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- Authors:** Гринберг Я.З.  
(Grinberg Y.)
- Article name:** Эффективность СКЭНАР-терапии. Физиологические аспекты
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- Summary:** This article, basing on modern ideas about functions, building, chemical provision of excitement transmission in nervous system, attempt to explain the physiological mechanisms of the therapeutic effect of SCENAR-therapy. Particular attention is paid to the role of neuromediators and biological activity and regulatory characteristics of neuropeptides. From this perspective, some of the postulates and the effects of SCENAR-therapy are viewed, for example such as the "principle of universality", absence of contraindications, analgetic effects and etc. It is concluded that there is indirect proofs of the fact that the high effectiveness of SCENAR-therapy is based on mechanisms of peptides activation, allow to consider the system "organism-device" as Generator of Regulatory Peptides.

## Effectiveness of SCENAR-therapy. Physiological Aspects

In the articles [1, 2] the peculiarities of SCENAR-therapy (SCENAR-influence), which single it out other methods of electrotreatment are reviewed.

The principal attention was given to difference of the influencing signal from those ones, usually used in electrotreatment.

Therapeutic mechanisms at this were reviewed in general, reasoning on the mechanisms, known in physiotherapy [3, 4]. It was marked, that thanks to activation of the tissues of somatic, as well as autonomous nervous systems with the help of SCENAR-influence it is possible to achieve a significant (in comparison with other methods of electrotreatment) therapeutic effect.

How, with the help of what physiological mechanisms is this effect achieved? To answer this question, basing on modern ideas about functions, building, chemical provision of excitement transmission in nervous system, is the aim of this article.

First of all, we will remind the basic peculiarities of SCENAR-influence [1, 2]:

1. High-amplitude and, at the same time, not damaging (short) influence.
2. Absence (significant decrease) of adaptation process. Thanks to the presence of biofeedback every impulse differs from the previous one.
3. Neutralization of the possible accommodation effect (high steepness\ conductance of the front of influencing signal).

Also we would like to mark methodological peculiarities, typical to SCENAR-therapy: device moving during the influence, activation of a number of areas, as a rule, connected with accumulation of nerve-endings, a choice of special zones (zones of small asymmetry) and others [4,5].

SCENAR carries out an electrical influence on skin. Effect of excitement of nervous tissue depends on the type of nerve fibers, composing it. In accordance with classification of Gasser and Erlanger, several types of nerve conductors [3], different in diameter, speed of conduction, the presence of myelin membrane, are singled out. These are fibers of A type: A $\alpha$  (15-20; 90-120), A $\beta$  (10-15; 50-100), A $\gamma$  (5-10; 5-30), A $\delta$  (1-10; 5-30), fibers of B type (1-3; 3-15) and fibers of C type

(0, 5-1; 0, 6-20). In the brackets a diameter in microns and conduction speed in m/s are shown. The fibers of C type are non-myelin.

It is known, that C-fibers have a high threshold of excitement. There is a rule (for a single fiber), that a value of electrical excitement threshold is inversely to fiber diameter [6].

Then current intensity for activation of C-fibers must be 15-40 times more than for A $\alpha$  fibers. But, it is necessary to take into account that at influence current from electrodes flows along the volume of tissue. It is obvious, that it will be pro rata to conductor volume (at other equal conditions), and at the given length – to its area. In this case, current intensity in C-fibers will be 225-1600 times less, than in A $\alpha$  fibers. Accordingly, for excitement of C-fibers current is necessary (at equal levels of critical membrane potential), which is accordingly more: in utmost case (diameter of A fiber is 20 microns, C-fiber – 0, 5 microns) – 1600 times more.

Here it is necessary to remind one more time, that SCENAR generates high-amplitude current pulse. Accordingly, the possibility of Excitement of thin fibers, including C-fibers, is considerably higher, than at other methods of electrotreatment.

A qualitative correlation between the mentioned fibers is also significant. Here are some examples [7, 8]. In well studied cranial cervical sympathetic ganglion there are 42000 nerve cells (rat), 16000 (guinea pig), 100000 (cat), 911000 (human being). From the general quantity of the fibers, in particular, of cat – 80 % are sensor ones, from which only 20% of myelin kind, the rest ones – are thin non-myelin with diameter 1-2 microns, i.e. fibers of C type.

