Increased sympathetic activity and blood pressure in young asymptomatic men with 'organic' T-wave aberrations in the electrocardiogram

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Summary
1. Twelve asymptomatic young men with 'primary' T-wave aberrations in the electrocardiogram (group T) and 13 matched controls were subjected to a mental stress test, isometric exercise and a cold pressor test.
2. Plasma catecholamines and haemodynamics were studied.
3. Group T had signs of increased sympathetic activity at rest and enhanced sympatho-adrenal reactivity during stress.
4. Systolic blood pressure was consistently elevated in group T.
5. The T-wave aberrations may be explained by the increased sympathetic activity.
6. Several similarities exist between group T and borderline hypertensive subjects.

Key words: electrocardiography, haemodynamics, hypertension, impedance cardiography, sympathetic activity, T-wave aberrations.

Introduction
Stimuli causing sympathetic activation of the heart may produce changes in the electrocardiogram (Blom, 1954). Conversely, β-adrenoceptor blockade may reverse electrocardiographic changes resembling myocardial ischaemia in asymptomatic patients without other signs of organic heart disease (Taggart, Carruthers, Joseph, Kelly, Marcomichelakis, Noble, O’Neill & Somerville, 1979).

The purpose of the present study was to determine whether sympathetic activity, as evidenced by plasma catecholamine levels, is raised in asymptomatic young men with T-wave aberrations in the electrocardiogram. Another aim was to study the association between electrocardiographic changes and haemodynamics at rest and during standardized provocations.

Methods
Twelve asymptomatic men (aged 18–19 years) without any history of heart disease were sent from an induction centre for evaluation of T-wave aberrations (group T). Thirteen age-matched men from the same centre participated as a control group (group C). Haemodynamics and cardiac function were studied by electrocardiography and impedance cardiography. The first derivative of the impedance tracing was used as an index of heart contractility (dZ/dt max.). Pre-ejection period was obtained by lead Y in the vector cardiogram, phonocardiography and the impedance tracing. Blood pressure was measured with a semi-automated apparatus registering Korotkoff sounds from a conventional blood pressure cuff. Plasma catecholamines were determined by high-performance liquid chromatography (Hjemdahl, Daleskog & Kahan, 1979).

The standardized provocations included a filmed version of Stroop's colour word test lasting 20 min. The experience of 'stress' in the test situation was ranked on a graphic self-rating scale. This test has been used in a previous study of latent hypertensive subjects and has proved effective in eliciting cardiovascular responses (Hjemdahl & Eliasson, 1979). The subjects also performed an isometric handgrip test at one-third
of maximal voluntary power for 3 min, and a cold pressor test, immersing a hand in ice-water (0–2°C) for 3 min. The subjects were seated during the whole experiment, time relationships of which are shown in Fig. 1, which also indicates time intervals for blood sampling.

Results

At rest, group T had significant elevations of plasma noradrenaline (2.65 vs 1.47 nmol/l, \( P < 0.001 \)). Systolic blood pressure was also higher (125 vs 112 mmHg, \( P < 0.01 \)), whereas diastolic blood pressure and heart rate were similar in the two groups. All stress tests raised blood pressure and catecholamines significantly in both groups. Performance and experience of stress in connection with the colour word test was also equal. The higher levels of systolic blood pressure and noradrenaline in group T persisted throughout the series of tests (Fig. 1). Increases in plasma adrenaline and diastolic blood pressure tended to be larger in group T during each of the provocations. The severity of T-wave aberrations in the electrocardiogram was positively related to noradrenaline levels at rest.

Transthoracic impedance was higher in group T during the whole experiment, indicating a smaller central blood volume. Group T showed increased heart contractility both at rest and during stress (higher \( dZ/dt \) max. on impedance cardiography and more marked reductions in pre-ejection period during the colour word and isometric handgrip tests).
Discussion

The young men in group T had no history of cardiac disease or signs of cardiac hypertrophy. The types of T-wave aberrations found in their electrocardiograms are, however, usually considered to be caused by organic heart disease. The accidental finding of such ‘primary’ abnormalities in asymptomatic young men represents a medical problem and the aetiology of these aberrations has so far not been established. Our present study indicates that increases in sympathetic activity may explain the electrocardiographic abnormalities. Thus plasma noradrenaline was considerably increased in group T at rest. This highly significant increase was also present during different types of stressful provocations that raise blood pressure by different mechanisms. Another sign of increased sympathetic activity in group T was the increased heart contractility, evidenced by impedance cardiography measurements both at rest and during stress. The pre-ejection period was more markedly reduced in group T during the colour word and isometric handgrip tests, indicating an increased cardiac responsiveness to external stimuli. There were other signs of increased reactivity in group T as plasma adrenaline and diastolic blood pressure tended to increase more in connection with the colour word and isometric handgrip tests. The study thus provides evidence for increases in sympathetic activity at rest and in sympathetic-adrenal reactivity during provocation in individuals with T-wave aberrations. The severity of the T-wave abnormality was related to plasma noradrenaline at rest. The electrocardiographic changes may therefore be explained by increased sympathetic activity.

The increase in plasma noradrenaline was accompanied by an elevation of systolic blood pressure throughout the study in group T. Blood pressure is influenced by sympathetic activity (de Champlain, 1977). Therefore, it seems probable that the increased systolic blood pressure in group T was caused by the obvious increase in sympathetic activity. Apart from the raised blood pressure, there are several similarities between group T in our study and borderline hypertensive patients. It has been claimed that borderline hypertensive patients have an increased ratio of cardiac output to central blood volume, indicating increased cardiac inotropism (Tarazi, Ferrario & Dustan, 1977). We found signs of increased cardiac performance as well as decreased central blood volume (increased thoracic impedance) in group T. Raised noradrenaline levels are reported to exist in borderline hypertension (de Champlain, 1977) and so is the increased blood pressure responsiveness to mental stress (Falkner, Onesti, Angelakost, Fernandes & Langman, 1979). It is an interesting possibility that the men in group T might run an increased risk of the future development of ‘neurogenic’ hypertension.

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References


