Karel Frederik Wenckebach

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Karel Frederik Wenckebach was a physician, anatomist and cardiologist, born in The Hague, the seat of the Dutch parliament, government and Royal Court.

Wenckebach had two brothers, Henri Johan Eduard (1861–1924), Director of State Mines and later of the Dutch Ironworks at Ijmuiden; and Willem Reymert Ludwig (1860–1937), a renowned painter and book illustrator. Wenckebach's son Oswald became a painter, sculptor, and metallurgist, best known for his war monuments and for designing the Dutch coins issued between 1948 and 1981.

Wenckebach began his studies in 1881 at Utrecht University Medical School and graduated in 1888 with a thesis entitled 'About the structure and development of the bursa of Fabricius', a thesis on the sac-shaped lymphoid organ in the roof of the cloaca in birds. After graduating in 1888, Wenckebach worked at a zoological institute, but quickly switched to physiology because his color-blindness proved an insurmountable obstacle to a career in zoology.

Wenckebach started his career as a general physician in 1891 in rural Heerlen, in south-eastern Holland, the region in which his father Eduard (1813– –1874) had spearheaded the development of telegraphic communication lines between Haarlem and Amsterdam. Here, he gained a deep respect for the clinical elements of medicine and became fascinated with the rhythms of the beating

heart, sometimes listening to patients' heart sounds for hours on end.

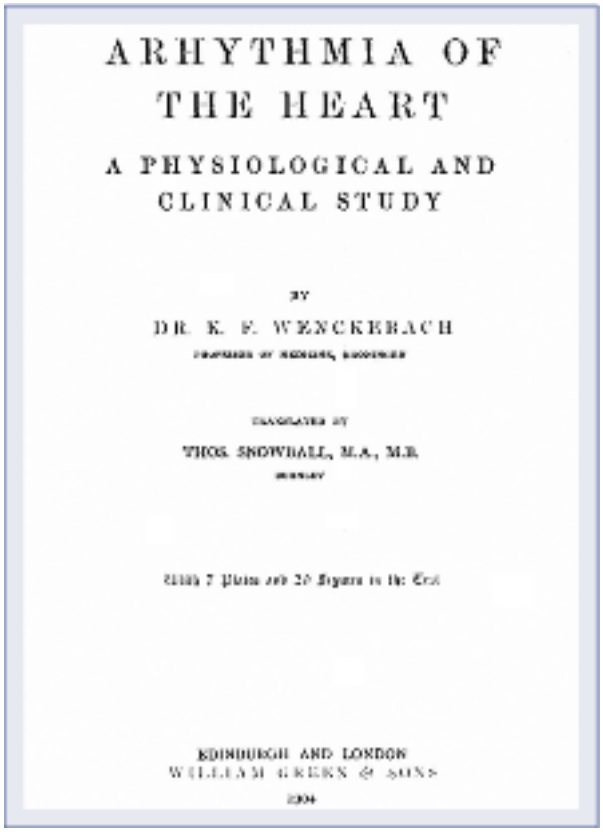
Wenckebach returned to academia at Utrecht University in 1896 to study under his mentor, the renowned German scientist T.W. Engelmann. Nurturing the curiosities born from his clinical experiences, he began to study irregular heart rhythms. He gained experience in kymographic recordings and rhythm disturbances in frogs. He observed that the irregular pulses with compensatory pauses seen in animals could also be detected in humans.

In 1901, Wenckebach became Professor of Medicine at the University of Groningen, and two years later he published his most important work: 'Arrhythmia as an expression of certain functional disorders of the heart' ('Die Arrhythmie als Ausdruck bestimmter funktions- störungen des Herzens' [1]) (Fig. 1).

Later, he held appointments as a professor at the universities of Strasbourg (1911–1914) and Vienna (1914– –1929). In Vienna, he studied cardiac function and pathology in soldiers. In his later years, he became intrigued with the cardiac manifestations of beriberi and visited the West Indies.

Karel Frederik Wenckebach died in Vienna in November 11, 1940 after eleven years of retirement.

Figure 1. Cover of Wenckebach's first book on cardiac arrhythmias entitled 'Arrhythmia of the heart: A physiological and clinical study', published in 1904.



ARHYTHMIA OF THE HEART

A PHYSIOLOGICAL AND CLINICAL STUDY

BY

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Why is he still remembered today?

Not only are the discoveries he made at the turn of the 20th century fundamental to our current understanding of cardiac electrophysiology and automaticity, this founding father of modern electrocardiology made these ground-breaking discoveries without having the electrocardiogram at his disposal and before the discovery of the sino-atrial (SA) and atrio-ventricular (AV) nodes. His groundbreaking 1899 report ‘On the analysis of irregular pulses’ [1], described the heartbeats of a patient using tracings of the radial pulse of a woman who complained of an irregular heartbeat. When analyzing her pulse, he noted predictable pauses every three to four beats. These pauses differed from the pauses coming after extrasystoles, in that they were not followed by small extra pulse waves. Through careful measurement, he noted that the length of the pause was not twice that of the preceding pulse-pulse interval, as one would expect with an extrasystole, but actually less than half the preceding pulse-pulse interval.

He concluded from this that the irregularity of the heart rhythm could not be due to extrasystoles. On further analysis, he noted that the first interval after each pause was longer than the others, and that subsequent intervals were shorter. This pattern was repeated again and again. Wenckebach called these groups ‘Luciani’s periods’ after the Italian physiologist [2], who while working in the laboratory of Carl Ludwig in Leipzig in 1873, was the first to show a group of heartbeats that he called ‘periodical rhythm’.

