

# RHYTHM OF HEART: ELECTROCARDIOGRAM

Awais Shuja

**Abstract:** The symbol of life heartbeat has been an enigma for health professionals for centuries. Centuries of development and research has enabled us to record, listen and demonstrate the rhythm of heart by electrocardiogram. This piece of equipment which is most commonly used tool to evaluate heart has a long arduous journey of failures and success. Willem Einthoven is considered father of ECG because of his contribution in taking ECG from laboratory. Dr. Willem Einthoven, a Dutch physiologist inspired by the work of Waller, refined the capillary electrometer even further and was able to demonstrate five deflections which he named ABCDE. In 1954, the American Heart Association published their recommendation for standardization of 12-lead electrocardiogram which gave the ECG the shape it is in currently.

**Key words:** Electrocardiogram, Galvano Meter, Galvani, Einthoven, Capillary Electrometer

The symbol of life heartbeat has been an enigma for health professionals for centuries. In ancient times the heartbeat was heard by physical contact. Centuries of development and research has enabled us to record, listen and demonstrate the rhythm of heart by electrocardiogram. This piece of equipment which is most commonly used tool to evaluate heart has a long arduous journey of failures and success.

## IDEA OF HEART RYTHM

For ages the function of heart was assessed by listening to heartbeat, palpating pulse, but the observations were subjective in nature. The scientific basis of ECG come from the work of Galvani.



Dr. Luigi Galvani

In the 1786, Dr. Luigi Galvani, an Italian physician and physicist at the University of Bologna, first noted that electrical current could be recorded from skeletal muscles. He recorded electrical activity from dissected muscles. In that year, Galvani placed the nerve of a nerve-muscle preparation on an

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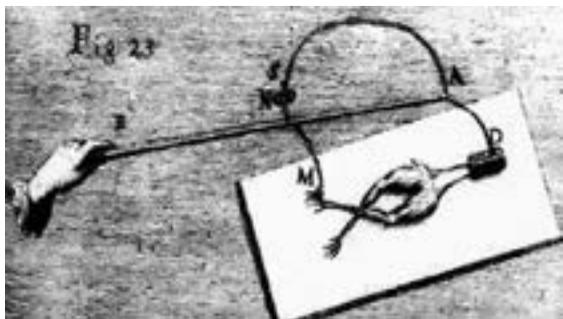
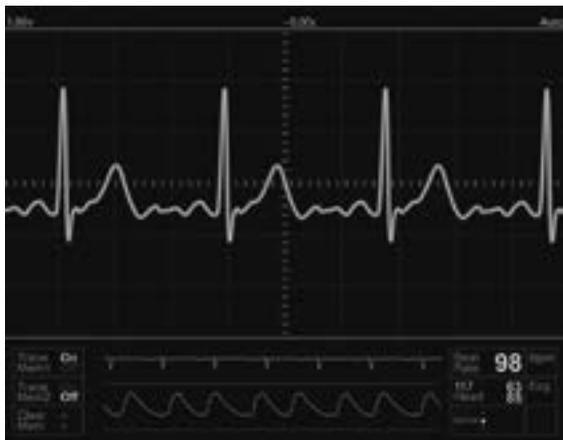
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injured muscle and noted contraction of the muscle of the nerve-muscle preparation.



Some 50 years later, Matteucci observed that if the nerve of the Galvani nerve-muscle preparation was laid across a beating heart, the muscle of the nerve-muscle preparation contracted in synchrony with the beating heart. In 1856, Kolliker and Muller placed the nerve of the Galvani nerve-muscle preparation on the beating heart and noted that not only did the muscle contract synchronously with the contraction of the heart but on occasion, two contractions were evident.

### FIRST CARDIAC RYTHM

The next important contribution to the evolution of the ECG was the capillary manometer introduced by Gabriel Lippmann in 1872. With this instrument it was possible to record from the body surface

voltage changes generated by the heart. The instrument consisted of a finely drawn glass tube filled with mercury and immersed in sulfuric acid. The surface of the mercury moved as the potential difference between the mercury and sulfuric acid changed. This motion was magnified and recorded on photographic paper.



Lippman Electrocardiogram

### Lippman electrocardiogram

Thirty-five years later, Augustus Waller, a British physiologist of St Mary's Medical School in London, published the first human electrocardiogram using a capillary electrometer and electrodes placed on the chest and back of a human. He demonstrated that electrical activity preceded ventricular contraction.

### FATHER OF ELECTROCARDIOGRAM

Willem Einthoven is considered father of

ECG because of his contribution in taking ECG from laboratory. Dr. Willem Einthoven, a Dutch physiologist inspired by the work of Waller, refined the capillary electrometer even further and was able to demonstrate five deflections which he named ABCDE. To adjust for inertia in the capillary system, he implemented a mathematical correction, which resulted in the curves that we see today. Following the mathematical tradition established by Descartes, he used the terminal part of alphabet series (PQRST) to name these deflections. The term 'electrocardiogram' used to describe these wave forms was first coined by Einthoven at the Dutch Medical Meeting of 1893.



Willem Einthoven

In 1901, he successfully developed a new string galvanometer with very high sensitivity,

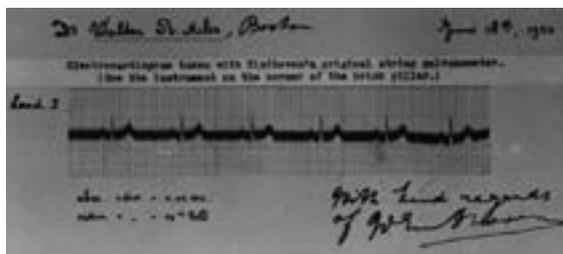
which he used in his electrocardiograph. His device weighed 600 pounds. Einthoven discussed the theory of the ECG and its application to the study of heart disease in two classic articles, "Le Telecardiogramme" published in 1906 (20) and "Weiteres uber das Elektrokardiogramm" published in 1908. Einthoven's contribution was widely recognized and in 1924 he was awarded the Nobel prize. In 1993, the Royal Post Office of the Netherlands issued stamps to commemorate three Dutch Nobel laureate, one being Einthoven.



### ELECTROCARDIOGRAM IN CLINICAL USE

In 1909, Sir Thomas Lewis of University College Hospital, London, discovered that 'Delirium Cordis,' a clinical diagnosis of irregular heartbeat, was a result of atrial fibrillation using the electrocardiogram.

In 1934, Dr. Frank N. Wilson of the University of Michigan developed the concept of the 'central terminal'. By connecting the three limb electrodes, a central negative lead reflecting a 'ground' or reference terminal was created. An electrode from the body surface connected through a galvanometer to this ground measured the potential difference between that point on the body and what can be thought of as zero.



## STANDARDISATION OF ECG

In 1938, the American Heart Association and the Cardiac Society of Great Britain published their recommendation for recording the exploring lead from six sites named V1 through V6 across the precordium. Thus, the chest leads were born. In 1954, the American Heart Association published their recommendation for standardization of 12-lead electrocardiogram which gave the ECG the shape it is in currently.



## MODERN ELECTROCARDIOGRAM

The ECG has developed from string galvanometer to present day light weight and mobile ECG machines. Electrocardiography has played an important role in our understanding of heart disease. It together with its offspring, electrophysiology, remains the final arbiter of the nature of rhythm disturbances. Moreover, it retains great value in managing patients with ischemic heart disease. It was among the first bits of technology to supplement physicians' clinical skills by providing objective data on the function and structure of the human

body. Many researchers contributed to the development and refinement of electrocardiograph.

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