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EXPERIENCE IN MICROWAVE THERAPY

[Following is a translation of two articles on microwave therapy from the Russian-language journal Voprosy Kurortologii, Fizioterapii, i Lechebnoy Fizicheskoy Kul'tury (Problems of Health Resort Therapy, Physiotherapy, and Therapeutic Physical Culture), Vol XXX, No 1, Moscow, 1965, pp 40-45 and 45-47.]

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EXPERIENCE IN THE USE OF MICROWAVE THERAPY IN PATIENTS  
SUFFERING FROM SYMPATHETIC GANGLIONITIS AND  
RADICULITIS OF THE THORACO-CERVICAL SEGMENT  
WITH A CARDIAC PAIN SYNDROME

By Ye. I. Sorokina

pp 40-45

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The present report elucidates apparently the first experience in the use of microwave therapy in patients suffering from the affection of sympathetic nodes of the boundary trunks and radicles of the somatic nerves with a clinical picture of a cardiac pain syndrome; we have not encountered in the literature any reference to the use of microwaves in these patients.

We observed 41 patients. Of these, 33 had a levolateral (23 patients), or bilateral (10 patients) sympathetic ganglionitis of thoraco-cervical localization (mainly of the stellate ganglion), not infrequently combined with radiculitis and deforming spondylosis, and 8 patients with deforming spondylitis and phenomena of secondary radiculitis without involvement in the pathological process of the sympathetic ganglions of the boundary trunks. In 13 patients, aged from 22 to 40 years, most thorough clinical examination established no cardiac pathology; it can, therefore, be assumed that the affection of the extracardiac nervous system was the sole cause of their cardiac pain syndrome. In two patients, aged 32 and 22 years, in addition to the sympathetic ganglionitis, also a mitral cardiac lesion of rheumatic etiology was present, and in 26 patients, aged 43 to 56 years -- there was atherosclerotic cardiosclerosis.

The clinical picture of the affection of sympathetic ganglions consisted mainly of irritation symptoms in the forms of characteristic eye symptoms (dilation of the palpebral fissure and pupil, exophthalmus) on the side of the lesion, tenderness in the region of the projection of cervical sympathetic ganglions and cervical vessels on the left, a rise of surface tenderness of the sympathetic type ("half-jacket"), prolongation of the period of pain adaptation, intercostal tenderness, tenderness of the paravertebral points and spinal processes of the thoracic part of the spine, increased perspiration, and a number of vascular disturbances of the left arm (reduced pulsation of the radial artery, assymetry of arterial pressure and of the oscillatory index, paresthesia, Reino syndrome, etc.). In spondylosis with a secondary thoraco-cervical radiculitis, there was tenderness of the paravertebral points corresponding to the affected segments, tenderness of nerve trunks, sensitivity disturbances of the radicular type, etc.

All patients were admitted to the hospital on account of the cardiac pain syndrome. Pain in the cardiac region constituted the main complaint of these patients. The pain would start in the form of attacks of prolonged and, as a rule, severe pain of a constriction or pressure type in the cardiac region, in the left half of the thorax, left arm, left suprascapular region, and in the area of the left scapula. The pain often radiated to the left arm, the 5th and 4th finger of the left hand, neck, left leg, and the left part of the head; the pain was sometimes accompanied by numbness, blanching or cyanosis of the left hand, and paresthesias in the finger tips of this hand. Coronary-dilating substances did not relieve the pain.

A careful anamnesis elicited in 29 patients, in addition to the above-described prolonged pain syndrome, transitory attacks of pain in the cardiac region, or retrosternally, which appeared during walk, physical exertion or emotional stress, and which were checked by validol or nitroglycerin, which is characteristic of the stenocardia syndrome. The stenocardiac pain was, as a rule, masked by continuous hyperpathic, i.e., ganglionic pain. In patients with thoraco-cervical radiculitis, the pain was of a more constant nature; it increased upon respiration and movements of the trunk and upper extremities and was localized in the dorsum, spinal column, left half of the thorax, and was of a girdle-type nature.

In 28 patients with a simultaneous affection of the heart and extracardiac nervous system, the complaints and objective symptoms of an organic cardiac affection were closely intertwined (atherosclerosis, cardiac defect) with complaints and objective evidence of ganglionitis or radiculitis. Special

attention was required in interrogating and examining these patients to differentiate pain and symptoms caused by ganglionitis or radiculitis with their secondary effect on the heart from pain caused by an organic heart affection.

