Cardiac Arrhythmias in Service Personnel— An Electrophysiologic Evaluation

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Electrophysiological studies utilising the His bundle electrogram and atrial tachypacing were performed in 50 service personnel which included 14 normal subjects. Associated A-V nodal disease could be identified in cases of sick sinus syndrome. His bundle electrogram was useful in determining the exact site of block in our cases of prolonged P-R interval. The group with pre excitation syndrome consisted of 4 cases of LGL syndrome and 8 cases of WPW syndrome. The associated tachyarrhythmia could be identified in these cases. Correct diagnosis of supraventricular ectopics with wide QRS complex could be made and in patients with complete heart block the decision regarding pacemaker implantation made on intracardiac ECG recordings.

THE electrode catheter technique for recording electrical activity of the cardiac conduction tissue in man during right heart catheterization first introduced by Scherlag et al[3] in 1969, has been a simple and useful means for the study of human AV conduction in both health and disease. This method has now assumed an important place in the evaluation and management of the disorders of cardiac conduction and impulse formation. This technique has also been used to study the pharmacological effects of antiarrhythmic drug therapy and to clarify the prognosis of various cardiac arrhythmias. Although cardiac electrophysiological studies are carried out as a routine in Western centres, the experience in our country in this field is limited.

The purpose of this brief communication is to discuss our initial experience of the cardiac electrophysiological evaluation of service personnel with various types of cardiac arrhythmias.

Material and Methods

A total of 50 subjects were studied during the past 30 months at the Military Hospital, Cardiothoracic Centre. There were 14 normal male adults, age ranging from 19 to 38 years. They were investigated to evaluate the significance of grade 1-2 systolic murmur detected during routine medical examination. Haemodynamic and angiocardiographic studies on these individuals did not show any abnormality. 36 patients with various types of cardiac arrhythmias referred for cardiac evaluation were studied in greater detail at the electrophysiological laboratory. All except one were male and their age ranged from 19 to 52 years.

Surface electrocardiogram (ECG), X-Ray chest and other routine parameters were done in all cases. His bundle electrogram recordings were obtained by the method described by Scherlag et al[3]. In brief, a 5F Bipolar pacing catheter was passed into the right femoral vein with the help of a 'Diselet' and positioned across the tricuspid valve. The proximal electrode terminals were plugged into the lead connector of the bioelectrical amplifier (No. 8811-A) of Howlett- Packard

8 channel research recorder (Model No. 4588D). The position of the catheter was adjusted so that optimal recordings of the His bundle potentials could be obtained. Bipolar His bundle electrogram was recorded at a frequency setting of 50-500 Hertz on the research recorder at a paper speed of 100 mm per second with time lines 40 milliseconds apart. An additional 5F or 6F pacing catheter was positioned against the lateral wall of the right atrium either through the same femoral vein or through the ante-cubital vein. In our Centre we introduce more than 2 catheters through a single femoral vein percutaneously. The proximal terminals of this electrode catheter were connected to the bioelectrical amplifier to obtain intra atrial electrogram or this lead was used for atrial pacing. The atrial pacing was carried out utilising a battery powered Medtronic external pulse generator Model No. 5880A, whenever indicated. One or two surface electrocardiographic leads were also recorded. Sinus cycle rate was calculated by dividing cycle length in millisecond into 60000, e.g., 60000 ÷ 600 = 100 bpm. The following intervals were measured in milliseconds at a paper speed of 100 mm per second :

(a) P-A interval which represents the intra atrial conduction time, measured from the onset of P in the surface ECG to the first deflection of A wave in the intra cardiac recording. During atrial pacing the P-A interval was measured between the stimulus artifact and A wave.

(b) A-H interval consists of the time from the first rapid deflection of the A wave to the first rapid deflection of the bundle of His electrogram. The A-H interval represents conduction time through the A-V node.

(c) H-V interval approximates conduction through the His Purkinje system. It was calculated from the first high frequency component of the potential to the onset of QRS deflection in the surface ECG.

After recording the His bundle electrogram during the basic resting state, stable right atrial pacing was carried out whenever indicated, beginning at a rate faster than the resting rate. The pacing rate was gradually increased in increments of 10 bpm and the cycle length at which Wenckebach block occurred was recorded. To evaluate cases of sick sinus syndrome, sinus node recovery time was calculated in the following manner. Stimulation of the sinus node was performed for a minute at each rate and then stimulation abruptly interrupted.

During atrial tachypacing A-H interval, H-V interval and QRS width were measured. The time between the last paced atrial complex and the first spontaneous sinus complex was considered to be sinus node recovery time (SNRT). Corrected sinus node recovery time (CSNRT) was obtained by subtracting the spontaneous sinus cycle length from the SNRT. Coupled atrial pacing and premature atrial stimuli could not be carried out due to lack of facilities. Whenever indicated, ventricular pacing was carried out and V-A conduction time was calculated. If the patient developed tachycardia the cycle length, QRS width, H-V interval, sequence of atrial activation and relationship of atrial complex to ventricular complex were noted.

