

Changing Epidemiology, Aetiology, Clinical Presentation and Outcome of Treatment in Infective Endocarditis Patients: A Comparative Retrospective Studies of 2 Groups of Patients; 3 Decades Apart

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ABSTRACT

Introduction: Infective Endocarditis is an infection of the endocardium and to a lesser extent, it involves non-valvular myocardium. Since its discovery, the epidemiology, aetiology, clinical presentation and treatment outcome have undergone a sea change. The aim of the study was to compare the epidemiology, aetiology, clinical presentation and treatment outcome between the two groups and to note if any significant change has occurred during the aforesaid three decades.

Material and methods: This article is a retrospective study comprising of patients between 18 – 90 years of age, categorised into two groups: Group 1 comprising of patients admitted between January 1985 and December 1989 and Group 2 comprising of patients admitted between January 2015 and December 2019. For diagnosis of IE, we had applied von Reyn criteria to Group 1 and for Group 2, we had applied Duke's criteria.

Results: In Group 1, we had 47 admissions (M : 33, F : 14) and in Group 2, we had 36 admissions (M:24 ; F: 12). The total number of indoor admissions in Group 1 was 140,078 and in Group 2, the total indoor admissions was 118, 009. In Group 1, the aetiological agent was predominantly Str. Viridians, whereas in Group 2, S. Aureus was observed to be the most common aetiological agent. IE was also seen in implanted devices such as ASD and PDA closure devices in Group 2, whereas implantation of these device procedures were not done in Group 1 in our study group. Osler's node, Roth's spot, Janeway lesions described in the past, were seen in Group 1 but not in Group 2. History of RHD in patients of Group 1 was significantly more than that of patients of Group 2.

Conclusion: Despite the advancement of the diagnostic facilities and treatment modalities, IE remains a highly enigmatic and serious disease. The sub-acute form of the disease has given way to more acute form. Causative organism has changed from commonest aetiological agent, Str. Viridians to S. Aureus and intravenous drug abusers have posed a challenging situation for the physicians.

Keywords: IE: Infective Endocarditis, VHD: Valvular Heart Disease, RHD: Rheumatic Heart Disease, ASD : Atrial Septal Defect, PDA : Patent Ductus Arteriosus.

INTRODUCTION

Infective Endocarditis is a disease primarily affecting the endocardium, particularly the heart valves and adjacent structures like mural endocardium, chordal structures and even the deeper layers of myocardium¹. Sir William Osler,

in his famous Gulstonian lecture delivered at the Royal College of Physicians, London in March, 1885 admitted that ulcerative endocarditis or malignant endocarditis (which was later on designated as infective endocarditis) was an elusive diagnosis². He further admitted that variable presentation as well as lesions in the heart in the form of vegetations, ulceration and abscess can occur as a single entity or in combination. The clinical presentations were vague and not uniform in most of the cases which led to the proposal of von Reyn CF in 1981 to set up criteria of diagnosis of infective endocarditis³. The aim of the study was to compare the epidemiology, aetiology, clinical presentation and treatment outcome between the two groups and to note if any significant change has occurred during the aforesaid three decades.

MATERIAL AND METHODS

We selected adult patients aged between 18 and 90 years of age who were admitted between 1st January 1985 to 31st December 1989 in Ispat General Hospital, Rourkela, Odisha, with diagnosis of IE using Reyn Criteria. This group comprised of 47 patients, out of whom 33 were males and 14 were females. We also selected adult patients aged between 18 and 90 years of age, admitted in Hi-Tech Medical College & Hospital, Rourkela, Odisha, diagnosed as IE using Duke's criteria between 1st January 2015 and 31st December 2019. Informed consent was obtained from each patient for undergoing this study voluntarily. Permission from Ethical committees of both institutions, i.e., Ispat General Hospital and Hi-Tech Medical College were obtained prior to commencement of the aforesaid studies.