Besides the pain syndrome, we observed in these patients disturbances of the cardiac rhythm in the form of tachycardia, extrasystoles, as well as impairment of the contractile abilities of the myocardium (dyspnea, changes in the ballistocardiogram).

Anamnesis of the patients showed infections (influenza, angina, exacerbation of chronic tonsillitis, arthritis), followed by a cardiac pain syndrome and disturbance of the cardiac rhythm. It can be assumed that an infection of the sympathetic ganglia and nerve radicles may represent the initial trigger mechanism in the development of cardiac pain, including stenocardia in patients suffering from atherosclerosis and a cardiac defect. In a number of atherosclerotic patients the stenocardiac pain was present prior to the affection of sympathetic ganglia. In such cases, pain of ganglionic or radicular nature followed the abated infection, thus considerably changing the picture of the cardiac pain syndrome. Simultaneously, pain of stenocardiac nature became more frequent.

In a number of patients (in 25 out of 41), ganglionitis and radiculitis were maintained for prolonged periods of time by a deforming spondylosis of the thoraco-cervical segment. In these patients, frequent exacerbation was observed of the pain syndrome under the effect of previous infections, supercooling, sudden movements of the spinal column, etc.

We usually started the treatment of patients of the first group (28) with pharmacological ganglioblocking agents (preferably 0.5 to 1 ml of a 2.5% solution of hexamethon, intramuscularly up to thrice daily, treatment course -- 10 to 25 days) so as to block the pathologically irritated sympathetic ganglia. As a result of blocking of ganglionic cells, the reflex arc of the autonomic reflexes is cut off, and the entry of nerve impulses to the organs, to the heart in particular, is discontinued, thus contributing to the creation of functional rest and elimination of dystrophic processes within the heart.

Under the effect of a course of hexamethon therapy, the clinical symptoms of irritation of sympathetic ganglia were considerably reduced, including the cardiac pain syndrome and the disturbances of cardiac rhythm; there remained, however, symptoms of thoraco-cervical radiculitis and deforming spondylosis and, in inflammatory or degenerative changes in the sympathetic

ganglia -- a number of ganglionitis symptoms. In this connection, the second stage required the use of physical methods of treatment. In our search for such methods we began using microwave therapy.

In patients of the second group (13) we started treatment with the use of microwaves without preliminary administration of ganglioblocking preparations. In patients of these of this group, where microwave therapy was unsuccessful and produced an increase of symptoms of irritation of the sympathetic ganglia, we prescribed injections of hexamethon during the second stage. This group was composed of patients suffering from pronounced phenomena of deforming spondylosis and secondary radiculitis without the involvement of sympathetic ganglia, or with mildly expressed symptoms of their irritation, these phenomena however distinctly altering the character of the cardiac pain syndrome (pain appears in the heart with extensive radiation, rhythm disturbances, etc.).

We shall describe together the results of therapy of both groups, since the character of changes in the disease symptoms were monotypic in both groups.

We employed the Ray-58 generator. Irradiations were carried out by the contact method. When phenomena of sympathetic ganglionitis predominated, we irradiated the region of cervical sympathetic ganglia (6 patients); in pronounced radicular phenomena and in deforming spondylosis we irradiated the thoraco-cervical part of the spinal column (35 patients). In 20 patients we treated consecutively the spinal column, cervical sympathetic ganglia and the upper part of the anterior surface of the thorax (the pain area). The course of therapy consisted of 10--15 procedures on the spinal column or sympathetic ganglia, and during subsequent exposures -- of 15 to 25 procedures. Duration of a single treatment: 10 minutes on the area of sympathetic ganglia and 10 to 15 minutes on the spinal column. The power flux density comprised 0.03 watt per  $\text{cm}^2$  of the irradiation area when the area of cervical sympathetic ganglia was irradiated, and 0.015 to 0.03  $\text{wt}/\text{cm}^2$  when the spinal column was irradiated.

During the procedure all patients experienced a sensation of heat at the seat of irradiation. The general condition of the patients showed no change during the treatment in the majority of cases. Only in individual cases we observed, upon irradiation of the sympathetic ganglia a pulse acceleration and an increase of cardiac pain, also vertigo and general weakness, as well as a 10-15 mm drop in arterial pressure. Irradiation of the spinal column with microwaves produced no negative side effects.