During investigation of the structure of splanchnic nerves (cat) it was determined, that among 13500 fibers, 11000 are, approximately, non-myelin. The presence of B afferents was discovered. They also have small diameter and, accordingly, high threshold of excitement. B-fibers were discovered also in parasympathetic vagus nerve and pelvic nerve. The quantity of C-fibers in them is 90% and 60 % accordingly.

So, thin non-myelin and weak-myelin fibers form the most part of the main nerve ways.

Further on we will review modern ideas of chemical conduction. Its foundations were laid at the beginning of the 20<sup>th</sup> century. Signal transmission in neuroeffector compounds is mediated by release of acetylcholine and adrenalin from nerve endings. Till the end of the 50<sup>th</sup>, 2 groups of chemical compounds were considered to be neuromediators (NM), they are called “classic” (“traditional”, “usual”) now: amine (acetylcholine ACH, noradrenalin (NA), adrenalin, dopamine, serotonin) and amino acids (glycine, glutamic, aspartic, gammaaminobutyric). In the 60<sup>th</sup> new, the third group of neuromediators was discovered – purine nucleotides.

In the middle of the 50<sup>th</sup> a supposition about neuromediator role of the peptide- P substance (PS) was made. Since, neuropeptides (NP) have made the fourth, the most numerous group of neuromediators. At this, the existence of the representatives of different groups of substances in the same neurons of central and peripheral nervous systems was observed [9]: several classical NM, classical NM+NP; several NP. Purines are added to these compounds.

In the context of the task, being discussed, we are interested in those characteristics of NM, which, finally, can influence the therapy. Biologically active characteristics of classical NM are known quite enough [3,6]. That's why the main attention we will pay to NP characteristics.

In table 1 [9,10] the more general characteristics of neuropeptides biological activity are given.

The following abbreviations are accepted for NP: CCK – cholecystokinin, VIP – vasoactive intestinal peptide, ACTH - adrenocorticotrophic hormone, CGRP – calcium-gene related peptide.

The analysis of the table shows, that every of the given NP (groups of NP) does not only have a completely coinciding list of biological activities, but has clearly expressed characteristics or the complex of characteristics. Together with it, a lot of physiological functions are under control of not one, but a number of NP, every of which plays as created by evolution ‘program package’ for switching on and modulation of a concrete complex of functions. NP, together with other humoral regulators forms functional continuum, providing realization of any compatible biological activities. In the table 2 there is a list of concrete functions, on which neuropeptides exert a significant

influence. Here it is appropriate to shift from the definition of NP to definition regulatory peptide (RP), which, in connection with the marked characteristics of NP, are used as synonyms.

Definition RP [9] is somewhat broader, because a whole range of RP is worked out not by neurons. Together with it, a persevering search of neurons, producing peptide, which was considered before to be not neuronal, in many cases, was a success.

The next important characteristic of NP is its long existence in the liquids of the organism. Thus, if an average time of existence of ACH effective concentration is splits seconds ( $10^{-2}$ ), catecholamines, serotonin, histamines, GABA, from  $10^{-1}$  up to 5 s, than for small peptides, it is up to dozens of seconds, and for mediums and large – up to dozens of hours.

Other characteristic of NP, which differs them from usual NM, lies in the fact, that NP decomposition is often not a simple act of regulator termination, but reaction of forming of a new bioactive compound. Activity of the last doesn't coincide with the activity of an initial NP and has a qualitative difference. There is a forming of complex series and cascades. Every of thoroughly studied peptides discovered the ability to induce the output\outcome in blood, liquor, and intercellular mediums of organism of other definite NP. Every of them, in their turn, are able to such inducing effects. It is possible, that prolonged effects of short-lived NP are explained by, namely, the existence of such regulatory chains\ chains.

Here it is appropriate to suppose, that the possibility of appearance of series and cascades significantly increases, if the dose of NP exceeds a certain threshold, i.e. when an effective dose of NP is released.

