Proceedings of the First International Congress of NEUROLOGICAL SCIENCES

BRUSSELS

Volume III

ELECTROENCEPHALOGRAPHY, CLINICAL NEUROPHYSIOLOGY AND EPILEPSY

Edited by
Dr. LUDO VAN BOGAERT
and Dr. J. RADERMECKER

PERGAMON PRESS
LONDON NEW YORK PARIS LOS ANGELES

FIRST INTERNATIONAL CONGRESS OF NEUROLOGICAL SCIENCES

PREMIER CONGRES INTERNATIONAL DE SCIENCES NEUROLOGIQUES

Brussels, 21–28 July 1957

VOLUME III

Edited by

L. van BOGAERT

J. RADERMECKER

FOURTH INTERNATIONAL CONGRESS OF ELECTRO-ENCEPHALOGRAPHY AND CLINICAL NEUROPHYSIOLOGY

EIGHTH MEETING OF THE INTERNATIONAL LEAGUE AGAINST EPILEPSY

IVE CONGRES INTERNATIONAL D'ELECTRO-ENCEPHALOGRAPHIE ET DE NEUROPHYSIOLOGIE CLINIQUE

VIIIE REUNION DE LA LIGUE INTERNATIONALE CONTRE L'EPILEPSIE

PERGAMON PRESS LTD.
4–5 Fitzroy Square, London, W.1.

PERGAMON PRESS INC.
122 East 55th Street, New York, 22.
P.O. Box 47715, Los Angeles, California.

PERGAMON PRESS SARL
24 Rue des Écoles, Paris, V^e^.

Library of Congress Card No. 58–12672

Printed in Great Britain by Billing & Sons Ltd.,
Guildford and London.

PREFACE

It was possible to publish the complete texts of the reports, concerning the invited discussions, before the opening of the First International Congress of Neurological Sciences, by reason of a subsidy from the National Institute of Neurological Diseases and Blindness. They were distributed to registered members of the Congress. A certain number of copies were obtained after the Congress by members or experts who were not subscribers, on application to the publishers, the Acta Medica Belgica.

The résumés of all communications presented and received before the 15th May 1957 were published before the Congress and edited by Excerpta Medica. Each member received those relating to the subject for which he was registered. A certain number of copies concerning other subjects were obtained by those requiring them from our publishers, during and after the sessions.

During the administrative sessions which were held on the closing day of the First International Congress of Neurological Sciences, we were commissioned by the organisers of the various sections to publish the complete texts of communications concerning the topics and open communications, those discussions and communications received late, and those discussions not yet published.

We have added to this the complete reports and discussions of the special session organised on the opening day of the Congress by the International League against Epilepsy, the résumés of which were not published in those papers circulated in advance by Excerpta Medica. These documents have been included in the volume of the Fourth International Congress of Electroencephalography and Clinical Neurophysiology.

The original texts of the Round Table Conference, under the auspices of the C.I.O.M.S. and the Congress, dedicated to the problem of the Future of Neurology, and entitled 'Neurology at the Crossroads', the speeches delivered at the official opening session in the presence of His Majesty the King, those given at Louvain at the Centenary Celebration of Arthur Van Gehuchten and those at the Congress Banquet have been inserted in Volume V entitled 'Joint Meetings'.

An appeal was sent a few days after the Congress to all authors of reports or discussions. Many of them sent us modified or revised texts or supplementary figures. Some did not reply at all. We are publishing the texts which were received.

Many texts were written by their authors in a language other than their mother or habitual tongue. This is a obligation inherent in Congresses such as ours.

On the other hand, the medical editors complain more and more of a lowering standard of literary expression and a lack of grammatical care in the papers received. In order that the quality and intelligibility of our publication should be maintained we have often been obliged to modify the

texts submitted or to translate them into one of the three languages used at the Congress. We have only made those changes which were indispensable, being more concerned with retaining the exact thought of the writer rather than giving impeccable literary style. This was an additional source of work and caused an unforeseen delay to this supplementary publication. This is also the reason for not having been able to submit the proofs to the authors, nor send for those figures mentioned in the texts and not enclosed, or the missing bibliographies. This would have delayed publication for several years and, in view of the rapid development in the various subjects, would have affected their pertinence and significance.

