Clinical Significance of the (Q-aU)/QQ Ratio, Especially in Relation to Actual Neurosis and Vegetative Dystonia

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On account of the fact that the position of a U wave between the T and P waves is different in different cases even in the classically normal ECGs, the relation between the QU and the QQ intervals was clinically investigated in actual neurosis, vegetative dystonia, coronary insufficiency and normal control. For example, in actual neurosis pattern the U wave merges into the downstroke of the T wave associated with the concave RS-T elevation in mid- and left precordial leads\(^5\), whilst in patients with vegetative dystonia the U wave tends to be accentuated and appears late from the end of the T wave\(^6\).

Usually, minor changes in the height and location of the U wave is not taken into consideration in a bedside interpretation of the electrocardiogram. Nevertheless, it is undoubtedly an electrical expression of action currents of the heart muscles which is subjected to psychic, nervous, humoral, mineral, mechanical, hemodynamic or metabolic changes. In fact, there are T-U fusion and U-P fusion waves in apparently normal hearts. That is, the U wave appears immediately after the T wave or before the end of the T wave in some (Fig. 1-b) and at the end of the diastole with a long interval after the end of the T wave immediately before or at the beginning of the following P wave in others (Fig. 2). Recently, ALTIERI\(^6\) published a comprehensive report on the U wave but made no reference to the QU/QQ ratio, and BERGES\(^7\) also published a comprehensive report: "Das Ausmaß von Tagesschwankungen im Ekg gesunder Versuchspersonen" but made no reference to the U wave. Numerous other investigators have taken advantage of such fortuitously occurring electrocardiograms to draw inferences concerning the clinical significance of the U wave changes. However, so few investigations have been made in respect to the shift of the U wave between the T and P waves that normal reference criteria on the QU/QQ ratio in classically normal ECGs are lacking. The observations now to be reported are regarded as a limited contribution toward providing these criteria.

Lately, disturbances in the autonomic nervous system have been classified into several groups by ABE\(^5\) and KRAEMER\(^8\). However, it seems to the author that the most important thing for us internists is to determine whether it is due to an increased irritability of the system resulting from the abuse (actual neurosis) or to a decreased adaptability of the system resulting from insufficient exercise of the autonomic nervous system (vegetative dystonia). Recently, SANO\(^9\) divided vegetative disorders into two by the mecholly test; type N which is improved by tranquillizers and types S and P which are improved by vegetative stabilizers such as Beller-gal and Novamin. As is well

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known "vegetative dystonia" has been differentiated from "Neurose," "vegetative Stigmatisierung" and "Konstitution" (Balzer, Vago and Schellong). The practical purpose of this paper is to show the possibility of differentiating actual neurosis from vegetative dystonia by the position of the U wave between the T and P waves in normotensive patients without congenital or acquired heart anomalies.

**Materials and Methods**

In order to minimize errors the QT and QU intervals were measured from the Q wave to the apexes of the T and U waves and termed (Q-aT) and (Q-aU), respectively. As illustrated in Fig. 3, the (Q-aT), (Q-aU) and QQ intervals were measured in ECGs taken from 20 patients with actual neurosis (presence of a long-continued emotional tension or mental stress, concave RS-T elevations in mid- and left precordial leads, precordial oppression and insomnia), 20 patients with vegetative dystonia (physical inactivity, classically normal ECGs, vertigo or dizziness on standing and casual systolic blood pressure lower than 110 mmHg), 20 patients with slight coronary insufficiency (nearly isolectric ST segments, positive T waves with terminal negativities and heightened U waves) and from 20 normal control subjects. The (Q-aU) interval was measured in the leftest precordial lead which showed the U wave. Representative ECGs of these 4 groups are shown in Fig. 1. The (Q-aT)/QQ and (Q-aU)/QQ ratios were calculated in each ECG. Blood pressure was measured in a supine position.

![Fig. 3. Measurement of the (Q-aT), (Q-aU) and QQ Intervals](image)

**Results**

As shown in Table I, the (Q-aT) interval averaged 0.272 sec in normal control, 0.292 sec in actual neurosis, 0.288 sec in vegetative dystonia and 0.332 sec in coronary insufficiency. The (Q-aU) interval averaged 0.472 sec in normal control, 0.480 sec in actual neurosis, 0.508 sec in vegetative dystonia and 0.568 sec in coronary insufficiency. The QQ interval averaged 0.861 sec in normal control, 0.978 sec in actual neurosis, 0.865 sec in vegetative dystonia and 0.980 sec in coronary insufficiency.

