

Corynebacterium Striatum Infective Endocarditis: A Systematic Review

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Background: *Corynebacterium striatum* (CS) is an uncommon but potentially fatal pathogen of infective endocarditis (IE). The literature on the patterns and clinical progression of *Corynebacterium striatum* infective endocarditis (CSIE) is limited. This article aims to provide insights into the clinical presentation and management of CSIE through a retrospective analysis of documented cases.

Methods: An electronic search was conducted across various databases including PubMed, China National Knowledge Infrastructure (CNKI), China Science and Technology Journal Database, and Wanfang database to identify relevant articles in both English and Chinese literature documenting CSIE. Subsequently, patient-level data were extracted and subjected to analysis.

Results: The systematic search yielded 38 patients from 35 articles. The median age was 68 [IQR 54, 73] years, and 63.2% of patients were men. A history of heart disease was present in 55.3% of cases, while 15.8% had a history of cardiovascular electronic device implantation. The mitral valve was the most commonly affected site, accounting for 52.8%. The misdiagnosis or missed diagnosis rate of CSIE was 28.9%. Microbiological confirmation by 16S ribosomal ribonucleic acid (16S rRNA) or metagenomic next-generation sequencing (mNGS) was present in 13.2% of cases. Vancomycin was the most effective antibiotic, with 41.7% of the CS isolates showing resistance to multiple drugs. Surgical intervention was performed in 55.3% of the CSIE patients, and the overall fatality rate was 37.8%, both of which were higher than those reported in standard IE due to common pathogens such as *Staphylococcus aureus* (surgical intervention rate 37.8%, fatality rate 22.4%) and viridans streptococci (surgical intervention rate 29.5%, fatality rate 36.6%).

Conclusion: CSIE often presents with nonspecific symptoms, making it prone to misdiagnosis or underdiagnosis. Echocardiography and blood cultures remain the primary diagnostic tools, but advanced approaches such as 16S rRNA and mNGS improve accuracy in pathogen identification. Compared to IE caused by common microorganisms (eg, *Staphylococcus aureus*, viridans streptococci), CSIE is associated with higher rates of surgical intervention and mortality, underscoring the urgent need for increased clinical vigilance and prompt, targeted management.

Keywords: corynebacterium striatum, infective endocarditis, diagnosis, echocardiogram, treatment, prognosis

Introduction

Infective endocarditis (IE) is characterized by inflammation of the heart valves or endocardium caused by various pathogens. Previous research indicated that the incidence of IE ranges from 15 to 60 cases per 1,000,000 individuals,¹ with an in-hospital fatality rate of 15%–20%.² The economic burden of IE is substantial and continues to rise, particularly among younger individuals and women.^{3,4} Timely diagnosis and targeted treatment are crucial for improving patients' long-term outcomes. This highlights the significance of public health initiatives focused on preventing and managing this condition. *Corynebacterium striatum* (CS), a bacterium commonly found on human skin and nasal mucosa, has traditionally been considered a contaminant in bacterial cultures. However, it is increasingly recognized as a true pathogen, particularly in immunocompromised individuals and patients undergoing invasive medical procedures.^{5,6} Growing evidence has implicated CS in various infections, including pneumonia, arthritis, meningitis, and sepsis.⁷ Despite occasional case reports and small-scale retrospective studies, there remains a limited understanding of the

populations most susceptible to *Corynebacterium striatum* infective endocarditis (CSIE), as well as its clinical features and patient outcomes.^{8–10} The study aims to systematically analyze existing cases of CSIE to better understand its clinical characteristics and patient outcomes.

Methods

Literature Search

We conducted a comprehensive search of the following online databases: PubMed, China National Knowledge Infrastructure (CNKI), China Science and Technology Journal Database and Wanfang Database, to compile all Chinese or English case reports of CSIE. The literature search was conducted from inception to February 8, 2024, using “*Corynebacterium Striatum*” and “infective endocarditis” as the keywords.