We have done our best not to depart from the author's original ideas. If we have not always succeeded we ask you to excuse us.

We should like to thank Captain Maxwell and all those connected with Pergamon Press Ltd., for their work and time without which even an attempt at publication could not have been considered. We wish in particular to thank Miss M. Fleming for her valuable assistance in helping with the completion of this task.

Ludo van Bogaert
Joseph Radermecker

Editors

PREFACE

Les textes complets des Rapports, ceux des Discussions sur Invitation avaient pu être publiés avant le début du Premier Congrès International des Sciences Neurologiques grâce à un subside du National Institute of Neurological Diseases and Blindness. Ils furent distribués aux membres régulièrement inscrits au Congrès. Un certain nombre d'exemplaires ont été obtenus après le Congrès par les interessés non inscrits, sur demande auprès de nos Editeurs, les Acta Medica Belgica.

Les résumés de toutes les communications présentées et reçues avant le 15 Mai 1957 avaient été publiés avant le Congrès dans les fascicules édités par Excerpta Medica. Chaque membre les a reçus pour la discipline où il était inscrit. Un certain nombre d'exemplaires concernant d'autres disciplines ont été obtenus par ceux qui le désiraient auprès de ces Editeurs, pendant et après les Sessions.

Lors des séances administratives qui ont eu lieu le jour de la clôture du 1er Congrès International des Sciences Neurologiques, les Bureaux des différentes disciplines nous ont confié la tâche de réaliser la publication des textes complets des communications concernant les thèmes et des communications libres, ceux des discussions et communications reçues trop tard,ceux des discussions non encore publiées.

Nous y avons ajouté les Rapports complets et les discussions de la Séance spéciale organisée le jour de l'ouverture du Congrès par la Ligue Internationale contre l'Epilepsie, rapports dont les résumés n'ont pas été publiés dans les fascicules précirculants des Excerpta. Ces documents sont insérés dans le volume du IVe Congrès International d'Electroencéphalographie et de Neurophysiologie clinique.

Les textes originaux de la Conférence de table ronde consacrée, sous les auspices du C.I.O.M.S. et du Congrès, au problème de l'Avenir de la Neurologie, les allocutions de la Séance Solennelle d'Ouverture en présence de Sa Majesté le Roi, celles prononcées à Louvain lors de la Célébration du Centenaire d'Arthur Van Gehuchten et au Banquet du Congrès sont insérés dans le volume V consacré aux 'Journées Communes'.

Un appel avait été envoyé au lendemain du Congrès à tous les auteurs de rapports et de discussions. Beaucoup d'entre eux ont envoyé des textes remaniés ou augmentés avec des figures supplémentaires. D'autres n'ont pas répondu. Nous publions ce que nous avons reçu.

Beaucoup de textes ont été rédigés par leurs auteurs dans une langue qui n'était pas leur langue maternelle ou leur langue véhiculaire habituelle. C'est là une servitude inhérente à des Congrès comme les nôtres.

D'autre part, les éditeurs médicaux se plaignent de plus en plus d'une baisse dans la pertinence de l'expression littéraire et dans le souci grammatical des travaux reçus. Pour conserver à la publication que nous avions entreprise une certaine qualité et surtout une intelligibilité

suffisante nous avons été obligés souvent de remanier les textes soumis ou de les faire traduire dans une des trois langues véhiculaires principales de nos Congrès. Nous n'y avons introduit que les changements indispensables, plus soucieux de ne pas altérer la pensée exacte des des auteurs que d'apporter un texte linguistiquement impeccable. Ce fut une source de travail supplémentaire et l'origine d'un délai imprévu dans la réalisation de cette publication complémentaire. C'est aussi la raison pour laquelle nous n'avons pas pu soumettre aux auteurs les épreuves de leur contribution, ni réclamer les figures annoncées dans le texte et non envoyées ou les bibliographies manquantes. Ceci eut remis la parution à plusieurs années et aurait - en raison de l'évolution rapide de nos disciplines - enlevé à beaucoup de travaux leur actualité et, de ce chef, leur portée.

