ORIGINAL RESEARCH PAPER

Cardiology

KEY WORDS:

A STUDY OF CORONARY ANGIOGRAPHIC PROFILE IN PATIENTS UNDERGOING PERMANENT PACEMAKER IMPLANTATION

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The aim of this study was to examine the coronary angiography pattern for patients who were undergoing permanent pacemaker implantation to determine the common pathological and anatomic basis for conduction disturbances.

MATERIALS AND METHODS

SELECTION OF STUDY GROUP.

This was a prospective study done at the Department of Cardiology, Government General Hospital, Chennai. The patients who were referred to our department for the evaluation and management of symptomatic bradyarrhythmias formed the study cohort.

The study population consisted of 72 consecutive patients who had symptoms of bradyarrhythmias due to sick sinus syndrome (SSS) and atrioventricular block (AVB), who underwent permanent pacemaker implantation between January 2014- June 2016 .

None of these patients received ß-blockers, calcium channel blockers or other medications responsible for sinus node dysfunction or conduction disturbances. All patients underwent coronary angiogram prior to or at the time of permanent pacemaker implantation. Patients with valvular heart disease ,congenital heart disease, cardiomyopathy and renal failure (serum creatinine >3.0 mg/*d*l), were excluded.

Inclusion and Exclusion Criteria:

Inclusion Criteria
Patients with symptomatic Bradyarrhythmias
Age > 18
Exclusion Criteria
Hemodyamnically significant Valvular heart disease,
Congenital heart disease,
Cardiomyopathy
Renal failure((serum creatinine >3.0 mg/*d*l).

Clinical Data

The clinical parameters, demographic data and echocardiographic findings were collected for all the patients. A detailed history of symptoms were recorded. Low cardiac output was defined as upright dizziness, fainting, lethargy, or decreased workload. The presentations of pulmonary congestion included dyspnoea on exertion, paroxysmal nocturnal dyspnoea, or frank pulmonary edema.

Presentation of angina included chest tightness with typical or atypical characteristics. Syncope was defined as transient loss of consciousness with spontaneous recovery and without neurological sequelae. Subjective sensation of an irregular heart rhythm was considered to be a symptom of palpitation.

Central nervous system (CNS) symptoms included transient ischemic attack (TIA) or cerebral infarction with evidence of focal neurological sequelae. Details of underlying cardiac disease, blood pressure, and fasting blood glucose and serum cholesterol levels were measured. The conventional coronary risk factors includingmalesex, age, diabetes mellitus (DM), hypertension, hypercholesterolemia, smoking obesity,family history of CAD and physical inactivity were recorded.

The presence of DM and hypertension were determined by history and fromold medical records. A fasting total serum cholesterol level above 200 mg/dl on two sequential blood tests was considered as hypercholesterolemia. Our definition of smoking risk factor requires at least 10 years exposure to tobacco with at least 10 cigarettes per day.

Mean age of the patients was 51.6 years (range 24 to 71), 30 were men (42%) and 42(58%) were females. 26 patients (36%) had angina ,among them 16pt (61.5%) patients had typical angina, 10 patients (38.5%) had atypical angina. Relevant demographic data of all patients is displayed in table 1.

Interpretation of coronary angiography:

Coronary angiography was performed during the same session as pacemaker implantation. A total of 3-4 views for left coronary artery and two views for right coronary artery were done. The coronary angiography was reviewed by two independent experienced cardiologists unaware of the patient's general data. The Coronary angiographic study included measurement of diameter and stenosis severity, qualitative assessment of flow particularly the blood supply to territories that supply conduction system(proximal LAD , Right coronary artery and Left Circumflex coronary artery) were documented.

Luminal stenosis was calculated as the percentage of diameter reduction in diseased segment compared to the proximal disease free reference segment. More than 50% stenosis in either one of three major coronary arteries including the left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA) or their first-order branches was considered as significant for CAD. The sinus nodal artery (SNA) and atrio-ventricular nodal artery (AVNA) were identified. Significant flow compromise was defined as more than 50% stenosis in the nodal artery or its feeding artery proximal to the origin.