We noted the demography, aetiology in the form of blood culture and clinical examination like presence of fever,

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murmur in the heart, its intensity and characteristic. CBC, ESR, Urine RE & ME, history of rheumatic heart disease, congenital heart disease, presence of Osler's node, Janeway lesion, Roth's spot, splinter haemorrhage and evidence of embolic phenomenon. Clinical evidence like haematuria, nephropathy, clubbing or splenomegaly were also noted.

These characteristics were noted in both groups and were compared with statistical analysis.

As mentioned above we applied von Reyn criteria and Duke's criteria for Group 1 & Group 2 respectively. Details of both the criteria along with modified Duke's criteria are cited below:

The von Reyn criteria for diagnosis of infective endocarditis

Definite

Direct evidence of infective endocarditis based on histology from surgery or autopsy, or on bacteriology (Gram's stain or culture) of valvular vegetation or peripheral embolus

Probable

(A) Persistently positive blood cultures^b plus one of the following:

- (1) new regurgitant murmur, or
- (2) predisposing heart disease^c and vascular phenomena^d.

(B) Negative or intermittently positive blood cultures^e plus three of the following:

- (1) fever,
- (2) new regurgitant murmur, and
- (3) vascular phenomena

Possible

(A) Persistently positive blood cultures plus one of the following:

- (1) Predisposing heart disease, or
- (2) Vascular phenomena

(B) Negative or intermittently positive blood cultures with all three of the following:

- (1) Fever,
- (2) Predisposing heart disease, and
- (3) Vascular phenomena

(C) For Viridans streptococcal cases only; at least two positive blood cultures without an extra-cardiac source, and fever

Rejected

(A) Endocarditis unlikely, alternative diagnosis generally apparent

(B) Endocarditis likely, empiric antibiotic therapy warranted

(C) Culture-negative endocarditis diagnosed clinically, but excluded by postmortem

At this point of time only TTE was available and TEE came

much later. Heart auscultation was done frequently and changes in quality and intensity of sound were noted. Fever with temperature above 38 °C on at least 2 occasions was noted. Evidence of arterial emboli including staphylococcal septicemia were noted. Since there were some shortcomings in these criteria, Duke made a new criteria for the diagnosis of IE.

A new criteria for diagnosis of IE was proposed by Durack DT, Lukes AC for diagnosis of IE in 1994³.

The Duke criteria for diagnosis of infective endocarditis

Definite infective endocarditis

(A) Pathologic criteria:

- (1) Micro-organisms demonstrated by culture or histology in a vegetation, or in a vegetation that has embolized, or in an intra-cardiac abscess, or
- (2) Pathologic lesions, vegetation or intracardiac abscess present, confirmed by histology showing active endocarditis

(B) Clinical criteria, using specific definitions:

- (1) 2 major criteria, or
- (2) 1 major and 3 minor criteria, or
- (3) 5 minor criteria

Possible infective endocarditis

Findings consistent with infective endocarditis that fall short of 'definite', but not 'rejected'

Rejected

- (1) Firm alternate diagnosis for manifestations of endocarditis, or
- (2) Resolution of manifestations of endocarditis, with antibiotic therapy for 4 days or less, or
- (3) No pathologic evidence of infective endocarditis at surgery or autopsy, after antibiotic therapy for 4 days or less

Major criteria

(A) Positive blood culture for infective endocarditis

- (1) Typical microorganism for infective endocarditis from 2 separate blood cultures:
 - (i) Viridans streptococci^b, Streptococcus bovis, HACEK^c group, or
 - (ii) Community-acquired staphylococcus aureus or enterococci, in the absence of a primary focus, or
- (2) Persistently positive blood culture, defined as recovery of a microorganism consistent with infective endocarditis from:
 - (i) Blood cultures drawn more than 12 h apart, or
 - (ii) All of 3 or a majority of 4 or more separate blood cultures, with first and last drawn at least

^aAdapted from von Reyn et al.¹³.

