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ORIGINAL ARTICLE

Infective Endocarditis Following Transcatheter Aortic Valve Implantation: A Retrospective Cross-Sectional Study of Risk Patterns, Diagnostic Challenges, and Short-Term Outcome

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Key words:
TAVI, infective endocarditis, prosthetic valve infection, diagnostic delay, Staphylococcus aureus, paravalvular abscess, short-term outcomes, retrospective study. Introduction

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ABSTRACT

Background*: Transcatheter Aortic Valve Implantation (TAVI) is a minimally invasive and effective alternative for treating severe aortic stenosis, particularly in high-risk surgical patients. However, infective endocarditis following TAVI (PTIE) represents a rare but serious complication with significant morbidity and mortality, compounded by diagnostic delays and atypical clinical presentations.* ***Objectives****: This retrospective cross-sectional study aimed to investigate the incidence, clinical features, microbiological profile, diagnostic challenges, and short-term outcomes of PTIE, as well as to identify predictors of poor prognosis.* ***Methods****: Data were collected from 599 patients who underwent TAVI between February 2021 and January 2025 at a specialised cardiovascular centre. Patients diagnosed with PTIE according to the modified Duke Criteria were analysed. Demographics, comorbidities, procedural details, microbiological findings, imaging results, and clinical outcomes were recorded. Statistical analyses included Chi-square tests, t-tests, and logistic regression to identify independent predictors of in-hospital mortality.* ***Results****: Out of 599 patients, 27 (4.5%) developed PTIE. The median time from TAVI to infection onset was 64 days. The most common pathogens were Staphylococcus aureus (37%), Enterococcus faecalis (26%), and Streptococcus species (15%). Culture-negative cases accounted for 22%. Echocardiographic findings included prosthetic valve vegetations (59%), paravalvular abscesses (15%), and valve dehiscence.(٪٧) Short-term outcomes included in-hospital mortality (25.9%), 30-day readmission (37%), and surgical intervention in 11.1%. Independent predictors of in-hospital mortality included S. aureus infection (OR = 3.5, p = 0.01), paravalvular abscess (OR = 4.2, p = 0.01), and diagnostic delay >7 days (OR = 5.1, p = 0.002).* ***Conclusion****: Although infrequent, PTIE carries a high risk of mortality and diagnostic difficulty. Early identification of clinical warning signs, especially in high-risk patients such as those with permanent pacemakers, chronic kidney disease, and prolonged ICU stays, is crucial. Improved imaging techniques and routine surveillance may reduce delays in diagnosis and enhance patient outcomes.*

INTRODUCTION

Percutaneous Trans catheter Aortic Valve Implantation and replacement (TAVI) has emerged as a transformative alternative to surgical replacement of the aortic valve for patients with severe symptomatic aortic stenosis, especially for those patients with high or significant surgical risk due to other comorbidities. While TAVI is a safe, less invasive and effective procedure with early post-procedural recovery, it also has certain complications, among which the post-TAVI infective endocarditis (IE) remains one of the most serious and potentially fatal complications.[1]

Post-TAVI infective endocarditis (PTIE) is a relatively rare but serious complication associated with increased risk of mortality, morbidity, and substantial diagnostic challenges. The clinical features and presentation of post-TAVI infective endocarditis are mostly atypical presentation and nonspecific findings, this will cause a delay in diagnosis and treatment of infection. Furthermore, the structural characteristics and features of bioprosthetic aortic valves and the perivalvular anatomical features and calcification of native aorta following TAVI may lead to difficulties in traditional imaging-based diagnosis, particularly with transthoracic and transoesophageal echo study.[2]

Despite the growing use of TAVI in patients with severe aortic stenosis worldwide, the available data on the risk factors, incidence and poor clinical outcomes of PTIE remain limited, especially in low- and middle-income settings. There is also a paucity of real-world data, examining and studying the timing of onset, clinical predictor factors and microbiological profile are associated with very poor outcomes. Early identification

of risk clinical features and patterns is important for perfect diagnosis and treatment, which may be important and potentially affect overall patient outcome and prognosis.[3]

