

AUTHORS: Klimkova-Deutschova E:

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TRANSLATION

CZECHOSLOVAKIAN NEUROLOGY (SELECTED ARTICLES)

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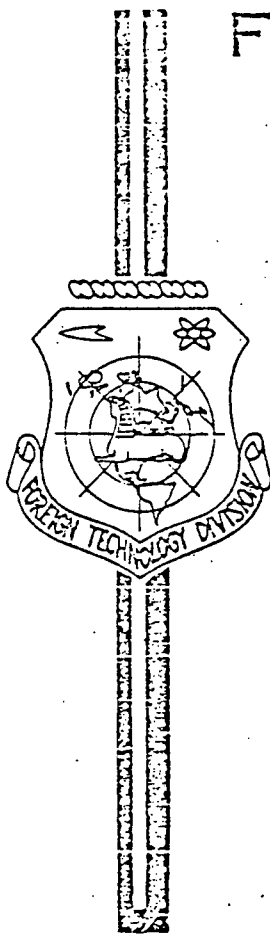
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FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

EFFECT OF RADIATION ON HUMAN EEG

By

E. Klimkova-Deutschova

Physical harm is of great importance in modern industry and in living conditions. The importance of the electroencephalographic method for the diagnosis and prognosis of laborers exposed to radiation was brought to the attention by one of us (K. D. 1957, 1958, 1959, 1962) in several reports. Attention was called to the fact that some laborers are exposed to the effect of electromagnetic radiation of centimeter wave magnitude, and this is interesting as far as a clinical picture is concerned. Further, a detailed analysis and certain metabolic factors, hemodynamic disturbances and a comparison of results of studying the higher nervous activity with clinical findings and EEG findings.

High frequency electromagnetic is used in industry during the manufacture and development of telecommunication equipment during high frequency heating and welding.

Classification of the clinical picture (K. D. 1957) of laborers exposed to centimeter radiation is divided into the following stages: 1. Neurasthenic syndrome with functional changes and symptoms from the vegetative sphere. 2. Pseudoneurasthenia, within its framework is included a majority of our cases. Disturbances in this group appeared in the form of fatigue, somolence in day time, headaches together with voluminous organic deviations which allowed to make mesodiencephalic diagnosis on bed patients. 3. Quite frequently the organic disturbances were already in transient stage approaching encephalopathia. This division was also used by other authors (Koelsch, Formanek and co-workers etc.)

By the EEG is quoted (k. D. 1957, 1958, 1962, partially the somnoelence activity in various stages according to Roth, partially the rough pathological

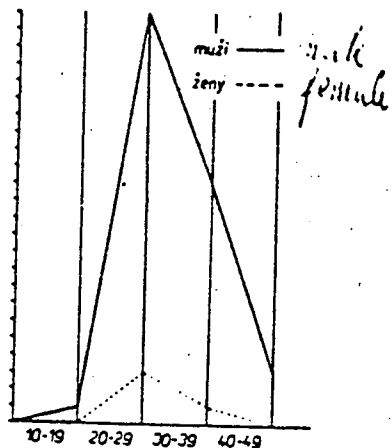
findings with generalized abnormally and the focal findings, and this is analogical as in case of toxic and extremely temporal incidences.

The activity here had an episodic expression. Fluctuation of the clinical process was in conformity with EEG changes, it varied parallel in accordance with the exposure stages and corresponded to reversible stages. After the employee took a rest, there was observed a clinical improvement as well as an improvement in encephalographic and higher nervous activity.

Vegetative and neurotic disturbances were diagnosed on persons exposed to electromagnetic centimeter radiation by such as Schliephacke, Osipev, Kevorkjan, Ulrich and Ferin, also Jiranyi, Oraveez and Semogyi, who examined 73 persons exposed to high frequency radiations of the magnitude of centimeter waves of this group 15 people were examined encephalographically (1960). They were in partial agreement with us as to the affliction of the mesodiencephalic region. Sercl and coworkers (1959) made pathological findings on 23.3% of 103 cases, and this included partially an epileptic activity of low amplitude and findings combined with damping somnolence activity; 13.5% yielded normal findings, boundary findings were established on 63.05%. They included somnolence activity, disintegrated alpha-rhythms, rapid low amplitude activity, and sections of 5-6 c theta-waves of sharp peaks with the sign of synchronization.

