea	3	10.0

In this study, 26 (86.6%) patients presented with positive Echo finding of vegetation while 18 (60%) patients had a positive blood culture of a typical microorganism consistent with IE. Patients with definite IE according to Duke Criteria were 22 (73.3%) while possible IE was present in 8 (26.7%) patients (table 2).

Table 2: Diagnostic criteria (n=30).

Criteria	No. (n= 30)	Percentage (%)
Major Duke Criteria		
Positive Echo	26	86.6
Positive blood culture	18	60.0
Minor Duke Criteria		
Predisposing factor (cardiac, central venous line)	30	100.0
Fever	23	76.7
Immunology problem (Positive rheumatoid factor, Osler nodes)	18	60.0
Evidence of embolism	2	6.7

This study found that 12 (40%) of patients showed negative blood culture. Staphylococcus aureus was the most common causative microorganism in 11 (36.7%) patients followed by Viridans-group streptococci in five (16.7) patients as shown in figure (1).

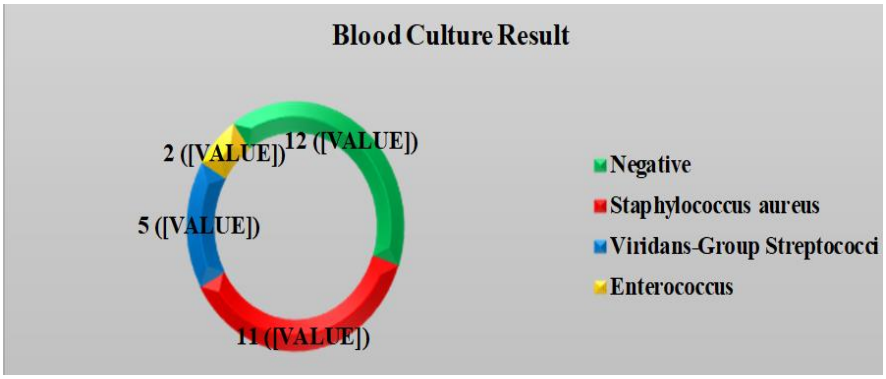

Figure 1: Blood culture results.

Laboratory results showed that most of the patients had high ESR level (93.3%); 73.3% had CRP > 5 mg/dl; 90% were anemic; 73.3% showed leukocytosis; and 80% had positive RF (Table 3).

Table 3: Laboratory results (n=30).

Variable	No. (n= 30)	Percentage (%)
ESR		
High	28	93.3
Normal	2	6.7
CRP (mg/dl)		
> 5	22	73.3
≤ 5	8	26.7
Anemia		
Yes	27	90.0
No	3	10.0
Leukocytosis		
Yes	22	73.3
No	8	26.7
RF		
Positive	24	80.0
Negative	6	20.0

Meropenem + 3rd generation cephalosporin was the most used regime in 13 (43.3%) of patients (figure 2) followed by Glycopeptid + 3rd generation cephalosporin (26.7%).

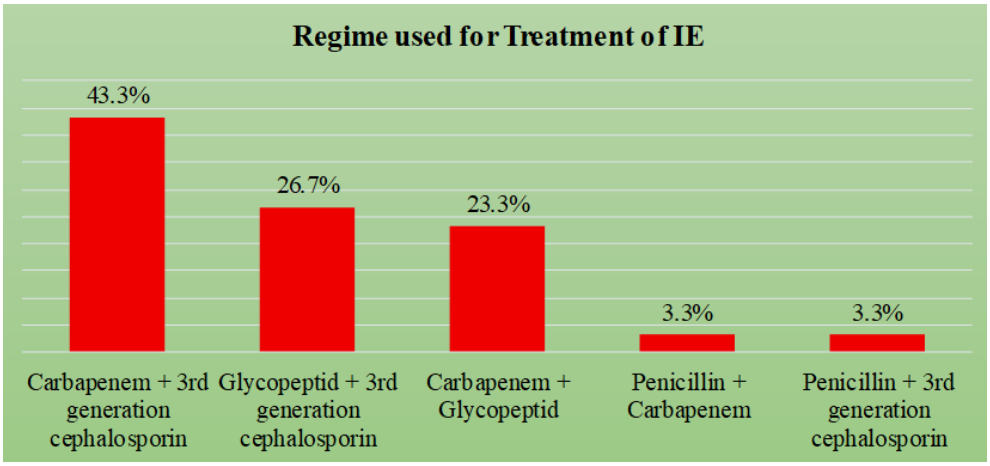

Figure 2: Regime used for treatment of IE.

