

ORIGINAL ARTICLE

Profile of Infective Endocarditis: At a Tertiary Care Referral Centre

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Abstract

Background: Infective endocarditis (IE) remains a serious challenge with a persistently high morbidity and mortality despite the availability of improved diagnostic and treatment amenities in the developing world. Data on the clinical and microbiological profile of IE in India is still limited. The emergence of modern risk factors such as hospitalization and device insertion has changed the epidemiology of the disease in the western world, whereas in India and other parts of the developing world the situation is more complex because of the concomitant burden of rheumatic heart disease and congenital heart defects. We therefore attempted to describe the changing epidemiology of the disease in a cohort of patients with definite IE admitted to a tertiary care centre.

Method: 145 cases were identified as IE during the period January 2010-December 2015 (6 years) of which 120 'definite' cases of IE according to the modified Duke's criteria were analysed.

Results: The mean age of patients was 53 years \pm 15 years (age range 18 to 79 years) with a male preponderance of 72%. Native valve disease was seen in 103 cases and 17 cases had prosthetic valve infections.

IE was classified as community acquired in 87 (72.5%) cases and healthcare associated in 33 (27.5%) events. Predisposing factors contributing to healthcare associated events included hemodialysis in 8.3%, recent surgical intervention which included urological instrumentation with urosepsis and gastrointestinal procedures in 5.8% events. Postpartum IE was seen in 1.7% cases. There was evidence of remote abscess, prior bacteraemia or septic foci in the preceding 3 months of presentation with IE in 8.3% of patients and 3.3% patients underwent prior dental procedure.

Prior structural heart disease was present in 47.5% of cases of which Rheumatic heart disease (RHD) was seen in 15%. A previous episode of infective endocarditis was observed in significantly more patients with PVE (29.4%) than with NVE (1.9%).

Blood cultures were negative in 50 (41.7%) of cases of whom 60% had received antibiotics prior to admission. Nine of 17 patients with PVE (52.9%) were culture negative. In the 70 (58.3% of all patients) patients with positive blood cultures, *Streptococcus* sp were the commonest bacteria isolated in 15.8%, of which Viridans group *Streptococci* (VGS) was seen in majority of the cases (13.3%) followed by *Staphylococcus* sp (14.2%) with methicillin resistant *Staphylococcus* was seen in 3.3% and *Enterococcus* sp in 13.3%. Gram negative bacteraemia were seen in 8.3%. In addition, ESBL *E. coli* constituted 4% of our culture positive cases, perhaps representing a complication of this common community acquired bacteraemia and increasing resistance in *E. coli*. Tissue / valve cultures in patients who underwent surgery was positive in four cases, 3 of whom where blood culture negative

The mortality rate was higher among PVE (33%) compared to 10% in NVE. The most common cause of death in IE was usually congestive cardiac failure.

Conclusion: Though Rheumatic heart disease continues to be the most common predisposing factor, degenerative heart diseases and healthcare associated IE

Introduction

Infective endocarditis (IE) is an endovascular microbial infection of cardiovascular structures. In recent years the epidemiology and clinical characteristics of IE have evolved continuously but neither the incidence nor the mortality rate of IE has declined significantly in the developing world. The emergence of modern risk factors such as hospitalization and device insertion has changed the epidemiology of the disease in the western world, whereas in India and other parts of the developing world the situation is more complex because of the concomitant burden of rheumatic heart disease and congenital heart defects.¹

Data on the clinical and microbiological profile of IE in India is still limited.¹⁻⁶ Despite several advances in diagnosis and treatment modalities, management of IE continues to remain a serious challenge and in-hospital mortality remains high at about 20%.⁷ We therefore attempted to describe patient demographics, clinical characteristics, predisposing conditions, microbiological profile, echocardiographic findings, treatment details and outcomes in a cohort of patients with definite IE admitted to a tertiary care centre.