Nous avons fait de notre mieux pour ne pas trahir la pensée des auteurs. Qu'ils nous excusent si nous l'avons fait.

Nous tenons à remercier le Capitaine Maxwell et le personnel d'edition de Pergamon Press à tous les degrés de la hiérarchie du sacrifice inconditionnel qu'ils nous ont consenti de leur travail et de leur temps, sacrifice sans lequel la tentative même de cette publication ne pouvait etre envisagée. Nous tenons à remercier tout spécialement à cette Miss M. Fleming de son aide si précieuse.

Ludo van Bogaert
Joseph Radermecker

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MEASUREMENT OF THE REFRACTORY PERIOD OF STRIATED MUSCLE IN MAN

MESURE DE LA PERIODE REFRACTAIRE DU MUSCLE STRIE CHEZ L'HOMME

PAUL F. A. HOEFER
New York, U. S. A.

The present report deals with an attempt to introduce into clinical neurology measurements of the refractory period of striated muscle in man.

This approach differs basically from other forms of electrodiagnosis in which the excitability of nerve and muscle is determined by threshold responses, chronaxie measurements and the plotting of strength-duration curves.

Our own measurements are concerned with the time necessary for recovery of excitability, following application of the first of two maximal shocks to the motor nerve. The muscle action potential is used as an indicator. The second shock is applied when the muscle action potential with its after-discharges is over. The interval between the two shocks is then gradually shortened until the second shock no longer produces a visible response. This critical interval represents the relatively refractory period.

Two square pulses are used for stimulation. They are independently variable in duration and amplitude. The maximal electromotor force is 135 volts. Conventional stimulating electrodes are used. The stigmatic electrode is placed on superficial motor nerves or motor points of muscles. The recording electrodes were purposely varied. We have used coaxial needles, single needles in reference to a large surface electrode, and finally also pairs of needle electrodes, inserted in the muscle at varying distances. Measurements are made from many areas in different portions of all muscles, which are tested. Each figure obtained for individual areas represents the average of three measurements. A two-beam oscilloscope is used with appropriate timing signals and calibrators. Each beam can be triggered by either one of the two stimuli. The time base is selected as to permit visualisation and photography of the entire double response.

Our findings so far are limited to 19 normal subjects, in whom representative muscles were tested. Most subjects had several examinations of one or several muscles. Thus we have data on a total of 258 examinations, derived as described.

The table is presented to show the muscles which were examined, the number of examinations for each muscle and the range of the refractory periods for each muscle in milliseconds. The low, high and average figures are shown.

By plotting all 258 determinations in terms of time, a suggestive Gaussian bell shaped distribution curve is obtained with the maximum at 1·8 milliseconds and with practically all points found between 1·2 and 2·6 milliseconds.

In contrast to the statistically significant distribution of these figures the muscle action potentials themselves show a great irregularity

	Number of Determinations	Refractory Period in Milliseconds		
		Low	High	Average
Trapezius	11	1·2	2·5	1·8
Deltoid	17	1·1	1·8	1·4
Biceps	32	0·9	2·8	2·0
Triceps	19	0·9	2·6	2·0
Ext. Carpi Radialis	2	1·1	1·8	1·5
Flexor Digitorum	6	1·7	2·2	1·8
Flexor Pollicis Brevis	16	1·0	2·0	1·9
Abductor Digiti V	21	1·7	2·4	2·0
Pectoralis	6	1·1	1·7	1·6
Brachioradialis	17	1·3	3·0	2·0
Quadriceps	44	0·9	2·1	1·5
Tibialis Anticus	16	1·0	2·3	2·0
Peroneus Longus	14	1·5	2·7	1·7
Gastrocnemius	37	1·3	2·8	2·0
Total Number	258			
Over-all Average				1·8

in appearance, phase-relationships and duration. We have found in tibialis anticus of the same subject tested on different days, variations ranging from a brief spike of about one millisecond duration on one occasion, to a highly complex, multi-phasic potential with after discharges lasting for almost ten milliseconds, both reproducible for the experiment and area of derivation. Yet, in these two instances the refractory periods varied only from 1·6 to 2·3 milliseconds.

