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Review

Wilhelm His Junior and his bundle

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Abstract We have reviewed the evidence relative to the initial description of the penetrating atrioventricular bundle, seeking to determine whether Wilhelm His Junior is deserving of his eponym.

Keywords: Atrioventricular node; Penetrating atrioventricular bundle; Atrioventricular conduction axis; Sunao Tawara; History of medicine

Introduction

When one of us was training in medicine, he was encouraged by his Professor of Anatomy not to use eponyms. The medical students, at the time, considered that the Professor probably took this stance because, despite his eminence as an authority on the anatomy of the autonomic nervous system, he had yet to achieve his own eponym. Be that as it may, and despite the fact that anatomists still disapprove of the use of these devices, eponyms have not gone away, nor are they likely to go away. The potential problem with their use, of course, is that we have no certainty that the honoree is worthy of the structure thus named. This is the case with regard to the "bundle of His". For many years, one of us had doubted the justification for the naming of this important structure. It was fortunate, therefore, that at the time we were preparing this review, we had the opportunity to read a discussion regarding the "history of evidence" [1]. In that review, Clarke points out that the last century is only 15 years behind us. We need to think about the century before last when contemplating the events of the 1800s. It is the events of the century before last that are pertinent to the achievements of Wilhelm His the Junior [2]. Clarke emphasizes the ease with which it is now possible to access the material published in the 19th century medical literature. Even if armed previously with this information, it would have proved difficult for many, if not most, investigators to appreciate the account of the atrioventricular bundle provided by His. In no small part this was because of its publication in the German language [3]. And, as was acknowledged by His himself [2], it appeared in an obscure journal. Access to the modern day search engines, however, directed us to an excellent translation of the original publication, including its illustrations [4]. This translation, furthermore, has been available for very many years, so our own shortcoming is reflected by our ignorance of its existence. Examination of the work in the English language has now prompted a major revision of our opinion of the validity of the original description. There is no doubt that Wilhelm His Junior discovered the bundle that bears his name, and provided illustrations demonstrating its location [3]. We discuss in our review why the entity initially proved to be enigmatic. We then show how its precise location can now be demonstrated in life by means of "living anatomy", endorsing the accounts provided by previous giants of cardiac anatomy. We begin, however, by discussing the heritage of Wilhelm His Junior [5], since it is arguable that his father was just as deserving of a suitable eponym.

The His family

Wilhelm His Senior was professor of anatomy and physiology in Basel, Switzerland, where Wilhelm Junior, the third of six children, was born on December 29, 1863 [2,5]. Wilhelm Junior was 9 years old when his father, already recognized as the foremost worldwide exponent of human development, was appointed as professor of anatomy at the University of Leipzig. During his appointment in Basel, His Senior had made formidable discoveries over and above those relating to human development, including the invention of the microtome [2]. Having established himself in Leipzig, he published the most complete account of human embryology as known at the time, including a description of cardiac development which still maintains its currency [6]. Amongst the illustrations to be found in His'

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Atlas is a depiction of a protrusion growing into the atrial cavity from the dorsal wall of the developing atrial chambers, overlapping the developing primary atrial septum (Fig. 1). His Senior named this protrusion the "spina vestibuli". We now know that this entity, along with a mesenchymal cap carried on the leading edge of the primary atrial septum, is muscularized to form the buttress that binds the atrial septum itself to the insulating tissues of the atrioventricular junctions [7]. The atrioventricular node is formed within this buttress. We also now know, of course, that this node is part of an axis of specialized myocardium that includes the bundle subsequently discovered by his son. The vestibular spine itself was neglected for well over a century, until its importance in separating the atrioventricular junctions was emphasized by Snarr and his colleagues [8]. The latter workers chose to describe the entity as the "dorsal mesenchymal protrusion". To our minds, this ignores the initial description by His Senior. Our own preference is to describe it as the vestibular spine [7]. It could be argued that the structure is deserving of description as the protuberance of His. Be that as it may, we can be sure that His Senior took pains to share his anatomical and embryological experiences with his son, thus paving the way for the initial discovery of the atrioventricular bundle. As was suggested by Schechter and colleagues [9], nonetheless, the "brief journey" of His Junior into the fields of anatomy and embryology was made at the instigation of His Senior. They argued that His Junior "had no particular inclination for his assignment, but nevertheless tackled the chore in earnest" [9].