Materials and Methods

Designs, patients and setting

A retrospective review of cases of IE was conducted at a 600 bed tertiary care hospital which serves as a referral centre for infectious diseases. All

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are also gradually increasing. Use of antibiotics prior to sending blood cultures remains a significant cause of culture negativity. Viridans streptococci continue to be the commonest pathogen and though ESBL E coli constituted a significant minority it could expound the changing epidemiology and risk factors for Gram-negative endocarditis especially non-HACEK group necessitating an updated review of this subject.

patient records from the period January 2010 to December 2015 (6 years) were analysed in the hospital database using discharge diagnosis according to International Classification of Diseases, Ninth edition (ICD-9) codes.

The modified Duke criteria⁸ were used for categorization of IE. One hundred and forty-five cases were identified as IE. Out of these, 4 patients were classified as 'possible' cases according to modified Duke criteria, 8 cases did not satisfy the modified Duke criteria for definitive or possible IE, and

Table 1: Demographic characteristics of patients with definite IE

Age (years)	Total=120	NVE=103	PVE=17	p
Mean	53±15	52±15	57±15	0.256
Median	55	54	60	
Mode	60	50	66	
Range (years)	18-79	18-79	30-77	
Male	86 (72%)	72 (70%)	14 (82%)	0.390
Female	34 (28%)	31 (30%)	3 (18%)	
Male: Female	2.5:1	2.3:1	4.6:1	
Prior IE	7 (5.8%)	2(1.9%)	5 (29.4%)	0.001
Community acquired	87 (72.5%)	70 (68%)	17 (100%)	0.02
Healthcare associated	33 (27.5%)	33 (32%)	0	0.01

Table 2: Clinical features and complications

Clinical features and laboratory findings	No. of patients (%)
Fever	
≤30 days	58 (48.3%)
>30 and ≤90 days	36 (30%)
>90 days	13 (10.8%)
Weight loss	42 (35%)
Neurological symptoms	23 (19.2%)
Anemia (Hb ≤10 gm/dl)	67 (55.8%)
Leucocytosis (WBC ≥11,000/cmm)	58 (48.3%)
Complications	
Congestive cardiac failure	15 (12.5%)
Multi-organ dysfunction syndrome	6 (5%)
Embolic manifestations	
CNS emboli/Intracranial haemorrhage	22 (18.3%)
Splenic infarct	7 (5.8%)
Renal/glomerulonephritis	7 (5.8%)
Peripheral/septic	10 (8.3%)

13 cases with incomplete records were excluded. Of the remaining 120 'definite' cases of IE included in the study, the following information was collected by chart review: demographic data, clinical manifestations, predisposing conditions and previous heart diseases, laboratory and microbiological findings, echocardiographic findings, medical/surgical treatment given, complications and outcomes.

Echocardiography and case classification

Echocardiographic findings, inclusive of exam modality (transthoracic or transesophageal), presence, location and mobility of vegetations and presence of valvular insufficiency were recorded.

Three separate sets of blood cultures were taken, each from a separate

Table 3: Predisposing conditions and co-morbidities

Predisposing conditions	No. of patients (%)
Dialysis	10 (8.3%)
Postpartum	2 (1.7%)
Dental procedure	4 (3.3%)
Recent surgical intervention	7 (5.8%)
Abscess/septic foci/ bacteraemia	14 (11.6%)
Co-morbidities	
Diabetes mellitus	16 (13.3%)
Chronic kidney disease (CKD)	12 (10%)
Chronic liver disease (CLD)	5 (4.2%)
Immunosuppressed (non HIV)	6 (5%)

Table 4: Previous cardiac diseases

Underlying cardiac condition	No. of patients (%)
Rheumatic heart disease	18 (15%)
Congenital heart disease	9 (7.5%)
Bicuspid aortic valve	6 (5%)
Ventricular septal defect	3 (2.5%)
Mitral valve prolapse with Mitral regurgitation	13 (10.8%)
Degenerative aortic valve disease	5 (4.1%)
Other valvular abnormalities	12 (10%)
Prosthetic valve	17 (14.1%)
Prior infective endocarditis	7 (5.8%)

venepuncture, at least one hour apart. Each set included a bottle containing an aerobic medium and an anaerobic medium, inoculated with at least 10ml of blood in each bottle.

