First degree atrioventricular block

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First degree A-V block, defined as prolongation of the PR interval on the surface electrocardiogram, is a not uncommon finding on electrocardiographic screening of asymptomatic young individuals. Prevalences of from 0-65% to 1-1% have been reported. In the majority of cases the PR prolongation may be rendered normal by autonomic intervention. Long-term follow-up studies have indicated that although the risk of subsequent coronary artery disease may be slightly increased, the risk of sudden death, syncope or advanced A-V block is not. Apart from the exclusion of organic heart disease, detailed invasive investigation is not warranted. It is a benign condition and as such no restriction on fitness to fly need be made on these individuals, but there may be a case for increased electrocardiographic scrutiny.

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DEFINITION
First degree atrioventricular (A-V) block is a delay within the AV conduction system and is defined as a prolongation of the PR interval on the surface electrocardiogram beyond the accepted upper limit of normal (0-20 s in the majority of studies - 0-21 s in some studies11). The PR interval is somewhat rate-dependent and appropriate corrections for heart rate must sometimes be made12. Prolongation of the PR interval may occur physiologically, or as a result of pharmacological intervention, in the setting of myocardial infarction and acute ischaemia, or as a chronic conduction disorder.

ELECTROPHYSIOLOGY
Although defined on surface electrocardiographic criteria, the standard ECG does not provide the precise information on the site of block within the A-V conduction system which is of importance in determining its prognostic significance. Significant delays can occur within the conducting system in the presence of a normal PR interval on the surface electrocardiogram13-14. With the advent of His bundle electrocardiography6, it has become possible to locate the sites of block and delay within the conduction system3,7-11.

Such studies3,10,11 have demonstrated that first degree A-V block may result from delay within the atrium, A-V node, His bundle or bundle branches. In one series of 244 cases11, the A-V node was the major site of delay in 83% of cases although delay occurred at more than one site in 79% of the cases studied. There was intra-atrial delay (prolonged PA interval) in 49% and delay within the His Purkinje system (prolonged HV interval) in 66%. These results differ somewhat from those of Puech el a10 who reported delays at multiple sites in only 20% of their cases.

A prolonged PR interval may be associated with either wide or narrow QRS complexes. A narrow QRS complex usually indicates delay within the proximal portion of the conduction system3,10,11, whereas in patients with bundle branch block, particularly LBBB or bifascicular block there is a very high incidence of abnormal HV intervals (50-90%)10-13 either alone or more usually superimposed on a prolonged AH interval. It has previously been implied16,17 that the presence of bundle branch block in a patient with a prolonged PR interval is indicative of bilateral bundle branch block with consequent poor prognostic implications. However, more recent studies13-16, using His bundle electrocardiography, have drawn more specific conclusions. In the presence of first degree A-V block:

(i) the pattern of RBBB and left axis deviation is highly suggestive of HV prolongation and probable trifascicular block, whereas in patients with normal PR intervals HV prolongation is unlikely14;
(ii) the pattern of LBBB or RBBB with right axis
deviation is often associated with HV prolongation (more than 50% of cases) but the incidence is not significantly greater than in patients with normal PR intervals\(^{[14]}\); (iii) the pattern of RBBB and a normal axis is often associated with a normal HV interval\(^{[18,16]}\).

The response of patients with first degree A–V block to incremental atrial pacing primarily depends on the site of delay. Patients with intra-atrial delay frequently demonstrate 1:1 conduction at rapid pacing rates although occasionally Wenckebach block within the atrium occurs \(^{[18,14]}\) and atrial arrhythmias may be provoked\(^{[16]}\). In patients with A–V nodal delay, Wenckebach periodicity usually occurs at rates less than 130 bpm\(^{[11]}\). In patients with more distal delay, 1:1 conduction at rapid rates is often possible despite a prolonged HV interval. However, in patients with LBBB or RBBB and left axis deviation, second degree block distal to the His spike may occur\(^{[16]}\).