This study is a retrospective cross-sectional study that aims to analyse the clinical characteristics, diagnostic timelines, and early outcomes of patients who developed infective endocarditis following a TAVI procedure in an interventional cardiovascular specialised centre. By early identification of infection, risk patterns and overcoming the obstacles to early diagnosis, the study seeks to highlight the most critical gaps in post-TAVI surveillance and inform effective prevention and prompt management.[4]

METHODOLOGY

Study Design and Setting:

This study is a retrospective cross-sectional study done at a specialised referral cardiovascular centre specialising in cardiac interventions. The study enrolled and reviewed all patients with severe AS who required transcutaneous Transcatheter Aortic Valve replacement (TAVI) that were contracted between February 2021 and January 2025. Ethical approval (3/1/2025, reference:#2021) was obtained from the institutional review board, and all patient data were anonymised to maintain confidentiality.

Study Population:

The patients included in the study were adult patients more than 65 years old who underwent successful TAVI intervention during the period of the study and then subsequently diagnosed with possible or definitive infective endocarditis (IE), depending on the modified Duke Criteria. Other patients who were excluded from the study were those Patients with prior prosthetic valve implantation other than TAVI or incomplete medical records.

Data Collection:

Our data were collected from the medical records and institutions of the TAVI registries in the Al Najaf Centre of cardiovascular intervention. The following data were involved in the study.

1. Demographic data were: gender, age and BMI,
2. The Clinical history of patients, such as comorbidities (chronic kidney disease, diabetic patient and atrial fibrillation), and patients with immunosuppression and previous old infection.
3. Procedural factors: such as type of aortic valve, the route of access (ex, femoral access), complications and duration of TAVI procedure.
4. the characteristic features of infective endocarditis: the period from TAVI procedure to the beginning of symptoms of infection, imaging and echocardiography results (TTE, TEE, cardiac CT), bacterial isolation and identification and classification of modified Duke Criteria
5. treatment and clinical outcomes of patients: intravenous antibiotic prophylaxis, mortality during 30-day readmission and surgical intervention

Outcomes of post-TAVIB infective endocarditis:

A. The primary outcomes for patients:

1. The prevalence of infective endocarditis after the TAVI procedure (PTIE) among the TAVI patients.
2. The time of diagnosis after the TAVI procedure and any delay in diagnosis of infective endocarditis.
3. Relatively Short-term results and poor outcomes, including 30-day readmission and mortality inside the hospital

B. Secondary outcomes of Post TAVI infective endocarditis, including identification and avoidance of high-risk factors causing PTIE, such as pacemaker implantation, vascular complications, especially femoral access, and duration of ICU stay.

Statistical Analysis:

The data of this study were statistically analysed by using SPSS version 26.0. Categorical variables were expressed as percentages, frequency and using the Chi-square or Fisher's exact test. The continuous data were expressed as means ± standard deviation (SD) using Student's t-test or Mann-Whitney U test, as appropriate. Logistic regression analysis was used to identify independent predictor factors of post-TAVI infective endocarditis. A p-value of less than 0.05 was regarded as statistically significant.

RESULTS

Study Population:

A total 599 patients underwent a TAVI procedure at the AL najaf Centre of Cardiology between February 2021 and January 2025. Among these patients, 27 (4.45%) developed infective endocarditis (PTIE) during follow-up periods.

(Table 1).

Clinical Characteristics and Demographic Features:

The mean age of patients with PTIE was 79.3 79.3+/_6.2 years, with 16(60.5%) (n = 16) being male. The most important comorbidities of patients were Chronic kidney disease = 53.5%, Diabetes mellitus = 39.2% and Atrial fibrillation 28.5%.

The incidence of infection after TAVI (PTIE) was more significant among patients with permanent pacemakers (11(41.7%) vs. 99(16.2%), p = 0.002), Femoral access complications (6(24%) vs51 (8.1%); p = 0.009), and the stay in ICU > 48 hours also significant to develop infective endocarditis (12(47.3%)vs. 130(21.4%); p = 0.005). (table 1).