The qualitative assessment of antegrade flow and retrograde flow to branches supplying the conduction system were graded qualitatively in each patient as good, moderate and poor.

Results

A total of 72 patients [30 males and 42 females, mean age of 51.6 years old (range 24-71) were included in our study. The diagnosis

of sick sinus syndrome in 10 patients (28%) and atrioventricular block in 26 patients (72%).

Table 1. Demographic Data

	Normal CAG	Abnormal CAG	p- value
	(No: 50)	(No:22)	
No. of patients	50(69%)	22(31%)	
Age,years (mean)	24-71 (41.8)	50-70(58.7)	
Male	1836%)	12(55%)	<0.05
Female	32(64%)	10 (45%)	<0.05
Sick sinus syndrome	16(32%)	4 (18%)	NS
Atrio-ventricular block	34(68%)	18 (82%)	NS

Table 2. Presenting Symptoms

	Normal CAG		Abnormal CAG		p- value
	(No: 50)		(No:22)		
Angina	14	(28%)	12(54%)		<0.05
Syncope	36 (72%)		8(36%)		<0.05
Palpitation	4	(8%)	2	(9%)	NS
Low cardiac output	2	(4%)	6	(27%)	<0.05
Cardiac congestion	4	(8%)	4	(18%)	NS
CNS symptoms	4	(8%)	2	(9%)	NS

There were no significant differences in baseline characteristics and presenting symptoms between patients with or without CAD. The three most frequent complaints for patients with abnormal CAG were angina (54%) syncope (36%) and symptoms of low cardiac output (27%). For patients with normal CAG, syncope was the most common symptom and observed in 72% of patients. Angina and low cardiac output were more common in patients with CAD group.

Table 3. Distribution Of Conventional Coronary Risk Factors

		Normal CAG	Abnormal CAG	p-value
		(No: 50)	(No:22)	
Age- years Mean	42	58.7		
Male sex	9(36%)	6(55%)	NS	
Hypercholesterolemia	2	(8%)	4 (36%)	NS
Hypertension	6	(24%)	6 (55%)	NS
Diabetes mellitus	4(16%)	4 (36%)	NS	
Smoking	8	(32%)	4 (36%)	NS
Obesity	6(24%)	3(27%)	NS	
Physical inactivity	6(24%)	2(18%)	NS	
Family H/O early onset CAD	4(16%)	2(18%)	NS	

Regarding coronary risk factors, patients with abnormal CAG had significantly

higher percentages of male sex (55% vs 36%) , hypertension (55% vs 24%),

hypercholesterolemia (36% vs 8%) and Diabetes mellitus (36% vs 16%); Table-3.

Multivariate logistic regression analysis of conventional coronary risk factors also revealed male sex, hypertension, hypercholesterolemia and Diabetes mellitus were the significant predictors of CAD (Table-4). The odds-ratio for male sex is 2.13, hypertension - 3.8, hypercholesterolemia –6.57 and for diabetes mellitus is 3.0.

Table 4. . Multivariate Analysis Of Coronary Risk Factors

Risk Factors	OR
Male sex	2.13
Hypercholesterolemia	6.57
Hypertension	3.8
Diabetes mellitus	3.0
Smoking	1.21
Obesity	1.19
Physical inactivity	0.7
Family H/O early onset CAD	1.17

In our patients with symptomatic bradyarrhythmias requiring permanent cardiac pacing, the incidence of CAD was 31% as determined by coronary angiography (CAG).

For patients with sick sinus syndrome, coronary artery disease incidence was 20% and in atrioventricular block was 35%. The sinus nodal-related artery was seldom involved among patients with coexistent CAD and symptomatic bradyarrhythmias (9%), and most patients (90%) had significant stenosis over LAD.