^bAt least two blood cultures obtained, with 2/2 positive, 3/3 positive, or at least 70% of cultures positive if 4 or more cultures obtained.

^cDefinite valvular or congenital heart disease, or a cardiac prosthesis (excluding permanent pacemakers).

^dPetechiae, splinter haemorrhage, conjunctival haemorrhage, Roth's spots, Osler's nodes, Janeway lesions, aseptic meningitis, glomerulonephritis, and pulmonary, central nervous system, coronary, or peripheral emboli.

^eAny rate of blood culture positivity that does not meet the definition of persistently positive.

1 h apart

(B) Evidence of endocardial involvement

- (1) Positive echocardiogram for infective endocarditis:
 - (i) Oscillating intracardiac mass, on valve or supporting structures, or in the path of regurgitant jets, or on implanted material, in the absence of an alternative anatomic explanation, or
 - (ii) Abscess, or
 - (iii) New partial dehiscence of prosthetic valve, or

(C) New valvular regurgitation (increase or change in pre-existing murmur not sufficient)

Minor criteria

- (A) Predisposition: predisposing heart condition or intravenous drug use
- (B) Fever: $>38.0^{\circ}\text{C}$ (100.4°F)
- (C) Vascular phenomena: major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhage, Janeway lesions
- (D) Immunologic phenomena: glomerulonephritis, Osler's nodes, Roth spots, rheumatoid factor (E) Microbiologic evidence: positive blood culture but not meeting the major criterion noted previously^d or serologic evidence of active infection with organism consistent with infective endocarditis (F) Echocardiogram: consistent with IE but not meeting the major criterion noted previously.

HACEK

Haemophilus spp., Actinobacillus, actinomycetemcomitans, Cardiobacterium hominis, Eikenella spp., Kingella kingae. Subsequently, there was a proposal for modification of Duke's criteria for diagnosis of IE.

Proposed new criteria for diagnosis of infective endocarditis (Duke University) Definite IE

Pathological Criteria

- 1) Micro-organism demonstrated by culture or histologic examination of a vegetation.
- 2) Pathologic lesions, vegetations or abscess confirmed by histologic examination.

Clinical Criteria

- 1) 2 major criteria or ;
- 2) 1 major criterion plus 3 minor criteria or ;
- 3) 5 minor criteria

Possible IE

- 1) 1 major criterion plus 1 minor criterion
- 2) 3 minor criteria

Rejected

- 1) Firm alternate diagnosis replacing IE or
- 2) Resolution of IE with antibiotics of less than 4 days duration or
- 3) No pathological evidence at surgery or autopsy with 4

days of antibiotics

4) Does not meet criteria for possible IE

Definition of terms used in the proposed diagnostic criteria (Duke University)

Major criteria:

Positive blood culture for IE

Typical microorganisms for infective endocarditis from two separate blood cultures

- (i) Viridans streptococci, Streptococcus bovis, HACEK group, or
- (ii) Community-acquired Staphylococcus aureus or enterococci, in absence of a primary focus, or

Persistently positive blood culture, defined as a microorganism consistent with infective endocarditis from:

- (i) Blood cultures drawn more than 12 h apart, or
- (ii) All of three, or a majority of four or more separate blood cultures, with first and last drawn at least 1 h apart

Evidence of endocardial involvement:

Positive echocardiogram for infective endocarditis:

- (i) Oscillating intracardiac mass, on valve or supporting structure, or in the path of regurgitant jets, or on iatrogenic devices, in the absence of an alternative anatomical explanation, or
- (ii) Abscess, or
- (iii) New partial dehiscence of prosthetic valve, or new valvular regurgitation (worsening or changing of preexisting murmur not sufficient)

Minor criteria Predisposition: predisposing heart condition or intravenous drug use Fever. $> = 38.0^{\circ}\text{C}$ Vascular phenomena: arterial embolism, septic pulmonary infarcts, mycotic aneurysm, intracranial haemorrhage, Janeway lesions Immunological phenomena: glomerulonephritis, Osler's nodes, Roth's spot, Echocardiogram consistent with infective endocarditis but not meeting major criterion as noted previously, or serological evidence of active infection with organism consistent with infective endocarditis.

