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Achilles Reflex Time and Sympathetic Tone

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ABSTRACT

The influence of increased sympathetic tone on the Achilles reflex time has been studied in different groups of subjects. Patients with the syndrome of vasoregulatory asthenia have a short reflex time that increases after adrenergic beta-receptor blockade. No effect of the blockade was recorded in patients with thyreotoxicosis or in healthy euthyroid controls. Smoking and moderate physical exercise caused a significant decrease in reflex time. This effect disappeared after 20 minutes. Standardization of the conditions of examination in a way similar to those for measurements of BMR seems to decrease the influence of temporary rises in sympathetic tone.

INTRODUCTION

Many authors have found a significant correlation between thyroid function and Achilles reflex time (1, 2, 3, 9, 10, 12), while others have found the connection to be less reliable (13, 14, 16). Ringqvist (12) analysed various sources of error in the determination of Achilles reflex time and found that the method has a diagnostic reliability comparable to that of other tests of thyroid function. One of the problems from the diagnostic standpoint is the falsely positive hyperthyroid values, that is, short reflex times in euthyroid patients.

Adrenalin is known to produce shortening of the reflex time in euthyroid subjects (5). A temporary rise in sympathetic tone is said to occur in various emotional states, in connection with physical exertion and in association with smoking. More or less constant disturbances of autonomic balance with increased sympathetic tone occur in patients with certain psychiatric disorders (4) as well as in the syndrome vasoregulatory asthenia (8).

In previous studies the importance of changes in autonomic balance in regard to the Achilles reflex time has not been investigated. It was thus of interest to study this relationship more closely, especially the question whether an increase in symphathetic tone produces a shortening of the reflex time. The first part of the study was aimed to compare the reflex time in patients with thyreotoxicosis and vasoregulatory asthenia respectively and healthy control subjects before and after a beta-blockade. The aim of the second part was to study the influence of smoking and physical exercise on the reflex time. The third part of the study was aimed at determining whether a residual effect of sympathetic tone on the reflex time was still present after a standardization of the examination procedure.

MATERIAL

The material in the first part of the study (I) consisted of 8 patients with typical clinical and laboratory signs of thyrotoxicosis. Seven were women, and the mean age for the group was 46 years. Their resting pulse was rapid ($m = 106$ beats/min) and their basal metabolic rate was high ($m = 55\%$), as was the mean value for PBI ($m = 12.0$ mg%).

The material also included 8 patients with signs of vasoregulatory asthenia (VA) (8), as well as 8 euthyroid healthy controls with normokinetic circulatory signs. The VA patients were 2 women and 6 men with a mean age of 33 years. They had a rapid resting pulse ($m = 95$ beats/min) but a normal basal metabolic rate ($m = +12\%$). They were further characterized by a rapid pulse when standing and a low capacity for work in relation to the circulatory dimensions (heart volume and total amount of hemoglobin respectively). Most of them also had sympathotonic ECG changes during an exercise test. The controls in this part of the study were 7 women and 1 man with a mean age of 22 years. They had a normal resting pulse rate ($m = 72$ beats/min) and a normal basal metabolic rate ($m = -1\%$). Their physical working capacity was normal in relation to the circulatory dimensions.

In the second part of the study (II) 8 healthy control subjects from the laboratory with no clinical signs of disturbances of thyroid function were investigated. They consisted of 5 women and 3 men with a mean age of 23 years.

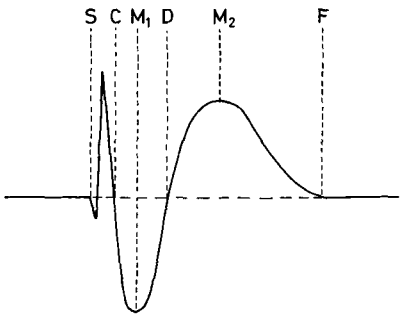

Fig. 1. The normal reflexogram obtained with a kinemoneter. Point *S* corresponds to the tap on the Achilles tendon. Phase SC includes oscillations provoked by the tap on the Achilles tendon and the propagation time of the reflex impulse to and from the spinal cord. Phases CD and DF correspond to the contraction and relaxation, respectively, of the calf muscles. Points M_1 and M_2 correspond to the highest velocity of contraction and relaxation respectively. Interval from *S* to *D* was used as measure of reflex time.