In today's report, we are analyzing EEG of 46 persons, 41 of which were exposed on their jobs to centimeter wave radiation, and 4 were exposed to a wavelength of several meters and on one person was diagnosed the effect of x-rays. There were a total of 42 men and 4 women. Forty-two persons were of the age between 20 to 40 years. Three workers were in the fifties, and one person was 19 years old. In reviewing these data, attention is attracted by the age curve (graph 1) of males and females in our group of laborers who

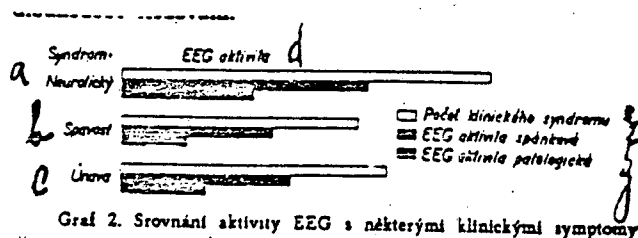
have been subjected to electroencephalographic examination; they were selected from a large group of clinically investigated workers. Exposure time varied from one year to 17 years.



Graph 1. Age curves of laborers exposed to radiation.

ogy and long lasting examination,

In conformity with previous investigations, the subjective complaints were in majority of neurotic nature in form of higher fatigue, somnolence, nervousness, head aches, and general illnesses in a majority manifestations of damped nature. There were also frequent complaints against various vegetative disorders, as rise in perspiration, pounding of the heart etc. Some patients showed less of memory. Only four persons lodged no subjective complaint during EEG examination. All those exposed to cm-waves were examined in preventive scrutinies in ambulatory framework of industrial neurology



Graf 2. Srovnání aktivity EEG s některými klinickými symptomy

Graph 2. Comparing EEG activity with certain clinical symptoms. a- neurotic syndrome; b- somnolence, c- fatigue, d- EEG activity, e- number of clinical syndrome, f- EEG somnolence activity, g- EEG pathological activity.

In objective diagnosis, we found on our patients clinical symptoms of vegetative disorders, and in some cases also extrapyramidal symptoms, pyramidal signs, cerebellum and vestibular disorders analogous as in entire groups of workers from previous investigations. From the viewpoint of clinical complaints, the examined persons were divided in accordance with analogical criteria into three groups. Twenty-seven cases pertained to light complaints. This group includes such laborers without subjective complaints, but with slight subjective findings. Nineteen laborers are classified as medium seriously afflicted; none of the examined had any serious complaints.

The electroencephalographic investigation was made with a 16-channel apparatus produced by the Schwartz Co. Some laborers were examined with a 8-channel Grass device. Activation of each patient was examined by 3-minutes deep respiration. The symptoms were evaluated in accordance with ordinary criteria. Special attention was devoted to EEG findings pertaining to reduced vigility.

Abnormal EEG manifestations were found in 16 cases of 54, i. e., in 30% of all the cases. In ten cases, there were symptoms of light anomaly. In six cases medium serious; in no case, have we found a real serious anomaly. Pathological EEG manifestations were found in six cases only in calm stages. In ten instances, they have been manifested after activation by deep respiration.

Table 1

(1) Klinické symptomy		(2) EEG nálezy	
		(6) Aktivita spánková	(7) Aktivita patologická
(3) Spavost	25	16	7
(4) Únava	28	18	9
(5) Neurotické	39	25	14

Key to Table 1

- 1) Clinical symptoms
- 2) EEG findings
- 3) Somnolence
- 4) Fatigue
- 5) Neurotic
- 6) Sleeping activity
- 7) Pathological activity

Since we deal in anomaly cases which are in conformity with disorders, we will describe same in the toxic group. Their intensity is lower. The anomalies of people exposed to high frequency electromagnetic radiation are mostly anomalies of theta activity or diffusion activity, or are exposed only in the forward part of the skull and forming episodes, particularly after deep respiration. Delta-hypersynchronia episodes were also observed after deep breathing. In some instances, we find sharp waves and in some instances focal changes in temporal activity, as one of us described it already in larger groups of toxic and mixed laborers exposed to the effect (k. D. 1959, 1962). A dominating rapid activity was also found in several cases.