Selection Criteria

Two independent reviewers (Hong M.H. and Xiang W.) conducted the initial screening of the literature abstracts, excluding literature that was not case reports or duplicates. The inclusion criteria were as follows: diagnosis of IE according to accepted guidelines,^{11–17} identification of CS as the causative agent, and publication in either Chinese or English. A total of 51 articles were initially retrieved, no Chinese-language articles were found. Studies that lacked individual case data were excluded, as were expert opinions and review articles, to reduce subjective bias. Finally, 38 patients from 35 articles were reviewed (Figure 1).

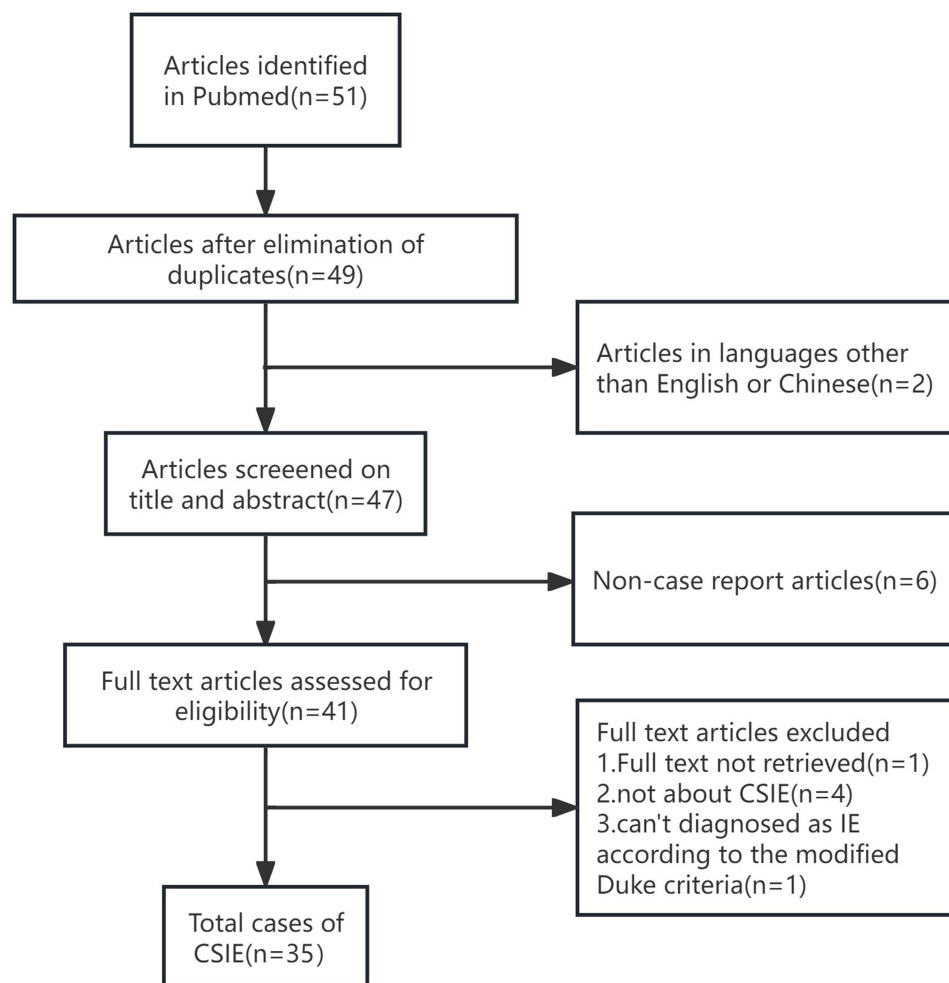


Figure 1 Flowchart of inclusion and exclusions of cases of CSIE.

Data Extraction

Two independent reviewers (Hong M.H. and Xiang W.) extracted relevant patient information from the 35 included articles. Any discrepancies or inconsistencies in the data were resolved through discussion and decision by the third senior author (Kong L.Y). The following data were collected: patient sex, age, clinical manifestations, medical history, sites of cardiac involvement, diagnostic methods, instances of misdiagnosis or under-diagnosis, drug susceptibility results, effective antibiotics used in treatment, surgical intervention status, and outcomes (including death, improvement, and recurrence).

