AGE-RELATED DIFFERENCES IN THE REACTIVITY AND SENSIBILITY OF SKIN VEGETATIVE STRUCTURES DETERMINED BY MEANS OF VARYING IN INTENSITY ELECTROPHORETIC EFFECTS OF ACETYLCHOLINE

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The process of aging is characterized, apart by various morphological, biochemical, physiological and psychic changes (1, 6, 12), also by changes in the sensibility and reactivity of the organism. Some authors accept that the ontogenetic development is characterized by various levels of adaptation to the environment (9). It is furthermore stressed that no significant changes in the homeostasis occur, regardless of the reduction of the adaptational capabilities of the organism.

We utilized the electrophoretic dermogram (EPDG) and described characteristic age-related differences, equally concerning the values of electroconductivity, and the typology of vegetative reactivity (3).

Based on literature and personal data, we made it our aim to trace the age-related changes in the electroconductivity of the skin, employing varying in intensity electrophoretic effects with acetylcholine. Thus an attempt was made to obtain data not only about the age differences in the reactivity and sensibility of the skin, represented by its electroconductivity, but also about elucidation of some of the theoretical issues concerning the EPDG, assumed as a method of determination neurovegetative reactivity.

METHOD. We used the principle of the EPDG method (5, 13, 14), introducing electrophoretically only acetylcholine with which in an earlier report (3), we described the most significant and characteristic changes as related to the various age groups.

Two series of experiments were carried out, each based on the investigation of two groups of individuals — one comprising young subjects (up to 20 years) and the other — elderly subjects of advanced age (over 75 years).

In the first experimental series (group one of 21 subjects with average age 19 years, and group two, comprising 24 subjects with average age 78 years) the dosage of the acetylcholine was secured by introducing one and the same concentration of the substance (1:10) over different time intervals (for one minute — strong effect; for half a minute — medium intensity effect; for a quarter of a minute — weak intensity effect). In the second experimental series (group three, comprising 20 individuals with average age 10 years, and group four of 19 individuals with average age 75 years), the various acetylcholine dosage was secured by introducing acetylcholine at different concentration over a 1 min. period, at 3 different points (1:10 — strong effect; 1:100 — medium effect and 1:1000 — weak effect).

The introduction of acetylcholine was invariably accomplished with the anode at 1 mA power of the current, using the skin along the volar aspect of the left forearm. The electroconductivity over the treated areas was measured with the cathode (plane 1 cm^2) per minute during application of current with tension 1 volt. The Multiflex galvanometer (2.10^{-8} A per scale degree; 60 ohm) was used for recording. Recordings were taken three times — at 4 min. after the introduction of acetylcholine; at 10 minutes after the first recording; at 10 minutes after the second recording. For control purpose, the electroconductivity over the untreated site of the skin was also measured prior to electrophoretic influence and after each measurement. This background electroconductivity never exceeded 0.5—1 scale degrees of the galvanometer, and in most of the cases was zero or within the limits 0.1—0.2 scale degrees of the galvanometer. The temperature of the room where the investigation was carried out ranged between 18 and 22 degrees C.

Results and Discussion

The reactivity of the skin vegetative structures may be determined with the aid of the ratio between the values of the first and second measurement of electroconductivity after the acetylcholine electrophoresis (Table 1).

Table 1

Arithmetical means (M), mean square variation (σ) and average error of the arithmetical means (m) of electroconductivity, measured in the skin points treated with acetylcholine, according to age groups