Cases were also classified based on side of involvement (left, right or bilateral), according to valve involvement (mitral, aortic, tricuspid or multiple) and whether native valve endocarditis (NVE) or prosthetic valve endocarditis (PVE) was present. PVE was defined as early or late depending on diagnosis of infection within 1 year of valve replacement or later, respectively.

Healthcare associated IE was defined as occurrence of IE which was acquired >48 h after admission to hospital or following invasive procedures like haemodialysis or any surgical intervention in the preceding 3 months

Statistical analysis

All categorical variables were expressed as number of cases (percentage). All continuous variables were expressed as mean ±SD. Comparison of continuous variable was done by independent "t"- test. Fisher exact test or Chi-square test was applied for comparison of categorical

Table 5: Microbiological characteristics

Organism	No. of events
Culture Negative	50 (41.7%)
Culture Positive	70 (58.3%)
Streptococcus sp	19 (16%)
Viridans group streptococci	16 (13.3%)
Other strep (pyogenes=1, galloyticus=2)	3 (2.5%)
Staphylococcus sp	17 (14%)
Coagulase negative <i>Staph</i>	6 (5%)
Methicillin sensitive <i>Staph aureus</i>	7 (5.8%)
Methicillin resistant <i>Staph aureus</i>	4 (3.3%)
Enterococcus sp	16 (13.3%)
Other Gram positive bacteria	8 (6.7%)
Leuconostoc pseudomesenteroides	1 (0.8%)
Kytococcus sedantarius	3 (2.4%)
Kocuria rosea	1 (0.8%)
Kocuria kristinae	1 (0.8%)
Erysipelothrix rhusiopathiae	1 (0.8%)
Gemella morbillium	1 (0.8%)
Gram negative organisms	10 (8.3%)
E coli	7 (5.8%)
Pseudomonas aeruginosa	1 (0.8%)
Burkholderia pseudomallei	1 (0.8%)
Klebsiella pneumoniae	1 (0.8%)
Others (tissue culture)	
Coagulase negative <i>Staphylococcus sp</i>	2 (1.6%)
<i>Klebsiella pneumoniae</i>	1 (0.8%)
<i>Mycobacterium fortuitum</i>	1 (0.8%)

Table 6: Echocardiographic findings

Echocardiography findings	No. of patients (%)
Side of cardiac valve involvement	
Left	108 (90%)
Right	7 (5.8%)
Both	5 (4.2%)
Valve involvement	
Mitral valve (MV)	50 (41.7%)
Aortic valve (AV)	47 (39.2%)
Tricuspid valve (TV)	7 (5.8%)
Multiple (more than 1)	16 (13.3%)
MV+AV	11 (9.1%)
MV+TV	1 (0.8%)
MV+Pulmonary valve (PV)	1 (0.8%)
AV+TV	2 (1.7%)
MV+ AV+ PV	1 (0.8%)
Number of vegetations	
Single	72 (60%)
Multiple	48 (40%)

Table 7: Echocardiographic modality

Findings	TTE	TEE
Total no. of patients	114	89
Identified vegetation	56 (49.1%)	86 (96.6%)
Only diagnostic modality confirming vegetation	31	6

*Repeat TEE after 1 week showed vegetation

Table 8: Treatment and outcome

Treatment / Outcome	No. of patients (%)
Surgical	31 (25.8%)
Emergency (≤ 48 hrs)	0
Urgent (>48 hrs and ≤ 7 days)	8 (25.8%)
Elective (>7 days)	23 (74.2%)
Medical therapy	89 (74.2%)
Death	12 (10%)