Missing Data

Due to variations in the information provided in each case report, some data were missing. Missing important clinical manifestations and complications were assumed to be absent. In summarizing these data, denominators were determined by either explicitly mentioning the presence or absence of a variable or by inferring their existence when appropriate.

Statistical Analysis

Quantitative data following a normal distribution are expressed as mean and standard deviation, whereas data not following a normal distribution are presented as median and interquartile range (IQR), while categorical data were presented as frequencies and percentages.

Results

Demographics and Baseline Characteristics

This study collected data from 38 patients reported in 35 articles. The median age of CSIE patients was 68 [IQR 54, 73] years, and 63.2% (24/38) of the patients were male. About 55.3% (21/38) of the patients had a history of cardiovascular diseases (Table 1). Among them, 4 cases (10.5%)^{18–21} had a history of two or more cardiovascular diseases. About 15.8% (6/38) of the cases had a history of cardiovascular electronic device implantation, including 13.2% (5/38) with cardiac pacemaker implantation and 2.6% (1/38) with cardiac resynchronization therapy with cardioverter defibrillator (CRT-D) implantation. About 13.2% (5/38) of the patients had a history of artificial heart valve replacement. About 15.8% (6/38) of cases had a history of catheter insertion, including 4 cases (10.5%) with venous catheters, and 1 case (2.6%) with both

Table 1 Demographics in CSIE

Variable	Total n/N (%)
Demographics	
Age at attack, years, median [IQR]	68(54–73)
Male	24/38(63.2%)
Risk factors	
Arterial hypertension	10/38(26.3%)
Diabetes	13/38(34.2%)
CKD ^a	10/38(26.3%)
CKD 3	2/38(5.3%)
CKD 5 (Dialysis)	4/38(10.5%)
COPD ^b	2/38(5.3%)
OSAHS ^c	1/38(2.6%)
Pulmonary tuberculosis	1/38(2.6%)
Pneumonia	1/38(2.6%)
COVID-19 ^d infection	1/38(2.6%)
Renal transplantation	1/38(2.6%)
Previous stroke/TIA ^e	5/38(13.2%)
Chronic autoimmune disease	3/38(7.9%)
Long corticotherapy	2/38(5.3%)
Long corticotherapy (with immunosuppressive treatment)	1/38(2.6%)

(Continued)

Table 1 (Continued).

Variable	Total n/N (%)
History of cardiovascular diseases	
Heart failure	7/38(18.4%)
Arrhythmia	8/38(21.1%)
Previous endocarditis	1/38(2.6%)
Ischaemic heart disease	4/38(10.5%)
Valvular heart disease	7/38(18.4%)
Aortic aneurysm	1/38(2.6%)
Cardiac device therapy	
Pacemaker	5/38(13.2%)
Prosthetic valve	5/38(13.2%)
CRT-D ^f	1/38(2.6%)
Other device therapy	
Intravenous catheter	4/38(10.5%)
Ventriculo-atrial shunt	1/38(2.6%)
Vein transfusion port	1/38(2.6%)

Abbreviations: ^aCKD, Chronic kidney disease; ^bCOPD, Chronic obstructive pulmonary disease; ^cOSAHS, Obstructive sleep apnea hypopnea syndrome; ^dCOVID-19, Corona Virus Disease 2019; ^eTIA, Transient ischemic attack; ^fCRT-D, Cardiac resynchronization therapy with cardioverter defibrillator.

an infusion port and a ventriculoatrial shunt catheter. About 26.3% (10/38) of patients had chronic renal insufficiency, with 10.5% (4/38) having a history of hemodialysis, and 7.9% (3/38) were using immunosuppressive drugs (corticosteroids; one post-kidney transplant patient among them was also using tacrolimus and mycophenolate mofetil). Demographic data are provided in [Table 1](#).