Group	The dosage of influence	I measurement			II measurement			III measurement		
		M	σ±	m±	M	σ±	m±	M	σ±	m±
Group I up to 20 y.	for 1 min.	50.30	17.00	3.71	22.00	11.15	2.41	11.60	7.22	1.58
	for 1/2 min.	43.90	11.15	2.41	17.70	10.00	2.18	8.90	5.56	1.23
	for 1/4 min.	32.60	7.32	1.58	10.90	6.46	1.41	5.60	3.50	0.76
Group II above 60 y.	for 1 min.	22.10	8.19	1.67	12.60	6.72	1.37	8.30	5.06	1.03
	for 1/2 min.	19.50	7.96	1.63	11.20	6.08	1.25	7.50	4.63	0.95
	for 1/4 min.	13.00	8.67	1.77	7.10	4.75	0.97	4.20	4.38	0.89
Group III up to 20 y.	with 1 : 10 sol.	49.90	18.30	4.08	16.90	10.65	2.44	7.90	6.62	1.48
	with 1 : 100 sol.	41.20	15.05	3.36	11.50	9.35	2.09	4.80	3.94	0.88
	with 1 : 1000 sol.	32.90	17.30	3.86	9.20	8.80	1.96	3.80	4.07	0.90
Group IV above 60 y.	with 1 : 10 sol.	23.90	5.32	1.22	13.50	4.81	1.10	9.20	4.43	1.13
	with 1 : 100 sol.	20.90	5.34	1.22	11.90	4.64	1.07	7.30	4.85	1.11
	with 1 : 1000 sol.	18.90	4.31	0.99	9.40	4.50	1.04	6.20	5.20	1.19

The optimal integration of these values is presented by the angle at the peak of the EPDG, expressed graphically (Fig. 1). The data concerning the angle for the various groups and for the varying in intensity influences are the following:

Influence	Group I	Group II	Group III	Group IV
Strong	25°	57	21	55
Medium	25	62	24	57
Weak	30	77	30	57

The above data warrant the inference that with aging, the skin reactivity decreases. It is evident that for the young group it is changed at comparatively equal rates, from strong towards weak influence. The greatest changes in the reactivity as regards the different types of stimulants is observed

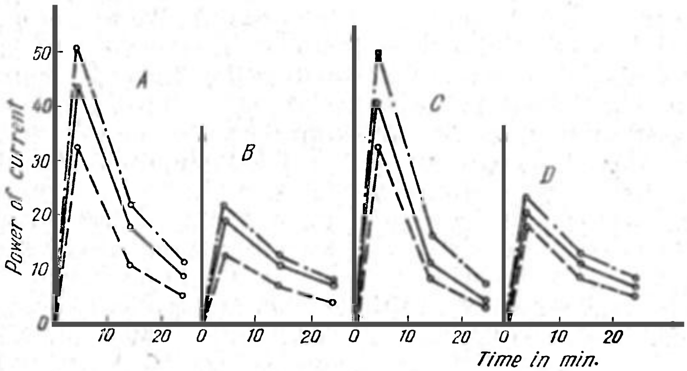

Fig. 1

[1]- - - - strong effect
——— medium intensity effect
—.—.— weak in intensity effect
A. young individual of the first experimental series
B. old individuals to the first experimental series
C. young individual of the second experimental series
D. old individuals of the second experimental series

in group two, where the angle from 57° is increased to 77 degrees. Virtually no changes are noted in group IV when comparison is made of the values of the angle for the varying in intensity stimulants. In the same group, the angle remains within the range 55—57 degrees. This is an indication that the reactivity in the first experimental series, where the dosage of the stimulant is effected by altering the duration of electrophoresis, fails to reveal a significant age-related difference. The intensity of the stimulant is differentiated in a similar fashion also in group III (Fig. 1, 6), where the dosage of the stimulant is provided by the difference in concentration. In the second experimental series, however, visible age conditioned differences in the reactivity are established.

From the results submitted, the law conformity already established by the authors is outlined, namely, that electroconductivity of the skin in young and old individuals is quite different. This concerns both the varying in duration effects (Fig. 1 A and B), and the influence with different acetylcholine concentrations (Fig. 1 C and D). The differences between the respective values of the groups of each series at the first measurement and upon exerting influence with strong stimulant, only at the second measurement, are statistically reliable. Insignificant are the values between the groups of each series at medium and weak stimulant at the second measurement and in all kinds of influences for the third measurement.