Distant effects are logical continuation of the previous characteristics (duration of existence and forming of complex series and cascades). NP leave the area of synapse and influence more or less remote receptors. The majority of NP are recognized regulators, transferring by blood and (or) CSF in any part of organism. For some distant acting NP there are special carrier proteins, stabilizing them in the process of transport by blood. At distant action of NP their ability to induce output of other NP is very important.

The next peculiarity of NP (RP), which differ them from other NM is connected with their multiplicity. As a result, the ability of many new functional combinations, as within the limits of one synapse, as well as at synaptic interactions, appears.

And, at last, we will mark, that profound investigation of every NP always led to revealing of their influence on the activity of genes under action of NM, especially, RP, are either obligatory, either widely spread process. It is caused by mediators, the action of which seems to be so momentary, that it should be concentrated on quick synaptic reactions.

Let us sum up: in the organism there are biologically active substances, the basis of which are RP. Together with other humoral regulators they provide realization of any compatible biological activities. Abilities for forming of complex regulatory series and cascades, long time of existence, distant effects, and influence on genome activity are peculiar to RP.

The last question, necessary to be answered, is connected with localization of NP. Short answer to this question is: all the parts of central a peripheral nervous systems – somatic and autonomous. We will use the list of co-existence of different NP with each other [9]. Bridge of the brain, big cerebral hemispheres, striatum, spinal ganglia, parasympathetic neurons, peripheral vegetative nerves, cells of retina, preganglionic sympathetic nerves, hippocampal formation, medullary substance of adrenal glands, hypothalamus, hippocampus, brain stem, olivocochlear neurons, dorsal raphe nuclei, locus coeruleus, primary afferent neurons.

Now we will review in detail modern data concerning chemical provision of excitement transmission in peripheral autonomous reflex [7]. The main mediator of preganglionic sympathetic and parasympathetic structures is ACH. The main mediator of postganglionic parasympathetic structures is still ACH, of sympathetic structures – NA. in postganglionic sympathetic ways, together with adrenergic ones, there is a certain number of cholinergic cells. Classical mediators, as it was marked above, are present in combinations with different peptides. These are: vasopressin (VP), CGRP, BOM\GRP, VIP, SOM, pancreatic peptide (PP), NT, neurotensin A (AT), halonino

like peptide (HAL), peptide-histidine- isoleucine (PHI), gastrolyberin (GLB), enkephalin, neuropeptide U and others.

The fact, which always amazes the researchers at consideration of distribution of visceral fibers, innervating inner organs (floating, splanchnic, pelvic nerves), is predominance of sensitive fibers over motor [8]. In composition of floating nerve it is 9:1, in splanchnic – 3:1, in pelvic – 1:1. Inconsistency between detailed information about visceral object and much more rough control mechanism is resolved by notion about efferent functions of sensor fibers. These fibers not only give information about object state, but also carry out their own local control of an object. In response to adequate stimulation or irritation by electrical current there is a release of biologically active substances (mainly RP), exerting a specific action on surrounding tissue (as it follows from the mentioned above facts – not only on surrounding) the process of effective regulation by sensor endings becomes especially clearly apparent at regulation of immune, inflammatory trophic processes, at wounds healing [7], lies at the heart of gastrointestinal mechanism, preventing ulcer formation [8].

We will stop here speaking about NP localization, and mark the following. Classical teaching about neurosecretion examined, in general, hypothalamo- pituitary-adrenal bonds. Nowadays it is clear, that neurosecretory cells in large quantity are scattered round different parts of nervous system and their activity is tightly connected with production of peptide bioregulators. From the positions of all this, we will consider some postulates and, effects of SCENAR-therapy, received on practice.

**SCENAR treats everything** (see also ‘the principle of universality’ [4]). This direction very often causes circumspection of the doctors, especially scientific workers, who see the device method for the first time. The results of SCENAR-therapists (nowadays the device is used by specialists of more than 30 specialties), publications in collections of articles concerning SCENAR-therapy, numerous tests, including 5 chairs of Moscow Medical Academy, named after Sechenov (see appendix to the 2<sup>nd</sup> collection of articles) to a great extent removed this circumspection.

The main model of SCENAR-therapy, explaining this phenomenon, is the following.