Presentation and Sequelae

The most common symptoms were fever (94.7%, 36/38), dyspnea (47.4%, 18/38), and congestive heart failure (36.8%, 14/38). Among the 24 patients whose peak temperatures were recorded, 83.3% (20/24) had a temperature of 38°C or higher. Neurological symptoms, such as drowsiness and delirium, occurred in 31.6% (12/38) of cases. Arrhythmias, including sinus tachycardia, atrial fibrillation, ventricular fibrillation, and atrioventricular block, were observed in 26.3% (10/38) of patients during the course of the disease. Arterial embolism occurred in 21.1% (8/38) of cases, including 5 cases (13.2%)^{22–26} with cerebral infarction, 2 cases (5.3%)^{20,27} with splenic infarction, and one case (2.6%)²⁷ with both external iliac artery and common femoral artery embolism. Conjunctival hemorrhage²⁸ and retinal hemorrhage²⁹ each occurred in one patient (2.6%). Chest tightness and chest pain were reported in 18.4% (7/38) of patients, and new-onset kidney injury occurred in 15.8% (6/38). Heart murmurs were observed in 52.6% (20/38) of patients, with no instances of Osler nodes or splinter hemorrhages noted. A complete list of symptoms of CSIE is provided in [Table 2](#).

Diagnostics

All patients underwent echocardiography, and vegetation was detected by echocardiography or autopsy in 94.7% (36/38) of the patients. Transesophageal echocardiography (TEE) was performed in 60.5% (23/38) of patients, with a positive vegetation detection rate of 91.3% (21/23). Among these TEE patients, 34.8% (8/23) did not have vegetation detected by transthoracic echocardiography (TTE). The most commonly affected sites were heart valves, accounting for 94.4% (34/36). Specifically, the mitral valve was involved in 52.8% (19/36) of cases, followed by the aortic valve in 33.3% (12/36), the tricuspid valve in 11.1% (4/36), and the pulmonary valve rarely affected, at 5.6% (2/36). Simultaneous involvement of two or more valves occurred in 8.3% (3/36) of cases. Of these, 80.6% (29/36) involved native valves (including one patient³⁰ who had vegetation in the left atrium), and 13.9% (5/36) involved prosthetic valves, including one patient²¹ with both prosthetic valve involvement and native valve involvement. Additionally, 13.9% (5/36) of patients had

Table 2 Symptoms of CSIE

Symptoms	Total n/N (%)
Fever	36/38(94.7%)
Heart failure	14/38(36.8%)
Lower limb edema	6/38(15.8%)
Shock	4/38(10.5%)
Neurological symptoms	12/38(31.6%)
Dyspnea	18/38(47.4%)
Chest tightness and chest pain	7/38(18.4%)
Renal function damage	6/38(15.8%)
Pleural effusion	4/38(10.5%)
Arrhythmias	10/38(26.3%)
Epidural abscess	1/38(2.6%)
Complications	
Arterial embolism	8/38(21.1%)
Cerebral infarction	5/38(13.2%)
Splenic thrombosis	2/38(5.3%)
External iliac artery thrombosis	1/38(2.6%)
Common femoral artery thrombosis	1/38(2.6%)
Rheumatoid factor positive	1/38(2.6%)
Glomerulonephritis	1/38(2.6%)
Conjunctival hemorrhage	1/38(2.6%)
Retinal hemorrhage	1/38(2.6%)

pacemaker lead involvement and 2.8% (1/36) had CRT-D lead involvement; 8.3% (3/36) had vegetation exclusively on cardiovascular electronic device leads. There were 21.1% (8/36) of patients with valve or perivalvular leakage, perivalvular abscesses, and valve perforations secondary to IE. Additionally, valvular regurgitation was reported in 55.3% (21/38), including three patients whose echocardiography did not initially show vegetation. Of these three patients, one underwent aortic valve replacement due to severe aortic regurgitation, with no vegetation found intraoperatively, but tissue culture confirmed the presence of CS.³¹ Another patient had CS-related vegetation confirmed via autopsy on the aortic valve.⁸ The third patient had only new-onset valvular regurgitation without other positive findings.³² A complete list of cardiac infectious involvement is available in Table 3.

