CHAPTER 1

Historical notes and classification of the variants of ventricular preexcitation

Almost 25 years ago, Gallagher et al. [1] stated that “the role of Mahaim fibers in the genesis of cardiac arrhythmias in man has been controversial since they were first described.” The original description of these fibers was made by Ivan Mahaim in the late 1930s [2, 3] (Fig. 1.1).

He found a conducting tissue extending from the atrioventricular (AV) node to the ventricular myocardium. There are only a few articles dealing with anatomical studies of Mahaim fibers [3–8]. Early investigators found that Mahaim fibers were accessory connections taking off from the bundle of His and the fascicles (fasciculoventricular [FV] fibers) into the right ventricle or from the AV node (nodoventricular [NV] fibers) to the right ventricle or to the right bundle branch (nodofascicular [NF] fibers). Anderson et al. [9] proposed two varieties of NV fibers: one arising in the transitional zone and the other taking off from the deep, compact nodal portion of the AV junction. The NV concept was consistent with the findings published in the Gallagher series [1] series, wherein some patients had ventriculoatrial (VA) block during wide, complex tachycardia, proving that in those patients the atrium was not part of the reentrant circuit. Wellens [10] was the first to report the electrophysiological findings by using the technique of programmed electrical stimulation in a patient with an accessory pathway with decremental properties and long conduction times and assuming the pathway’s relationship with the fibers described long ago by Mahaim. The term nodofascicular was used when the retrograde right bundle branch potential preceded the ventricular deflection, whereas the pathway was assumed to be nodoventricular when the retrograde His bundle deflection followed the beginning of the ventricular potential. The next step was the understanding of the functional significance and the anatomical–electrophysiological relationship of such pathways. An important observation was made in 1978 by Becker et al. [7] when they described an accessory AV node associated with a bundle of specialized fibers measuring 1 cm, coursing through the right ventricle, and mimicking a second AV conduction system located on the lateral tricuspid annulus. However, this finding did not change the mainstream concept of NV fibers at that time.

During the early 1980s, cardiologists started to refer patients with drug refractory tachycardias due to Mahaim fibers for surgical treatment. Although Gillette et al. [11] reported as early as 1982 a Mahaim fiber located on the anterior
Chapter 1

Ivan Mahaim (1897–1965). Born in Liège, Belgium, and educated in Lausanne, Switzerland, he was a fellow of Prof. Wenckebach in Vienna (1926). Mahaim wrote more than 100 papers, which were published in the leading journals of his time. His most influential works were his books on histological research concerning the connections of the bundle of His. This research was a resounding success in Europe in 1937 because it provided the basis for later electrophysiological discoveries. His last work, still a reference for musicians, was devoted to Beethoven’s last quartets and published in 1964.

portion of the tricuspid ring, according to the concepts at that time, ablation of the AV node was considered to be the logical strategy for curative treatment of patients with NV/NF fibers. Some electrophysiologists introduced a new technique delivering high-energy current through a catheter to achieve ablation of the AV node to treat a patient with a Mahaim fiber. This technique resulted in complete AV block but persistent ventricular preexcitation [12]. The turning point came in 1988, when Klein et al. [13] decided to extensively freeze the AV node and the upper His bundle region of a 29-year-old man and discovered that preexcitation did not go away. This finding indicated to them that the accessory pathway was not connected with the AV node. In another patient the AV node was not damaged, but the decrementally conducting accessory pathway was successfully blocked by ice mapping at the right lateral aspect of the tricuspid annulus. Klein’s manuscript was published in 1988. Shortly thereafter, Tchou et al. [14] published a paper titled “Atriofascicular Connection or a Nodalventricular Fiber? Electrophysiologic Elucidation of the Pathway and Associated Reentrant Circuit.” In this elegant study the authors describe a simple maneuver to prove that such pathways are in fact inserting in the atrium and not in the A-V node. They showed that it was possible to advance ventricular depolarization during preexcited tachycardia by delivering late atrial premature beats during AV node refractoriness. In the following years, catheter ablation techniques shed more light on the subject. Discrete high-frequency potentials resembling the His bundle potential, considered the electrical activation of the atriofascicular pathway, were used as an effective target for ablation [(15, 16]. Observations during pharmacological interventions
Abstract

The preexcitation syndromes were originally classified on the basis of their anatomical location and course and named according to the original investigators. This classification resulted in Mahaim, James, and Kent fibers. Later, such a description was considered inadequate because it did not fit the new electrophysiological or anatomical knowledge. In 1975 the European Study Group for Preexcitation [9] introduced a new classification based on the anatomical connections of the accessory pathways. However, the eponym Mahaim survived the changes proposed by the group. Why? It seems that the major issue here is the common electrophysiological finding of long and decremental conduction properties (AV node-like behavior) of such pathways, the so-called Mahaim physiology. We also need to emphasize that the eponym Mahaim
is already known to generations of arrhythmologists who witnessed the long and exciting process that took place until full understanding of the anatomical-functional relationship became possible. An updated anatomical classification of the preexcitation variants follows and is illustrated in Fig. 1.2.

Proximal insertion in the AV node–His bundle branch system:
1 NF bypass tract;
2 NV bypass tract;
3 FV pathway.

Proximal insertion in the atrium (right and left atrium):
1 Atriofascicular pathway;
2 short AV pathway with prolonged and decremental conduction;
3 long AV pathway with prolonged and decremental conduction.

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Historical notes and classification

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6 Chapter 1

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