Changes of the Ta Wave in Standard Leads Following Stimulation of the Vagus Nerves.* (17904)

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In experiments in which the right or left vagus nerves are stimulated in the neck with a faradic current during regular sinus rhythm marked changes of the P-R segments develop in the standard leads. The experiments were performed on dogs which were anesthetized with nembutal. The heart was exposed by removal of the sternum and the adjacent parts of the ribs and by opening the pericardium. The vagus nerves were severed in the neck and the peripheral end was stimulated with the aid of a Cambridge Inductorium.

Results. Fig. 1a shows a sinus tachycardia with a rate of 192. The P waves are large (lead II). The P-R segment is within the zero line. Following stimulation of the right vagus nerve, for 2.2 seconds, the first P wave differs in form from the others; the P-R segment is markedly depressed. This depression persists in a number of subsequent P waves which resemble those which were registered before the stimulation of the vagus. The depression gradually disappears.

Fig. 1b, which was obtained on Feb. 28, 1950 (lead II) shows a sinus rate of 115. This time only the right vagus nerve had been severed. Following faradic stimulation of the right vagus nerve for 2.4 seconds the first P wave again has an abnormal form but succeeding P waves, which look like those before the stimulation, are followed by a depression of the P-R segment which slowly diminishes and finally disappears.

These changes were observed in all of 17 experiments. They were barely recognizable in lead I, more marked in lead III and very distinct in lead II. Repetition of the stimulation of the vagus nerve again elicited this phenomenon without evidence of fatigue. We did not observe any difference in the effect of right or left vagus stimulation. The number of beats showing the depression of the P-R segment after the end of the stimulation varied with the rate.

We did not gain the impression that depression of the P-R segment was sustained longer by more prolonged stimulation of the vagus nerve. Thus in one experiment with a sinus rate of 176, vagus stimulation for 2 seconds caused a P-R depression persisting for 9 sinus beats; about 20 seconds later, after stimulation for 4.6 seconds, the same changes were seen for 12 beats; after stimulation for 8.4 seconds the P-R segment was depressed for 9 beats and about 25 seconds later, after stimulation for 9.6 seconds, changes were present for 8 beats; finally after a stimulation for only 3.8 seconds, the changes of the P-R segment were observed in 7 beats.

Intravenous injection of 0.005 g of acetylcholine chloride "Roche" invariably caused similar changes. After a temporary cardiac standstill, sinus rhythm reappeared and, as Fig. 2 shows (lead II), there was a marked depression of the P-R segment which quickly diminished and disappeared. This depression of the P-R segment can be attributed to the appearance of a pronounced Ta wave. It is known that a very distinct Ta wave may deform also the RS-T segment. We did not observe this, however, in our experiments, because the accentuated Ta wave following stimulation of the vagus nerves was of short duration. The steep return of the depressed P-R segment to the zero line demonstrates this fact. Shortening of the P-Ta interval during stimulation of the vagus nerve in frogs and mammals has been described(1,2).

Discussion. In the classic studies on the effect of stimulation of the vagus nerves on the electrocardiogram, these changes have

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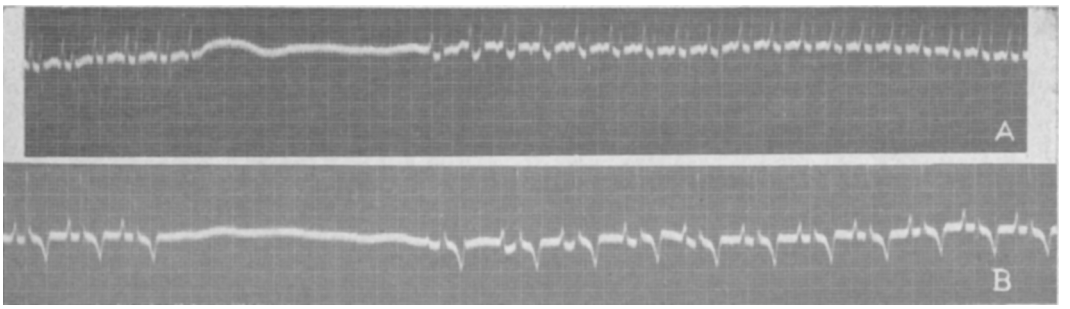

FIG. 1.
Fig. 1a shows a depression of the P-R segment during sinus tachycardia; Fig. 1b shows the same phenomenon during a normal sinus rate.

