PRÆCORDIAL ELECTROCARDIOGRAMS

A COMPARISON OF CF AND V LEAD CONNECTIONS*

BY

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Received January 14, 1946

In the Michael Reese Heart Station, leads CF₂, CF₄, and CF₅ are used to record the præcordial electrocardiogram. This has been found to be satisfactory for ordinary clinical use (Katz, 1946). Other chest positions have been used and the chest electrode has been combined with different distant electrodes by others. Wilson and his school (Wilson *et al.*, 1944) have been recommending a special electrode to be combined with the chest electrode; this is the central terminal which connects the three limb electrodes (each through 5000 ohms resistance): the leads so obtained are called V leads. The theoretical advantages of these leads have been questioned (Katz, 1946, and Wolforth and Livesey, 1944). Præcordial electrocardiograms recorded by V leads and by CF leads obtained from chest positions 2, 4,

FIG. 1.—An example of CF and V leads in chest positions 2, 4 and 5, seen in about one-quarter of the normal subjects.

FIG. 2.—An example of CF and V leads seen in one-third of the cases with left heart strain.

* Aided by the A. D. Nast Fund for Cardiovascular Research. The department is supported in part by the Michael Reese Research Foundation.

and 5 were compared to determine how different they were from each other under various circumstances. This was done in order to determine whether or not the V leads offered any significant information of practical value not obtainable from the CF leads.

In order to make the records with V and CF comparable, they were taken immediately after one another for each of the three chest positions, the chest electrode being held in the same place while first the CF and then the V lead was taken. All records were standardized in the conventional manner, viz., 1 cm.=1 millivolt. Ninety-one cases were investigated, the first sixty being taken at random and the last thirty-one being selected to fill out the various

FIG. 3.—Comparison of CF and V leads in chest positions 2, 4 and 5 in subject with anterior wall infarction. Similar changes were found in about one-third of the cases.

FIG. 4.—Comparison of CF and V leads in subject with posterior wall infarction. Similar changes were found in about half the cases.

groups in which we were interested. In several instances, more than one tracing was taken on the same individual. The cases included: (1) records that were within normal limits, some with right, others with left, and still others without either axis shift; (2) records with right, left, or combined heart strain patterns; (3) records with anterior wall, posterior wall, or atypical coronary patterns; (4) records with various types of intraventricular block; and (5) records with non-specific abnormalities. Three limb and the three CF and three V chest leads were taken in every case. The diagnostic criteria for classifying the records have been described elsewhere (Katz, 1946).

The CF and V records so obtained were analyzed for the comparative heights of the various deflections, viz., P, QRS, and T as well as the deviation of the S-T junction and S-T segment. The individual phases of QRS were also compared. The data are summarized in Table I and typical differences between CF and V leads for several of these groups are shown in Fig. 1 to 4. An instance showing an extreme difference is illustrated in Fig. 5.

The salient findings of this analysis may be summarized as follows.

1. The differences between the CF and V leads were numerically greatest in position 5, least in position 2, and intermediate in position 4. Thus, more differences were found as the chest electrode was moved to the left of the midline.

2. No significant changes in the QRS amplitude and contour, or in the level of S-T segment and S-T junction were noted. In general, T tended to be more positive in V leads than in CF leads in all types of curves and P tended to be upright more often in V leads than in CF leads.

3. There were no significant differences between V and CF leads in the group of cases showing (a) "non-specific abnormalities," (b) "right heart strain" patterns, (c) "combined heart strain" patterns, (d) "atypical coronary" patterns, and (e) the various types of "intraventricular block."

4. In about one-quarter (16 out of 57) of the leads from records that were "within

FIG. 5.—Comparison of CF and V leads showing unusual differences in subject with posterior wall infarction. These changes in position 5 occurred in one-third of the cases.

normal limits," T in V leads tended to be more upright (more positive) than T in CF leads; in the remainder, no differences were seen.

5. In the "left heart strain" pattern group there were minor to moderate differences in two-thirds (28 out of 45) of the leads. The trend was for the T waves to be more positive in V leads than in CF leads.

6. There were no differences in about one half (23 out of 45) of the leads between the T waves in V and CF leads in the "anterior wall infarction" pattern group. T was less inverted (more positive) in V than in CF in one third (15 out of 45) of the leads. Even in this group, the S-T junction and S-T segment deviations between V and CF leads were insignificant with but few exceptions.

