A METHOD OF STUDY OF THE HUMAN MYOTATIC REFLEX

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Translated from Byulleten' Eksperimental'noi Biologii i Meditsiny, Vol. 52, No. 9,
pp. 124-126, September, 1961
Original article submitted September 7, 1960

The myotatic or stretch reflex is one of the simplest, and was studied in detail by Sherington and his school [2]. The effect is that an innervated muscle offers a resistance to extension. The reflex is maintained as long as the tension is applied, and its strength depends upon the applied tension.

This simple spinal reflex illustrates many of the general features of human reflex activity.

Because until recently no clinical studies have been made, we decided to investigate the problem by using the method of G. V. Dzhikiya [1], who applied the technique of equitonometry.

The apparatus is shown in Fig. 1. It consists of a vertical column (7) which bears a horizontal arm to the end of which is fixed a scale (6) and a pendulum (5). A movable platform (1) is pivoted about a vertical axis fixed to the base, and its angular position is indicated by a pointer (3), which is read against a scale (2), while a writer (4) makes a mark on a kymograph.

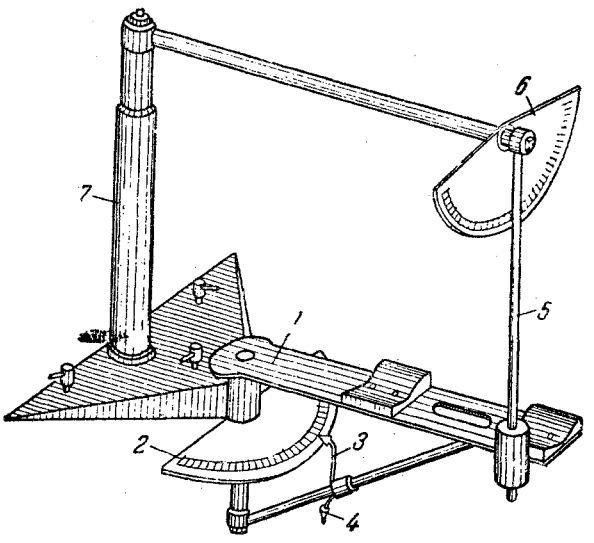

Fig. 1. Diagram of the equitonometer. Explanation in text.

In use, the forearm and wrist lie freely on the platform in such a position that the forearm can rotate about the elbow joint as it lies on the platform, and all the muscles of the arm are, as far as possible, relaxed. The bob of a pendulum can be made to strike the edge of the platform. The strength of the blow is measured by the angle of deviation of the pendulum from the vertical, as indicated by the scale, and may be calculated (in kg-meters) from the formula:

$$E = mgH \sin\alpha \frac{1}{\cos\frac{\alpha}{2}}$$

where H is the length of the pendulum arm; m the weight of the bob.

In our experiment H was 36 cm, and m was 450 g.

After the blow, the horizontal platform to which the arm was applied is slightly displaced, with the result that there is a passive extension of a certain group of muscles (the flexors or extensors, according to the direction of the blow). The reflex extension causes a reverse movement of the platform on account of the contraction of the stretched group of muscles.

As a rule, a kymographic record obtained with a series of blows of increasing strength has the appearance shown in Fig. 2,a.

Sometimes, after a single extension of a group of muscles, a large number of oscillations occur (rhythmical reflex, Fig. 2,b).

The electromyographic recording confirms the true reflex nature of the myotatic response.

In analyzing the curve, G. V. Dzhikiya suggests that account be taken of the amplitude of deviations I and II (see Fig. 2, a). Deviation I represents the movement of the platform, and corresponds to the passive extension of the muscles. Deviation II, is the portion representing the return movement of the platform produced by contraction of the stretched group of muscles, and it continues after the platform has returned to its original position. Consequently, deviation II represents part of the myotatic reflex, and indicates its magnitude.