Epidemiology and natural history

Data from studies involving the routine electrocardiographic screening of large numbers of asymptomatic individuals\(^{[1,11-18]}\) have indicated that the prevalence of first degree A–V block in a young adult population ranges from 0.65% to 1.1%. His and Lamb\(^{[12]}\) in their survey of 122043 airmen, of whom over 100000 were aged 40 years or less, found an overall prevalence of 0.65% with no significant difference in the rate for the different age groups apart from subjects aged over 50 years (1.36% prevalence). The longest PR intervals did however tend to occur in the younger age groups\(^{[11]}\). Clinical evaluation of approximately one-third of the subjects found to have first degree block demonstrated evidence of heart disease in only 3.6%. The authors concluded that in the majority of asymptomatic individuals first degree block was purely a physiological variation. This theory was endorsed by the PR interval returning to normal with exercise, hyperventilation, orthostasis or atropine in most subjects. Two subjects, however, developed type II second degree block with breath-holding manoeuvres, and three subjects developed Wenckebach periodicity after exercise. The significance of these findings is unknown.

In a similar study of 1000 airmen (aged 20 to 30 years) Graybiel et al.\(^{[11]}\) found a prevalence of first degree A–V block of 1.1%. In a 10-year follow-up study of these patients\(^{[14]}\), five of the 11 patients developed a normal PR interval and none of the patients developed clinical heart disease. In the study group as a whole the mean PR interval increased over the ten years and was presumed to be related to ageing. This interpretation was confirmed by the study of Rose et al.\(^{[11]}\) who, in a much older subject group (40–64 years), found an overall prevalence of 2.4% with an increasing prevalence with age. In a five-year follow-up of these patients there was no increased incidence of death from heart disease compared to the study group as a whole. Similarly in a long-term follow-up study (13 years) of 3983 pilots\(^{[18]}\) with ‘partial A–V block’ (presumed to be a combination of first and second degree block) no case of clinical heart disease was reported. The only study to indicate a poorer prognosis associated with first degree block is that of Blackburn et al.\(^{[14]}\) who, in patients aged 40–59 years, found a slightly increased risk of coronary artery disease when compared with appropriately matched controls.

As would be expected of a finding which varies with autonomic influences, studies with 24 h dynamic electrocardiographic monitoring have reported a higher prevalence of first degree block. For example, Brodsky et al.\(^{[17]}\) in a study of 50 male medical students observed periods of prolonged PR intervals in four subjects (8%). Similarly, in a study of highly trained athletes\(^{[18]}\) first degree block was detected in 8.7%.

In many of these epidemiological studies\(^{[1,11-18]}\) it is presumed, although it is difficult to be sure, that all patients with first degree block had narrow QRS complexes.

INVESTIGATIONS OF VALUE

In subjects presenting with first degree A–V block, organic heart disease, especially coronary artery disease, valvular heart disease and cardiomegaly should be excluded by appropriate investigations such as chest X-ray, echocardiogram and exercise electrocardiography. In the absence of associated heart disease, although the site of block may be defined precisely by electrophysiological studies, in view of the extremely benign nature of the condition such studies are not indicated. Exercise, hyperventilation or the administration of atropine may be used to confirm the ‘physiological’ origin of the PR prolongation in any individual subject.

Conclusions

First degree A–V block with a narrow QRS complex is an extremely benign condition. In healthy young subjects, in the absence of associated heart disease, it may be a normal variant related to individual variability of the refractory period of the A–V junction and its sensitivity to autonomic influences. Long-term follow-up studies have indicated
that the risk of subsequent coronary artery disease may be slightly increased but that the risk of sudden death, syncope or advanced A-V block is not increased—at least during the period of the follow-up studies reported (5–13 years). Electrocardiograms should be recorded at a slightly increased frequency—perhaps at one-year intervals regardless of age in flying personnel.

Patients with first degree A-V block and certain patterns of bundle branch block (LBBB, RBBB with right or left axis deviation) have a higher incidence of disease of the distal conduction system. The incidence of prolonged HV intervals in subjects with LBBB or RBBB with right axis deviation in the presence of first degree block is no greater than in subjects with normal PR intervals. The incidence is increased in subjects with RBBB and left axis deviation, but it is not significantly greater than in other forms of bifascicular block. The recommendations and investigations for this small subgroup of patients should therefore follow those recommended for patients with bifascicular block and normal PR intervals.

References