

PRÆCORDIAL LEADS IN ELECTRO-CARDIOGRAPHY

From the early days of electrocardiography, attempts to understand the cause of the various waves have been made by the use of leads on different parts of the surface of the heart. This method has not been available for use in man, and clinical study has been mainly confined to the three standard leads, the appearance of which has now become familiar to all. More recently leads from various points over the chest wall have been used and many valuable papers have been published. Unfortunately different conventions have been adopted for placing the electrodes so that comparisons have been difficult, and in some cases the normal curves have shown inverted T waves and in others upright T waves, with corresponding changes in the other complexes. It is not yet certain if the fourth lead, or still other leads, will become essential in routine clinical work, but it is certain that they help greatly in understanding what is taking place in the heart. It is, therefore, important that all these should be as easy to compare as possible and intelligible to as wide a circle as possible.

At the first General Meeting of the Cardiac Society of Great Britain and Ireland, held at Edinburgh on April 15, 1937, Dr. John Cowan proposed that a committee should be appointed to see if it was possible to reach agreement on the points to be adopted for a standard lead IV. This was approved, and fortunately the American Heart Association had already appointed a committee for the same purpose. It proved possible for the two to reach agreed conclusions, embodied in the following memorandum. This was published in the *British Medical Journal* and in the *Lancet* on January 22, 1938, and at the same time in America ; but it seems desirable to reprint it in this Journal, partly for convenience and partly as a record of the work of the first committee appointed by the Cardiac Society.

A JOINT MEMORANDUM

At the request of the Council of the Cardiac Society of Great Britain and Ireland we print below a Memorandum on Præcordial Leads in Electrocardiography. Many different positions have been used for the electrodes in obtaining these electrocardiograms, and much confusion has arisen from the different methods in use. As it has been possible for the Cardiac Society of Great Britain and Ireland and the American Heart Association to reach agreement it is hoped that these joint recommendations will be useful, both to those working at the subject and to all others who are interested.

RECOMMENDATIONS FOR STANDARDIZATION

In the last few years electrocardiographic leads in which an electrode placed upon the præcordia is paired with an electrode in contact with some part of the body distant from the heart have come into widespread use. The confusion which has resulted from the lack of uniformity and precision in the technique and nomenclature employed by different observers in connexion with leads of this kind has led to an almost universal desire that a standard practice be established. To this end the Cardiac Society of Great Britain and Ireland and the American Heart Association have each appointed a committee to consider this matter and make recommendations. The two committees have conferred and have agreed jointly to make recommendations with reference to the routine use of a single præcordial lead. It is understood that either committee may make additional reports with reference to multiple præcordial leads and other matters not dealt with in the present report.

1. It is recommended that those who employ a single præcordial lead place the præcordial electrode upon the extreme outer border of the apex beat, as determined by palpation. If the apex beat cannot be located satisfactorily by palpation the electrode may be placed in the fifth intercostal space just outside the left border of cardiac dullness, or just outside the left mid-clavicular line if percussion of the heart is unsatisfactory. Where præcordial leads are taken by a technical assistant, the position for the præcordial electrode should be marked on the chest by the physician.

2. It is recommended that a single præcordial lead in which the præcordial electrode has the location specified in the preceding paragraph be known as lead IV B when this electrode is paired with an electrode in the left interscapular region ; lead IV R when it is paired with an electrode on the right arm ; lead IV L when it is paired with an electrode on the left arm ; lead IV F when it is paired with an electrode on the left leg ; and lead IV T when it is paired with a central terminal connected through equal resistances of 5,000 or more ohms to electrodes on each of the three extremities mentioned.

It is suggested that for all ordinary purposes lead IV R or lead IV F be employed. The latter lead should have the preference until it has been established that the former, which is somewhat more convenient, is equivalent to the latter for all practical purposes, or yields results of equal value.

3. It is recommended that in taking the præcordial leads specified the galvanometer connexions be made in such a way that relative positivity of the apical electrode is represented in the finished curve by an upward deflection (a deflection above the iso-potential level) and relative negativity of the apical electrode by a downward deflection. It is urged that this convention be adhered to in the case of præcordial leads other than those specified, and also in the case of all leads in which one electrode is placed much closer to the heart than the other. In other words, it shall be the standard convention in taking such leads to make the galvanometer connexions in such a way that relative positivity of the electrode nearer the heart is represented by an upward deflection.

4. It is recommended that with the galvanometer connexions made as described in the preceding paragraph the deflections of præcordial leads be designated by the symbols P, Q, R, S, and T, and that in the application of these symbols the same conventions be employed as in the case of the standard limb leads.

5. It is recommended that in taking præcordial leads the electrocardiograph be so adjusted that a deflection of 1 cm. in the finished record corresponds to a potential difference of one millivolt, as in the case of the standard limb leads. Any reduction in sensitivity made necessary by very large deflections should be clearly indicated on the curve, preferably by photographing the effect of introducing a potential difference of 1 mv. into the galvanometer circuit.

6. It is recommended that the greatest dimension of the apical electrode employed in taking the leads specified in this report be 3 cm. or less. A circular electrode between 2 cm. and 3 cm. in diameter should ordinarily be employed.

7. It is recommended that the terms lead IV (R, F, etc.), apical lead, apex-leg lead, etc., be used henceforth only in connexion with the leads specified in this report.

The above recommendations have been drawn up by the following two committees, working in co-operation :

Committee of the Cardiac Society of Great Britain and Ireland

D. Evan Bedford (London)
 John Cowan (Glasgow)
 A. N. Drury (Cambridge)
 I. G. W. Hill (Edinburgh)
 John Parkinson (London)
 P. H. Wood (London)

Committee of the American Heart Association

Arlie R. Barnes (Rochester)
 Harold E. B. Pardee (New York)
 Paul D. White (Boston)
 Frank N. Wilson (Ann Arbor)
 Charles C. Wolferth (Philadelphia)

These joint recommendations have been approved by the Council of the Cardiac Society and by the American Heart Association, who now authorize their publication. The following addendum to the joint report has been made by the Cardiac Society.

ADDENDUM BY CARDIAC SOCIETY

1. The above report deals with the nomenclature and technique for obtaining a single præcordial lead suitable for routine clinical work. The committee of the Cardiac Society had insufficient evidence available to permit their making recommendations in respect of multiple præcordial leads. The American

Heart Association will, however, draw up such recommendations, and, when published, copies of these will be available for those specially interested on application to the secretary of the Cardiac Society (Dr. Maurice Campbell, 25, Upper Wimpole Street, London, W.1).

2. In using either of the two standard præcordial leads—for example, lead IV R or lead IV F—the correct polarity (paragraph 3) is obtained as follows. The lead switch is turned to lead I. The L.A. terminal is connected to the præcordial electrode. The R.A. terminal is connected to the distant electrode—for example, to the right arm for lead IV R, or to the left leg for lead IV F.