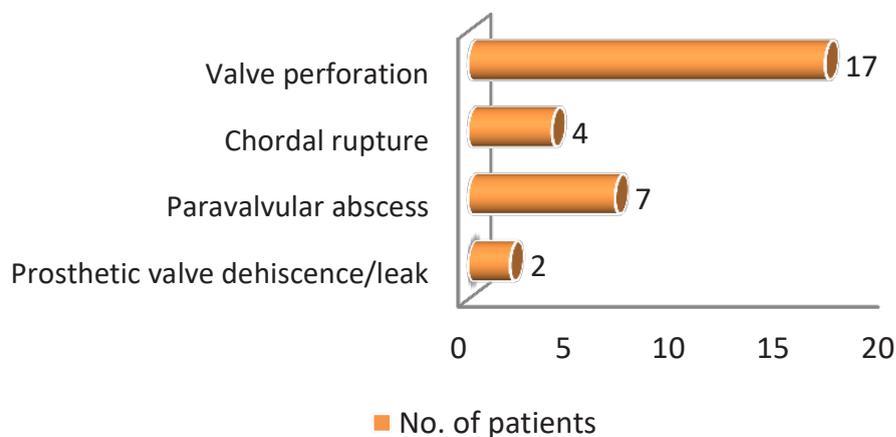
Table 9: Comparison of culture positive and culture negative IE cases

	Culture Positive N=56 (%)	Culture Negative N=29 (%)	p
Total number of patients	70 (58.3%)	50 (41.6%)	
Native valve IE	62 (88.6%)	41 (82%)	0.309
Prosthetic valve IE	8 (11.4%)	9 (18%)	
Prior antibiotics	19 (27.1%)	30 (60%)	0.0001
Improved	49 (87.5%)	24 (82.8%)	0.552
Dead	7 (12.5%)	5 (17.2%)	

variables. A value of $p \leq 0.05$ was considered statistically significant. Data was collected and entered into a database using Microsoft excel. Statistical analysis was conducted using SPSS for Windows version 16.0

Ethical Clearance

This study was approved by the Hospital Ethics committee prior to commencement.

**Fig. 1: Valvular complications****Table 10: Comparison of native valve IE and prosthetic valve IE**

	Total	Native	Prosthetic	p
Mean age (yrs.)	53 \pm 15	52 \pm 15	57 \pm 15	
Male: Female	2.5:1	2.3:1	4.6:1	
Prior IE	7	2	5	
Embolic	46	39	7	0.99
Congestive cardiac failure	15	13	2	1.000
Culture positive	70	62	8	
Culture negative	50	41	9	
Prior antibiotics	49	42	7	
Valve surgery	31(25.8%)	23(22.3%)	8(47.1%)	0.40
Medical therapy alone	89(74.2%)	80(77.7%)	9(52.9%)	
Dead	12	8	4	
Improved	73	65	8	
Community acquired	87(72.5%)	70(68%)	17(100%)	0.02
Healthcare associated	33(27.5%)	33(32%)	0	0.01

Results

Demographic and clinical characteristics

A total of 120 cases of definitive IE were analysed. Table 1 summarises the demographic characteristics of patients with NVE and PVE. There were 86 men and 34 women with a mean age of 53 years \pm 15 years (age range 18 to 79 years).

Fever was the commonest symptom, observed in 107 (89.2%) patients; however, it was absent in 13 (10.8%) patients. The duration of fever prior to hospital admission was ≤ 30 days in 58(48.3%) and >30 and ≤ 90 days in 36 (30%); 13 (10.8%) patients had prolonged fever (>90 days) before presentation. Weight loss was noted in 42 (35%) and 23 (19.2%) patients presented with neurological symptoms (focal deficits and headache). Anemia (Hb ≤ 10 g/dL) was seen in 55.8% (mean Hb 9.8 \pm 1.9) and 48.3% of patients had leucocytosis (mean TLC 12.4 \pm 6.7).

Complications like cerebro vascular

embolic manifestations were seen in 22 patients (18.3%) and other organ/peripheral embolism were seen in 24 (20%) events. Fifteen (12.5%) patients presented with congestive cardiac failure (CCF) and 6 (5%) had multi organ dysfunction syndrome (MODS) as summarized in Table 2.

Predisposing conditions/ co-morbidities/ previous cardiac diseases.