Peak deflections of the action potentials do not vary greatly for a given type of muscle, for instance 12·0 to 24·0 millivolts in peroneus longus.

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ELECTRODIAGNOSIS AND ELECTROMYOGRAPHY IN PROGRESSIVE MUSCULAR ATROPHY AND AMYOTROPHIC LATERAL SCLEROSIS

ELECTRODIAGNOSTIC ET ELECTROMYOGRAPHIE DANS L'ATROPHIE MUSCULAIRE SPINALE PROGRESSIVE

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The paucity of literature in progressive muscular atrophy and amyotrophic lateral sclerosis as to the diagnostic or prognostic value of any electrodiagnostic procedure suggested that we undertake this study. From previous investigations in various clinical entities, it has been found that no one electrodiagnostic or electromyographic procedure was adequate. Many times, one procedure would be normal where another one would be abnormal. We have found that a battery of electrical tests enables us to come to a more definite conclusion as to the abnormality of the muscle.

With this in mind we gathered together all of our material on these two subjects and then attempted to analyse and correlate then with whatever clinical findings we had available. An attempt will also be made to explain these electrical findings which do not always show the so-called classical picture of complete reaction of degeneration.

The battery of electrical tests consisted of speed of muscular contraction to galvanic stimuli, cathodal tetanus ratio, (and in some cases both cathodal and anodal tetanus ratio), and the response to repetitive stimuli or interval curves (using 1 msec. stimuli at 1, 5 and 12 msec. intervals). Electromyographic examinations consisted of the recording of spontaneous potentials, such as fibrillation and fasciculation, and the observation of active potentials as to strength, duration, and frequency on minimal and maximal motion. Only a single amplifier was available.

I. PROGRESSIVE MUSCULAR ATROPHY

In this group there were 11 patients with 59 muscles examined electrically. The diagnosis was made by more than one neurologist over a period of time. All the patients had the classical signs of progressive muscular atrophy. The duration of illness was from one-half year to 28 years with a median duration of five years. The age of onset ranged from 25 to 60 years, with a median of 45 years. The deep reflexes were said to be absent in 6 patients and decreased in 5 patients. In none were the deep reflexes considered normal. Of the 11 patients all four extremities were involved in weakness, and to paralysis in 9; in one patient only the lower extremities were involved; and in one only the upper extremities were involved. In 2 patients there were bulbar signs. In one patient the face was thought paretic, but this was not clear-cut.

Speed of contraction of galvanic stimuli

There was a total of 46 examinations with respect to this type of contraction. Four plus is considered a normal rapid twitch. In 7 there was no contraction at maximum amounts of current. In 7 the contraction was one plus; in 11, two plus; and in 17, three plus. In 4 the contraction was considered normal at four plus. In other words, in 25, or 54%, the type of contraction was abnormally slow from zero to two plus.

Cathodal galvanic rheobase (Fig. 1).

Cathodal rheobase was determined in 55 muscles. The range of current was from 1·1 milliamperes to greater than 25 milliamperes. The median rheobase was 4.3 milliamperes. These may well be within the range of normal although 1 milliampere shows a hyperirritable muscle.