Results

The 50 subjects submitted for electrophysiological studies were divided into the following groups :

Normal controls	—	14
Sick sinus syndrome	—	15
Pre-excitation syndrome	—	12
Atrioventricular block	—	4
Bifascicular blocks	—	3
Supraventricular ectopics	—	2

The A-V conduction intervals obtained in normal subjects are shown below :

A-V Conduction Time in Normal Controls

Age (Yrs)	Heart Rate (per min)	P-A	A-H	H-V	CSNRT (millisec)
		Intervals (millisec)			
19-38	70±8	25±5	90±8	40±3	300±100

The 15 patients with sick sinus syndrome presented with the following features in the surface ECG :

Sinus bradycardia	—	8
Sinoatrial block with escape rhythm	—	4
Bradytachy syndrome	—	3

The corrected sinus node recovery time was observed above 600 milliseconds in all cases. It was abnormally prolonged in four patients. The underlying escape mechanism could be documented with certainty in all cases. Associated A-V node disease as manifested by prolonged A-H interval could be recorded in four patients.

The 12 cases of pre-excitation syndrome included four patients with LGL syndrome. All the cases with classical WPW syndrome showed very short H-V interval at the resting period. Following atrial pacing, the H-V interval became either negative or markedly shortened. In two cases intermittent atrial fibrillation could be recorded. One case developed supraventricular tachycardia during the study.

In the group with A-V block, two subjects showed evidence of complete heart block. In both of them electrophysiological studies indicated severe disease and subsequently they were given permanent pacemaker therapy. One case, a young airman, showed surface ECG changes suggestive of prolonged P-R interval during medical board prior to commissioning. He underwent His bundle studies and intermittent block above the A-V node as a result of increased vagal tone was documented. Another officer underwent electrophysiological studies for first degree A-V block when persistent prolongation of A-H interval was recorded.

Three cases of right bundle branch block with left axis deviation underwent His bundle and atrial tachypacing studies. These cases did not show any H-V prolongation and therefore pacing could be avoided.

Two patients were referred for evaluation of ectopic rhythm detected during routine examination. The surface ECG showed broad QRS complexes. Both were found to have supraventricular ectopics with aberrant conduction.

Discussion

The conventional 12 lead surface electrocardiogram can provide information regarding atrial depolarization process with the status of A-V conduction. However, the information obtained from the surface electrocardiogram is usually inferred from the configuration and relationship of the P waves and QRS complexes. It is impossible to identify, for example, His bundle activity by the surface electrocardiogram. Another example is that prolongation of the P-R interval is usually designated as first degree A-V block but it is impossible to identify the exact location of the delayed conduction. On the other hand, an intracardiac electrocardiogram, such as the His bundle electrogram, can provide direct information regarding the site of cardiac impulse formation and the exact location of a heart block.

As far as the history of His bundle electrocardiography is concerned, the first His bundle electrogram was recorded by Alanis and associates[1] in 1958 in the isolated perfused animal heart by placing electrodes directly to the His bundle. Later in 1969, Scherlag et al[3] introduced the catheter technique for recording the His bundle electrogram in humans. Since then, extensive work in the field of His bundle electrocardiography has been carried out at various laboratories. We have already reported our experience[2] on the effect of nitroglycerine on the cardiac conduction.

The safety and simplicity of His bundle technique provides better understanding of cardiac electrophysiology including normal and abnormal conduction and the mechanisms involved in the genesis of various tachyarrhythmias including those related to WPW syndrome. The normal A-V conduction intervals recorded in our subjects are similar to those reported by other workers but it has been found that the values are on the lower side of normals.

By definition A-V conduction disturbances are characterised by slower than normal A-V conduction. It can produce a prolonged P-R interval or intermittent block of atrial impulses or complete failure of conduction to the ventricles from the atrium (third-degree block). His bundle ECG analysis may reveal the exact site of A-V block

The WPW syndrome has been traditionally classified into two types, namely type A and type B depending upon the direction of the delta wave. However, this classification is an oversimplification because many cases with WPW syndrome do not belong to either type A or B. The direction of the delta wave is primarily influenced by the location of the accessory pathway.

The electrophysiologic assessment of a patient with Wolff-Parkinson-White syndrome is a multifaceted study which attempts to: (1) confirm the presence of preexcitation, or nothing, (2) identifiy the nature of the associated tachyarrhythmia, (3) presumptively localise the site of the accessory pathway, (4) confirm participation of the accessory pathway in the tachyarrhythmia, (5) characterize the functional behaviour of the accessory pathway and (6) examine the effect of drugs or pacemaker therapy. We propose to study our cases of WPW syndrome with extra stimulus techniques once a programmable pulse generator available.

The role of His bundle electrocardiography in t diagnosis of ectopic rhythm is to confirm the surfa ECG finding in most of the cases. However, in c tain cases His bundle diagnosis is certainly necessa The best example of this is the concealed His bun extra systole which is impossible to be detected in t routine ECG. Differentiation between supraventricu tachyarrhythmias with broad QRS complexes due bundle branch block, aberrant ventricular conducti or WPW syndrome and ventricular tachycardia is t most important, yet it is often difficult. Simila atrial premature beat with aberrant ventricular cond ction or bundle branch block closely simulates vent cular premature beat. In the above situations H bundle electrocardiography will be of immense he in arriving at a correct diagnosis.

References

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