SCENAR, thanks to peculiarities of its influence, activates and thin peptidcontaining fibers in quite a greater degree, than other methods of treatment. It allows to create an effective dose of RP, and they together with other humoral factors (also subjected to considerable influence of RP, create regulatory continuum – a complete set of biological activities, which are able to cope with practically any disease.

Here we can also name a numerous publications about RP influence on regulation of vascular tone [7], heart rhythm [11], respiratory system [12], reproductive system [13], expressiveness of epileptic activity [14], and integral activity of the brain [15], pain mechanisms [16] see - below).

**SCENAR- regulator.** This direction is often proved by practice. Not irrespective of the disease (the typical example – hypertension-hypotonia) one and the same zones of influence are used for therapy. It is natural, because SCENAR only activates release of regulatory peptides, which realize therapy according to the programs, laid in the organism. In usual electrotherapy it is not, as a rule, achieved because of limitations, connected with its peculiarities [1]. Moreover, taking into consideration the fact, that the main functions of afferent fibers of A type are to carry out the transmission as soon as possible, neuropeptides can hardly be chemical mediators of excitement transmission for terminals of these fibers [8], accordingly, at their activation (which is typical for usual methods of electrotreatment) the possibility of appearance of peptide series and cascades, realizing therapy, in comparison with SCENAR-therapy, is low.

**Children undergo treatment better.**

The practice of SCENAR-therapist proves this fact. From the positions of stated approach it has quite a simple explanation. The majority of fibers finish myelinization to the age of 1, 5-2 years. The quantity of endocrine cells of the fetus and a new-born child are much greater than in the organism of an adult. Here it is appropriate to remember the opinion of the 2nd city hospital of Taganrog, concerning a successful treatment of postnatal asphyxia after, practically single touch by

the device. It is known, that in neuroendocrine cells of the lungs not less than 10 RP are synthesized [12].

#### **False, true SCENAR-complications.**

A very typical case is unexpected pregnancy of women in the process or after treatment of, for example, osteochondrosis. There are a lot of positive results of a direct treatment of sterility. The explanation of this effect is obvious, if we will take into consideration, that not less than 30 NM participate in functioning of reproductive system [13]. They provide a chemical structure of autonomous reflex [7]. Distant characteristics of RP must also be named here.

#### **Absence of contraindications**

It distinguishes SCENAR-therapy from other methods of electrotreatment [1], and it is, to a considerable degree, agrees with reaction of organism on RP introduction.

It is known, that pharmacological (physiological) effect depends on functional status of tested system. When medium doses of RP are introduced into a “normally” functioning organism, i.e. into a system of balanced relations, exogenous factor will undergo an intensive influence of structure breaking influences, which must keep this homeostasis. Under conditions of pathology, on the contrary, balanced relations of biochemical and functional systems of cells, tissues and organism, in the whole, turned out to be broken, and the components, tend to undergo corrective action of regulator become revealed.

#### **Analgetic effects.**

SCENAR-influence turned out to be successful in this direction (see, for example, [18]). According a conception, existing nowadays [16], regulation of pain sensitivity in organism is based on mechanism of interaction of nociceptive and antinociceptive endogenous systems, forming functionally-movable pain threshold. Both systems have a multiple chemically-heterogeneous character, in which neurochemical base also includes, peptidergic mechanisms. Besides opioid peptides, in mechanism of regulation of pain sensitivity take part the following components: neurotensin, AT-2, CGRP, BOM, SOM, CCK and others. Here we should mark certain selectivity of peptide mechanisms, which is proved by activity of extreme small doses of some peptides. It is also important to bear in mind, that mechanisms of pain sensitivity represent interaction of different peptides functions. From all, mentioned above it is clear, how important the task of medical means working-out for anesthesia is. Only organism itself can solve it in an optimal way, and it is necessary to help it. The experience of SCENAR-therapy usage shows, that it solves all the three main tasks of fight against pain: pain relief without changing of general pain sensitivity, therapy, lowering of drugs application (refusal form them).

