Electrokymographic Studies of the Relationship Between Electrical and Mechanical Events of the Cardiac Cycle.* (17754)

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(Introduced by Arthur C. DeGraff.)
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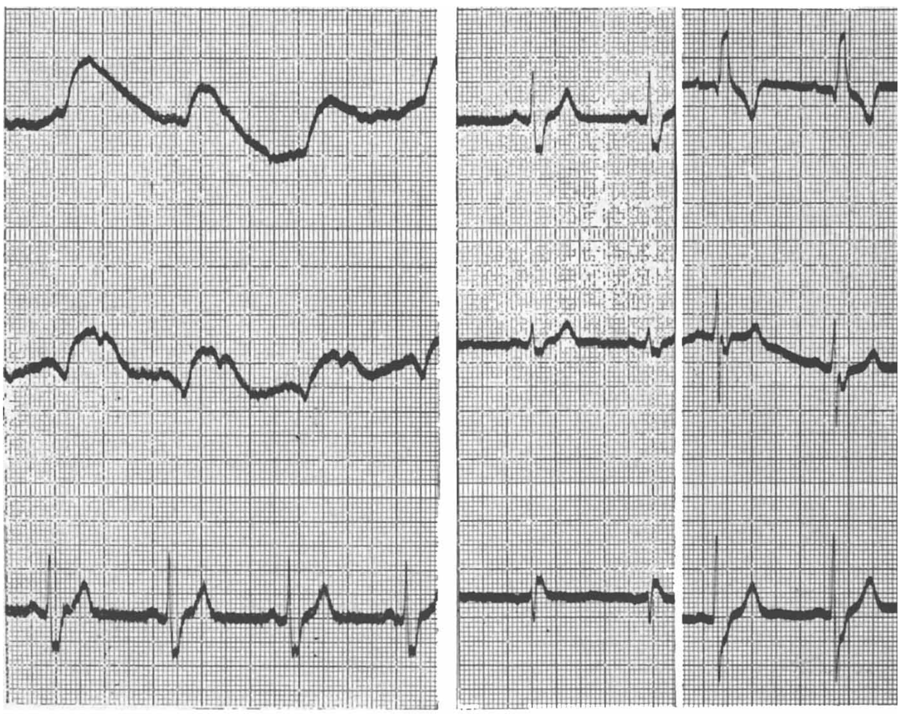
Studies of possible correlation between the electrical and mechanical events of the cardiac cycle have long been of interest. Wolferth and Margolies(1,2) and Nichol(3) measured the interval from the onset of the QRS to the beginning of the carotid artery pulsation in the neck in cases of left bundle branch block and found this interval prolonged compared to the normal. From this they concluded that correlation did occur. Other investigators



a. b.

FIG. 1.

Case 11. Complete RBBB. a. The uppermost curve is an electrokymogram of the ascending aorta, the middle an electrokymogram of the pulmonary artery and the lowermost lead 1 of the electrocardiogram. The upstroke of the pulmonary artery is .01 second ahead of the upstroke of the ascending aorta. b. Electrocardiogram of case 11. The 3 standard leads are recorded simultaneously on the left side. On the right side from above down there is V1, V3, and V5, recorded simultaneously.

* Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the results of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