Table 1: The baseline characteristic features of study population

Characteristic features	Group of PTIE N=27	Group of Non-PTIE (n=572)	P value
Age(mean±SD) year	79.3±6.2	75.6±6.2	0.15
Male, n(%)	16(60.5%)	359(60.1%)	0.93
Diabetic patient, n(%)	10(38.1%)	181(30.0%)	0.31
Chronic renal disease, n(%)	14(52.4%)	138(22.7%)	0.001
AF(atrial fibrillation),n(%)	7(27.4%)	95(15.4%)	0.08
PM(permanent pacemaker),n(%)	11(41.7%)	99(16.2%)	0.002
Complication of femoral access, n(%)	6(24%)	51(8.1%)	0.009
Stay in the ICU>48 hrs,n(%)	12(47.3%)	130(21.4%)	0.005

Features of infective endocarditis:

The time from TAVI procedure to onset of infection was (median 64 days and range: 10– 180 days)

The diagnosis of infective endocarditis was classified into:

- Definite infective endocarditis (62.3%),17 patients
- Possible infective endocarditis (37%): 10 patients

Microbiological diagnosis as shown Table 2

Staphylococcus aureus in 10(37%), Enterococcus faecalis in 7(26%), *Streptococcus spp.* in 4(14.8%) and Culture-negative IE in 6(22.2%).

Table 2: The microbiological profile of PTIE patients

The microorganism species	Frequency (n)	Percentage (%)
Staphylococcus aureus	10	37.03%
Enterococcus faecalis	7	25.9%
Streptococcus species	4	14.8%
Culture-negative bacteria	6	22.2%

The findings of echocardiography were (mostly from transesophageal echocardiography): as shown in Table 3

Prosthetic valve vegetations in 15(55.5%) patients, Paravalvular abscess in 5(18.5%) of patients, valve dehiscence in 3(11.1%) of patients and other nonspecific features in 4(14.8%) of patients.

Table 3: Diagnostic features and Echocardiographic findings

Imaging features	Frequency (n)	Percentage (%)
Vegetation of prosthetic valve	15	55.5%
Paravalvular abscess	5	18.5%
Valve dehiscence	3	11.1%
No definitive findings	4	14.8%

The outcomes and management of PTIE: as shown in Table 4

All patients received their medication according to microbiological culture and sensitivity through intravenous antibiotics, while 3 patients underwent surgical intervention (11.1%).

The short-term outcome of PTIE was: In-hospital mortality (25.9%) of patients, 30-day readmission rate: 10 (37%) of patients and heart failure requiring rehospitalization: 6(22.2%) of patients.

Table 4: The complications and outcomes in the PTIE group

Outcomes	Frequency	Percentage (%)
30-day readmission	10	37.03%
In hospital mortality	7	25.9%
Surgical valve replacement	5	18.5%
Heart failure	6	22.2%

The predictor features of poor outcome after PTIE: as shown in Table 5

There are several independent predictors of in-hospital mortality after PTIE, such as type of microorganism where Staphylococcus aureus infection was more risky (OR = 3.5, p =0.01), the presence of paravalvular abscess also had a significant predictor of poor outcome (OR = 4.2, p = 0.01), while the delay of diagnosis of PTIE is more than 7 days after early symptom (OR = 5.1, p = 0.002)

Table 5: The independent predictors of in-hospital mortality

variables	Odd ratio(OR)	95% CI	P value
Staphylococcus aureus	3.5	1.3-10.6	0.01
Paravalvular abscess	4.2	1.4-13.7	0.01
Diagnosis delay>7 days	5.1	1.8-15.3	0.002

DISCUSSION

This study is a retrospective cross-sectional study that highlights the clinical burden, diagnostic difficulties, and short-term clinical outcomes associated with post-TAVI infective endocarditis (IE) following this less invasive procedure. Although the incidence of post-TAVI infective endocarditis in this study was relatively low (3 %), the associated mortality and morbidity were significant and serious, so that early recognition and treatment of this condition are crucial and very important.[5]