We wanted to make a retrospective study of epidemiologic, aetiological and clinical presentation in our patients who were diagnosed as IE between 1st January 1985 and 31st December 1989 and compare them with patients diagnosed as IE between 1st January 2015 and 31st December 2019. This study was carried out in adult patients aged between 18 years and 90 years in the city of Rourkela which had population of 5,00,000 in 1985 and 7,50,000 in 2015 respectively. The Group 1 of patients were selected, examined and treated at Ispat General Hospital and the Group 2 patients were selected, examined and treated at Hi-Tech Medical College & Hospital, Rourkela. We wanted to find out the incidence of IE, clinical presentation, bacteriologic evidence by carrying out culture and sensitivity test. We also noted the outcome of the treatment which included pharmacological and surgical

^aAdapted from Durack et al.¹³

^bIncluding nutritional variant strains.

^cHACEK: Haemophilus spp. Actinobacillus actinomycetemcomitans, Cardiobacterium hominis, Eikenella spp., and Kingella kingae.

^dExcluding single positive cultures for coagulase-negative staphylococci and organisms that do not cause endocarditis.

Group 1(N-47)		Group 2 (N-36)	
Total no. of patients	47	Total no. of patients	36
Age		Age:	
Median	52	Median	47
Mean	54	Mean	54
Range	18-90	Range	18-90
Sex:		Sex:	
Male	33(70%)	Male	24(66.6%)
Female	14(30%)	Female	12(33.3%)
Anatomical sites of endocarditis		Anatomical sites of endocarditis	
Native Valve	24	Native Valve	16
Mitral Valve	12	Mitral Valve	06
Aortic Valve	08	Aortic Valve	04
Dual (Mitral & aortic affection)	03	Dual (Mitral & aortic affection)	02
Tricuspid	01	Tricuspid	04
Prosthetic valve	19	Prosthetic valve	12
Mitral valve	10	Mitral valve	06
Aortic valve	06	Aortic valve	04
DVR	03	DVR	02
PPM	03	PPM	02
ICD	01	ICD	02
		ASD closure device	03
		PDA Closure device	01
Atherosclerotic variety (Mitral-01, Aortic-02)	03	Atherosclerotic variety (Mitral-02, Aortic-04)	06
Streptococcal:		Streptococcal:	
Str. Viridans	20	Str. Viridans	10
Str. Bovis	03	Str. Bovis	04
Enterococci	02	Enterococci	02
Staphylococcal:		Staphylococcal:	
S. Aureus	10	S. Aureus	14
Coagulase negative	03	Coagulase negative	02
HACEK	02	HACEK	Nil
Culture Negative	07	Culture Negative	04
DVR: Double Valve Replacement, ASD: Atrial Septal Defect, PDA: Patent Ductus Ateriosus, ICD: Implantable Cardioverter Defibrillator, PPM: Permanent Pace Maker			
Table-1: Demography, Anatomical site and microbiological features of two groups.			

treatment.

For diagnosis of IE, we applied the Von Reyn classification in Group 1 patients, and for Group 2, we applied Duke's Criteria. In total, we had 47 cases (33 males & 14 females) of IE in the first group and 36 cases of IE (24 males & 12 females) in the Group 2.

