✓ Glaser

in Engl.

Materia Medica Polona (Warszawa), 5, 1973 (Jul.-Sept.)

Title (with author & pages for periodical articles) (Incl. edition, place & date) ☐ This edition only

Wroblewski, T. E., et al. Duodenal ulcer in persons occupationally exposed to microwave radiation. pp. 209-212

Verified in (or source of reference) ~~CIM 15, 2:428, 1974~~

TADEUSZ E. WRÓBLEWSKI
KAZIMIERZ ZARZECKI
ROŚCISŁAW DENISIEWICZ

Duodenal ulcer in persons occupationally exposed to microwave radiation

Department of General and Experimental Pathology, Medical Academy, Warszawa, Poland.
Head: Doc. dr Z. Kaleta.

Department of Radiology and Isotopes, Center of Radiological Protection and Radiobiology, Military Institute of Hygiene and Epidemiology, Warszawa, Poland.
Head: Dr J. Dyjak.

Summary

Duodenal ulcer was found in 14% of patients hospitalized in the Clinical Department of Radiology and Isotopes at the Center of Radiological Protection and Radiobiology and occupationally exposed to microwave radiation of density from 10 to 100 mW/cm². The authors are of the opinion that prolonged exposure to microwave radiation at work may be a causative factor inducing duodenal ulcer disease.

Hitherto, observations and studies of the influence of microwave radiation on the body have not entirely determined all the pathological phenomena caused by this factor. This pertains especially to the effect on alimentary tract function. The experimental study of Pietenin and Subbota (7) suggests the possibility of trophic disorders of the gastric mucosa resulting from the exposure of the stomacle to high-frequency radiation. Our previous study (9), conducted in animals, showed that microwave radiation without thermal effect causes hypersecretion of gastric juice with increased acidity and proteolytic potency leading to duodenal ulcer. The results of experimental studies impelled us to search for confirmation in the clinical material of patients hospitalized in the Clinical Department of Radiology and Isotopes at the Centre of Radiological Protection and Radiobiology.

Material and Methods

In the years 1965—1970, 250 patients exposed to microwave radiation of density from 10 to 100 mW/cm² in connection with their occupation were hospitalized. A group of 93 persons with the alimentary tract disorders was chosen from among these patients. All the patients were submitted to general, neurological and oculistic examinations. Additional investigations included blood count, reticulocytosis, E.S.R., and chest X-rays. The examinations of the alimentary tract included X-ray control of the stomach and duodenum and examination of gastric juice obtained by stomach tube. The volume and the acidity of the juice were measured by the Labling method.

Patients with digestive complaints in whom peptic ulcers were not found were divided into 3 groups according to age — group I 21—31 years, group II 31—41 years, group III 41—51 years; and into 3 groups according to the duration of the exposure to microwave radiation — group *A* 1—6 years, group *B* 6—11 years, group *C* 11—16 years (Tables I and II). The patients with peptic ulcers were divided similarly (Tables III and IV). Duodenal ulcer was found in 14 per cent of the patients hospitalized in the years 1965—1970 and in 38 per cent of the patients with digestive complaints. All the peptic ulcers were confirmed by X-ray examination. The incidence in the age groups (Table III) and in the groups of exposure (Table IV) shows that the largest num-

FOR PURPOSES OF STUDY OR RESEARCH IN LIEU OF LENDING THE ORIGINAL.

TABLE I

Number of patients exposed to microwave radiation; hospitalized in the years 1965—70 with digestive complaints, according to age groups

Group	Age in years	Number of patients
I	21—31	48
II	31—41	37
III	41—51	8

TABLE II

Number of patients exposed to microwave radiation; hospitalized in the years 1965—70 with digestive complaints, according to groups of exposure

Group	Duration of exposure in years	Number of patients
A	1—6	37
B	6—11	38
C	11—16	18

TABLE III

Incidence of duodenal ulcer in patients exposed to microwave radiation, hospitalized in the years 1965—1970, according to age groups

Group	Number of patients	Percentage of the group with digestive complaints
I	16	37
II	13	35
III	6	75

TABLE IV

Incidence of duodenal ulcer in patients exposed to microwave radiation hospitalized in the years 1965—1970, according to groups of exposure

Group	Number of patients	Percentage of the group with digestive complaints
A_1	10	27
B_1	17	45
C_1	8	44