The material in the third part of the study (III) consisted of euthyroid patients from four departments of the hospital who were referred for basal metabolic studies. There were 25 such patients, taken in consecutive order. The mean age for the material was 45 years. Their mean resting pulse rate was 72 beats/min and their mean basal metabolic rate was −2%.

METHODS

Measurement of reflex time

Apparatus. The Kinemometer, according to Lawson (10), consists of three elements: a horseshoe magnet, taped to the patient's heel, two coils wound on 2 identical soft-iron, L-shaped cores functioning as detectors of the movement of the magnet and a standard one-channel electrocardiograph. The detectors were connected to the AC input of the recording apparatus. The inductive current is generated by the movement of the magnet and is recorded as a tracing on the electrocardiograph (paper velocity 100 mm/sec) indicating the velocity and direction of the movement. The paper velocity is very stable. With a time marker generator the maximal variation was shown to be 0.1 mm corresponding to 2 msec with a paper velocity of 100 mm/sec.

As the movements of contraction and relaxation are in opposite directions, the generated electromotive force is also in different directions during the two phases. The phase of contraction can, therefore, be separated from the phase of relaxation.

Reflexogram. The recorded tracing (Fig. 1) is composed of three phases: The initial oscillations—phase SC in Fig. 1—are provoked by the tap on the Achilles tendon. These fairly high-frequency oscillations are succeeded by a slower movement of the heel-magnet when the reflex stimulus has been conducted to and from the spinal cord and has produced a contraction of the calf muscles. M_1 and M_2 correspond to the highest velocity of the contraction and of the relaxation respectively. *D–F* is the relaxation phase. The interval from *S* (the start of the contraction phase) to *D* (the end of the contraction phase) has been used as a measure of reflex time.

Technique of measurement. All measurements were taken with the patient kneeling on a chair. The examinations were carried out at least a 2 hour interval to any meal and 1 hour to smoking. Repeated reflexes were elicited until sixteen technically satisfactory tracings were obtained, eight from the right and eight from the left side. The reflex time was the mean value of these tracings. In studies I and II the subjects rested fifteen minutes before examination. In study III BMR conditions were used, i.e. the examinations were performed early in the morning with the patients resting and fasting.

Procedures. The patients in study I were investigated before, and 60 min after administration of an adrenergic beta-receptor blocking agent, Inderal, in a dose of 10 to 15 mg orally. The higher dose was administered to patients who weighed more than 60 kg.

In study II the reflex time was studied in connection with work on a bicycle ergometer. The male subjects worked for 6 minutes with a work load of 450 kpm/min and the female subjects for a corresponding time at 300 kpm/min. The effect of smoking on the reflex time was studied in the same subjects. The subjects smoked 1 cigarette with inhalation during the course of 5 min. The reflex time was measured before, immediately after, 10 min after, and 20 min after smoking.

The investigations in study III were carried out with at least a 2 hour interval between eating or smoking and the time of the study. The patients, who were not to have performed any physical work during the hours immediately preceding the investigation, were allowed to rest for 30 min before the examination. To get an idea whether this attempt at standardization was sufficient to eliminate the possible effect of increased sympathetic tone on the reflex time, these patients were also investigated after the administration of Inderal.

The statistical differences between the means of two groups were tested with the Wilcoxon matched-pairs signed-ranks test (15).

RESULTS

The patients with thyrotoxicosis were characterized by short reflex time, average 193 msec (Table I). Three VA patients also had short reflex times (less than 210 msec) while the reflex times in the others were normal. The mean time for this group of patients was 213 msec. After administration of 10–15 mg Inderal orally the reflex time was unchanged in the patients with thyrotoxicosis and in the healthy euthyroid controls. Among the VA patients, on the other hand, the reflex time increased significantly ($p < 0.001$) to a level characteristic of euthyroid subjects (Table I).