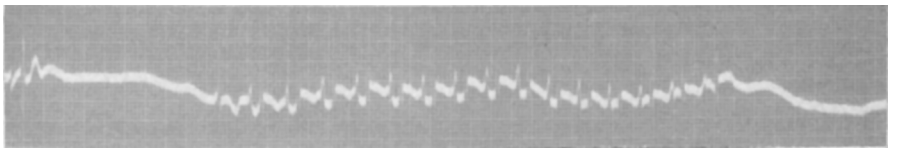

FIG. 2.
Shows the depression of the P-R segment following intravenous injection of acetylcholine.

escaped notice of the investigators. The phenomenon described above can easily be found in some of the tracings reproduced in their reports(3,4). Only in electrograms obtained with the exploring electrode within the right auricle of cats and dogs a similar deformity of the P-R segment has been registered. Standard leads are not described(2). In an investigation of the action of adenine nucleotides on the heart, Green and Stone stress the marked increase of vagus tonus after the intravenous injection of these compounds. Simultaneously with a marked inhibition of the A-V conduction, Fig. 29 and 30 of the monograph by these authors show a very distinct depression of the P-R segment in lead II(5). While our experiments were in progress, an accentuation of the Ta wave caused by acetylcholine was reported (6). These changes of the Ta wave are also found in clinical tracings. They appear in normal subjects after exercise(7). They are found for a few beats after carotid pressure. A similar depression of the RS-T segments has been described repeatedly in cases of coronary thrombosis and atrial infarction. The appearance of these changes by reason of a high vagal tonus has therefore some practical importance.

In an attempt of an explanation of this phenomenon certain experimental studies are pertinent. In an investigation of the effect of vagus stimulation on the conduction within the mammalian auricle an extremely rapid recovery was found during stimulation of the vagus nerve(8). The simultaneous reduction of the length of the refractory period is well known. Distinct shortening of the regression process was described(1,2), with the heart of the frog and in the mammalian heart after administration of acetyl-beta-methylcholine. Finally, Churney, Ashman and Biggins, in a study of the effect of the vagus on the monophasic action potential of the auricular

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muscle of the turtle, found a decrease in spike voltage due to a partial depolarization of the heart muscle fibers and an accelerated repolarization following vagal stimulation(9). A shortening of the repolarization process in the auricle may therefore be assumed to be responsible for the appearance of the Ta wave.

Conclusions. Vagal stimulation leads to the temporary appearance of a very pronounced Ta wave in the standard leads, particularly in lead II. This is explained by the abnormal repolarization process of the auricular muscle during and shortly after the stimulation.

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Anticomplementary Properties of Bone Marrow in Certain Diseases (17905)

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A low blood serum complement is often found in patients suffering of widespread disease of the bones(1). Because of this observation it was thought of interest to investigate the complement activity of the serous fluids expressed from the coagulate obtained from sternal bone marrow. Throughout this study the sternal puncture technic of v. d. Merwe(2) was employed. After the induction of local anesthesia with 2% novocain, the corpus sterni was punctured at the level of the second intercostal space. As a rule, the first drops obtained were smeared on slides for direct microscopic examination. After this, from 0.5 to 1 cc of the sternal marrow was withdrawn, ejected into a small serological test tube, and allowed to coagulate. After clotting the material was centrifugalized at 3000 r.p.m. for a period of 10 minutes and the supernate removed. For complement assay the hematocrit method of Jordan was used. One tenth of one cc of the fluid was employed and the titer obtained was compared with that of the blood serum which was tested at the same time.

It was found that in most cases the complement activity of the sternal fluid compared favorably with that of the blood serum. However, a small number of marrow fluids showed no complement activity at all while their corresponding sera possessed normal complement activity. It seems unlikely that these fluids should lack complement because a certain amount of blood is always obtained during puncture. It was found that the addition of complement components from normal serum failed to reactivate these marrow fluids. When these fluids were however mixed with active normal sera, they inhibited the complement activity of the latter. It was not feasible to work with larger quantities of sternal marrow since too great an admixture of blood would occur. It was observed that the anticomplementary power of these fluids resisted temperatures of 56°C and even 60°C so that it is possible to consider the anticomplementary activity as relatively thermostable (Olhagen)(3). In contrast to Olhagen's anticomplementary factor or factors the anticomplementary activity of these fluids is not acquired after heating of the fluids. In other words, they exist in the unheated fluid. In a number of patients whose sera and sternal marrows showed no complement activity, the sternal fluids were also tested for anticomplementary effects but none were observed.

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