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Table I  Average (Q-aT), (Q-aU) and QQ Intervals and Average (Q-aT)/QQ and (Q-aU)/QQ Ratios in Four Groups

<table>
<thead>
<tr>
<th></th>
<th>Q-aT (sec)</th>
<th>Q-aU (sec)</th>
<th>QQ (sec)</th>
<th>(Q-aT)/QQ</th>
<th>(Q-aU)/QQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal control</td>
<td>0.272</td>
<td>0.472</td>
<td>0.861</td>
<td>0.32</td>
<td>0.55</td>
</tr>
<tr>
<td>actual neurosis</td>
<td>0.292</td>
<td>0.480</td>
<td>0.978</td>
<td>0.30</td>
<td>0.49</td>
</tr>
<tr>
<td>vegetative dystonia</td>
<td>0.288</td>
<td>0.508</td>
<td>0.865</td>
<td>0.33</td>
<td>0.59</td>
</tr>
<tr>
<td>coronary insufficiency</td>
<td>0.332</td>
<td>0.568</td>
<td>0.980</td>
<td>0.34</td>
<td>0.59</td>
</tr>
</tbody>
</table>

The average (Q-aT)/QQ ratio was 0.32 in normal control, 0.30 in actual neurosis, 0.33 in vegetative dystonia and 0.34 in coronary insufficiency. And the average (Q-aU)/QQ ratio was 0.55 in normal control, 0.49 in actual neurosis, 0.59 in vegetative dystonia and 0.58 in coronary insufficiency. That is, the (Q-aU)/QQ ratio was largest in vegetative dystonia and smallest in actual neurosis.

**DISCUSSION**

How irrational it is when a man, seeing a girl lament over her mother’s death, states that tear is not caused by sorrow. In this case, the primary cause of the tear is undoubtedly the sadness due to the death of her mother, whatever the biological processes may intervene between the sadness and the tear. The author previously stated that the ECG change due to a transient mental upset is a reflex and that due to a long-continuing stress an adaptation.

*Fig. 5. Disappearance of the U wave after treatment with vegetative stabilizers and regular exercises in a patient with vegetative dystonia.*

C.C., a 30-year-old woman with true vertigo due to labyrinthitis and meningismus

a) She was still lying on her back and stated “I feel as if I were on board a ship and got seasick”. Note that the distinct U waves were present in V5 and V6. Usually, the U waves in these leads are isoelectric in this decade of life as reported previously. b) From February 17 the sensation of seasick began to decrease but she still could not walk because of vertigo on standing. From March 8, she began to walk but her gait was slow and she experienced dizziness while walking. Note that the U wave in V5 became isoelectric. c) From March 13 she could walk to the department of otolaryngology and felt no dizziness. On March 16 the author saw the patient walk steadily and straightly with a normal speed. Note that the U waves in V5 and V6 became isoelectric.

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He stated also that psychogenic paroxysmal cardiac arrhythmia might be due to an excess counter-regulation. Anyhow, it is undeniable fact that the changes in the U wave result from the changes in mechanism of the genesis of the U wave even when the mechanism of the genesis of the U wave is not completely elucidated. It seems to the author that the U wave is the most vulnerable portion of the ECG to psychic and vegetative alterations.

As stated above, disturbances in the autonomic nervous system have been divided into several groups from the psychosomatic viewpoint. But the author, being a clinician, prefers to classify the disturbances of the autonomic nervous system roughly into two from the therapeutic viewpoint; one is the disturbance due to an overload of the system (actual neurosis), and the other is the disturbance due to an over-protection of the system (vegetative dystonia). The ECG characteristics of actual neurosis and the normal percentage appearance of the U wave in each precordial lead have been described elsewhere. As to the ECG changes in vegetative dystonia, two examples were given below (Figs. 4 and 5). In both cases the U wave, which was distinctly present in the left precordial leads during the absolute bed rest, disappeared after she was up and about and began to exercise.

We now know that there is neither pure sympathicotonia nor pure parasympathicotonia. For example, patients with hyperthyroidism suffer from sometimes tachycardia (sympathicotonia) and sometimes from diarrhea (vagotonia), and patients with actual neurosis or anxiety neurosis sometimes from paroxysmal tachycardia and sometimes from spenic flexure syndrome. In general, patients with actual neurosis tended to be more sympathicotonic and those with vegetative dystonia to be more vagotonic. Symptoms of actual neurosis are improved by tranquilizers and psychotherapy, and those of vegetative dystonia by vegetative stabilizers and regular exercise such as walking in the morning or in the evening. In vegetative dystonia, administration of tranquilizers is in many cases contraindicated because they aggravate symptoms and signs.

SUMMARY

1) The interval from the Q wave to the apex of the U wave (Q-aU) and the QQ interval were measured in normal control, actual neurosis (over-loading of the autonomic nervous system), vegetative dystonia (over-protection of the autonomic nervous system) and coronary insufficiency, each consisting of 20 cases.

2) The average (Q-aU)/QQ ratio was 0.55 in normal control, 0.49 in actual neurosis, 0.59 in vegetative dystonia and 0.58 in coronary insufficiency. That is, the (Q-aU)/QQ ratio was largest in vegetative dystonia and smallest in actual neurosis.

3) Accentuated U waves in left precordial leads in vegetative dystonia were normalized by vegetative stabilizers and by regular exercises.

REFERENCES


8) cited by 7)


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