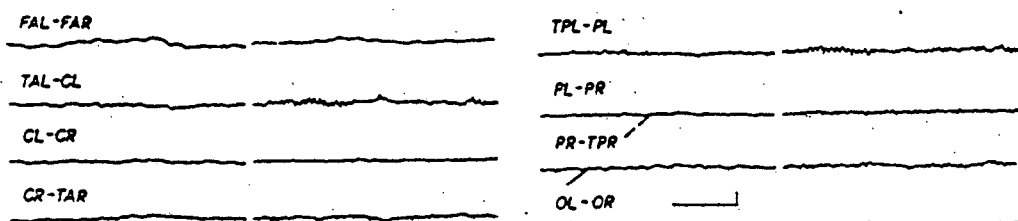


Fig. 1. EEG recording of patient R. C. exposed to cm. waves. 1. calm recording- sleeping rhythms, 2- after 3 minutes of deep breathing normal alpha rhythms.

EEG manifestations of sleep, resp. decrease in vigility

EEF manifestations of reduced vigility in this group were diagnosed on 32 persons, i. e. 59% of all investigated, other pathological changes were diagnosed simultaneously in six cases, in twenty cases somnolence activity was the only deviation from standard.

The nature of EEG activity in relation to clinical symptoms is explained by a numerical compilation in table 1.

Graphic representation of this relation is indicated in (graph 2) which shows that a majority of cases in our group have dampened manifestations and this is not evident clinically nor in the EEG records. This finding confirms our experiment that workers exposed to centimeter radiation have predominantly dampened manifestations. It is also evident from this graph that we found a pathological EEG record among a quite high percentage of persons, who clinically showed only neurotic syndrome.

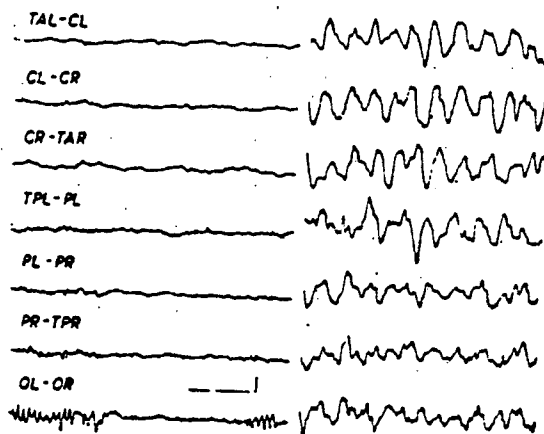


Fig. 2. Patient A. H. injured by ionizing radiation. 1- calm symptom, intermittent alpha rhythms, 2-3 minutes deep breathing diffusion occurrence of hypersynchronous delta waves with frontocentral maximum.

In these cases, the EEG findings are an objectivization of important disturbances which could otherwise not be determined by the clinical picture. Examples of EEG records of our workers exposed to radiation are illustrated by

the curves in fig. 1, 2, and 3.

Table 2.

(1) Klinický náleš	(2) normalni	(3) EEG aktivita			(7) spánková aktivita
		(4) abnormalita		(6) střední	
		(5) lehká	(6) střední		
Lehký 27	0	5	2	20	
Střední 19	3	5	4	13	
Těžký 0	0	0	0	0	

Key to Table 2.

- 1) Clinical finding
- 2) Normal
- 3) EEG activity
- 4) Abnormality
- 5) Light
- 6) Medium
- 7) Somnolence Activity

Normal entries

The entire normal entry w/o pathological and w/o somnolence rhythm was made in 12 cases, i. e. in 22 per cent of all entries.

Interesting is such a comparison of the intensity of clinical complaint with the degree of EEG changes. We see a convincing relationship in the group of persons with slight complaints, we had 21 per cent of abnormal cases, the group of laborers with really serious complaints had three per cent of abnormal cases. Similarly, also the serious EEG changes among other groups of workers were more frequent than in the first.

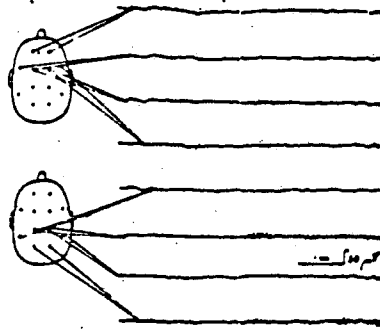


Fig. 3. Patient P. L. exposed to cm waves. 1-somnolence activity, 2-10 seconds later alpha rhythm.

A comparison of the degree of clinical complaint with the degree of weightiness of EEG findings is given in table 2.

The table shows that in the group of normal findings there are more instances of light clinical symptoms which have been already compared with toxic groups, and it was found then that laborers exposed to cm-waves do not as a rule suffer any important organic injuries. In conformity with this such EEG entries pertain to light nature. Most frequent is the diagnosis of somnolent activity which we considered finally as more frequent than normal diagnosis.