RESULTS

In Group 1, there were 47 admissions for infective endocarditis out of total indoor admissions of 1,40,078 between 1985 and 1989. This amounted to 0.335 admissions per 1000 indoor admissions. In Group 2, there were 36 admissions for infective endocarditis out of total indoor admissions of 1,18,009 between 2015 and 2019. This amounted to 0.305 admissions per 1000 indoor admissions. Thus, there was no statistical difference between these two groups as far as the incidence is concerned. In group 1, there were 33 males (70%) and 14 females (30%) and ; In group 2, There were 24 males (66.67%) and 12 females(33.33%). In group 1, native valve was involved in 24 cases whereas prosthetic valve was involved in 19 cases. Endocarditis on PPM was present in 3

patients and endocarditis on ICD was detected in 1 patient. In group 2, native valve was involved in 16 patients and prosthetic valve in 12 patients. Endocarditis on PPM was present in 2 patients, on ICD in 2 patients, on ASD closure device in 3 patients and on PDA, closure device in 1 patient. In group 1, tricuspid valve involvement was observed only in 1 patient whereas in group 2, tricuspid valve involvement was seen in 4 patients with staph aureus infection due to intravenous drug abuse.

In group 1, 3 patients had endocarditis on atherosclerotic valves (1 in mitral and 2 in aortic) and history of rheumatic fever and previous history of RHD was absent in these patients. In group 2, this number increased to 6 since there was involvement of mitral valve in 2 and aortic valve in 4 which indicates that there is an increase in number of geriatric patients and awareness of patients and their family members for proper treatment. History of RHD and Rheumatic fever was characteristically absent in these patients.

Device closure of congenital heart disease has become popular and also has posed chances of infective endocarditis on these devices. 3 cases in group 2 showed ASD closure

	Group 1(N-47)	Group 2 (N-36)	p value
Age			
Median	47	66	
Mean	43	57	
Range	18-90	18-84	
Sex			
Male	33	24	
Female	14	12	
History of RHD	32	6	<0.01 (Statistically significant)
Fever	45	35	0.72
Chills & Rigor	43	32	0.69
Weakness	39	28	0.55
Loss of weight	42	22	<0.01 (Statistically significant)
Petechiae	11	08	0.90
Osler's node	03	Nil	0.13
Roth's Spot	Nil	Nil	
Clubbing	08	03	0.25
Jaundice	06	02	0.27
Splenomegaly	06	02	0.27
Arthralgia	36	20	0.04 (Statistically significant)
Haematuria	04	01	0.28
Intravenous Drug Abuse	03	07	0.07
AIDS	02	Nil	0.21
Murmur	27	10	<0.01 (Statistically significant)
Neurological Manifestations	11	08	0.90
Pre-existing Heart Lesion	09	15	0.02 (Statistically significant)
ESR>=50mm/hr	15	07	0.20
Leucocytosis >= 15,000/cm	12	08	0.73

Table-2: Comparison of clinical profile in the 2 groups.

Group 1(N-47)		Group 2(N-36)	
Vegetation Mitral Valve	12	Vegetation Mitral Valve	8
AML	07	AML	05
PML	05	PML	03
Vegetation Aortic Valve	10	Vegetation Aortic Valve	02
Left coronary	06	Left coronary	01
Right Coronary	04	Right Coronary	01
Both mitral & aortic affection	04	Both mitral & aortic affection	01
Abscess Mitral	10	Abscess Mitral	03
AML	06	AML	02
PML	04	PML	01
Abscess Aortic	05	Abscess Aortic	02
Left Coronary	04	Left Coronary	01
Right Coronary	01	Right Coronary	01
Both Mitral & Aortic	02	Both Mitral & Aortic	01
TRICUSPID valve	01	TRICUSPID valve	04
Aneurysm	Nil	Aneurysm	Nil
Fistula	01	Fistula	01
Leaflet Perforation	Nil	Leaflet Perforation	Nil
Prosthetic Valve dehiscence	Nil	Prosthetic Valve dehiscence	Nil
Atherosclerotic valves	03	Atherosclerotic valves	03
Mitral	01	Mitral	01
Aortic	02	Aortic	02
PPM	03	PPM	03
ICD	01	ICD	01
		ASD Closure Device	03
		PDA Closure Device	01

Table-3: 2D Echo findings in both the groups.