All cases underwent blood cultures and the positivity rate of CS was 92.1% (35/38). Additionally, four cases^{23,33–35} were confirmed by 16S ribosomal ribonucleic acid (16S rRNA) sequencing analysis (one of which also had a positive blood culture), and another case³⁶ was confirmed via metagenomic next-generation sequencing (mNGS). Initially, 28.9% (11/38) of patients were misdiagnosed or missed diagnosed, including 7.9% (3/38) of patients who were considered as

Table 3 Cardiac Structure Involvement in CSIE

Structure	Total n/N (%)
Vegetation	36/38
Mitral valve	19/36(52.8%)
Aortic valve	12/36(33.3%)
Tricuspid valve	4/36(11.1%)
Pulmonic valve	2/36(5.6%)
Pacemaker	5/36(13.9%)
CRT-D	1/36(2.8%)

Abbreviation: CRT-D, Cardiac resynchronization therapy with cardioverter defibrillator.

contaminants, despite initial blood cultures being positive for CS. Additionally one patient (2.6%)³³ was initially mistaken for *Kocuria kristinae* but was later confirmed as CS through 16S rRNA sequencing analysis. Furthermore, 7.9% (3/38) of patients^{34,37,38} were under-diagnosed because of negative blood cultures, and 10.5% (4/38) were misdiagnosed at early stage due to atypical clinical presentations or echocardiogram findings, being mistaken for atrial myxoma,³⁰ pneumonia,²⁰ or immune system diseases.²⁹

Antimicrobial and Surgical Management

All patients received antibiotic treatment, including empirical antibiotic therapy for patients with IE who initially had negative blood cultures. Drug susceptibility testing was performed in 63.2% (24/38) of cases. The results showed resistance to β -lactam antibiotics in 37.5% (9/24) of cases and to quinolones in 29.2% (7/24). Other commonly resistant antibiotics included macrolide lipids (20.8%, 5/24) and clindamycin (16.7%, 4/24), with 10 cases (41.7%) being multi-drug resistant. There were no reports of resistance to vancomycin, daptomycin, or linezolid. The most sensitive antibiotic was vancomycin (83.3%, 20/24), followed by β -lactam antibiotics (50.0%, 12/24), aminoglycosides (such as gentamicin and netilmicin), linezolid (29.2%, 7/24), and daptomycin (25%, 6/24). Other sensitive antibiotics included rifampicin, teicoplanin, tetracyclines (12.5%, 3/24), and clindamycin (8.3%, 2/24). The results of the drug sensitivity testing are provided in Table 4.

The most effective antibiotics (criteria for effectiveness included the disappearance of symptoms such as fever and murmurs, negative blood cultures, and disappearance of vegetations) were vancomycin (50%, 19/38), followed by β -lactam antibiotics (21.1%, 8/38), and daptomycin (18.4%, 7/38). Other effective antibiotics included aminoglycosides (13.2%, 5/38), linezolid (10.5%, 4/38), and others such as telavancin, teicoplanin, doxycycline, and rifampicin (2.6%, 1/38) (some cases involved combination therapy). A complete list of the effective antimicrobial therapy is also available in Table 4.

In addition to antibiotic therapy, 55.3% (21/38) of cases underwent surgical treatment. Among them, valve replacement was performed in 52.4% (11/21) cases, including aortic valve replacement (33.3%, 7/21), mitral valve replacement (28.6%, 6/21), and tricuspid valve replacement (4.8%, 1/21). One patient²² underwent combined mitral, tricuspid, and aortic valve replacement, and another case³⁰ underwent combined replacement of the aortic and mitral valves. Additionally, 23.8% (5/21) patients had pacemakers or pacemaker leads replaced, and 4.8% (1/21)¹⁸ had a CRT-D device replaced. One patient¹⁹ had a venous catheter removed and another³² had an infusion port removed. Another patient attempted to remove an arterial catheter unsuccessfully, and in another case the surgical procedure was not specified.

Follow Up and Outcomes

Of the 37 patients with reported outcomes, the overall fatality rate was 37.8% (14/37), and the in-hospital fatality rate was 29.7% (11/37). Follow-up results were available for 16 patients, with a median follow-up time of 75 days (IQR 14–365 days). Among these patients, 18.8% (3/16) died due to non-CS bacteremia or acute myocardial infarction.

