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Momentary Atrial Electrical Axes in Paroxysmal Tachycardia.

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A recent study[1] of our cases of paroxysmal atrial tachycardia has shown the presence of some grade of A-V block with dropped ventricular beats in a large proportion of the group. The block varied in duration as well as degree, and seemed most likely to appear in patients who had either severe myocardial disease or digitalis over-dosage. This led us to the observation,[2] which has also been reported by Barker and his associates,[3] that this group of patients was prone to develop atrial flutter or fibrillation, or both, in close association with the episodes of paroxysmal tachycardia with block. These facts logically raise the question of a possible resemblance between the fundamental disturbances of atrial mechanism in these 3 types of arrhythmia. Barker *et al.*[4] have suggested, in fact, that a circus movement is probably present in each instance. Others have made similar proposals, which have been reviewed elsewhere.[2,5]

Lewis, after preliminary animal experiments, reported studies of 3 patients,[6] one who had flutter and 2 who had fibrillation. Using simultaneous chest leads placed in 3 planes, he was able to calculate the direction of movement of the atrial electrical axis for each 1/50 second. His results are compatible with the presence of a circus movement in flutter and fibrillation, though they can scarcely be said to supply conclusive proof. One possible approach to the above problem seemed to be the analysis of similar tracings, taken in patients with paroxysmal atrial tachycardia. It is fortunate that the electrocardiograms of the patients most likely to show flutter or fibrillation, *i.e.*, those with A-V block during the paroxysm, are best suited for this type of analysis; while the block is present, at least half of the P waves will avoid superimposition on the preceding T wave.

Method. Accordingly, Lewis' technic was repeated in a series of patients showing both normal and abnormal atrial mechanisms. For the sagittal plane, the right arm electrode was placed on the manubrium sterni, the left arm electrode below the xiphoid, and the left leg electrode just to the right of the 7th dorsal spine. For the horizontal plane the right arm electrode was placed below the left nipple, the left arm electrode below the right nipple, and the left leg electrode left in position in the back. For the frontal plane, the left leg electrode was shifted to the manubrial position. In each plane the electrodes were placed as nearly equidistant as possible. It must be borne in mind that these planes are only approximately vertical to one another. The sagittal plane deviates slightly to the right posteriorly, and the horizontal plane slants downward to a variable degree. Using the Sanborn Tri-Beam, two leads may be taken simultaneously, and each pair taken in sequence. The simultaneous chest leads, taken in 3 planes, were enlarged 10 diameters by an opaque projector, and traced onto graph paper. The magnitudes of potentials of the P waves were measured from the generally accepted zero line of the T-P interval. The vectors of the electrical axes were calculated from Leads I and III for each plane, using Einthoven's triangle, every 1/100 second. We have considered it desirable to use a method of graphing the momentary elec-

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1 Decherd, G. M., Herrmann, G. R., and Schwab, E. H., *Am. Heart J.*, 1943, **26**, 446.