7. In the "posterior wall infarction" pattern group, there were no differences between T in V and CF leads in about one-third (10 out of 27) of the leads. T was more negative in V than in CF in half (14 out of 27) of the leads. The tendency was for T to be less upright in V than in CF. In three instances T was inverted in V₅ while the corresponding T in CF₅ was upright.

TABLE I
DIFFERENCES BETWEEN V AND CF LEADS IN VARIOUS CONDITIONS IN 91 CASES

Chest Position	2	4	5
Records showing "Within Normal Limits": 19 Cases.			
No difference *	14	10	10
T _v more positive†	4	7	5
R _v taller	1	1	2
S _v smaller		1	3
S _v present			1
No R _v /S _v present		1	
Records showing "non-specific Abnormalities": 10 Cases.			
No difference	6	3	1
T _v more positive	4	3	4
T _v more negative ‡		2	2
R _v taller	1		
S _v smaller		1	2
ST _v more negative			3
T _v less notched		1	
Records showing "Left Heart Strain": 14 Cases.			
No difference	7	4	3
T _v more positive	4	5	5
T _v more upright		4	3
T _v less inverted			2
T _v more negative	2		1
T _v less upright	2		
T _v more inverted			1
Q _v larger			1
Q _v smaller	2	2	1
R _v larger		1	
R _v smaller	2	1	
S _v larger	1	2	
ST _v less elevated	1	1	
ST _v more horizontal			1
Records showing "Combined Heart Strain": 3 Cases.			
No difference	2	2	2
T _v more negative	1	1	1
Records showing "Right Heart Strain": 4 Cases.			
No difference	2		2
T _v more positive		1	1
T _v more negative	1	1	1
Q _v larger	1		
R _v larger			1
ST _v more positive			1
ST _v more negative	1	1	1
S _v and S _v ' smaller			1
Records showing "Intraventricular Block": 11 Cases.			
(1) Of the Common Type—4 Cases.			
No difference	2	2	3
T _v less inverted	1		
T _v more upright	1	2	1
QRS _v smaller	1		1
ST _v more elevated		1	
ST _v less depressed			1
(2) Of the S type—4 Cases.			
No difference	3	3	1
Q _v smaller	1		
T _v more upright		1	2
S _v deeper			1
(3) Of the Indeterminate type—2 Cases.			
No difference	1	1	1
T _v more upright	1		
T _v less inverted		1	
No R _v '	1	1	
R _v smaller			1
(4) Of the Uncommon type—1 Case.			
T _v less upright	1	1	1
Records showing "Anterior Wall Infarction": 15 Cases.			
No difference	10	9	4
T _v more positive	5	4	6
T _v more negative			1
Q _v present			1
R _v larger			1
S _v larger			2
S _v smaller			1
ST _v more elevated			1
ST _v less elevated	1	2	1
ST _v less depressed		1	
QRS _v larger		1	
Q _v smaller		1	1
Records showing "Posterior Wall Infarction": 9 Cases.			
No difference	5	9	3
T _v more negative	4	6	6
T _v less upright		4	5
T _v inverted			1
T _v more inverted			1
T _v inverted by TCF upright			3
T _v isoelectric			1
T _v more positive	1	1	
R _v smaller	2		
S _v larger		2	1
S _v smaller		2	
ST _v more positive			3
ST _v more negative		1	
QRS _v smaller		1	1
Q _v S _v small and present			1
Records showing "Atypical Infarction": 6 Cases.			
No difference		1	1
T _v more positive	4	3	3
T _v more negative	1	2	2
R _v taller		1	2
S _v larger		1	2
ST _v more negative	4	2	3
ST _v more elevated	1		
QRS _v small	1		

* Differences in amplitude of less than 5 per cent are considered insignificant.

† More positive means either less inverted or more upright.

‡ More negative means either more inverted or less upright.

CONCLUSION

Our experience reveals that the few differences encountered between these V and CF leads were minor. It would therefore appear that the V leads offer little if any diagnostic information not obtainable in the homologous CF lead. Since the supposed theoretical advantage has been seriously questioned, there appears no reason for those accustomed to the use of CF leads to substitute the V leads.

This study was suggested by Dr. L. N. Katz, and we are indebted to him and Dr. R. Langendorf for their advice in carrying out this study.

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