

Serum Potassium and Prolongation of Q-T Interval of Electrocardiogram in Acute Myocardial Infarction.* (20706)

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(Introduced by Henry Brody.)

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Recently, one of us (S.O.K.) has demonstrated that the Q-T interval of the electrocardiogram is definitely prolonged in acute myocardial infarction, especially during the early weeks of the disease(1,2). Several reports(3-5) have described prolongation of the Q-T interval, attributed to low serum potassium levels, in a variety of clinical conditions. It was the object of this study to determine whether or not the prolongation of the Q-T interval that does occur during the acute myocardial infarction can be correlated with a low serum concentration of potassium.

Method. Forty-seven consecutive cases of acute myocardial infarction admitted during the past year to the ward medical services of the Northern Division of the Albert Einstein Medical Center were studied. Sixty-seven potassium levels were obtained on blood specimens drawn on the same day as electrocardiograms were made on these patients. Serum potassium levels were performed using the flame photometer, and employing lithium as an internal standard. All determinations were done in duplicate. The normal serum potassium for this laboratory during the time of this study, based on random sampling of healthy blood donors, was $5.0 \pm \text{S.D. } 0.46$ meq/L. Measurement of the duration of the Q-T interval of the electrocardiogram done on the day of the serum potassium determination, and the correction to be made for cardiac rate, were performed as described in previous studies (1,2). The modified formula of Bazett was

employed, $Q-T_c = \frac{Q-T}{\sqrt{R-R'}}$. The normal cor-

rected Q-T interval was found to be $0.397 \pm \text{S.D. } 0.015$ second, with a range of 0.38 to 0.43 second. The serum potassium level will here-

TABLE I. Relation of Serum Potassium Concentration to $Q-T_c$ in Myocardial Infarction.

No.	Q-T _c (sec.)		[K ⁺] (meq/L)	
	Range	Avg	Range	Avg
44	.44-.50	.46 $\pm$.02	4.1-6.3	5.3 $\pm$.5
23	.36-.43	.40 $\pm$.02	4.6-6.4	5.4 $\pm$.43

after be referred to as [K⁺] and the corrected Q-T interval as $Q-T_c$.

Results (Table I). In 44 electrocardiograms the $Q-T_c$'s were significantly longer than normal, ranging from 0.44 to 0.50 second (average 0.46 ± 0.02 second). The 44 serum samples drawn the same days as these electrocardiograms were done, revealed [K⁺]'s ranging from 4.1 to 6.3 meq/L (average 5.3 ± 0.5 meq/L).

In 23 electrocardiograms the $Q-T_c$'s were normal or shorter than normal ranging from 0.36 to 0.43 second (average 0.40 ± 0.013 second). In this group 13 tracings were taken at a time when the patients were receiving digitalis. The 23 serum samples drawn on the same day revealed [K⁺]'s ranging from 4.6 to 6.4 meq/L (average 5.4 ± 0.43 meq/L). (Fig. 1)

Discussion. It has been demonstrated by this study that during myocardial infarction, at a time when the $Q-T_c$ is definitely prolonged, the [K⁺] is within normal limits or even slightly higher than normal. It can therefore be concluded that the prolongation of the $Q-T_c$ that does occur in acute myocardial infarction is not associated with a low level of serum potassium. Such prolongation, however, is noted in the presence of a normal or slightly higher than normal serum potassium concentration.

Why, then, is there a prolongation of the Q-T interval of the electrocardiogram during the early weeks in acute myocardial infarction? The factors of age, sex, species and body position seem to have little effect as previously dis-

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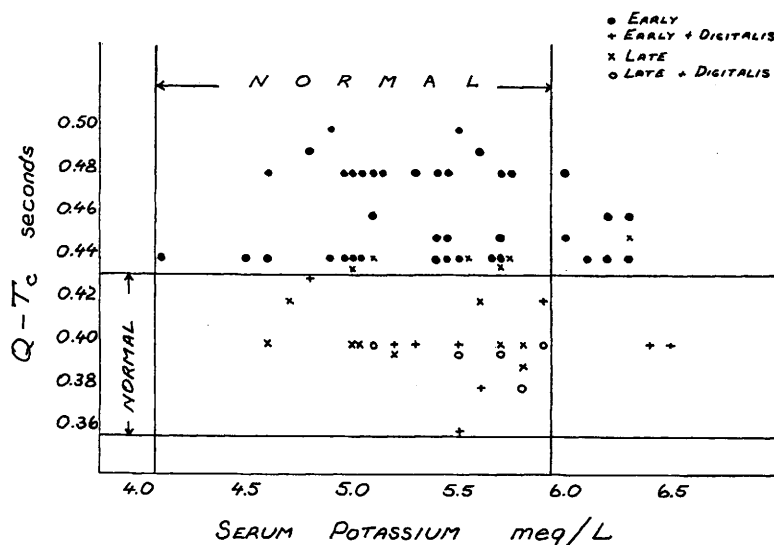


FIG. 1. Relation of serum potassium level to the $Q-T_c$ early (first to fourth wk inclusive) and late (after fourth wk) in acute myocardial infarction.

cussed(2). Simple physical interference with electromotive forces has yet to be demonstrated adequately, but it seems hardly likely that it could be of a magnitude as to cause a delay of 0.04 to 0.08 second per cardiac cycle. Could the $Q-T_c$ prolongation be associated with, or related to changes in the potassium concentration in heart muscle *per se*, rather than its concentration in the serum? Iseri and his co-workers(6) have recently demonstrated a marked lowering of heart muscle potassium in blocks taken from infarcted hearts. These investigators report a heart muscle concentration of 8.32 meq/100 g of wet tissue in normal hearts compared to 4.19 meq/100 g of wet tissue taken from hearts with acute infarction.

Lepeschkin and Surawicz(7) recently observed that "the true corrected $Q-T$ duration is not increased and may even be shortened in typical hypopotassemia without hypocalcemia". In view of this report and our study, it appears entirely possible that the changes observed in the duration of the $Q-T$ interval are entirely unrelated to the serum potassium concentration.

Summary. In a study of 67 electrocardiograms taken on 47 patients with acute myocardial infarction in conjunction with a similar number of serum potassium determinations, it was found that the $[K^+]$ was either normal or slightly above normal at a time when the $Q-T_c$ was prolonged, normal or shortened. The prolongation of the $Q-T_c$ that occurs during acute myocardial infarction is not correlated with a low level of serum potassium. Other possibilities for prolonged $Q-T_c$ are discussed.

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