2 Decherd, G. M., and Herrmann, G. R., in press.

3 Barker, P. S., Wilson, F. N., Johnston, F. D., and Wishart, S. W., *Am. Heart J.*, 1943, **25**, 765.

4 Barker, P. S., Johnston, F. D., and Wilson, F. N., *Am. Heart J.*, 1943, **25**, 799.

5 Barker, P. S., Wilson, F. N., and Johnston, F. D., *Am. Heart J.*, 1943, **26**, 435.

6 Lewis, T., Drury, A. N., and Iliescu, C. C., *Heart*, 1921, **8**, 341, 361.

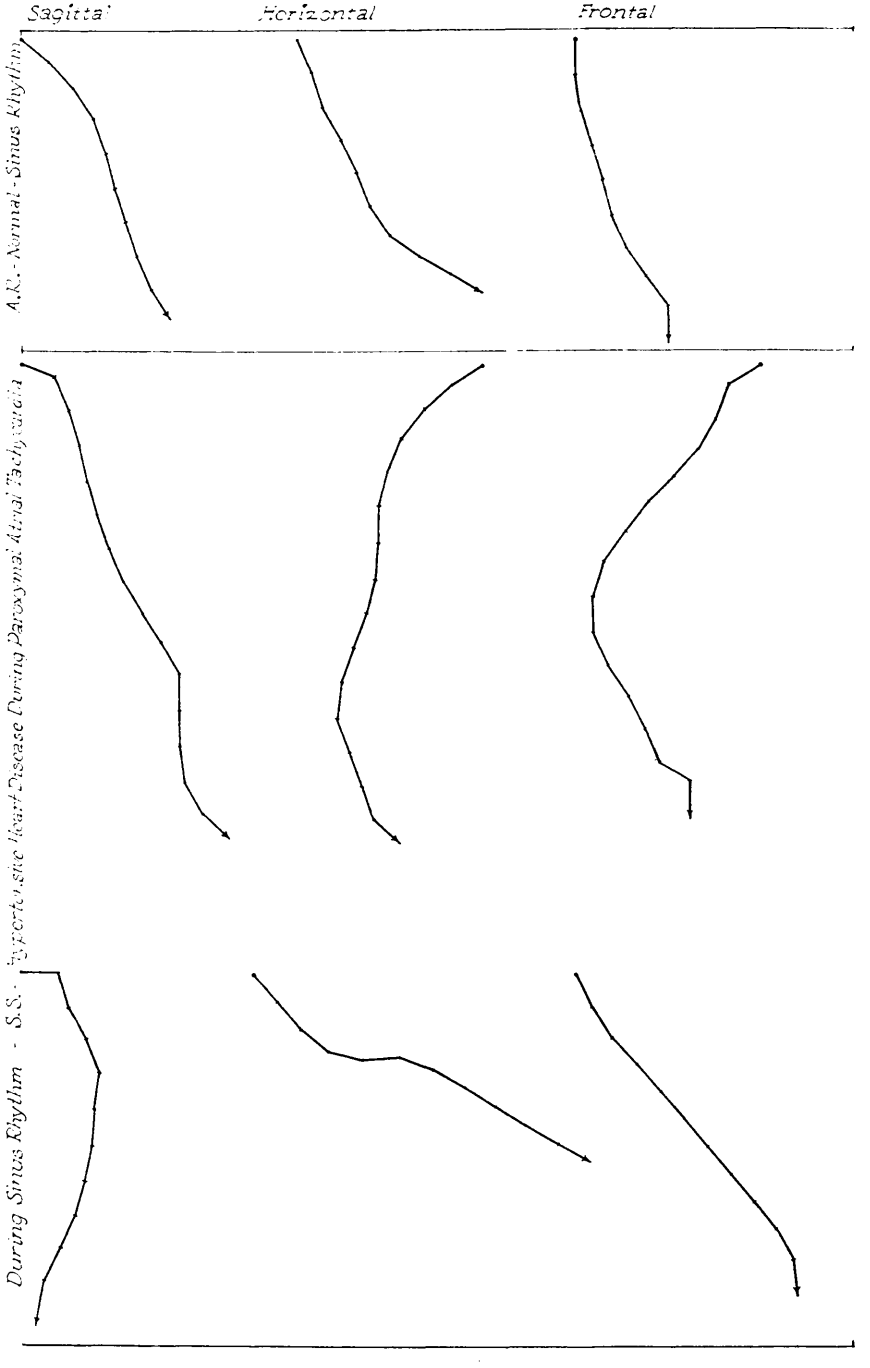

FIG. 1.

Curves showing the consecutive atrial electrical axes; each segment represents the axis for 1/100 second. The sagittal plane is viewed from the right, with the subject erect; the horizontal plane is viewed from above, with the back of the subject at the top of the diagram; the frontal plane is viewed from the front, with the patient erect.

The upper set of curves are a typical normal sinus rhythm.

The middle set is derived from a paroxysm of atrial tachycardia; the lower set is from the same patient, taken during sinus rhythm.

trical axes which differs from those employed by Lewis. A line of unit length has been drawn for the first 1/100 second at the calculated angle from a zero-point; a line of similar unit length for each 1/100 second was then drawn, at the proper angle, using as its zero-point the end of the preceding line. In this fashion is derived a curved line, made up of 1/100 second segments, which shows the direction of change of the electrical axes. Although the curve thus obtained rests ultimately on an anatomical basis, the relationship is an indirect one. It is merely a series of vectors showing only time and direction, and not magnitude, of the electrical potentials.

Though this method is obviously subject to some error, from both the theoretical and practical standpoints, the results obtained have been surprisingly satisfactory. It is well recognized that the hypothesis embodied in the Einthoven triangle is subject to serious error. The triangle is not perfectly equilateral, the heart is not placed in the center thereof, and the electrical properties of the adjacent tissues do not render them a homogeneous conducting medium. Schellong[7] has reviewed these objections, as well as the empirical usefulness of the triangle. In view of the many sources of error, the curves obtained in the 3 planes show remarkable agreement, and permit visualization in 3 dimensions.

Results. In normal individuals with sinus rhythm the curves representing consecutive electrical vectors pass, with some individual variation, downward, forward, and to the left. While there have been considerable individual variations in direction and amount of curvature, due possibly to differences in habitus and position of the atria, the general trend has been uniform. A fairly typical set of normal curves is shown in Fig. 1. In 2 patients with dextrocardia, one with situs inversus, and one with extensive cystic disease of the left lung, the curves have moved downward, forward, and to the right. The variations due to heart disease, with atrial fibrosis or enlargement, will be discussed elsewhere.

We have had the opportunity thus far to study one patient with flutter, and a large number with atrial fibrillation. The data obtained appear to be in fairly good agreement with those reported by Lewis, in that the consecutive axes inscribe a curve which in some instances closely approximates a circle or oval, and in other cases shows different degrees of deviation from this theoretical ideal. We will not discuss at this time the question of whether or not there is a circus movement in flutter and fibrillation, but content ourselves with the statement that if it does exist, this method seems capable of showing it, in our hands as well as Lewis'.

