Quantitative study of action tremor in various patient categories

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An electronic method is proposed for quantifying the action tremor revealed by a threefold test of skill, which distinguishes young adult controls from elderly normals and patients with tremor. Parkinsonian patients can be differentiated from patients with essential tremor. The value of drugs against tremor is discussed.

Key-Words: Action Tremor — Tremorscope — TR Index

Similmente operando a l'artista che ha l'abito dell'arte e man che trema (Dante, Par. X:III, 77-78)

Working like an artist with his wonted skill but a trembling hand

Tremor is defined as a series of involuntary rhythmic oscillations in one or more spatial planes. The classic types are: resting tremor, postural tremor and action or volitional tremor. The first type is parkinsonian while the other two belong to no definite etiological categories. Some authors allow a fourth type, intention tremor, distinct from action tremor [15], seen typically in the finger-nose test.

Resting tremor and postural tremor are relatively simple models both for heuristic and for applied research compared to action tremor, which is not only more complex in scientific research terms but is also a neurological sign that is profoundly disturbing in daily life. To paraphrase Dante’s lines, we may say in modern terms that patients with action tremor often have intact cognitive functions. They are therefore woefully aware of their handicap, which to people in some jobs may be more disabling than a mild paresis [2].

Our aim here is to define a suitable method for the clinical study of action tremor and then to apply it to several categories of subjects, well and ill, before and after tremor suppressant therapy. Accurate measurement of tremor is still a problem. The rhythmic oscillations may be compounded by phenomena of hypotonia, dysmetria and myoclonia. One patient may have several types of tremor. The tremor may develop in one plane rather than another. Refined techniques are costly and in the main suitable for the laboratory; for research rather than for routine clinical use. A three-dimensional system for tremor of the hand using accelerometers connected to electronic computers may perhaps yield the most complete measurements [17]. Almost all simple techniques explore only one plane, by means of optical, mechanical or electrical devices. Our experimental model simulates a routine motor skill, the act of writing. In rare cases this motor act may be the only one to trigger the tremor, perhaps a variant of essential tremor. The method is not costly or tedious for the patient. The apparatus is simple and portable. The test may be administered by a nurse. The questions we investigate are as follows: 1) the validity of the method; 2) the difference between elderly normals and a young control group; 3) the difference between elderly normals and patients with pathological tremor; 4) the difference between groups of patients with tremor of different origin; 5) the effectiveness of drugs.
Method

Subjects

We studied 74 patients classified by their history and by examination, internist and neurological, as follows: 28 parkinsonians (all with associated rigidity), 5 hyperthyroid patients (with raised T3 and T4 and radioisotope scan showing increased uptake), 8 patients with senile tremor, 14 with emotional tremor (basically neurotics), 5 with toxic tremor (alcoholics), 8 with familial tremor (arising in youth without a family history and without manifestly neurotic personality).

There were two control groups: one of 48 elderly subjects (mean age 71 years); healthy, active and not on drugs of any kind, and the second of 100 young adults (mean age 29) likewise free from disease.

All the recordings were taken in the morning after breakfast. The patients had been off drugs for at least 15 days. After the test they were treated for two weeks and then retested.

Apparatus

Action tremor was measured with an instrument we call a "tremorscope", which consisted of a metal panel mounted on a box at an angle of 15° and a digital display. The panel presented three full-thickness grooves, one straight and parallel to the edge of the panel, one oblique and one wavy, of varying length: 21, 22 and 52.4 cm respectively. The examinee had to hold a metal stylus having a 1.8 mm tip, like a pen. The panel had zero voltage and the stylus an anode voltage of 10 V; every contact closed a circuit (Fig. 1). The panel was like a desk, on which the examinee could rest his forearm. A minimum of training immediately before the test was necessary. The test started when the stylus passed in front of a photodiode hidden under the panel which operated a clock. Running along the groove from left to right, trying to avoid contacts, the examinee stopped the clock when he ran the stylus in front of a second photodiode, also hidden under the panel. The digital display could show three values: the total test time, that is the number of seconds between two consecutive passes in front of the photodiodes, the number of contacts, and the total time spent in the contacts, that is the time accumulated for each error. To avoid resonance, the "tremorscope" was fitted with an RC set acting as a filter to ensure that a unit and not a multiple of it would appear on the display for each contact. A reset device cleared the display for the next test.

Statistics

Three values were obtained for each examinee for each of the 3 runs. As none of the three parameters recorded could be considered discriminant on its own, we took the frequency of contacts per second and a function, which we called $T_R$, based on all the values measured. With $t$ the total test time, $n_c$ the number of contacts and $t_c$ the total contact time, the frequency of the contacts $f_c$ was given by $f_c = n_c / t$ and the function $T_R$ by:

$$ T_R = \int \left( \left( \frac{t_n \times t_{tc}}{t - t_c} \right) \right)^{1/2} $$

$T_R$ is zero if one of the parameters is nil: absence of tremor.

$T_R$ is a decreasing function of $t - t_c$, decreasing as the error-free interval lengthens, while it is an increasing function of the parameters: total time, number of contacts and total contact time.

The 74 values of the function $T_R$ and the 74 values of $f_c$ were subjected to the Kruskal-Wallis