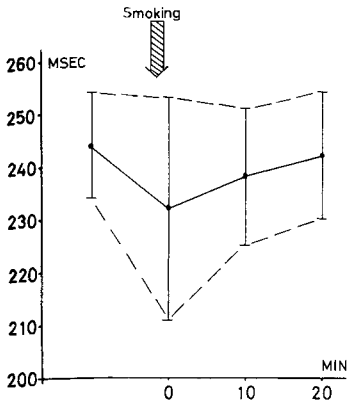

Fig. 2. Mean and S.D. of the duration of the Achilles tendon reflex of 8 healthy euthyroid subjects before, immediately after, 10, and 20 min after smoking a cigarette.

The healthy euthyroid controls in study II had normal reflex times (Table II). Immediately after physical exercise and smoking respectively there was a significant decrease of the average reflex time ($p<0.01$ and $p<0.05$ respectively). The change had been partially reversed after 10 min, and after 20 min the times were not significantly different from the corresponding values obtained before exercise and smoking respectively (Fig. 2 and Table II).

The patients in study III were investigated after the conditions of examination had been standardized in a way similar to those for measurements of basal metabolic rate. The mean reflex time in these patients was 224 msec (range 206–259). It was not affected by the administration of Inderal. No connection was demonstrated between reflex time and age or physical variables.

Table I. *Mean and range of the duration of the Achilles tendon reflex before and after beta-blockade in patients suffering from hyperthyroidism and vasoregulatory asthenia respectively and in healthy euthyroid controls*

Group		Reflex time before blockade (msec)	Reflex time after blockade (msec)
HT	*m*	193	193
	range	171–223	174–214
VA	*m*	213	226
	range	200–236	212–244
Controls	*m*	226	226
	range	210–248	206–256

Table II. *Mean and range of the duration of the Achilles tendon reflex of 8 healthy euthyroid subjects, before, immediately after, 10, and 20 min after smoking a cigarette, and after moderate physical exercise*

		Reflex time after smoking (msec)	Reflex time after exercise (msec)
Initial value	*m*	244	242
	range	230–259	220–266
Imm. afterwards	*m*	232	227
	range	187–256	212–233
10 min afterwards	*m*	238	234
	range	213–254	206–255
20 min afterwards	*m*	242	240
	range	224–256	208–274

DISCUSSION

There have been few methodological studies concerning the determination of reflex time. Ringqvist (12) has recently demonstrated a number of sources of error which can affect the determination of reflex time to various degrees. It is apparent that the reliability of the test has been unsatisfactory in many previous investigations. This would seem to be the reason why some authors have found the test to have little validity.

With his more standardized methodology Ringqvist was able to improve the validity of reflex time determination as a measure of thyroid function. In connection with the development of the method, the present investigation was concerned with a closer study of the effect on reflex time of autonomic disturbances in which there is a relative increase of sympathetic tone. Since adrenalin is known to shorten the reflex time in euthyroid individuales (5), it seemed probable that increased sympathetic tone would be a factor leading to falsely short reflex time.

It has been previously shown that patients with anxiety neuroses (6, 11) can have a short reflex time characteristic of the hyperthyroid state. In cases of anxiety neurosis with cardiac symptoms the symptomatology can lead to a suspicion of thyroid disturbance. After administration of beta-blocking agents the reflex time becomes normal. This also appears to be true of patients with vasoregulatory asthenia. Their symptomatology plus the fact that certain patients have a short reflex time can lead to a suspicion of hyperthyroidism. It is thus important that if anxiety neurosis or

vasoregulatory asthenia is suspected in a patient with a short reflex time the test be repeated after administration of beta-blocking agents. The reflex time is not affected in patients with hyperthyroidism or in euthyroid individuals after oral administration of Inderal in doses of 10–15 mg. Even when higher doses are given the reflex time remains short in hyperthyroidism (7).

More transistory disturbances of automatic tone can occur in connection with anxiety and tension before the examination or after smoking or physical exertion. This study has shown how the latter factors produce temporary shortening of the reflex time in euthyroid persons. It is important to be aware of this when determining reflex time. For practical reasons, reflex time determination should be carried out in connection with the determination of basal metabolic rate, since the standard conditions for the two tests are the same. Judging from the third part of the study, these conditions eliminate the effect of changes in autonomic tone. Exceptions are patients with anxiety neurosis and those with vasoregulatory asthenia. A combination of both tests gives, in addition, increased diagnostic validity in the evaluation of thyroid function (12).

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