IE was classified as community acquired in 87 (72.5%) and healthcare associated in 33(27.5%) cases. Predisposing factors contributing to healthcare associated cases included hemodialysis in 8.3%, recent surgical intervention which included urological instrumentation with urosepsis and gastrointestinal procedures in 5.8% events. Postpartum IE (seen within 1 month post-delivery) was seen in 1.7% cases. There was evidence of remote abscess, prior bacteraemia or septic foci in the preceding 3 months of presentation with IE in 8.3% of patients and 3.3% patients underwent prior dental procedure. Significant co-morbidities included diabetes

mellitus (13.3%), chronic kidney disease (10%) and decompensated chronic liver disease (4.2%), steroids or other cytotoxic drug exposure (5%) (Table 3).

Eighteen patients (15%) had rheumatic heart disease (RHD); 13 (10.8%) had mitral valve prolapse (MVP) and 6 (5%) had bicuspid aortic valve. IE was seen in 15 (12.5%) patients with no valvular abnormalities. Prior IE was noted in 7 patients (2 with NVE and 5 in PVE). Table 4 summarises the underlying cardiac disease.

Microbiology

Blood cultures were negative in 50 (41.7%) of cases of whom 60% had received antibiotics prior to admission. Nine of 17 patients with PVE (52.9%) were culture negative. In the 70 (58.3%) patients with positive blood cultures (Table 5), *Streptococcus* sp was the commonest bacteria isolated in 15.8%, of which Viridans group *Streptococci* (VGS) was seen in majority of the cases (13.3%). *Staphylococcus* sp was isolated in 14.2% and *Enterococcus* sp in 13.3%. Gram negative bacteria were seen in 8.3%. Tissue / valve cultures were sent in all patients who underwent valve surgery: of the four cases whose valve tissue was culture positive, 3 had prior negative blood cultures.

Echocardiography

Seventeen patients had PVE and 103 patients had NVE. Left sided IE occurred in 108 (90%) cases, right sided IE in 7 (5.8%) of cases and bilateral involvement was seen in 5 (4.2%) cases (Table 6). Aortic valve was involved in 47 (39.2%), mitral in 50 (41.7%), tricuspid in 7 (5.8%) cases and multiple valves were involved in 16 (13.3%). There were no predisposing valvular abnormalities in 15 (12.5%) patients. Valvular dehiscence was noted in 3 patients with PVE. Paravalvular abscess was more common in PVE than NVE [2/13 (15%) vs. 3/92 (3%)]. Valve perforation was noted in 18 (17.3%) of NVE (Figure 1).

Vegetations on the cardiac structures and associated lesions were detected in all patients by either transthoracic echo (TTE) or trans-esophageal echo (TEE) as shown in Table 7. TTE was performed in 114 out of the 120 patients: vegetations were detected in only 56 patients (49.1%). TEE was done in 89 (74%) cases and showed vegetations in 86 (96.6%). Six patients underwent TEE as the only

diagnostic modality in view of a high suspicion of IE.

Treatment and outcome

Eighty nine (74.2%) patients received only medical therapy: among them 17 (14.2%) patients were also advised early valve replacements but they refused surgery. Valve replacement was done in 31 (25.8%) patients (25 with NVE and 6 patients with PVE). Surgical intervention was most often an elective procedure [23/31 (74.2%) cases] after a 4 week course of IV antibiotics (Table 8). Out of 120 patients, 10 patients were discharged against medical advice and 25 improved at the time of discharge from hospital but were lost to follow up. In total there were 14% (12/85) in-hospital deaths. Mortality was higher in PVE [4/12 (33.3%) compared to 8/73 (10%) NVE].

Comparison of clinical features in culture positive and culture negative IE is as shown in Table 9.

Comparison of clinical features in NVE and PVE is as shown in Table 10.

Discussion

We hereby present a large series of patients with IE, all of whom had definite endocarditis by the modified Duke criteria.

The mean age of patients in our study was 53 ± 15 years. This is comparable to data from western studies¹⁰ and higher than in Indian studies such as by Garget al¹ in 2005 (27.6 years) and by Gupta et al in 2009 (49.2 years)⁹. The rise in the average age of presentation in India may be indicative of a general increase in longevity and access to better healthcare facilities as well as a shift in predisposing factors from rheumatic heart disease to degenerative valvular heart disease and invasive interventions in hospitals.