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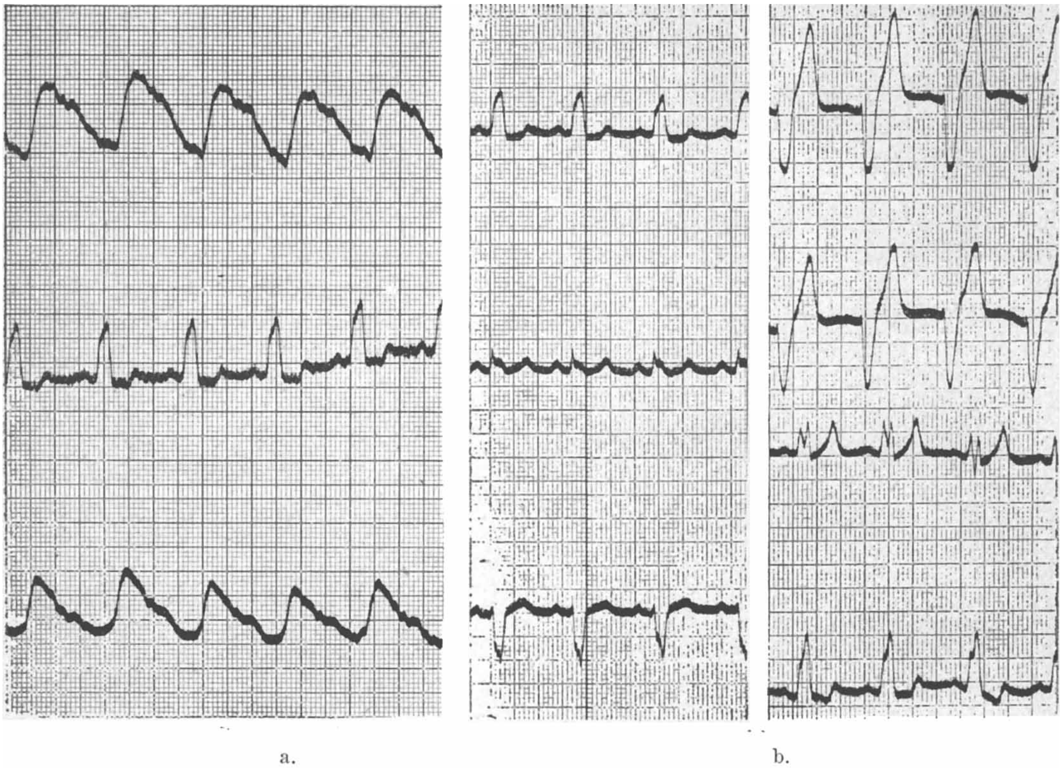

FIG. 2.

Case 23. Complete LBBB. a. The pulmonary artery upstroke (lowermost curve) is .02 second ahead of the upstroke of ascending aorta (uppermost curve). The middle curve is lead 1. b. Electrocardiogram of case 23. The 3 standard leads are to the left; on the right from above down there is V1, V2, V5 and V6.

including Castex *et al.*(4), Kossman and Goldberg(5), Richards *et al.*(6), Elinger *et al.*(7), and Coblentz *et al.*(8) have had similar experiences. On the other hand, Katz(9) and Battro(10) came to the opposite conclusions as a result of their studies.

With the development of the electrokymogram(11-13), a new technic for study of this problem became available. We felt that reinvestigation of this problem by the recording of electrokymograms of the pulmonary artery and ascending aorta simultaneously would be of great interest and value in deciding the issue. Simultaneous electrokymograms of the 2 great vessels allow an exact study of the onset of the ejection phase of the 2 ventricles without recourse to the carotid artery pulse as a reference point, thereby increasing the accuracy of the measurements. By means of a

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TABLE I.

Case No.	Results	Relations of pulmonary aorta and ascending aorta*	Correlation of electrical and mechanical events
		A. Cases of incomplete RBBB, QRS duration	
1.	.11	+.02	No
2.	.11	+.04	”
3.	.11	—.06	Yes
4.	.12	+.03	No
5.	.12	+.05	”
6.	.12	—.02	”
		B. Cases of complete RBBB, QRS duration	
7.	.13	—.04	Yes
8.	.13	+.04	No
9.	.13	.00	”
10.	.14	—.09	Yes
11.	.14	+.01	No
12.	.14	.00	”
13.	.15	.00	”
		Cases of incomplete LBBB, QRS duration	
14.	.11	+.05	Yes
15.	.12	+.08	”
16.	.12	+.03	No
17.	.12	+.02	”
		D. Cases of complete LBBB	
18.	.13	—.03	No
19.	.13	+.06	Yes
20.	.14	+.01	No
21.	.14	+.01	”
22.	.14	+.05	Yes
23.	.14	+.02	No
24.	.15	+.08	Yes
25.	.15	+.02	No

* + means that the onset of the pulmonary artery upstroke precedes that of the ascending aorta.
— means the reverse.

new 3 channel direct-writing recording apparatus (the Technicon†), we have recorded the electrocardiogram simultaneously with the two electrokymograms. The tracings were taken with the patient sitting, and in the right anterior oblique position. In this position, on the anterior border of the heart, the ascending aorta and (below the ascending aorta) the pulmonary artery are readily visible. The photo-electric cells of the electrokymograph can easily be placed over the edges of the ascending aorta and pulmonary artery in this position, so as to obtain the proper tracings.

