ACCOMMODATION OF A-V NODAL CONDUCTION AND FATIGUE PHENOMENON IN THE HIS-PURKINJE SYSTEM

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INTRODUCTION

To understand the mechanisms responsible for disturbances in cardiac rhythm and conduction, it is useful to have a working knowledge of electrophysiologic events underlying normal and abnormal impulse propagation through different segments of the A-V conducting tissue. The ability to study these events in man has been facilitated by the development of the catheter technique for recording His bundle (BH) electrograms. Artificial pacing of the human heart, by permitting variations in site, rate and duration of stimulation, when used in conjunction with BH recordings have contributed significantly to the understanding of disturbances in impulse formation and conduction.

Various characteristics of impulse transmission through the normal or abnormal A-V node and His Purkinje System (HPS) have been previously elucidated to a large extent by animal experiments and studies in man (304, 362, 364, 407, 422, 541, 548). However, certain aspects of conduction have not been systematically analyzed. The purpose of this presentation is to explicate the following two characteristics: a. the phenomenon of accommodation in the normal A-V node; and b. the “Fatigue” phenomenon in the diseased HPS.

I. ACCOMMODATION OF A-V NODAL CONDUCTION

The changes in A-V nodal conduction time associated with sustaining of an increased but constant rate have been defined as A-V nodal accommodation. These changes in A-V nodal conduction time are over and above the expected rate related increase in conduction time, since the A-V nodal conduction velocity during its relative refractory period is frequency dependent. The latter is noted in the first beat at the establishment of the new cycle length. However, the phenomenon of accommodation pertains to changes in A-V nodal conduction noted in the subsequent beats of the new cycle length. A-V nodal accommodation is related to the magnitude of increase in rate and the duration for which the increase is sustained. Except for a preliminary report from this laboratory this phenomenon has not been defined previously in man (707).

Patients with normal sinus rhythm and a normal P-R interval were studied during diagnostic right heart catheterization. Patients were studied in the postabsorptive state and were premedicated with 100 mg of Nembutal administered intramuscularly 30 minutes prior to the study. His bundle electrograms were obtained by the standard technique and A-H interval was normal in all. The recordings were made at a paper speed of 100 mm/sec.

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The right atrium was stimulated at 100 and 120/min for periods of two and five minutes at each level. Continuous BH recordings were obtained before atrial pacing (AP), during AP and on termination of AP. The A-H time was measured during normal sinus rhythm, during AP in the first 10 or more paced beats and thereafter at intervals of one minute through the duration of pacing. A-H time was also measured in the sinus beats immediately following the cessation of AP.

Two types of A-V nodal conduction responses were observed as follows:

**Type I:** This type of response was exhibited by a majority (80%) of the cases. During AP, the first beat at the established new cycle length showed a lengthening of A-H time as compared to that of sinus beats and is a rate related phenomenon. The subsequent ten paced beats showed a gradual lengthening of A-H time despite the maintenance of a constant pacing rate and is due to A-V nodal accommodation. This increase in A-H time in the first ten paced beats was usually 15–30 msec (range 0–55 msec). Additional A-H increments of a lesser magnitude were usually observed in the subsequent beats with stabilization and occurrence of a plateau by one minute in most of the cases (fig. 1 and 2). In a few patients further A-H lengthening (range 5–65 msec) was seen between one and five minutes of pacing levels. The magnitude of total A-H lengthening was greater at higher pacing rates. For example, figure 2 shows a total increase of 35 msec in A-H time during AP at 120/min as compared to an increase of 20 msec during AP at 100/min.

**Fig. 1.** Accommodation in A-V nodal (A-H) conduction and type I response during onset of atrial pacing (AP) at 100/min. A. First beat shows control A-H (105 msec) time during normal sinus rhythm (NSR). The beat numbered one, is not the very first paced beat but is the first paced beat after the establishment of the new atrial rate (100/min) and shows an A-H time of 145 msec. A gradual increase in A-H time (145–155 msec) is noted in the first three beats and is due to A-V nodal accommodation. B & C. Further increase in A-H time (155 to 165 msec) is noted after one minute of AP as compared to the seventh paced beat in panel A, despite a constant rate. This suggests additional accommodation in A-V nodal conduction reaching a plateau after one minute with a constant A-H time up to five minutes of AP (panel C). Cessation of AP is immediately followed by a return to control A-H (105 msec) time in the first sinus beat. The H-V time (40 msec) remained constant throughout.