Participation of peptide mechanisms in this process is proved by effect of pain increase (acute period) at evident improvement of functional state (through acute period – to recovery). The patient worries, SCENAR-therapist convinces that it is necessary to endure it. In this effect significant shifts of RP distribution are revealed. Function restoration takes place on the background of RP, which are also respond for nociception, changing. It can lead to increase of pain sensitivity.

A phenomenon, which is known to every SCENAR-therapist, does not demand complicated explanations. This phenomenon is: while treating one disease, cured (including) the other. This is – regulatory continuum of biological activities and distant effects of RP.

**Positive results of single procedures [17]** are connected with long duration of RP existence, with characteristic to form new bioactive compounds during decay.

#### **Quick effects, a considerate acceleration of recovery process.**

(See the review of MMA, named after Sechenov I., the collection of articles #2). Quick-action of RP (in contrast to steroid hormones), is conditioned by activation of ferments and proteins, which were synthesized before [15]. This peculiarity is used in some peptide preparations [12] for correction of functions in extreme conditions.

In brief, we will remind SCENAR-theses, explanation of which follows from mentioned above facts.

Restoration of reproductive function.

Treatment of brain tumor through influence on adnexa area (distant characteristics pf RP).

Enteroparesis. CCK, BOM, VIP considerably influence secretion of gastrointestinal tract (see [19] in this collection of articles).

First aid effects (see above, quick effects).

Stunted growth CCK stimulates secretion of growth hormone.

Mental retardation. ACTH, alphanelanotropin stimulate training and memory.

Disorder of motor activity and tactile sensitivity. Effective usage of the device in this case follows from the table analysis.

Positive cases at epilepsy treatment. The role of black substance in mechanisms of epileptic activity stopping is known, as well as participation of neuromediator and peptidergic brain systems [14] in this process.

In conclusion we will see, in what way several methodological techniques of SCENAR-therapy are in compliance with the facts, we spoke above.

Influence on projection of center of affection. In this case distant effects are realized quicker and the doctor can wait for quick therapeutic effect, what is usually observed in practice.

Influence on three tracks, 6 points, collar zone, gastrointestinal tract projection, on active points and zones – is activation of a great number of nerve cells, containing practically all the set of RP. This leads to a desired therapeutic result.

***Given in this article indirect proofs of the fact, that high effectiveness of SCENAR-therapy is based on mechanisms of peptides activation, allow to consider the system “organism-device” as Generator of Regulatory Peptides.***

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**The following abbreviations are accepted in the table:**

N – nociception,  
Aoa -antiopiate action,  
E – emotionality,  
Ma – motor activity,  
Is- influence on sleep,  
Sa – sexual activity,  
A – appetite,  
T – thirst,  
SSH – participation in the processes of stress and shock,  
TaM – influence on training and memory,  
TD – availability for treatment of depression and parkinsonism,  
TSCH – the same for treatment of schizophrenia,  
T – body temperature,  
BP – blood pressure,  
VT – vascular tone,  
SGIT – secretion of gastrointestinal tract organs,  
Sd – small doses,  
Ld – large doses,  
S – sedative effect,  
C – catatonia is possible.  
(-), -, --, - different degrees of manifestation and reproducibility on different objects, strengthening influence on the function,  
(↑) – the same for overwhelming influence;  
(+) – participation in the process;  
CE – complicated effect, which cannot be unambiguously treated.  
The sectors, not filled, mean either the absence of data, either their antipathy.

*Table 1*

**General influences of NP (RP)**

1	Rate and amplitude of heart contractions
2	Respiratory rate
3	Blood pressure
4	Muscular, vascular tone
5	Body temperature
6	Training, memory, positive reinforcement
7	Sleep, level of wakeful state
8	Analgesia
9	Modulation of drinking behavior
10	Modulation of eating behavior
11	Drugs tolerance

12	Sexual conduct
13	Reproductive function
14	Mood modulation
15	Comfort sensation modulation
16	Growth stimulation
17	Emotional behavior
18	Motion activity
19	Participation in the processes of stress and shock
20	Digestive organs motor activity
21	Secretion of digestive glands
22	Immunity
23	Diuresis
24	Outcome of other peptides
25	Depression treatment
26	Schizophrenia treatment
27	Parkinsonism treatment