The male: female ratio of 2.5:1 in our study is consistent with male preponderance seen in other Indian studies^{2,4,11} and as well as western data.¹⁰ In India the higher male to female ratio may be because of overall decrease in the incidence of rheumatic heart disease which was more prevalent in women.² However gender bias is likely to reduce with increasing age as degenerative conditions and healthcare associated factors come into play.

Predisposing factors

Prior heart disease was present in 47.5% of cases. Rheumatic heart disease

(RHD) was seen in 15%, much lower than the 40% of cases on average^{2,9} in most Indian studies and closer to the 5% of IE in Western studies.¹² Mitral valve prolapse accounted for 10.8% of cases in our study which is higher than that of the other Indian studies which report rates of 3.3 to 6.7%.^{1,2,5,6} but it is similar to a study published in van der Meer JT et al¹³. Bicuspid aortic valve was observed in 5% of cases.

A total of 17 (14.1%) of our patients had PVE, which is higher than the rates of 9.6% reported by Jain et al from Ahmedabad.² There is a definite increase in the number of cases of PVE as compared to earlier series, consistent with more patients having had valve surgeries in recent years.

A previous episode of infective endocarditis was observed in significantly more patients with PVE (29.4%) than with NVE (1.9%). Hoen et al¹⁴ reported that 9% of their patients had previous episodes of IE but about 34% of their patients had prosthetic valves as compared to only 14.1% in our study.

Co-morbidities

Significant co-morbidities included diabetes mellitus (13.3%), CKD (10%), CLD (4.2%) and immune-suppressed states other than HIV (5%). Co-morbidities were more commonly present in patients with NVE (31%) as compared to 5.8% in PVE. The rate of co-morbidities in an Italian¹² study was 88% for NVE and 100% for PVE with CLD (21%) and HIV (19%) as the most frequent co-morbidities. The rate of IE in HIV patients in all Indian studies including ours is low, probably because of the low number of injecting drug users (IDU). There were no cases of reported IDU in our study but studies from France¹⁴ (4%) and Italy¹² (26%) showed higher rates amongst their population.

Health care associated IE

About 15.8% of patients in our study had healthcare associated IE, including evidence of a haemodialysis (8.3%) and others like recent surgical intervention (5.8%) which included gastrointestinal surgeries or urological instrumentation and post-partum IE was seen in 1.7%. All involved native, not prosthetic valves. An increasing trend in healthcare associated IE in native valves in non-IDU subjects was reported by Martin¹⁵ et al: there is not much data available on healthcare associated IE

from other centres in India.

Clinical features

Fever was the main presenting symptom seen in 89.2% of our patients. Fever lasting more than a month was seen in 40.8% of cases. This finding is consistent with both Indian and western studies^{2, 12}. Fever was present in all patients with PVE. Any prolonged fever in a patient with a prosthetic valve should evoke suspicion of IE and appropriate evaluation with blood cultures prior to initiation of antimicrobial therapy should be mandated.

Twenty two patients (18.3%) presented with neurological complications like focal deficits, which is less than the 30% that reported by Jain² et al.

Microbiological profile

Blood cultures were performed in all patients but only 58.3% (70/120 patients) overall yielded positive bacterial growth. Positive cultures were obtained only in 47% of PVE patients. *Streptococcus* sp (15.8%), *staphylococcus* sp (14.2%) and *enterococcus* sp (13.4%) were almost equal in distribution. This is in concordance with other studies in India⁹. Viridans group streptococci was the most frequently isolated bacteria in NVE. Western studies showed a higher incidence of staphylococcal endocarditis, perhaps due to greater numbers of IDU and healthcare associated infections. Recent case series from large tertiary care referral centres have not only illustrated the previously noted shift in risk factors but also concomitant changes in microbiology, with *staphylococcus aureus* exceeding streptococci as a causative agent^{14, 16}. In contrast, population based series, particularly if not dominated by cases among injecting drug users illustrate the continued importance of rheumatic and congenital valvular disease as predisposing factors and the predominance of streptococci as casual agents.^{14, 15, 17} Tissue / valve cultures were sent in all patients who underwent surgery: four cases were positive, of whom 3 were blood culture negative. In addition, *E coli* constituted 5.8% of our culture positive cases, perhaps representing a complication of this common community acquired bacteraemia and increasing resistance in *E coli*.