While he recognized the pattern in his data, Wenckebach was unable to postulate a physiological explanation. Progress was made when he analyzed old data given to him by Engelmann — simultaneous tracings of a dying frog’s atrial and ventricular contractions. Wenckebach observed a gradual lengthening in the interval between atrial and ventricular contractions until an atrial contraction occurred that was not followed by a ventricular contraction — resulting in a pause [3].

At this time, before the 1907 description of the SA node, Wenckebach believed that the “rhythmic excitation” of the heart originated in the mouth of the vena cava. He concluded that as the heart’s action gradually worsens, the interval between atrial and ventricular systole interval gradually becomes longer due to decreased electrical conductibility in the tissue, and there finally comes a time when the atrial excitation is no longer conducted.

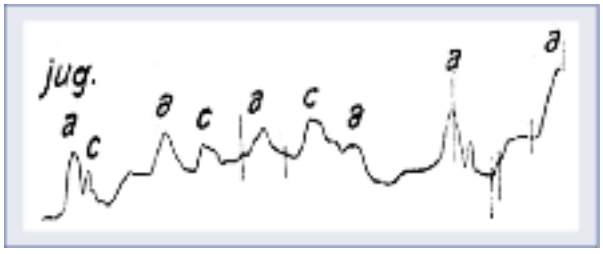

Figure 2. Wenckebach second degree atrio-ventricular block (Mobitz type I) in the jugular venous pulse.

During the subsequent pause, the conductibility has time to recover and the pattern begins to repeat itself [4]. Comparing the frog and human tracings, Wenckebach realized that: “in both cases, the

repeated irregularity was exactly the same, and was repeated with almost mathematical precision. ”He went on to speculate that this phenomenon must be due to damaged heart muscle at the AV border [5].
The tracing in Figure 2 is an original of a jugular venous pulse recorded by Wenckebach. Note the progressive widening of the ‘a-c interval’ (corresponding to the PR interval) until the ‘a wave’ is not followed by the ‘c wave’.
Following Einthoven’s introduction of the string galvanometer electrocardiograph, Wenckebach was able in 1906 to demonstrate the progressive prolongation of the PR interval before a dropped ventricular beat, a phenomenon now known as the Wenckebach phenomenon [6]. In the same paper, Wenckebach described the median bundle of the intra-atrial conduction system of the heart. This bundle joins the SA node to the AV node. Even now, this bundle is referred to as ‘the median bundle of Wenckebach’ and it is one of the recognized internodal pathways, along with ‘the posterior internodal tract of Thorel’ and the two branches of ‘the anterior internodal pathways or Bachmann’s bundle’) (Fig. 3).

Wenckebach was also one of the firstproponents of the use of quinine to treat paroxysmal atrial fibrillation [7]. *Cinchona officinalis* (family Rubiaceae) is a tree from the Andes whose bark contains the alkaloids quinine and quinidine. ‘Jesuit’s bark’, as it was called, was discovered in Europe in the 17th century to be valuable in treating malaria. At Strasbourg University, he administered quinine to several patients. He noted that while only a few patients converted to sinus rhythm, many felt better. Wenckebach demonstrated in 1914 that quinine (1 g/daily) could halt paroxysms of this arrhythmia [5].

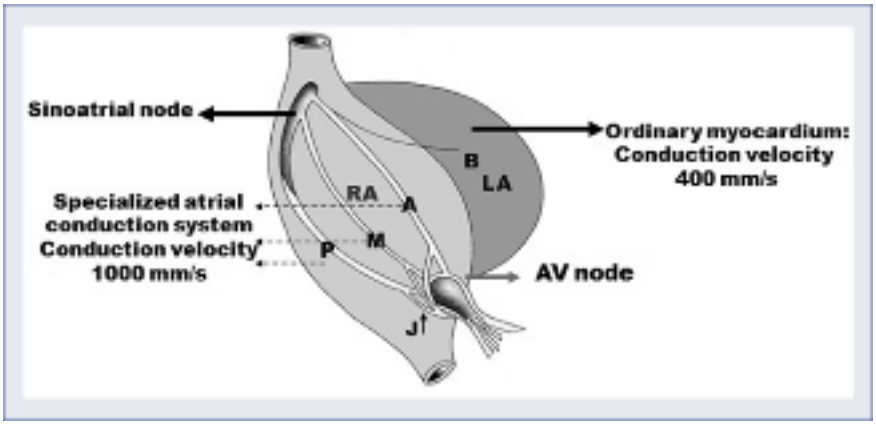

Figure 3. Specialized atrial cardiac electrical system: sinoatrial or sinus node; anterior, middle and posterior internodal tracts and Bachmann bundle; A — anterior internodal tract or anterior internodal bundle; M — middle internodal tract or Wenckebach's bundle; P — posterior internodal tract or Thorel's tract; B — Bachmann's bundle, also known as the anterior interatrial band, is one of the four conduction tracts; J — James's tract; RA — right atrium; LA — left atrium; AV — atrio-ventricular.

In his brilliant career, Wenckebach earned numerous awards: The Order of Merit of the Austrian Republic, Honorary Fellow of the Royal College of Physicians and Surgeons of Glasgow, Honorary Member of the Medico-Chirurgical Society of Edinburgh and the Cardiac Society of Great Britain and Ireland, and a Corresponding Foreign member of the Societé Française de Cardiologie.

Karel Frederik Wenckebach was a man who stood out for his modesty, and had many famous friends who would visit him in his Vienna home.

We would like to finish this brief summary of his life by quoting his own words:

"*In medical science there are vast realms of which I have no special knowledge and, again, no, I am not a great man; I am a happy man.*"

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