6191

Observations on Heart Sounds with Particular Reference to Gallop Rhythm and Sounds of Auricular Origin.

A. GARRARD MACLEOD, FRANK N. WILSON AND PAUL S. BARKER.

From the Department of Internal Medicine, University of Michigan Medical School.

The study of a large number of phonocardiograms from a series of patients with heart disease and from normal subjects suggests the tentative conclusions enumerated below. Two Einthoven galvanometers coupled in tandem were used to record the electrocardiogram and the heart sounds simultaneously and the electric stethoscope manufactured by the Western Electric Company was used to convert the sounds into electrical variations.

From the graphic standpoint gallop rhythm may be defined as a condition in which 3 sounds occur during each cardiac cycle; 3 or perhaps 4 varieties may be distinguished.

(a) Protodiastolic gallop rhythm in which the extra sound follows the second heart sound by a constant interval and occupies the same position in the cardiac cycle as the normal third heart sound.

(b) Presystolic gallop rhythm in which the extra sound precedes the first heart sound by a constant interval, and is almost certainly of auricular origin. The onset of the extra sound falls within the P-R interval of the electrocardiogram. This appears to be the most common type of gallop rhythm; it is particularly frequent in cases of arterial hypertension.

(c) Systolic gallop rhythm in which the extra sound falls within the limits of ventricular systole. This type of gallop rhythm is uncommon and apparently has no clinical significance.

(d) Gallop rhythm due to audible auricular sounds when the P-R interval of the electrocardiogram is increased beyond normal limits in which case the extra sound may fall in any part of diastole. This should probably be considered a variety of presystolic gallop rhythm since the extra sound is linked to the first heart sound which follows auricular systole by a constant interval so long as there is no dropping out of ventricular beats.

In 3 cases of bundle branch block with gallop rhythm the extra sound occurred in presystole and preceded the first heart sound by a constant interval. The extra sound could not therefore be attributed to asynchronous contraction of the 2 ventricles. In a fourth case of bundle branch block no gallop rhythm was present; the first and second heart sounds showed normal time relations.

We have seen one instance in which 2 extra sounds, one of which was linked to the first and the other to the second heart sound fell together at the usual heart rate and gave rise to a very pronounced gallop on auscultation. When the heart rate was slowed by pressure upon the carotid artery these 2 sounds were separated.

In complete and in high grade partial heart block auricular sounds are as a rule easily recorded. Very frequently each auricular contraction produces 2 sounds. The intensity of the auricular sounds varies greatly with the relation of auricular to ventricular systole; they are often very loud when the P-deflection of the electrocardiogram falls near the end of the T-wave. In one case of complete heart block auricular sounds occurred during ventricular systole as well as in diastole, indicating that auricular contraction may produce a sound even when it expels no blood into the ventricles.

In some cases of complete heart block the R-T interval of the electrocardiogram is nearly twice as long as the length of systole measured from the beginning of the first to the beginning of the second heart sound. Less pronounced discrepancies between the R-T interval and the length of mechanical systole were observed when the cardiac mechanism was normal.

6192

Electrocardiographic Leads Which Record Potential Variations Produced by the Heart Beat at a Single Point.

FRANK N. WILSON, A. GARRARD MACLEOD AND PAUL S. BARKER.

From the Department of Internal Medicine, University of Michigan Medical School.

In a recent publication[1] we have shown that if the assumptions upon which Einthoven's equilateral triangle is founded are valid the potential of the right arm (V_R), the potential of the left arm (V_L), and the potential of the left leg (V_F) at any given instant in the cardiac cycle are defined by the following equations:

[1] Wilson, F. N., Macleod, A. G., and Barker, P. S., *Am. Heart J.*, 1931, **7**, 207.