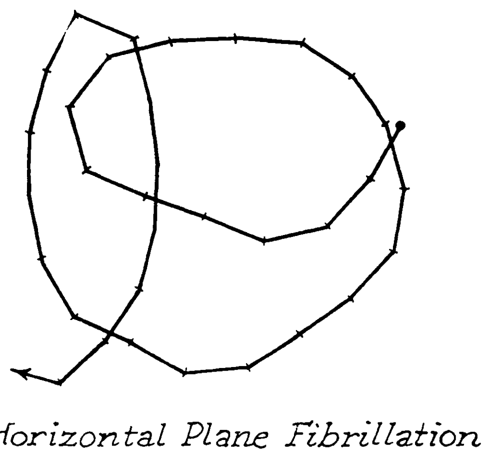

FIG. 2.
Horizontal plane; atrial fibrillation. Consecutive area for 34/100 second.

Electrocardiograms have been analyzed from 6 patients with paroxysmal atrial tachycardia. The projections into the 3 planes employed have been illustrated for one case in Fig. 1. In this instance the curve passes downward, forward, and to the right with a convexity towards the right. The atrial axes in the same patient, taken during sinus rhythm, are shown just below in the same figure; they are well within the normal range, *i.e.*, downward, forward, and to the left. Two other cases of paroxysmal tachycardia have shown the same general direction of the curves representing the consecutive electrical axes. In 2 cases the curves have been directed downward and to the right, but backward instead of forward. The sixth of the group thus far examined showed a curve which ran upward, backward, and to the left, with a left anterior convexity.

[7] Schellong, F., *Erg. inn. Med.*, 1939, **56**, 657.

These curves show varying degrees of curvature; however, so do many of the curves from other patients with heart disease, but with sinus rhythm. In no instance does the curve obtained in paroxysmal tachycardia show the tendency to inscribe a circle or oval, such as has been seen in flutter and fibrillation. For purposes of comparison, Fig. 2 illustrates the axes for 34 consecutive 1/100 seconds, taken in the horizontal plane, from a patient with mitral stenosis and atrial fibrillation; they inscribe a varying circus movement, clockwise in direction.

Comment. Further study of similar cases must be made when opportunity offers, but the contours of the curves of the momentary electrical axes in these cases of paroxysmal tachycardia resemble those obtained in normal sinus rhythm; only their direction is different. On the basis of our present experience, and using a method which appears capable of showing a circus movement if it be present, we are forced to conclude that our evidence points to the presence of an ectopic pacemaker, rather than a circus movement, in paroxysmal tachycardia.

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The Excystation, Cultivation and Encystation of *Endamoeba coli.*

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Although much experimental work has been done on the cultivation of the intestinal amebæ, most of the time and effort has been spent on the pathogen, *Endamœba histolytica.* This organism has been cultured *in vitro* for two decades, but the closely related organism, *Endamœba coli,* has presented difficulties in cultivation. Many protozoologists have found that the latter species tends to die out after a few transfers and have concluded that it cannot be maintained in culture indefinitely. Dobell[1] says, *Endamœba coli* is indeed more difficult to cultivate properly than any other amœba living in man." From the present study it has been found that in the majority of cases cysts of *E. coli* from man will excyst and reproduce *in vitro* and can be maintained in culture for many months. The original strain which was planted from cysts in March, 1942, is still in cultivation after a period of 19 months and shows no indication that it will not continue to live and reproduce in the test tube.

Twenty-six strains of *Endamœba coli* were used for this series of culture experiments. Two were in the trophic and 24 in the cystic stage. All were from human material and none had any associated amebæ. All diagnoses were checked by members of the Department of Tropical Medicine, Tulane University. Examinations were made by the use of unstained, iodine-stained, and iron-hematoxylin-stained preparations.

Method Used to Obtain Maximum Number of Organisms for Culture. In order to obtain a maximum yield of cysts from a stool specimen, a modified combination of the zinc sulphate centrifugal floatation method (Faust *et al.*[2]) was used with the Lane[3] superimposed cover-glass technic. The specimen was thoroughly emulsified with tap water, 10 cc portions were strained through cheese cloth into Wassermann tubes and centrifugalized for 70 seconds at 2600 r.p.m. The supernatant fluid was poured off the tubes, the packed sediment broken up, washed and centrifugalized again. This process was repeated until the supernatant fluid became clear. Zinc sulphate of the specific gravity 1.180 was then added to

[1] Dobell, C., *Parasitol.*, 1936, **28**, 541.

[2] Faust, E. C., *et al.*, *Am. J. Trop. Med.*, 1938, **18**, 169.

[3] Lane, C., *Trans. R. Soc. Trop. Med. and Hyg.*, 1924, **18**, 278.