TABLE V

Disorders coexisting with duodenal ulcer in patients exposed to microwave radiation, hospitalized in the years 1965—1970

Disorders	Number of cases
Vegetative neurosis	11
Cataract	1
Hearing defect	3

bers of cases are in groups A_1 and B_1. Neurotic symptoms predominated in the patients with duodenal ulcer (Table V). In the laboratory investigations in patients with duodenal ulcers, no alterations were found, except the ulcers on the X-ray films and disorders of gastric juice secretion. Examinations of gastric juice in patients with digestive complaints but without ulcers showed normal acidity amounting on the average to 10 mEq/L. In patients with duodenal ulcers acidity was higher, amounting on the average to 13.7 mEq/L. i.e. within normal limits. The volume of secreted juice amounted respectively to 202 ml. and 280 ml. In all 3 groups of exposure to microwave radiation gastric juice acidity and volume were also higher in patients with duodenal ulcers as compared with the control group (Fig. 1 and 2). The highest increase in juice volume (statistically significant, $P < 0.05$) was observed in groups A_1 and B_1. The average hydrochloric acid secretion was increased most in group C_1, statistically significantly.

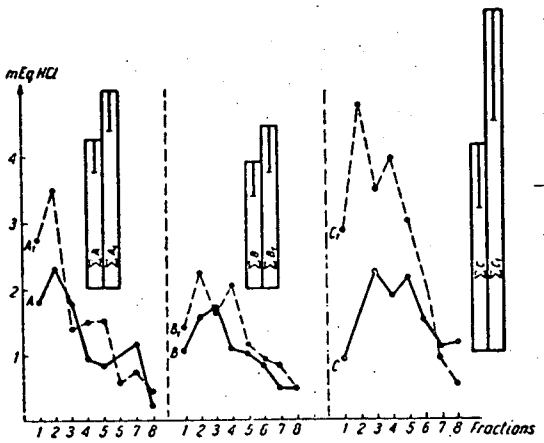
Discussion of the results

There is a steady upward tendency in the incidence of the peptic ulcer in connection with increased scope of etiological factors of this disease. Incidence statistics of gastric and duodenal ulcer reported by various clinical center give percentages of ulcer patients ranging from 1.3 to 13 per cent of all hospitalized patients (4, 8). As these data comprise the total incidence of gastric and duodenal peptic ulcer, it may be assumed that cases of duodenal ulcer are only a part of registered cases of this group and are really lower. Hence, the 14% incidence rate found in our clinical material indicates special exposure of the investigated group to ulcerigenic factors. There are some experimental data confirming this assumption. Wróblewski and Zarzecki (9) have shown that whole body irradiation of dogs with high-fre-

THIS IS A SINGLE PHOTOCOPY MADE BY THE NATIONAL LIBRARY OF MEDICINE

Fig. 1. Volume of secreted gastric juice in patients with duodenal ulcer exposed to microwave radiation

A, B, C — control groups, A_1 — 1—6 years of exposure, B_1 — 6—11 years of exposure, C_1 — 11—16 years of exposure



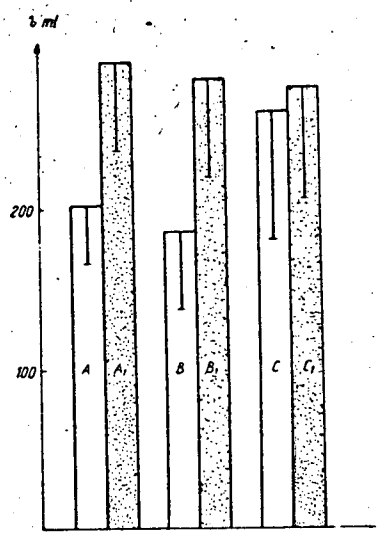


Fig. 2. Secretion of hydrochloric acid in patients with duodenal ulcer in groups of exposure to microwave radiation and average secretion in these groups

1 — average secretion of all fractions in the group, A, B, C — control groups, A_1 — 1—6 of exposure, B_1 — 6—11 years of exposure, C_1 — 11—16 years of exposure

quency electromagnetic waves without thermal effect causes gastric secretion disorders of hyperacidity type and increased proteolytic potency leading to the production of duodenal ulcers. An increase in gastric juice and hydrochloric acid secretion was found in all the investigated patients with duodenal ulcer exposed to microwaves. However, the highest values of acidity were observed in group C_1. This proves that ulcerogenic action of microwaves is related to the duration of exposure. It should be emphasized that the values of hydrochloric acid secretion and the shape of secretion curves in all the groups of investigated duodenal ulcer patients were lower than those normally occurring in this disease. Presumably this was related to hospitalization of the patients. Hospital conditions are often a factor alleviating subjective and objective symptoms of this disease. An effect of microwaves on central nervous system structures and particularly on the reticular formation and hypothalamus which take part in the visceral regulation in the body may also be involved, inhibiting gastric secretion.