The findings in this study showed that any delay of diagnosis, the type of microorganism (Staphylococcus aureus) infection, and the presence of complications such as paravalvular abscess were regarded as independent predictor factors of in-hospital morbidity and mortality. These data are consistent with previous studies suggesting that Staphylococcus aureus infective endocarditis is more serious and aggressive, often leading to rapid and significant deterioration and less response to standard intravenous antibiotic treatment. The delay in diagnosis of infective endocarditis after procedure, often more than 7 days from the onset of clinical symptoms, highlights a persistent gap in clinical suspicion and the limitations of current imaging modalities, especially in the context of prosthetic aortic valves, where the vegetations and structural complications may be difficult to visualise.[6]

Importantly, our study identified chronic kidney disease, ICU stay, and permanent pacemaker implantation as significant risk factors for developing PTIE. This supports previous literature that implicates these factors in bacterial seeding or impaired immune response post-procedure. Notably, patients with vascular access complications and longer ICU stays were also at higher risk, possibly due to increased exposure to invasive lines, antibiotic-resistant organisms, and procedural trauma.[7]

One of the key challenges in PTIE remains the subtlety and variability of clinical presentation, particularly in elderly and frail populations. Symptoms may mimic post-TAVI recovery or other chronic conditions, leading to underestimation. Moreover, culture-negative cases (25%) further complicate diagnosis and delay treatment, often requiring empirical therapy with broad-spectrum antibiotics.[8]

Echocardiographic findings in our cohort demonstrated that vegetations and abscess formation were present in more than half the cases. However, in a significant portion of patients, imaging was inconclusive. This reinforces the need for advanced diagnostic strategies such as cardiac CT or FDG-PET/CT, which are increasingly used to detect prosthetic valve infection, especially when echocardiography is nondiagnostic.[7]

The in-hospital mortality rate of 28.5% and 30-day readmission rate of 35.7% observed in our study align with previously reported data, emphasising that PTIE continues to be a life-threatening complication. Surgical intervention was limited due to advanced patient age and procedural risk, reflecting the clinical dilemma of balancing operative risk versus disease progression.[9]

Despite its insights, our study has several limitations. First, its retrospective design introduces inherent bias and limits causal inference. Second, data were collected from a single tertiary centre, which may affect generalizability. Third, long-term outcomes beyond 30 days were not assessed. Nevertheless, these findings underline the need for routine surveillance protocols, standardised diagnostic pathways, and preventive strategies, including careful risk stratification before TAVI.

Clinical Implications:

Enhanced vigilance is warranted in high-risk patients, especially those with pacemakers or CKD.

There is a need for routine microbiological and imaging screening when symptoms suggest infection, even if nonspecific.

Multidisciplinary heart teams should include infectious disease specialists for early decision-making.

CONCLUSION

Infective endocarditis following Transcatheter Aortic Valve Implantation (PTIE) remains a rare but severe complication associated with high in-hospital mortality and diagnostic challenges. This study highlights that delayed recognition, Staphylococcus aureus infection, and structural complications such as paravalvular abscess significantly worsen outcomes. Additionally, identifiable risk factors—including permanent pacemaker implantation, chronic kidney disease, and prolonged ICU stay—can guide early suspicion and preventive strategies.

The findings underscore the need for enhanced post-procedural surveillance, routine psychological and clinical screening in high-risk patients, and improved imaging modalities to detect early signs of prosthetic valve infection. Addressing these gaps is critical to improving survival and quality of care in post-TAVI patients.

Recommendations

1. Implement routine screening for infective endocarditis symptoms in all patients during early post-TAVI follow-up, especially within the first 3 months.
2. Develop standardised diagnostic protocols incorporating advanced imaging (e.g., PET/CT, cardiac CT) for early detection when echocardiography is inconclusive.

3. Identify high-risk individuals pre-procedure, such as those with CKD or requiring permanent pacemakers, for targeted prophylaxis and close monitoring.
4. Involve infectious disease specialists as part of the heart team for prompt decision-making in suspected PTIE cases.
5. Educate healthcare providers on the subtle presentations and diagnostic complexity of PTIE to minimize delays.
6. Encourage multicenter registries and longitudinal studies to better understand long-term outcomes and guide future guidelines.

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