The sensibility of the skin vegatative structures might be furthermore measured with the difference between the values of electroconductivity, obtained at varying in intensity influence at one and the same measurement and in one and the same group. In the young individuals' group (groups I and **III**), at the first measurement, statistically significant differences are established equally between the strong and weak influence, and between the medium and weak, and medium and strong influence. The elderly subjects' groups (groups II and IV) disclose statistically significant differences only between the strong and weak influence. At the second measurement, the differences are statistically reliable, in all groups, only between the strong and weak influence. The findings at the third measurement are similar to those of the second measurement for I, II and III group. The differences concerning group IV are insignificant.

The character of the curve at various influences with utilization of 1:10 solution of acetylcholine, introduced over varying periods of time (first experimental series), is of particular interest. Upon drawing up the curve and accordingly setting the values dependent upon each consecutive influence from the three different points, the pattern is obtained shown in Figure 2. The characteristic exponential character of the curves is evident in both groups and in the three types of influence employed. It must be accepted that a general regularity is involved of the skin electroconductivity, measured with the aid of EPDG, which is not influenced by age. The age has exerted a definite effect only on the level, which in the young group for the first and second measurement yields substantially higher values than those for the elderly subject. At the third measurement differences exist, but they are not significant (the highest T amounts to 1.78).

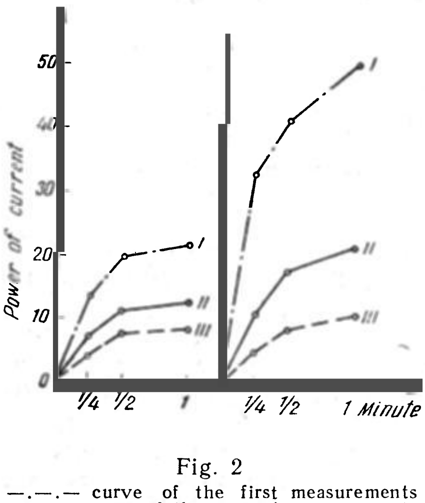

Fig. 2

—.—.— curve of the first measurements
——— curve of the second measurements
- - - - curve of the third measurements
In the leftside — elder individual of first experimental series
In the right side — young individual of the first experimental series

Our results are not in contradiction with the data available by modern gerontology, characterizing the structural and functional changes which take place in the process of aging. The studies carried over the past few years show that with the advancement of age, the functions are by no means simply dying away, but rather a qualitatively new level in the activity of the organs and systems (2, 10) is reached. The results of the present study demonstrate that in elderly individuals a reduced reactivity and lowered mobility of the vegetative processes exist, related to the electroconductivity of skin. It is true that data about increased inertness of certain vegetative functions, brought about by aging, could be found in the literature (8), but insofar as skin vegatative functions integrated in the skin eletroconductivity following electrophoretic influence with acetylcholine are concerned no reports were found.

We accept that the level of electroconductivity at the first and second measurement depends not merely on the membranous potential of the cells of stratum lucidum (15) and of the sweat glands (7, 17), but also on the sympathetic influence on the skin vegetative structures and on the level of the trophic processes in them, which was demonstrated in the course of simultaneous measurements of the EPDG and resistance of the horny layer of the skin as regards sodium base (4). The lower values of electroconductivity in old persons should be assumed as due to changes in the activity of cholinesterase and cholinoreceptors (11), and furthermore, that with aging the parasympathetic reactivity gains a prevalent role (3), never underestimating the permeability of the cells, which determines the quantity of the substance penetrating (11, 16), which in this case is connected with the «potassium-sodium pump» (3). Our data provide sufficient reason to accept the above facts, since the group of old subjects reveals significant differences in electroconductivity at the sites influenced by varying in intensity stimulants.