		Group 1(N47)	Group 2(N36)
Valve Replacement	MVR	11	10
	AVR	04	06
	TVR	Nil	03
	DVR	03	02
PPM	Implantation Single Chamber	02	03
	Dual Chamber	03	02
	ICD	01	02
	Surgery for vegetations & abscess	02	04
	Fistula	01	01
	Prosthetic Valve Dehiscence	Nil	Nil

MVR: Mitral Valve replacement, AVR: Aortic Valve Replacement, TVR: Tricuspid Valve replacement, ICD: Implantable Cardioverter Defibrillator, PPM: Permanent Pace Maker

Table-4: Patients undergoing surgical interventions including device implantation during hospitalization

	Group 1(N-47)	Group 2(N-36)	p Value [#]
Stroke	04	02	0.606
Embolism(Non-stroke)	04	01	0.28
CHF	07	03	0.36
Intracardiac Abscess	09	16	0.01 (highly significant)
Persistent positive culture	11	07	0.66
Conduction Abnormality	03	01	0.45
Surgical therapy	21	20	0.33
In hospital Mortality	12	08	0.73

When p Value is determined below .05, it indicates statistical significance

Table-5: Complications and treatment outcome

device endocarditis and 1 patient had PDA closure device endocarditis. (Table I).

As far as aetiology of organisms is concerned, Str. Viridans still is one of the commonest causative organisms for infective endocarditis. But its incidence has drastically reduced from the past.

In our study, 20 cases were seen with Str. Viridans in group 1, whereas only 10 cases were seen in group 2. In contrast, infection with Staph. Aureus has increased in recent years, possibly due to intravenous drug abuse. In our study, we observed an increase of Staph. Aureus infection from 10 in Group 1 to 14 in Group 2 in spite of Group 2 being a smaller group. Infections with HACEK group of organism have drastically come down and we did not find a single patient with HACEK infection. In spite of our best efforts, we could not find any organism in the blood culture obtained from 7 patients in group 1 and 4 in group 2. Blood culture was done prior to instituting antibiotics in these patients. However, prior use of antibiotics in previous hospitals could not be overruled. Leucocytosis $\geq 15,000/\text{cmm}$ and ESR $>50 \text{ mm/hr}$ posed a grave situation, and out of 12 patients in group 1, 7 died whereas out of 7 patients in group 2, mortality was observed in three patients in spite of treatment with proper antibiotics at the earliest.

History of RHD was present in 32 patients in Group 1 whereas history of RHD was present only in 6 patients in group 2. Loss of weight seen in the past in 42 patients of Group 1 whereas in Group 2, loss of weight was seen in only 22 patients of Group 2 which is much less in comparison to

Group 1. This may be due to improved nutritional status in patients in Group 2.

Arthralgia is also less commonly seen in Group 2 (20 patients) in comparison with Group 1 (36 patients). Although Haematuria was seen more frequently in the past, but it did not pose any risk of mortality in the patients. Osler's node, Roth's spot are rarely seen nowadays. Incidence of changing character of murmur has also decreased as compared to the past; 27 in group 1 as compared to 10 in group 2 (Table II). Trans-thoracic 2D echocardiography was carried out in patients in both groups. Vegetations and abscesses could be clearly seen and the 2D echocardiogram was a great help to surgeons prior to reaching at their decision of taking the patient for surgery. Aneurysm and fistula could be detected by expert echocardiographers and could be referred to higher centre for surgery. In case of culture negative cases, 2D echo was of great help in the diagnosis of infective endocarditis. Due to advancement in interventional cardiology, device implantation in cases of ASD, VSD, complete heart block, PDA, dilated cardiomyopathy, HOCM have become common and offer a great benefit to the patients. But at times these devices may offer a nidus for infective endocarditis. The findings of 2D echo in both the groups are depicted in table III. In group 2, more number of patients were benefitted by surgical interventions and implantation of devices as shown in table IV. Group 1 patients had more number of ischaemic as well as embolic stroke (4 each) as opposed to 2 patients of ischaemic stroke and 1 patient of embolic stroke in Group 2. This may be due to early antibiotic and anti-platelet therapy.

