Ageing and Atrial Electrophysiologic Properties in Man


Summary: In order to assess the influence of age on atrial electrophysiologic properties, we studied 17 normal subjects, whose ages were homogeneously distributed between 17 and 78 years, measuring in each of them effective (ERP) and functional (FRP) refractory periods at 3 sites of the right atrium (high, middle and low in the lateral wall) at the same driven frequency (120/min). Two threshold stimuli of 2 msec duration were applied. Dispersion of refractoriness (D) was measured as the longest minus the shortest refractory period. A significant direct correlation was observed between age and D (of ERP: $r = 0.75$, $p < 0.001$; of FRP: $r = 0.82$, $p < 0.001$). Moreover age showed a significant direct correlation with refractoriness at high right atrium (ERP: $r = 0.66$, $p < 0.01$; FRP: $r = 0.76$, $p < 0.001$) but did not correlate with that at the other two sites. In conclusion we suggest that ageing modifies atrial refractoriness in a non uniform manner inducing a progressive increment of D. The impression is that a slow but continuous process takes place from juvenility to old age. Even if it is not easy to establish the clinical relevance of our data we think that they should be considered in view of the differences in susceptibility to and electrophysiologic manifestations of arrhythmias at various ages.

Introduction

Previous studies on humans concerning the influence of age on atrial electrophysiologic properties (1, 2) were performed measuring refractoriness at only atrial site (parasinusal zone). Recent papers (3–5), however, indicated the possibility of performing a more extensive evaluation of atrial excitability in clinical electrophysiology. Results obtained testing more than one atrial site allowed a better definition of some pathophysiological conditions, such as sinus node dysfunction and atrial tachyarrhythmias. If we consider that a possible implication of these studies concerns the role exerted by ageing on clinical electrophysiologic results, it becomes necessary to perform further evaluation of this problem, adopting the more extensive protocol of the above mentioned studies (3–5).

Material and Methods

The study group consisted of 17 normal subjects (14 males and 3 females) whose ages were homogeneously distributed between 17 and 78 years. Complete medical history was obtained and physical examination was performed by at least two of the authors. Analysis of blood, urine and chest roentgenograms did not show abnormalities in any subject. Particular attention was given to exclude latent coronary artery disease. In all subjects
ECG, response to multistage treadmill stress test, systolic time intervals, echocardiogram, and Holter monitoring were normal. The electrophysiological study was carried out: during an atrial pacing performed for atypical chest pain (8 cases) and before a cardiac catheterization performed to exclude the presence of a gradient between right or left ventricles and pulmonary artery or aorta (9 cases).

All patients had: 1. normal sinus rhythm with sinus rates between 60 and 100/min in all recorded resting electrograms; and 2. absence of documented atrial dysrhythmias. The subjects were observed for a period of 12 to 30 months (mean 18 months). Periodic controls confirmed normal cardiac conditions. Blood pressure was normal in all subjects. The subjects were studied in the resting, nonsedated and postabsorptive state after informed consent had been obtained. None of them was receiving cardioactive drugs.

Two electrodes, number 6F USCI quadripolar and number 6F USCI tripolar, were inserted percutaneously via a right antecubital vein and the right femoral vein respectively. The distal pair of electrodes of the quadripolar catheter were used to stimulate the atrium and the proximal pair of electrodes to record a right atrial electrogram (A). The tripolar catheter was positioned across the tricuspid valve and was used to record the His bundle electrogram (HBE). The A, HBE and four surface electrocardiographic leads (I, II, III and V1) were simultaneously displayed on a Hewlett-Packard eight channel oscilloscope and were recorded on a Elema-Schonander Mingograph 62–6 channel ink-jet at a paper speed of 100 mm/sec. Overdrive and premature programmed atrial stimulation were performed using an electrically isolated battery-powered Medtronics 5325 stimulator. The pulse width was 2 msec and the amplitude was adjusted to twice diastolic threshold. The stimulating electrodes were first positioned at the high right atrium (HRA) near its junction with the superior vena cava to determine corrected sinus node recovery time and total sinoatrial conduction time as previously indicated (6, 7). Atrial extrastimuli were applied at 10 msec decrements after eight beats of atrial pacing at a rate of 120 beats/min until atrial refractoriness was determined. The stimulating poles were then fluoroscopically repositioned, the threshold was reevaluated and atrial stimulation performed at two additional right atrial sites in the lateral wall at least 1 cm distant from the HRA: mid-lateral (MRA) and low-lateral (LRA) right atrium. Atrial functional refractory period (FRP) was the shortest coupling interval recorded on the atrial electrogram. Atrial effective refractory period (ERP) was the longest interval between the stimulus artefact (atrial pacing) and the extrastimulus failing to propagate. Dispersion of atrial refractoriness (D) was determined from the range of refractory periods measured in each subject at the three atrial sites as the longest minus the shortest refractory period. Values are expressed in milliseconds and as mean ± 1 standard deviation. Correlation coefficients for the relationship between age and atrial refractoriness or D were derived using standard linear regression methods.

Results

Sinus cycle length ranged from 700 to 980 msec (mean 828 ± 111 msec). Atrioventricular conduction, corrected sinus node recovery time and total sinoatrial conduction time proved to be normal in each subject. Mean A-H and H-V intervals were respectively 105 ± 10 msec and 44 ± 3 msec. Mean corrected sinus recovery time was 244 ± 55