Does Heart Rate Differentiate Neurotic From Normal People in a Conditional Reflex Test?

GUY SANTIBÁNEZ-H. AND HEIDEMARIE SCHROEDER
Institut für Physiologie des Bereichs Medizin (Charité)
der Humboldt-Universität zu Berlin
German Democratic Republic

Abstract—This study is to compare heart reactivity between normals and anxiety neurotic patients. Five male and five female patients with anxiety neurosis and four male and five female normal persons were submitted to classic delayed conditional reflexes with different probabilities of reinforcement (shock), to a defensive instrumental conditional reflex, and to a neutral nonreinforced stimulus. The basal heart frequency was higher in neurotics and in women than in normals and men. The conditional stimulus (CS) associated with a shock generally produced a bradycardia in normal individuals and in neurotic men, but a tachycardia in neurotic women (effects most pronounced in cases with 100% shock probability). The instrumental CS caused a tachycardia in all of the groups, with highest values in neurotic women. The neutral stimulus produced bradycardia in all persons. The aftereffect of the light stimulus depended on whether a shock was administered and on the CS. The differences between neurotics and normals are explained as caused by the heightened excitatory level of the CNS of the neurotic group, produced by the unspecific activating effect of chronic anxiety, and differences of plastic processes in both groups, resulting in different effects of phasic anxiety on the heart. Complex inhibitory-excitatory interactions of the sympathetic and the vagal system underlying the heart rate changes may be assumed. Possible mechanisms leading to sex differences are discussed.

As many experimental findings (Jennings and Matthews 1984, Lawler 1980, Light and Obrist 1980, Steptoe, Melville and Ross 1984) have stressed the nosological connection between a heightened cardiovascular reactivity to psychological stressors and the etiology of cardiovascular diseases, defensive conditioning experiments have been used as a model to study cardiac behavior under the influence of negative emotions. Many such experiments indicate that defensive reflexes are accompanied by an increase of heart rate (Cornelius and Berg 1976, Grayson 1982, Hare et al. 1971, 1972, 1975, Klorman et al. 1977). Recent observations of Santibáñez-H. et al. (1986) in normals and anxiety neurotic patients have shown that a natural fear-anxiety triggering stimulus (subjective representation) provokes a clear cut increase of heart activity.

On the other hand, Schroeder et al. (1986) found phobic patients who responded with bradycardia to a fear-provoking stimulus. Several authors (Graham and Clifton 1966, Headrick and Graham 1969, Obrist et al. 1965, 1967, 1969) have shown that conditional stimuli associated with a shock are able to induce a triphasic variation of the heart rate with a predominant bradycardic component. In cats trained in a delayed defensive conditional reflex, Santibáñez-H. et al. (1963) found a reduction of the heart rate during the delay. Diaz-C. et al. (1969) and Giavelli et al. (1977) reported some evidence that indicated this bradycardic reaction was not produced by a simple inhibition of sympathetic activity and a reciprocal activation of the vagus but by a predominant inhibition of the cardiac sympathetic activity, which was found to be increased tonically.

The aim of this study was to compare heart reactivity of normal subjects with that of anxiety neurotic patients submitted to classical delayed conditional reflexes with different types of reinforcement, to a defensive instrumental conditional reflex, and to a neutral nonreinforced stimulus, to find out whether the changed higher nervous activity in anxiety neurotic patients has an influence on visceral reactions.

Address reprint requests to: Guy Santibáñez-H., Institut für Physiologie des Bereichs Medizin (Charité) der Humboldt-Universität zu Berlin, Hessische Str. 3-4, Berlin, 1040, GDR.
Methods

Subjects

Four different groups of subjects were used, one group of normal women (5 NoW), and one of normal men (4 NoM), one group of neurotic women (5 NeW), and one of neurotic men (5 NeM). The normal group included students and scientists of the medical faculty of the university. Their ages ranged from 20 to 40 years. They were free of physical or psychical problems (normal FPI-scores). The neurotic group was formed by 18- to 40-year-old patients of the psychiatric clinic of the university. The patients were diagnosed as having “anxiety neurosis” (pathological FPI-scores) and were under psychotherapeutic, but not drug, treatment.

Procedure

The experiments were conducted in a conditional reflex chamber, with the subjects lying on a bed. A panel (60 x 60 cm²) two meters in front of the subject could be illuminated by different colors (red, yellow, blue, green) and showed the words “your attention please.” The attention signal (AS) was lit for 7 seconds and indicated the appearance of a coloured light. The different lights were distributed at random, each lasting 21 seconds. The red light was followed by an unavoidable unpleasant shock (the shock intensity fixed to the maximum level acceptable by the subject). The yellow light indicated a 50% shock probability. The blue light was followed by a shock in case of a wrong performance of an instrumental reaction (an estimation of a time span of 10 seconds and pressure of a button located near the left hand of the subject); the subjects were informed about the correctness of their reaction by the illumination of the word “right” on the panel. The green light was always presented without shock. The first session was dedicated to adapt the subjects to the experimental situation: 16 trials were carried out without shock reinforcement. The subjects, then were informed of the meaning of the different lights and of the instrumental reaction. Two conditioning sessions, each consisting of 20 trials, followed.

Recording

Recording and stimulating instruments were placed in a prechamber with visual and auditory communication to the conditional reflex chamber. The ECG was recorded according to Einthoven II, amplified and recorded with a paper speed of 15 mm/seconds.

Quantification of Data and Statistical Analysis

Each trial was divided into six periods (Figure 1): basal time (B), 15 seconds before the attention signal; attention signal time (AS), lasting 7 seconds, 21 seconds of light presentation subdivided into three parts of 7 seconds each (L1, L2, L3); and post-light period, lasting 7 seconds after discontinuation of the light (PLP). Complete RR-intervals were counted for each period and extrapolated to beats/minutes. The mean HR of the six periods was compared (AS with B; LI, L2, L3 with AS; L2, L3 with LI; L3 with PLP) using the simple t test; for intergroup comparison, the Welsch-test was used. Differences were viewed as significant if p ≤ 0.05.

Results

Adaptation Session (AdS)

Basal Heart Rate. The analysis of the mean values shows that the NoM group presented the lowest values (x̄ = 64.8; SD = 4.70), while the NeW group had the highest (x̄ = 80.74; SD = 20.55); the other two groups were intermediate (NoW: x̄ = 77.44; SD = 4.91; NeM: x̄ = 71.65; SD = 4.63) (Figure 2). However it must be considered that the high values of NeW were mainly caused by one patient whose cardiac frequency was 115 bpm. Without her the mean