

B. coli was grown in synthetic media (Mavor's and Uschinsky's); the filtrates so obtained from the synthetic media were each mixed with one part of nutrient broth, to aid growth. In both of these mixtures the fermentation by *C. diphtheriae* was not interfered with or retarded.

The *B. coli* filtrate was placed in contact with kaolin at various hydrogen-ion concentrations, but the inhibiting substance was not removed.

Summary. *B. coli* produces, when grown in small batches of nutrient broth, a relatively thermostable substance which inhibits or retards fermentation of dextrose, galactose, and dextrin by *C. diphtheriae*. The diphtheria bacilli seem to absorb this substance and also to destroy it, and there is no permanent effect of this substance upon the diphtheria bacilli. The action is not dependent upon exhaustion of nutrient substances or alteration in the pH of the media.

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Lead IV of the Electrocardiogram in Rheumatic Fever.

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The most important clinical problem which presents itself in patients suffering from rheumatic fever is the recognition of active cardiac involvement. Bedside observation is sometimes adequate for decisive diagnosis. Serial electrocardiography, with employment of the 3 standard leads, has proved to be a valuable method for following the effect of the rheumatic process on the heart.¹ We have found that the additional use of lead IV has, in certain instances, revealed evidence of active carditis when in the first 3 derivations either no form changes were apparent in successive records, or the alterations noted were regarded as equivocal.

Thirty-eight patients with acute rheumatic fever were studied in the wards of the Presbyterian Hospital. None of these patients were taking digitalis or quinidine, although to a majority salicylate or pyramidon was being given. Two hundred and ten electrocardiograms were taken. In recording lead IV, the right arm elec-

¹ Cohn, A. E., and Swift, H. F., *J. Exp. Med.*, 1924, **39**, 1.

trode was placed over the lower precordial region just to the left of the sternum, the left arm electrode being placed at a corresponding level in the back, to the left of the spine.² Form changes in lead IV which were considered to be abnormal were an upright T wave, a negative T wave deeper than 9 mm., a monophasic or notched QRS group, an R-T or S-T segment above the isoelectric line or one that was more than 2 mm. below the isoelectric level.³ Changes in form occurring in records taken on the same patient at different times were regarded as indicating alterations in the state of the myocardium. By far the most frequently observed changes in lead IV were alterations in the direction or voltage of the T wave. In this series, no example of elevation of the R-T or S-T segment occurred. The signs described, while they show that the heart is affected, are not specific for rheumatic fever.

In 7 cases a change was noted in lead IV only. In 16 cases changes were observed in all 4 leads; but in a number of these records minor variations in the first 3 leads, especially slight changes in the T wave in lead III, were rendered significant by the finding of gross alterations in lead IV. In 5 cases changes were observed only in the 3 standard leads, whereas lead IV was not affected. In 10 cases no changes were seen in any lead.

The series is small and no significance is attached to the relative number of cases in which each of these occurrences was noted. It seems likely that had electrocardiograms been taken at more frequent intervals, the incidence of changes indicative of cardiac involvement would have been higher.

A single record only was taken on 34 ambulatory patients with rheumatic heart disease who came to the Vanderbilt Clinic. In 8, deviations from the normal were observed in lead IV only.⁴ In 7, changes were seen in all 4 leads. In 11, changes were observed in the 3 standard leads only. In 18, no changes were recorded in any lead.

Seven additional cases observed in the hospital came to the autopsy table. In none of these were changes observed in lead IV only. In 4, changes were noted in the first 3 leads and the T wave in lead IV was upright. In 3 of these cases numerous Aschoff bodies were found in the heart muscle. In the fourth patient acute fibrinous pericarditis established the presence of active rheumatic fever,

² Wolferth, C. C., and Wood, F. C., *Am. J. Med. Sci.*, 1932, **183**, 30.

³ Katz, L. N., and Kissin, M., *Am. Heart J.*, 1933, **8**, 595. Master, A. H., *Ibid.*, 1934, **9**, 511.

⁴ Katz and Kissin (ref. 3) and others have made similar observations in single records.

although no Aschoff bodies were observed in the sections of the myocardium. In one case the 3 standard leads showed changes, whereas lead IV was normal. In this patient acute rheumatic pancarditis was present. In 2 cases in which active rheumatic heart disease was suspected during life, no changes were present in any of the 4 leads of the electrocardiogram. In neither instance were Aschoff bodies found at autopsy. One proved to be an example of verrucous endarteritis associated with quiescent valvular lesions. The second case was one of gonococcal endocarditis superimposed upon old, but inactive, rheumatic heart disease.

Summary. In acute rheumatic fever, lead IV of the electrocardiogram sometimes furnishes evidence of active carditis, when changes indicating myocardial involvement are not observed in the standard 3 leads. Frequently definite changes in lead IV render significant minor alterations in the first 3 leads which might otherwise be regarded as of doubtful importance. On occasion, changes denoting rheumatic lesions in the heart muscle may appear in the first 3 leads without change being present in lead IV. In ambulatory patients with rheumatic heart disease a single electrocardiogram may reveal evidence of myocardial damage in lead IV only. Obviously, a single record does not establish the presence of rheumatic activity in the heart.

Changes in the electrocardiogram characteristic of myocardial involvement were found in 5 patients whose hearts, at autopsy, showed the lesions of active rheumatism. In 2 cases in which active rheumatic carditis was suspected during life, but was not found at autopsy, the electrocardiograms were normal.

On the basis of these observations it is concluded that the use of lead IV of the electrocardiogram is of definite clinical value, as a supplement to the 3 standard leads, in the recognition of active myocardial involvement in rheumatic fever and in following its course.