Inadvertent or inappropriate use of antibiotics for pyrexia prior to blood cultures leads to a large number of culture negative endocarditis. Notably, most patients who had long duration of symptoms had negative cultures due to prior antibiotic therapy before hospital admission.

Echocardiography

Echocardiography is one of the cornerstones for the diagnosis of infective endocarditis. Using TEE as a gold standard the sensitivity of TTE in our study was 31.25%. In a recent retrospective analysis of comparison between TTE and TEE in IE patients Abhishek Biswas¹⁸ et al reported a TTE sensitivity of 29%. TTE would seem to be a poor choice for the initial evaluation of IE but it was able to detect vegetations in 56 of 114 (49.1%) patients and 27% of cases TTE alone identified and confirmed the presence of vegetations. Hence it continues to be an effective screening modality in patients with IE.

TEE detected vegetations in 96.6% (86/89 events) in our study. A study by Heidenreich¹⁹ et al concluded that TEE was more cost effective than TTE in people with high pre-test probability of IE. In our study, 6 patients underwent only TEE without TTE due to a high index of suspicion of IE and all of them showed evidence of vegetations. TEE should be done in all patients in whom transthoracic window is poor and those with negative TTE but in whom there is a high suspicion of IE. An initially non-diagnostic TEE does not exclude the possibility of IE and a repeat study is indicated in 3 to 5 days if the clinical index of suspicion remains high. Three patients underwent a repeat TEE after 1 week, which confirmed vegetations in this study.

Treatment and outcome

The mortality outcomes in IE depend upon factors like age, CCF, embolic episodes, renal dysfunction and sepsis and conduction disturbances.²⁰ In hospital mortality rate in our study was 14%. There has been a gradual decrease in the mortality rates in Indian studies from 42% in 1970 to 13% in 2001. Other western studies reported mortality rates of 10-24%.¹⁴ The mortality rate was higher among PVE (33%) compared to 10% in NVE. The most common cause of death in IE is usually congestive cardiac failure. Early surgical intervention in

moderate to severe heart failure has been associated with reduced mortality rates.²¹

Valve replacement surgery was done in 25.8% of patients including 47.1% of PVE and 22.3% NVE patients. The mortality of patients who underwent surgery was 41.67% (NVE=2, PVE=3). Valve replacement surgeries in our series were done mostly as an elective procedure. Most international studies showed trends towards improved outcomes in patients undergoing early surgery.¹⁰ A cardiac surgical centre from North India had no mortality in their series probably due to early surgical intervention and also probably due to difference in disease characteristics⁹.

Conclusion

The average age of patients presenting with IE in India has increased while the male predominance is maintained. Rheumatic heart disease continues to be the most common predisposing factor though less than in earlier studies, whereas degenerative heart diseases and healthcare associated IE are also gradually increasing. We found TEE a very important diagnostic tool with excellent sensitivity for detecting vegetations. Culture positivity rates were found better than in previous Indian studies but use of antibiotics prior to sending blood cultures remains a significant cause of culture negativity. Viridans streptococci continue to be the commonest pathogen but staphylococci are not far behind and ESBL *E coli* constituted a significant minority. The excised native or prosthetic valve should be sent to the microbiology laboratory in saline for immediate culture particularly in culture-negative patients.

Surgical outcome assessment is difficult as the patients referred are frequently those with severe complications related to virulent organisms. Often many patients due to other comorbidities are deemed unfit for surgery. If surgery is undertaken early, before cardiac tissue destruction and development of CCF, the overall outcome is better. Our mortality rates for IE were low and comparable with western data though mortality in prosthetic valve endocarditis patients was significantly higher.

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