Incidence of CHF is decreased due to better therapy both pharmacological as well as device implantation. In-hospital mortality remained high in both groups, since most of the patients came to secondary and tertiary Hospitals in critical state and with complicated co-morbid conditions including diabetes, renal failure, hypertension and conduction disorders of the heart.

DISCUSSION

The incidence of infective endocarditis has remained stable throughout the world. Even over the last three decades, the incidence rate has not changed in our vicinity. P Fefer, D Raveh¹ in their publication had shown an incidence rate of 0.4 admissions per 1000 indoor admissions which was supported by Hoesley CJ, Cobbs CG⁶, Garvey JG⁷, Hogeveck H⁸ and Watanakunakorn C⁹ in their work. We have a small catchment area and ours being a medium sized referral centre, the incidence is slightly low as compared to other authors' work.

The incidence of right sided infective endocarditis has increased owing to high incidence of intravenous drug abusers in our society. The number of prosthetic valve endocarditis has increased as the facility for valve replacement surgery is available in many centres across India. The incidence of IE in heart valves due to rheumatic heart disease is becoming lower due to decrease in the number of cases of rheumatic fever⁶. Mortality in group 1 patients (12 out of 47) was higher than in group 2 patients (4 out of 36) as advancement in antibiotic treatment has occurred and availability of better diagnostic facilities as well as advanced surgical procedures are available¹⁰. Incidence of pacemaker induced infective endocarditis has increased due to the implantation of permanent pacemakers in large number of elderly patients in the last two decades^{11,12}. Number of implantable cardioverter defibrillator implantation also has increased and so has the incidence of IE due to these devices^{13,14}.

Low incidence of neurological complications was seen in both the groups probably due to early institution of anticoagulants in both the groups in our hospitals. We have facilities for CT scan within 6 hours of admission in patients with evidence of thrombo-embolic phenomenon and treated the patient with UHF and followed by warfarin in Group 1 and with low molecular weight heparin followed by warfarin in group 2^{7,8,13}. There might be a bias in our study since we received patients in lesser critical state than the large tertiary referral centers which usually receive their patients in a very critical state. We used to carry out a blood culture within 24 hours of admission and blood cultures up to a maximum number of 4 with 20 ml of blood being drawn, at an interval of 30 minutes in a span of 2 hours. Haematuria was reported in large number of admitted patients and carried mortality of about 14% in the past as reported by Durack et al¹⁴; however, no mortality was observed. in the groups pertaining to our study.

Study limitations

Our studies in both groups were mostly from the local vicinity and a few from surrounding states. The catchment area was small and hence, the statistics might have shown a

lower rate of incidence. Patients referred from other centers might have represented a different population group than patients who were directly admitted in our centers from our locality. The study lacked long term follow-up as most of the patients were lost for follow-up after being discharged from the hospitals. In our centre, we have facilities for implantation of permanent pacemaker but we do not have the facility for conducting open heart surgery and balloon valvotomy. This has constrained us to make a post surgical observation and outcome study in our patients.

CONCLUSION

Despite advancement of the diagnostic facilities and treatment modalities, IE remains a highly enigmatic and serious disease. The sub-acute form of the disease has given way to more acute form. The causative organism has changed from the most common aetiological agent, *Str. Viridans* to *S. Aureus* and intravenous drug abusers have posed a challenging situation for physicians¹⁵. There are a number of developments in the diagnostic modality and treatment module of IE in the recent years. However, high index of suspicion, confirmation of early diagnosis and adequate and prompt treatment are of utmost importance for better prognosis of patients and treatment outcome.

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