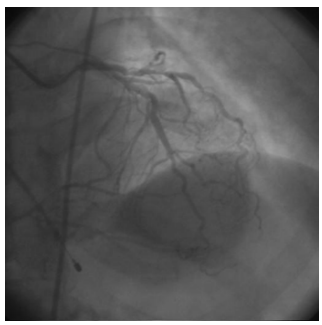
Table 5. Coronary Arterial Profile

Right Dominance	80.6% (58 / 72)
Left Dominance	13.8% (10 / 72)
Codminance	5.6 % (4 /72)
SA nodal artery	
RCA	61% (44/72)
LCx	49% (28 /72)
AV nodal artery	
RCA	83.4%(60 / 72)
LCx	8.3% (6/72)
Not visualised	8.3% (6 /72)

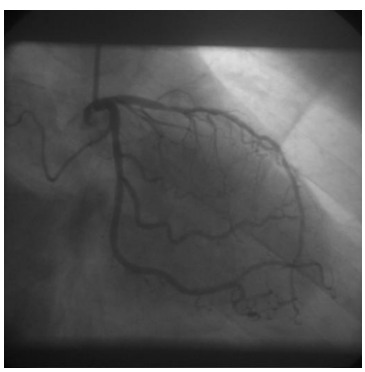
We further divided patients with CAD into 2 subgroups based on their diagnoses of bradyarrhythmia. The findings of their coronary angiographies are presented in Table -5 and 6. Both subgroups had similar distributions with respect to the coronary arteries involved. Most patients had significant stenosis over LAD (>90% patients). The sinus nodal-artery insufficiency was quite infrequent among our patients with SSS (5.5%). One patient in the both SSS group and AVB had sinus nodal artery involvement. AV nodal artery involvement was 13%, all of which occurred in the AV block group.

Table 6. Distribution Of Involved Coronary Arteries In Different Diagnosis

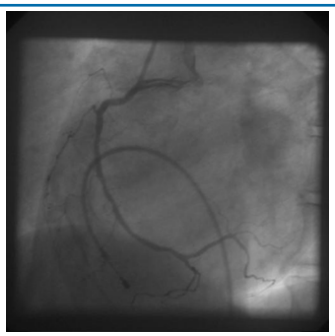
	SSS No: 4/20	AV block No: 18/52
LAD	4	16
LCX	0	2
RCA	4	10
SN artery	2	2
AVN artery	0	10



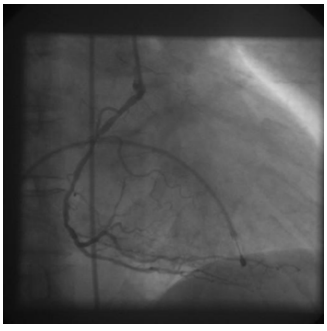
LAD and LCX Lesion, Collaterals to RCA in case of nodal AV block



LAD Disease in a patient with infranodal AV block



Mid RCA / AV nodal artery involvement in AV block patient; LAO



Mid RCA / AV nodal artery disease in a patient with AV block; RAO

Table 7.flow Quality In Septal Branches, San And Avn Arteries

	Septal Branches of LAD	SAN artery	AVN artery
Moderate to	10	18	8
Good			
Poor	12	4	14
Total	22	22	22

Table 8. Clinical Diagnosis, Location Of Conduction Disturbance And Involved Coronary Arteries

S.NO			Corona
	Clinical	Location of	ry arteries
	Diagnosis	Conduction	involved
		Disturbance	
1	SSS	SA node	LAD, RCA
2	SSS	SA node	LAD, RCA
3	AVB	AV node	LAD
4	AVB	AV node	LAD, RCA
5	AVB	AV node	LCX
6	AVB	Infranodal	LAD, RCA
7	AVB	Infranodal	LAD, RCA
8	AVB	Infranodal	LAD
9	AVB	Infranodal	LAD
10	AVB	Infranodal	LAD, RCA
11	AVB	Infranodal	LAD, RCA

Statistical analysis.

The patients were divided into two groups based on their coronary angiographic findings. All parametric data are expressed as the mean (SD of the measured variables. Intergroup differences in means were checked by two-sided unpaired Student's t-test. The categorical variables were measured by the chi-square test with or without Yate's correction as needed. Multivariate logistic regression analysis was performed to determine independent predictors of CAD including sex, age (dichotomized at 70 years old), DM, hypertension, hypercholesterolemia, and smoking. The odds ratios and 95% confidence intervals of independent factors were calculated. A p value of less than 0.05 was considered significant.