We noticed that during admission; five (16.7) patients developed complications, three (10%) patients complained from thromboembolic events and two (6.7) patients suffered from acute renal injury. Most of patients were discharged (83.3%), three (10%) patients died and two (6.7%) required surgical intervention.

Table 4: Morbidity and mortality.

Variable	No. (n= 30)	Percentage (%)
Complication		
Thromboembolic event	3	10.0
Acute renal injury	2	6.7
No	25	83.3
Outcome		
Discharged	25	83.3
Surgery	2	6.7
Died	3	10.0

DISCUSSION

Due to its uncommon occurrence but high potential for harm, IE continues to be a major worry in pediatric cardiology. Children with congenital cardiac disease had a higher risk of IE, according to this study. This population faces special difficulties, such as delayed diagnosis and a wide range of symptoms.[15] Compared to the pre-antibiotic era, reported mortality rates are far lower now. However, the overall morbidity and the financial burden of extensive and often lengthy medical and surgical treatments are still enormous.[16] This study found that CHD was the underlying factor in 90% of patients (acyanotic heart disease, with a VSD account for the vast majority) which is similar to studies conducted by Parvar SY et al in 2023.[17] and Rachamadugu SI et al in 2022.[18] This increment in CHD compared to Rheumatic Heart Disease (RHD) as underlying cause of IE seems to be related to the growing numbers of children who survive with complex CHD in addition to the growing number of surgical and interventional techniques and proves that RHD is no longer a common predisposing factor for IE similar to the developed countries. In the current work, fever was the most presenting symptom in 76% of patients and this agreed with what found in studies conducted by Stavropoulou E et al in 2025.[19] and Ata H et al in 2025.[20] This might be explained by the fact that Staph. aureus which is the most common causative pathogen in most of these studies including ours; usually associated with acute form of endocarditis that is presented with a toxic course with high fever, systemic debilitation, and more overt hemodynamic changes on presentation.

In this study; twelve patients (40%) had a negative blood culture; that was similar to study conducted by Fihman V et al in 2021.[21] and higher than studies conducted by Kong WK et al in 2022.[22] and Suardi LR et al in 2021.[23] It will be clear that the percentage of negative blood culture is lower in more developed countries due to many causes as a prior AB use before obtaining blood samples due to the widespread use of AB in pediatric population in any febrile illness, improper blood culture sampling technique and unavailability of culture medias for all causative microorganism especially the rare one.[24] Staphylococcus aureus was the most common causative microorganism in this study with eleven (37%) patients, and this agreed with the majority of studies as those conducted by Ekwueme DE et al in 2025.[25] and Barrau K et al in 2004.[26] Staphylococcus aureus is the most common microorganism in infective endocarditis due to its virulence factors, modes of entry into the bloodstream, and ability to evade immune responses, contributing significantly to its associated morbidity and mortality.[27]

Study limitations

Despite the benefits of this study, it has certain limitations such as

- The study may not have been representative of the pediatric community due to its small sample size of 30 patients with IE.
- Limited applicability to different areas or healthcare settings due to its single center design. Different results may be achieved in different regions due to differences in healthcare systems, diagnostic tools, and patient demographics.
- The study used the Duke criteria to diagnose IE, which might not work for all patients or in all settings. Misclassification of patients due to the strict and inconsistent criteria might affect actual prevalence rates.

CONCLUSION

IE is not uncommon disease in Iraq. CHD is the main underlying cause of IE in this era with significant decline in RHD as an underlying cause. IE can result from a wide spectrum of CHD, among acyanotic VSD is the most common predisposing factor and among cyanotic; TOF is the most common. Frequent use of antibiotics leads to increase the percentage of culture negative IE and prolongs the time interval between the initiation of symptoms and the final diagnosis of IE. Staphylococcus aureus is the most common causative microorganism even in developing countries due to the rise in survival, surgical intervention, and invasive procedures of children with CHD. Despite the use of antibiotics that are not restricted to the guidelines of management of IE; high cure rate can be achieved. IE is a serious disease with life-threatening complications; thromboembolic events are at top of them.

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