As per the data of L. A. Skurikhina, a single treatment with microwaves of  $0.03 \text{ wt/cm}^2$  power flux density, the skin temperature following irradiation of the sympathetic ganglia would rise 0.6 to 2 degrees, and after exposure of the spinal column -- by 4 to 6 degrees. The rate of cardiac rhythm showed little change -- a slowing-up of the rhythm by 2-4 beats per minute (more often, following exposure of the area of the cervical sympathetic ganglia), or the cardiac rhythm remained unaltered. The arterial pressure and the magnitude of oscillatory index on shoulder oscillograms (investigations by L. A. Skurikhina) changed within the limits of physiological variations: the maximal and minimal arterial pressure varied within 5-10 mm upon irradiation of the cervical sympathetic ganglia, and still less in the case of the spinal column. A tendency was noted toward the disappearance of assymetries of the arterial pressure, the oscillatory index, as well as of capillary circulation (reduction of capillary spasms) on the side exposed to microwaves.

Electrocardiograms, taken prior and directly after irradiation of the cervical sympathetic ganglia, showed small changes in the form of rhythm retardation by 2-4 beats per minute; in three patients, a sinus arrhythmia was noted, as well as irregular changes (shortening or lengthening) of P--Q interval by 0.01 to 0.03 seconds, and sometimes also a lowering of T waves in the standard or thoracic leads. Irradiation of the spinal column, as a rule, had no effect on the ECG.

Thus, our observations offer no basis for a conclusion concerning any blocking effect of a single irradiation of microwaves in the accepted dosage of the sympathetic autonomic apparatus, or of any evidence of its vagotonic effect.

Dynamic observations of the cardiac pain syndrome and of the symptoms of ganglionitis and radiculitis showed that microwave irradiation, as per our method, of the area of the cervical sympathetic ganglia led in 10 out of 14 cases to the exacerbation of symptoms of ganglionitis, previously abated under the effect of hexamethon which was administered during the first stage of treatment, and to the increase of cardiac pain, in particular to more frequent attacks of stenocardia. During the period of exacerbation of ganglionic manifestations and the cardiac pain syndrome, changes on the ECG were recorded in the form of an accelerated cardiac rhythm, lower voltage of T waves, and displacement of the S--T interval. These changes, combined with the clinical picture of a cardiac pain syndrome, could be interpreted as manifestations of transitory myocardial damage. Following administration of coronary-dilating medicinal preparations and a repeated course of hexamethon injections, the general feeling of the patients improved and the symptoms of exacerbated ganglionitis abated.

As an illustration we shall cite an excerpt from a disease history.

Patient P., 50 years old, was admitted with complaints of attacks of prolonged retrosternal pain, pain in the cardiac region, left scapula and left arm, accompanied by the sensation of fear and of lack of air, difficulty in inhaling deeply, numbness and paresthesias in the fingers of the left hand. Validol and nitroglycerin brought no pain relief. The patient also experienced several times daily attacks of intense pressure pain retrosternally which were checked with nitroglycerin. The pain appeared two months previously, following an attack of influenza. The patient was attended by several physicians who made a tentative diagnosis of a microinfarct of the myocardium; however, treatment with vasodilating agents brought no relief. Objective findings: heart enlarged one centimeter to the left; tones dulled; accent on the second tone on the aorta. Arterial pressure 110/70 mm on the right arm, 120/80 mm on the left arm. ECG findings: left electric position of the heart, voltage of T<sub>1</sub>, 2, 3, v<sub>4</sub> -v<sub>6</sub> waves is considerably reduced. Analysis of the urine and blood are within norm. The left palpebral fissure is larger than the right, levolateral exophthalmus, left pupil larger than the right. Tenderness on palpation of the area of left cervical vessels, of the projection area of the upper cervical sympathetic and stellate ganglia, intercostal spaces, paravertebral point on the left side, and D<sub>1</sub>--D<sub>12</sub> spinous processes. Hypersthesia on the left side of the "half-jacket" type with a hyperpathic nuance. Diagnosis: atherosclerotic cardiosclerosis. Levolateral sympathetic ganglionitis and radiculitis of the thoraco-cervical segment. Stenocardia. Of interest in this case is the painless course of cardiosclerosis before the sympathetic ganglionitis of influenza etiology supervened. Presumably, ganglionitis was the trigger mechanism in the origin of stenocardia. The prolonged attacks of sympathalgia simulated prolonged stenocardiac pain -- a fact which led to the original diagnosis of myocardial microinfarct.