An important inference reached from our results is the fact that the sensibility in the first experimental series is more pronounced, regardless of the age, than that in the second experimental series. We would like to draw attention to the circumstance that the ratio between strong, medium and weak in intensity effect in the first experimental series is 1:2:4, whereas the same ratio in the second experimental series is 10:100:1000. Despite the great difference in the intensity of influence ratio in the second experimental series, the values of the electroconductivity are comparatively lower (Fig. 1 C and D). Hence, in determination of the EPDG the katelectrotonic excitability plays an outstanding role. Therefore, it should be recognized that the katelectrotone is the basic mechanism of the EPDG. Of course, the fact could by no means be overlooked that acetylcholine is being introduced into the skin. The continuous effect with direct electric current only, regardless of the substance administered, could hardly explain the occurrence of different values in the equal by duration electrophoresis of adrenalin or pilocarpine as compared to acetylcholine. The role assumed by the electrophoretically introduced acetylcholine in the local stimulation of the skin was proved by Daskalov, Markov and Milarov (13). They established that this local excitation is strongly inhibited by atropine.

And finally, it should be accepted that the katelectrotonic excitability towards which the tissues exhibit an active attitude represents a basic mechanism, substantiating the skin electroconductivity measured after electrophoretic introduction of some sort of substance, in this case EFDG-mediator substances.

Inferences

1. The reactivity of the skin vegetative structures, measured by means of varying in intensity electrophoretic influences with acetylcholine shows a reduction with aging. The reactivity is more pronounced and depends, regardless of age, on the factor duration of the effect rather than on the concentration of the substance.

2. The sensibility of the skin vegetative structures is different and depends on the intensity of influence with acetylcholine and is better pronounced in the group of young individuals.

3. The curve of the various effects reveals a character of exponential pattern, regardless of the age, which is assumed as a general regularity. The age has exerted an influence only upon the level of the curve: higher in the younger and lower in elder persons.

4. The katelectrotonic excitability substantiates the differences in electroconductivity at EPDG, without however, underestimating the type of the substance being introduced by electrophoretic routes, which accounts for electroconductivity level modulation.

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ВОЗРАСТНЫЕ РАЗЛИЧИЯ РЕАКТИВНОСТИ И ЧУВСТВИТЕЛЬНОСТИ КОЖНЫХ ВЕГЕТАТИВНЫХ СТРУКТУР, ОПРЕДЕЛЕННЫЕ С ПОМОЩЬЮ РАЗЛИЧНЫХ ПО СИЛЕ ЭЛЕКТРОФОРЕТИЧЕСКИХ ВОЗДЕЙСТВИЙ АЦЕТИЛХОЛИНА

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РЕЗЮМЕ

Опыты проводились на двух сериях людей, причем каждая укомплектовывалась из двух возрастных групп — молодых (младше 20-и лет) и стариков (старше 75-и лет). Различная дозировка воздействия осуществлялась двумя способами: одна и та же концентрация ацетилхолина вводилась в течение 1 минуты, 30 секунд и 15 секунд или в течение одного и того же времени вводились различные концентрации (1:10, 1:100, 1:1000).

Устанавливается, что реактивность кожных вегетативных структур с возрастом понижается, причем она лучше выражена, независимо от возраста, при дозировке с помощью электрофореза различной продолжительности. Чувствительность также бывает различной и зависит от силы воздействия ацетилхолина, причем лучше она выражена у лиц молодого возраста. Кривая различных воздействий имеет экспоненциальный вид независимо от возраста и поэтому допускается, что это общая закономерность. Возраст сказывается лишь на уровне кривой, причем она выше у лиц молодого возраста.

В основе различий электропроводимости, измеренной с помощью ЭФДГ, принято считать кателектротоническую возбудимость. Вид электрофоретически введеного вещества также играет немаловажную роль и позволяет дать оценку типологии невровегетативной реактивности.