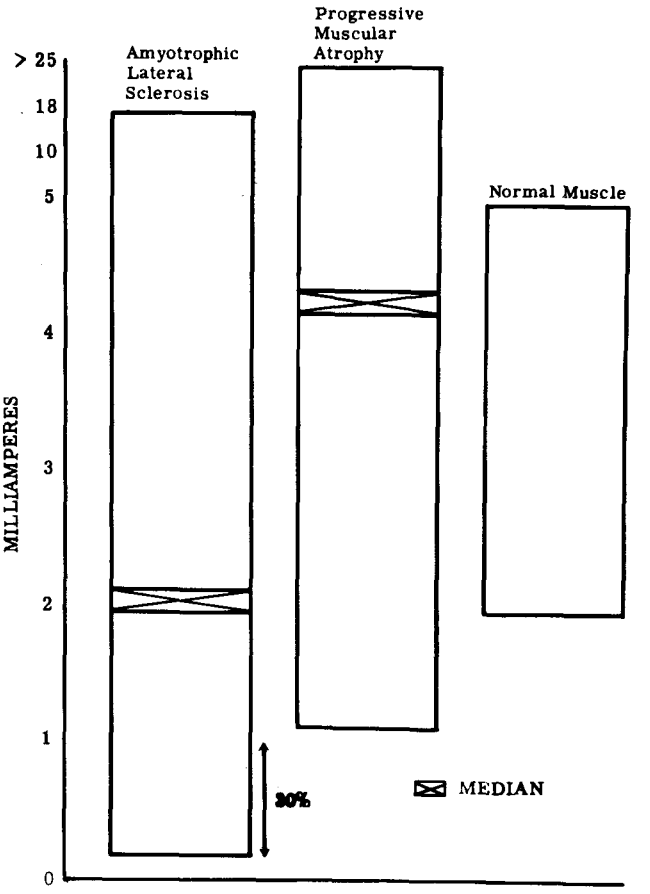

Fig. 1. Rheobase-Range and/or Median.

Greater than 25 milliamperes was certainly to be considered a hypo-irritable muscle. This could be due to reneurotised muscle, unless very little or no muscle was left, or in which there were trophic changes i.e. edema which would shunt the current in the muscle. Re-innervation or neurotisation has been shown by us (Pollock, et al), and recently by Wohlfart in the branching out from normal neurones to previously denervated muscle.

Rheobase or polar ratio (Fig. 2)

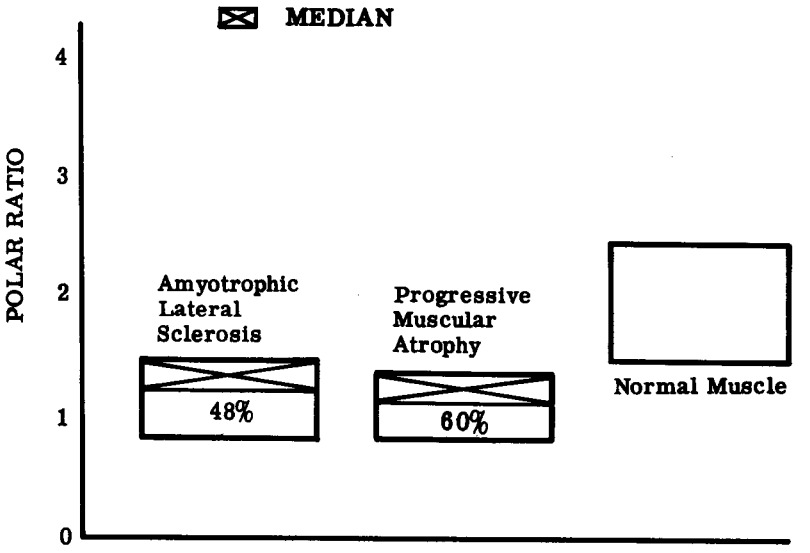

Fig. 2. Polar Ratio - Median and/or Range

In the older literature the reversal of the polar ratio was considered very diagnostic and significant. We have not always found it so in analyses of various clinical entities. This ratio results from the anodal rheobase divided by the cathodal rheobase. Normally the ratio is at least 3 to 2, or 1·5. The polar ratio was 1 or less in 8 muscles, and 1 to 1·3 in 5 muscles. The remainder of the examinations were over 1·4; i.e. in 13, or 60% of these examinations the polar ratio was abnormal between less than 1 to 1·3.

Chronaxie (Fig. 3)

There were 45 examinations for chronaxie. The range was less than 1 (normal) to 20 msec. In 20 muscles the chronaxie ranged from 5 to 20 msec., and in 27 muscles, or 60%, the chronaxie was from 1·5 to 20 msec. If a safer figure of 5 or more msec. was taken, then there were 20, or 44%, such abnormalities in the total muscles examined for chronaxie.