A hexamethon therapy was instituted for a period of 16 days, following which pain in the cardiac region and in the thorax disappeared; there remained, however, tenderness in the spinal column and in the left arm upon movement. Objectively, all symptoms of ganglionitis abated considerably; there remained only slight tenderness of the sympathetic ganglia and vessels of the neck, paravertebral D<sub>1</sub>--D<sub>8</sub> points and intercostal spaces along the anterior surface of the thorax on the left side. During the second stage, microwave therapy was carried out of the area of the spinal column in the amount of 10 procedures, following which the pain in the spinal column disappeared; there remained a tenderness of the upper third of the thorax, vessels and

sympathetic ganglia of the neck. Exposure to microwaves of the area of cervical sympathetic ganglia (4 treatments) caused resumption of cardiac pain of the type of sympathalgia and stenocardia and increase of ganglionitis symptoms; tachycardia and extrasystoles appeared; the ECG recorded negative T<sub>v4--v6</sub> waves. It was, therefore, necessary to discontinue treatment.

In analyzing the causes of negative results from this therapy, of particular importance is the rise in skin temperature on the irradiated surface. It is well known that patients suffering from the affection of the sympathetic nervous system poorly tolerate the effect of heat procedures; therefore, frequent exacerbations of ganglionitis with their subsequent secondary effect on the heart in microwave therapy can be ascribed to the pronounced thermal effect of microwave irradiation with power flux density up to 0.03 wt/cm<sup>2</sup>.

Consequently, treatment of patients suffering from sympathetic ganglionitis with a cardiac pain syndrome by means of microwaves, as employed by us in the above-mentioned doses in regard to the area of cervical sympathetic ganglia, cannot be recommended.

We achieved somewhat better results with the use of microwaves on the thoraco-cervical segment of the spinal column in patients with sympathetic ganglionitis and radiculitis of thoraco-cervical localization, in whom, following a course of treatment with ganglioblocking substances, the symptoms of irritation of the sympathetic ganglia disappeared leaving only the radicular phenomena and manifestations of deforming spondylosis. An improvement has taken place in 18 out of 35 such patients: abatement of the pain syndrome and radiculitis symptoms; however, in 11 patients we did not obtain positive results, and in 8 patients an exacerbation of ganglionic symptoms set-in, with their secondary effect on the heart.

Taking into consideration the marked rise in skin temperature under the effect of microwaves which could lead to the exacerbation of sympathalgia, we attempted to use microwaves on the spinal column area in lesser doses (0.01 wt/cm<sup>2</sup>) which cause a minimal increase in skin temperature (not higher than 0.1 to 0.2 degrees). In all 5 patients treated with microwaves in such dosage we observed no substantial positive changes in the clinical picture of the disease, although no exacerbations were present either. In this connection, we did not consider it expedient to continue the investigation of this method of treatment.

In prolonged pain along intercostal spaces of the anterior surface of the left half of the thorax and at projection points

of the thoraco-cervical plexus often observed in sympathetic ganglionitis and radiculitis of the thoraco-cervical segment, we used microwaves also on this area. After 6 to 7 treatments a reduction of pain could be noted in this area in only 5 out of 12 patients, exacerbation of pain in three cases, and no change in four patients. Thus, also the use of microwaves directly on the area of the pain zone has met with no success in the majority of patients.

Better results of treatment were obtained with the use of microwaves on the thoraco-cervical part of the spinal column in patients with deforming spondylitis and secondary thoraco-cervical radiculitis where no sympathetic ganglions of the boundary trunk were involved. In all these patients (8) a marked improvement was noted: there was reduction of pain in the spinal column in the left half of the thorax and cardiac region, and in the objective symptoms of radiculitis. No exacerbations were observed.

Thus, our experience with the use of microwaves in patients with sympathetic ganglionitis and a cardiac pain syndrome showed that in the majority of patients the method of treatment employed in our investigations and dosage are ineffective and often lead to the exacerbation of the disease. Most frequent negative results of therapy were observed when the pathologically changed sympathetic ganglia were irradiated. The use of microwaves on the area of the spinal column in patients with deforming spondylitis and secondary radiculitis without the involvement of the sympathetic nervous system, as a rule, leads to the reduction of the pain syndrome, including also cardiac pain and the objective symptoms of secondary radiculitis.

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