Table 4 Antibiotics About CSIE

	Sensitive	Resistance	Effective in Practical Application
Vancomycin	19/24	–	19/38
Linezolid	7/24	–	4/38
β -lactam antibiotics	12/24	14/24	8/38
Daptomycin	6/24	–	7/38
Rifampicin	3/24	–	1/38
Tetracyclines	3/24	1/24	1/38
Teicoplanin	3/24	–	1/38
Aminoglycosides	7/24	2/24	5/38
Clindamycin	2/24	4/24	–
Macrocyclic lipids	1/24	5/24	–
Quinolones	1/24	7/24	–
Methoxybenzyl pyrimidine/sulfamethoxazole	1/24	2/24	–
Telavancin	–	–	1/38

Table 5 Outcomes of CSIE

Outcomes	Total n/N (%)
In hospital	
Improve	26/37(70.2%)
Dead	11/37(29.7%)
Follow-up	16
Recovered	9/16(56.3%)
Recurrence	4/16(25.0%)
Dead	3/16(18.8%)

Additionally, 25.0% (4/16) experienced fever or shock, with 12.5% (2/16) cases showing positive blood cultures for CS again, likely due to incomplete prior antibiotic treatment. However, these cases improved after subsequent antibiotic therapy. The remaining 9 cases (56.3%) had a favorable prognosis.

Subset analysis among patients with outcome data shows that the fatality rate for CSIE related to prosthetic valve and native valve was 40.0% (2/5) vs 48.3% (14/29). The fatality rate for patients with a history of cardiovascular electronic device implantation was 50.0% (3/6), while for negative patients, it was 40.6% (13/32). The fatality rate for patients treated solely with medication was 50.0% (8/16), whereas for those treated with surgery, it was 36.4% (8/22). The outcomes were reported in [Table 5](#).

Discussion

To our knowledge, large prospective studies on CSIE are lacking. This study summarizes reported CSIE cases from both English and Chinese literature to enhance understanding of their clinical features. The findings suggest that CSIE is frequently misdiagnosed or underdiagnosed due to its non-specific clinical symptoms. However, TEE and emerging technologies such as 16S rRNA sequencing and mNGS may be valuable in improving the diagnostic process. Additionally, compared to IE caused by common pathogens, CSIE patients experience a higher rate of surgical intervention, a significant fatality rate and a poor prognosis. Therefore, it is essential to raise awareness and provide careful attention to this condition.

Belmares et al⁹ reported that CS is the primary pathogen in cases of corynebacterial IE, particularly affecting individuals with hospital-related risk factors such as arteriovenous fistula, vascular catheter insertion, and pacemaker implantation. A study conducted in Sweden¹⁰ revealed that IE attributed to corynebacteria, including CS, is more prevalent in patients with prosthetic heart valves and is associated with a higher rate of surgical intervention compared to IE caused by *Staphylococcus aureus* and non- β -hemolytic streptococci. Consistent with previous findings,³⁹ this study found that 15.8% of CSIE cases were related to a history of cardiovascular electronic device implantation.

The 2023 Duke-International Society for Cardiovascular Infectious Diseases Criteria for Infective Endocarditis⁴⁰ emphasize the importance of maintaining a high level of vigilance for CSIE in patients with cardiovascular electronic device implantation. This underscores the growing recognition of CSIE within this specific patient population. However, this research has shown that 84.2% of patients diagnosed with CSIE did not have a history of cardiovascular electronic device implantation. Among these individuals, more than half had a history of heart disease. This suggests that patients with underlying heart conditions also require careful evaluation for CSIE.

This study has revealed that CSIE is susceptible to misdiagnosis or under-diagnosis, with an incidence rate as high as 28.9%. Several factors contribute to the misdiagnosis or under-diagnosis:

First, CS is often misidentified as a colonizing bacterium on the skin and nasal mucosa and is frequently dismissed as a contaminant in blood cultures.⁷ Second, the absence of specific clinical manifestations in CSIE makes accurate diagnosis challenging. Additionally, the affected sites in CSIE lack specificity, with the mitral valve being the most commonly affected, followed by the aortic and tricuspid valves, while pulmonary valve involvement is rare. In CSIE patients with pacemakers and CRT-D implants, infection often involves the leads, similar to *Staphylococcus aureus* IE.⁴¹

However, research indicates that *Streptococcus viridans* and *Streptococcus bovis* IE predominantly affect the aortic valve.⁴² These complexities underscore the challenges associated with accurately recognizing and diagnosing CSIE.