Results. It was, of course, first necessary to establish the normal relationship between the electrokymograms of the ascending aorta and pulmonary artery by this technic. In a study of more than 50 normals, we found that the normal range was from +.03 to −.02 second. That is, pulmonary artery ejection might precede aortic ejection (as measured by the upstroke of the electrokymographic curves in both instances) by as much as .03 second, or might follow it by as much as .02 second. In 25 cases of bundle branch block, we found correlation between the electrical and mechanical events in only 8. In 17 cases the relation between the onset of the pulmonary artery upstroke and that of the ascending aorta was with the normal range listed above. In all cases the diagnosis of bundle branch block was made from the standard and at least 6 precordial leads, using the intrinsicoid deflection of the precordial leads to decide the side of bundle branch block. Mention must also be made of the fact that repetition of the curves at different times leads to the same results within the error of measurement of .01 second—the results are reproducible. Fig. 1, 2 illustrate some of our curves. In these figures, the distance between the thin vertical lines represents .04 second, and the

† We are indebted to the Technicon Corp., 215 E. 149th St., New York City, for the use of this instrument.

distance between the heavy vertical lines 0.2 second as on ordinary electrocardiograms. Our overall results are shown in Table I.

Attention should be drawn to Case 5. Here the QRS is .12 second and incomplete right bundle branch block is present. But the onset of the pulmonary artery upstroke is .05 second ahead of the onset of the upstroke of the ascending aorta, a result well outside the normal range, but in a direction opposite to that expected. In Case 18, with left bundle branch block (QRS .13), the onset of the upstroke of the ascending aorta is .03 second ahead of the onset of the upstroke of the pulmonary artery, again a relation outside the range of normal, but in a direction opposite to that expected.

We are continuing investigations of this problem in cases of ventricular premature beats and Wolff-Parkinson-White syndrome, but our results to date indicate lack of correlation between electrical and mechanical events in these instances also.

Summary. In a study of 25 cases of bundle branch block, we have found no correlation between the electrical and mechanical phases of the cardiac cycle in 17 cases. Furthermore, in two cases of bundle branch block, an abnormal mechanical relationship between the onset of ejection in the pulmonary artery and ascending aorta was noted in a direction opposite to that expected.

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Content and Distribution of Glycogen in *Schistosoma mansoni*.* (17755)

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Carbohydrate metabolism of *Schistosoma mansoni* proceeds at an exceedingly high rate. These trematodes utilize in one hour an amount of glucose equivalent to almost one-fifth of their dry weight(1). In the course of investigations concerned with the carbohydrate metabolism of schistosomes, a study was made of the content and distribution of glycogen in these helminths.

Methods. The flukes were removed from the mesenteric and portal veins of mice infected 6 to 23 weeks previously by the intraperitoneal injection of 160 cercariae of *S. mansoni.* The worms were placed in an ultrafiltrate of ox serum. After separation of the males from the females, both sexes were divided into two groups. A predetermined number of one group (5 males or 30 females) was used for the determination of glycogen, another for that of the dry weight. Glycogen was determined by a previously described modification(2) of the method of Good, Kramer and Somogyi(3), or by the colorimetric procedure of Seifter and Dayton(4). In the latter procedure, filter No. 60 of the Klett-Sumerson colorimeter was substituted for filter No. 62, since this resulted in a higher sensitivity and in a better proportionality between extinction and glycogen concentration. Provided the glycogen was precipitated prior to colorimetric analysis, results obtained by the two methods agreed within 3%. The other group of worms was rinsed quickly in distilled water, placed in small tared cups and dried to constant weight at 90°C. Glycogen content was calculated from the total amount of glycogen found and the dry weight of a similar number

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