Concerning the occurrence of somnolent rhythm, it is somehow more frequent in the less afflicted group, but the difference is not great 60 % against 52% of all entries. The occurrence of pathological findings in the group of workers exposed to radiation differs from the norm. Thirty per cent of abnormal cases, 59% with somnolence rhythms.

During careful analysis of pathological finding in professional etiology, we discover further possible nonprofessionally applicable factors in 22 cases, 24 laborers showed no other etiological possibilities than radiation. From the subordinate factors, we found in 13 cases, a suitable factor in the development of a neurotic syndrome, a component constitutionally of exogenously reactive. Post infectious asthenia came into attention three times. These

were especially conditions after infectious hepatitis, which terminated before long. Cranial trauma in anamnesia was found in one case only. It is interesting that these subgroups of laborers in which the factors could be considered as suitable. The abnormalcy findings were less than among the group of persons in which no further possible etiological moments could be determined. The first sub-group had 27% abnormalcy, 50 % somnolent rhythm. In the other subgroups, e. e. laborers exposed to electromagnetic waves only, we had 31% of pathological symptoms and 66% of somnolent. Since there are no important differences, it can be explained not only by the small number of cases in both groups, but also by a similar pathophysiological effect in both etiological groups.

A comparison of groups with suitable factors and w/o same is given in table 3.

The occurrence of somnolent rhythms was recorded by us in the sense of communal pathophysiological mechanisms such as neurosis of psychogenic origin and pseudoneurosis of various origin as well. It corresponds here mostly to the damping phenomenon among our laborers exposed to cm-radiation.

We will sum up the findings in the entire group of people exposed to radiation. We find 22% of strictly normal cases, 30 % of abnormal EEG manifestations and 5% of somnolent rhythms among the laborers.

If we have to compare our groups of laborers in accordance with the labor difficulties, we mentioned about it in a different place (K. D. 1958), that there was no difference in the seriousness of the clinical complaint in three groups formulated in accordance with data of exposure of our laborers, which we had to our disposal according to data furnished by the laborers.

It should be underlined that also in the EEG deviations, we had in a great majority of cases only slightly has anomaly, which was manifested most frequently after deep breathing activation.

Frequent occurrence of somnolent rhythms is in conformity with our own findings and with those of other authors (Fischgold and co-workers) and is connected with organic or functional changes of the mesodiencephalic region, as we have repeatedly called attention to such changes as neurosis and pseudo-neurosis of infectional, toxic, or physical origin.

Examination of EEG alone does not furnish us with information about the weightiness of the working medium; according to the EEG rhythm we cannot evaluate the extent of harm to the nervous system. EEG examination is an important objectification, especially in analogy with small clinical symptoms, especially neurotic. EEG is often more important than clinical finding. The method enables to evaluate the prognosis and suitable effective countermeasure.

Russian language summary

This report appears to be a continuation of previous announcements, in which one of the authors (K-D) analyzed a clinical chart, of change metabolism and also hemodynamic and physiological changes in humans, working under radiation conditions.

An evaluation is made of EEG data from 46 persons, working conditions of electromagnetic radiation. Involved here are 41 persons subjected to the effect of high frequency centimeter radiation. Four laborers were under the effect of meter waves, and one worked under the influence of x-rays.

Subjective disorders were predominantly of neurotic nature; in a majority of instances, they appeared in fatigue and sleepiness during the day time. In the objective clinical chart, they corresponded with disturbances of vegetative regulations, rarely extrapyramidal, pyramidal, cerebral and vestibular disorders. They were all of light anomalies. In six cases were established changes in medium seriousness. Symptoms of reduced cheerfulness were found in 5%, six times in combination with other pathological changes. A comparison of clinical symptoms and EEG investigation results showed the predominance of slowing down

phenomena in the clinical chart and in EEG findings. The intensity of EEG changes corresponded to light clinical occurrence and was of medium seriousness. Symptomatically there was no difference between the group of cases in which in etiological respect attention was devoted only to radiation, and the group of people, on which in anamnesis was possible to establish certain additional etiological moments, constitutional changes, long endured infectious diseases or trauma.

The advantage of somnolent activity in our recordings allows, together with data of clinical investigations, to judge about mesodiencephalic injuries.

The EEG method represents the possibility of objectivating subjective disorders, and on persons, working under conditions of radiation, often point toward more serious disorders than it could be estimated on the basis of clinical data only. It also allows to make a prognosticating conclusion and helps in evaluating ability to work.

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