TEE should be conducted for patients who are suspected of having IE, according to the 2023 ESC guidelines for the management of IE,¹¹ even if TTE results are positive. This research supports this recommendation by demonstrating that in cases of CSIE, TEE exhibits greater sensitivity in detecting vegetation compared to TTE. Notably, approximately one-third of the patients did not show vegetation on TTE but were detected by TEE examination. Therefore, there is a strong rationale for prioritizing TEE in suspected cases of CSIE to improve diagnostic accuracy.

Despite the common use of blood cultures and echocardiography in diagnosing CSIE, there are instances where cases may be missed or misdiagnosed. Recent studies have highlighted the potential value of emerging technologies such as mNGS and 16S rRNA sequence analysis to improve the diagnostic accuracy.^{36,43} Notably, previous research⁴³ has demonstrated that 16S rRNA sequence analysis exhibits high sensitivity and specificity, with a positive and negative predictive value exceeding 90% in identifying pathogens in native valve endocarditis. In this study, three cases that tested positive in blood cultures were confirmed to be CSIE through 16S rRNA sequence analysis. Furthermore, one patient³³ initially misdiagnosed with *Klebsiella oxytoca* was later correctly identified as having CSIE through 16S rRNA sequence analysis. These findings highlight the potential significance of these novel detection methods in improving the diagnosis of CSIE in the future.

The most effective antibiotic was vancomycin, followed by β -lactam antibiotics and daptomycin. This study investigated the frequency of antimicrobial resistance to CSIE, demonstrating a high proportion of resistance to β -lactam antibiotics, while no instances of resistance to vancomycin, daptomycin, or linezolid were reported. Despite antimicrobial therapy, a considerable proportion of CSIE patients required surgical intervention, with 55.3% undergoing surgery in this study, a notably higher surgery rate compared with IE caused by common pathogens like *Staphylococcus aureus* (37.8%) and *viridans streptococci* (29.5%).^{42,44} The fatality rate for CSIE was 37.8%, which is higher than the fatality rate caused by *Staphylococcus aureus* (22.4%) and *viridans streptococci* (36.6%), suggesting a poor prognosis of CSIE. Timely diagnosis and treatment are crucial for improving outcomes. For patients with history of cardiovascular implantable electronic devices and those experiencing IE within six months post-valve replacement surgery, the 2023 ESC endocarditis management guidelines¹¹ recommend a combination of initial empirical antibiotic therapy and surgical intervention in selected cases.

Limitation

The study has several limitations that should be noted. Firstly, there is a notable selection bias as the search for articles was restricted to those published in Chinese and English, excluding articles in other languages. Despite efforts to comprehensively search major Chinese databases, the absence of Chinese case reports on CSIE introduces a potential bias. Secondly, an information bias exists due to the retrospective nature of the study, which relied solely on data extracted from published case reports. The lack of access to original case records raises concerns about data consistency and completeness, potentially affecting the accuracy and reliability of the study findings. Lastly, the rarity of CSIE results in a limited number of cases compared to more common pathogens that cause infective endocarditis. This scarcity contributes to the predominance of case reports and small retrospective studies in the literature. Due to the lack of specific diagnostic and treatment guidelines for CSIE in existing IE guidelines, this study provides an important retrospective summary of currently available cases.

Conclusion

Despite its limitations, this study summarizes currently available data on CSIE. The findings suggest that CSIE tends to affect older men and is often characterized by non-specific symptoms, which may contribute to misdiagnosis or underdiagnosis and adverse outcomes. Echocardiography and blood cultures remain important tools for diagnosis, while 16S rRNA sequencing and mNGS may help improve pathogen identification. Compared to infective endocarditis caused by more common pathogens, CSIE appears to be associated with increased rates of surgical intervention and higher mortality. Increased clinical awareness and timely management may improve patient outcomes.

Disclosure

The author(s) report no conflicts of interest in this work.

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