The presented clinical observations indicate that the incidence of duodenal ulcer in persons exposed to microwave radiation is highest between the ages of 20 and 30 years. This is evidence of an aggressive action of high-frequency radiation on the stomach and duodenum which markedly increases the chances of the disease at an age of lesser predisposition (8).

It may be concluded from these data that the percentage of duodenal ulcers is highest in persons exposed to the high-frequency radiation for 6 to 11 years. However, it should be noticed that the incidence rate is very similar in the group of longest exposure to microwave radiation, i.e. 11 to 16 years. It seems, therefore that prolonged exposure to radiation increases the hazard of duodenal ulcer.

At present we have a good deal of evidence especially indirect, proving an ulcerigenic effect of high-frequency radiation. This radiation

OR PURPOSES OF STUDY OR RESEARCH IN LIEU OF LENDING THE ORIGINAL.

causes various functional and organic alterations in the body, which activate already known mechanisms of peptic ulcer pathogenesis. The role of neurotic disorders in the pathomechanism of peptic ulcer is generally recognized (2). This type of disorders is a characteristic result of the influence of microwave radiation on the body and is called microwave neurosis (1, 5). In the observed clinical material, vegetative neurosis was a frequent symptom accompanying duodenal ulcer. In the light of these data, it may be concluded that this pathogenic factor plays an important role in the development of duodenal ulcer in persons exposed to the high frequency radiation for long periods of time.

On the ground of experimental studies, it may be assumed that microwave radiation causes a state of hypervagotonia, which plays an important role in the pathogenesis of duodenal ulcer (1, 6). The results of our studies seem to confirm this assumption indirectly. This is supported by the observation of hypersecretion of gastric juice with increased acidity, as well as by the localization of the ulcers.

Trophic lesions of the stomach and duodenum as a direct effect of microwave radiation on this part of the alimentary tract are an additional factor predisposing to peptic ulcer. Pietienin and Subbota (7) suggested this concept on the ground of their own studies. They found various microscopic alterations of the gastric mucosa consisting in initial stimulation of the gastric secretory cells, followed by inhibition of their function resulting from the lesions of cell structures, especially in young cells.

The presented clinical studies, as well as previous experiments with animals, allow the conclusion that a causal relation exists between the effect of microwave radiation and the incidence of duodenal ulcer, which undoubtedly enlarges the scope of etiological factors of this disease.

References

1. Barański Z.: *Badania biologicznych efektów oddziaływania mikrofal*, Inspektorat Lotnictwa, Warszawa 1967. 2. Brodie D.A.: *Neurogenic Factors in Experimental Peptic Ulcer.*, Ed. Scoryna S.C., Philadelphia 1963. 3. Kholodov J.A.: *Biul. Eksper. Biol. Med.*, **9**, 42 (1963). 4. Dzikowski M.: *Społeczne aspekty choroby wrzodowej żołądka i dwunastnicy*, Leczenie choroby wrzodowej, Ed. E. Ruzyłło, PZWL, 24, Warszawa 1968. 5. Gruszecki L.: *Biul. WAM*, **18**, 5 (1965). 6. Minecki L.: *Promieniowanie elektromagnetyczne wielkiej częstotliwości*, Wydawnictwa Związkowe, 93, Warszawa 1967. 7. Pietienin J.W., Subbota A.G.: *Biul. Biul. Eksper. Bicl. Med.*, **9**, 5 (1965). 8. Ryss S.M., Ryss E.G.: *Yazvennaya bolezn'*, Meditsina, **8** (1968). 9. Wróblewski T.W., Zarzecki K., *Acta Physiol. Pol.*, **22**, **5**, 609 (1971).

THIS IS A SINGLE PHOTOCOPY MADE BY THE NATIONAL LIBRARY OF MEDICINE