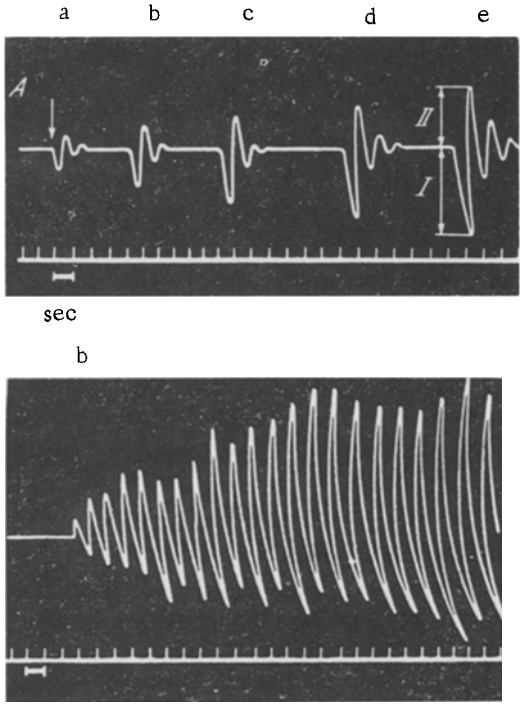

Fig. 2. Record of (A) a normal myotatic and (B) a rhythmical reflex; a, b, c, d, and e) myotatic reflex to blows of increasing strength (pendulum displaced to 10, 15, 20, 25 and 30° from the vertical); I and II – deviations. The arrow indicates the direction of the initial movement of the platform.

We also recorded the reflex time: the ratio of deviation I to deviation II when the reflex elicited was due to the action of the extensors, and when it represented the flexor response, and we also recorded the number of successive oscillations.

We investigated 20 healthy subjects aged 25 to 32 years. The reflex was repeated several times under identical conditions in the same subject at different time intervals (1 - 2 hours, 1 - 2 days, 2 months) in order to establish consistent results. In all 1,070 recording were obtained.

The results showed the following features.

1. In a single individual, the nature of the reflex remains fairly constant.

2. The reflex time is 0.3 - 0.9 seconds.

3. The amplitude of deviation I, elicited by stretching the extensors is greater than that due to stretching the flexors. For the right arm the difference was 3.8%, and for the left 11.5%.

4. The amplitude of deviation II for stretching either the extensors or the flexors of the right hand has

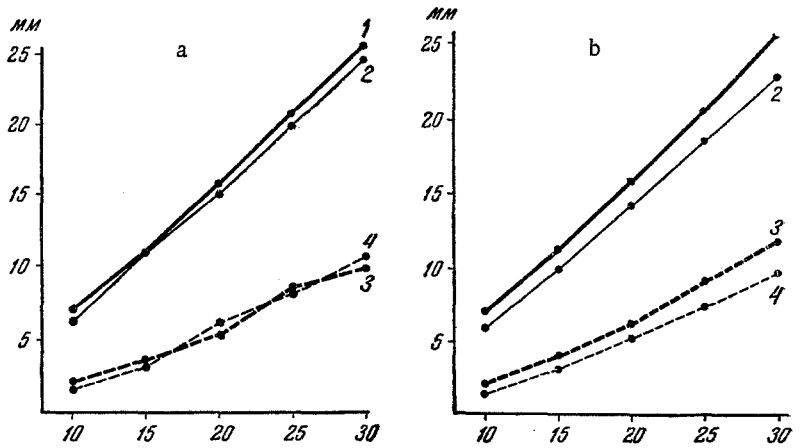

Fig. 3. Mean values of the myotatic reflex for the right (a) and left (b) arm. Abscissa – angular displacement of pendulum (in degrees); ordinate – amplitude of the deviation (in mm). 1) Extensors; 2) flexors; 3) extensors; 4) flexors; 1, 2) deviation I; 3, 4) deviation II.

almost the same value, whereas in the left hand, the value for the extensors was 18.8% higher than for the flexors.

5. In comparing the deviations II of the right and left hands, it was found that for the extensors it was 8.9% higher for the left arm, whereas for the flexors it was 7.8% higher for the right arm.

6. There is, therefore, a difference in the amplitude of the reflex of the left and right arms. Graphs showing the relationship between the main values of deviations I and II are shown in Fig. 3.

7. The correlation between the amplitude of the reflex and the extensive force is very constant, i.e. there is a regular strength relationship (Fig. 3).

From what has been said it can be seen that medical application of this method is justified for studying patients in whom impairment of reflex activity might be anticipated.

SUMMARY

The results obtained by the method of equitonometry in measuring the myotatic reflex in man are described. Besides recording the responses mechanically as suggested by G. V. Dzhikiya [1, 2] a control was made by recording the electromyogram. A determination was made of the mean reflex time, and of its correlation with the strength of the stimulus; both flexors and extensors were stimulated in 20 healthy individuals, and consistent readings were obtained from a total of 1,070 records of the movements. The method may, therefore, be recommended for the clinical study of reflex disturbances.

LITERATURE CITED

1. G. V. Dzhikiya, Research Reports of the N. K. Krupskaya Moscow Regional Pedagogical Institution [in Russian] 102, No. 5, 1961.
2. R. Creed and D. Denny-Brown, Eccles I. Reflex Activity of the Spinal Cord [in Russian] Moscow, Leningrad 1935 (Translated from the English).

All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