Discussion

There are very few studies concerning the incidence of CAD in patients receiving permanent pacemaker implantation for symptomatic bradyarrhythmia. Our study results have revealed that 31 % of patients with symptomatic bradyarrhythmias had coexistent CAD.

Rubenstein[1] et al found that 20 of their 56 patients with sick sinus syndrome had coronary artery disease based on either historical or electrocardiographic evidence; Shaw[2], et al reported that 12 of their 25 patients with sick sinus syndrome had abnormal postmortem CAG.

Hsueh[3], et al reported a prevalence of 20% CAD in their study

The CAD incidence in the present study was similiar to those of previous reports. Nearlyhalf of our study patients complained of chest tightness with either typical or atypicalcharacteristics. The patients were mean of more than 58 years old and most of them acquired one additional coronary risk factor. Furthermore, considering the major prognostic role of CAD in patients undergoing permanent cardiac pacing, these patients dictate an aggressive evaluation for ischemic heart disease.

However, patients with bradyarrhythmia are usually not suitable for conventional noninvasive evaluation for coronary artery disease, and the left bundle-branch-block ECG pattern after right ventricular pacing, is invalid for the diagnosis of CAD. On the other hand, routine CAG is costly and low yielding in non-selective patients. Our study revealed that male sex, hypertension, hypercholesterolemia and DM were more prevalent coronary risk factors in these patients. These factors may be used as clinical markers in selecting patients undergoing further CAG. The distribution of diseased vessels in our patients was not different between the two different bradyarrhythmia diagnoses. LAD was the most frequent vessel involved. Sinus nodal artery insufficiency was noted in one patient among 20 patients diagnosed with sick sinus syndrome. Atrioventricular nodal artery insufficiency was noted in 10 patients among 52 patients with the diagnosis of high degree atrioventricular block.

Jordan.[9], et al found significant sinoatrial conduction time (SACT) prolongation in patients with sinus nodal artery insufficiency and suggested a pathogenetic role of CAD in the development of sinus nodal dysfunction. However, Shaw, et al reported only 4 of 25 patients with chronic sinoatrial disorder had angiographic evidence of more then 75% stenosis obstructing the sinus nodal artery. Our data disclosed that a sinus nodal related artery was seldom involved in patients with symptomatic bradyarrhythmia and coexistent CAD.

Contrary to earlier studies, AV nodal artery involvement was significantly higher in our patients with AV block. This could be due to inclusion of patients with documented myocardial infarction in the past.

Although our study population was small and confined to south Indian population, the results suggest that the prevalence of CAD is significant in patients with symptomatic bradyarrhythmia.

STUDY LIMITATIONS.

Our cohort of patients with permanent pacemakers who also underwent coronary angiography is biased, has both patients with or without ischemic heart disease, and does not represent the general population of patients with a permanent pacemaker.

Nevertheless, the comparison of the study group with a matched control group is valid and yields meaningful results.

Coronary angiography is not indicated routinely in patients with permanent pacemakers but there is no other way to study the pathological anatomy of these patients.

CONCLUSIONS

- In conclusion, coexistent CAD was noted in a significant number (31%) of our patients receiving permanent

pacemaker implantation for symptomatic bradyarrhythmia.
- Among the conventional coronary risk factors, male sex, hypertension, DM and hypercholesterolemia were the significant predictors and may act as important markers for the judgment of further coronary artery evaluation.
- The AV nodal artery was commonly involved among patients with bradyarrhythmia due to AV block and coexistent CAD.

LIST OF ABBREVIATIONS

AVN = artery to AV node

AVB = atrioventricular block

CAD= coronary artery disease

LAD = left anterior descending coronary artery LAO = left anterior oblique

LCx = left circumflex coronary artery

PDA = posterior descending artery

PL = posterolateral

PTCA = percutaneous transluminal coronary angioplasty

RAO = right anterior oblique

RCA = right coronary artery

SA = sinoatrial

SAN = artery to sinoatrial node

SSS = Sick Sinus Syndrome

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