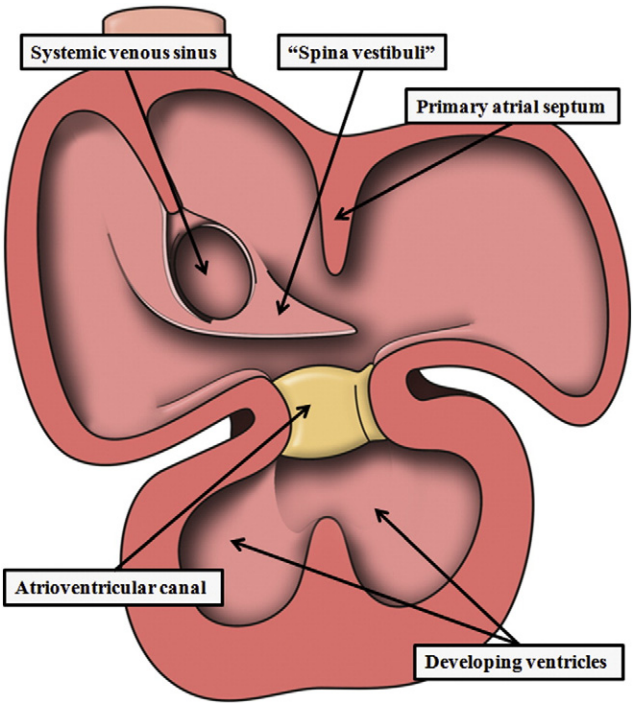

Fig. 1. The cartoon is re-drawing of the diagram provided by Wilhelm His Senior to show the growth of the so-called "spina vestibili" from the dorsal wall of the developing atrial chambers. Modified from His W. 1885. Das Herz. In: W His (ed.) Anatomie menschlicher Embryonen. Vol. 3: Zür Geschichte der Organe, Vogel, Leipzig, pp. 129–184.

Discovery of the atrioventricular bundle

Thanks to the connections of his father, His Junior had been able to study at the very best universities in Europe as he obtained his medical training, spending periods in Geneva, Bern, Strasbourg, and Leipzig [2,5]. It was in Leipzig that he graduated as a physician in 1889. During the initial years subsequent to his graduation, he remained in Leipzig. It was in Leipzig where, at the instigation of his father, he carried out the researches leading to the discovery of the bundle. At that time, it was still generally believed that conduction between the different components of the heart depended on the cardiac nerves. The extensive work of His, published in the "home" journal of the medical clinic in Leipzig [3], outlined the evidence he had obtained from studies of cardiac development, which showed that the heartbeat was established prior to the onset of cardiac innervation. The experiments conducted on the developing heart, coupled with evidence provided previously by Gaskell [10], led His to examine hearts histologically in search of a muscular connection between the atrial and ventricular myocardial masses. His description of these findings accounts for less than one page in the overall publication. The key passage was translated by Bast and Gardner as follows:

"The bundle arises from the posterior wall of the right auricle, near the auricular septum, in the atrioventricular groove, attaches itself along the upper margin of the ventricular septal muscle by means of numerous fiber exchanges; proceeds on top of this toward the front until near the aorta it forks itself into a right and left limb which latter ends in the base of the aortic cusp of the mitral valve."

He illustrated his findings from mouse (Fig. 2) and human (Fig. 3) hearts. With the aid of subsequent knowledge, we are able to appreciate the validity of these illustrations, in particular the image showing the location of the bundle in the mouse (Fig. 2). Even with benefit of the ongoing studies, nonetheless, it must be acknowledged that the findings shown in Fig. 3 are difficult to understand. Thus, we know that the minimalism of the original description, coupled with the paucity of illustrative material, was sufficient to generate skepticism in the eyes of a cardiac anatomist as skilled as Arthur Keith [11–13].

The skepticism of Keith

In 1895, as described in his autobiography, Arthur Keith, at the age of 30, was establishing his anatomical credentials. As part of his training, he spent time in Leipzig, hoping to study with His Senior so as to improve his knowledge of cardiac development. He was less than impressed by the training on offer, commenting in his autobiography that "he lost interest in me when he found that I had no theme in embryology on which I proposed making a research" [11]. At the time, Keith had been most interested in anthropological research, although subsequently he was to become the