

Enhancement of Allergic Skin Wheal Responses by Microwave Radiation from Mobile Phones in Patients with Atopic Eczema/Dermatitis Syndrome

Hajime Kimata

Department of Allergy, Unitika Central Hospital, Uji, Kyoto, Japan

Key Words

Skin prick test · Atopic dermatitis/eczema syndrome · Substance P · Vasoactive intestinal peptide

Abstract

Microwave radiation from mobile phones enhanced skin wheal responses induced by house dust mite and Japanese cedar pollen while it had no effect on wheal responses induced by histamine in patients with atopic eczema/dermatitis syndrome (AEDS). Microwave radiation also increased plasma levels of substance P (SP) and vasoactive intestinal peptide (VIP) in patients with AEDS. These results indicate that microwave radiation from mobile phones may enhance allergen-induced wheal responses in association with the release of SP and VIP. This finding may be useful in elucidating the pathophysiology and treatment of AEDS.

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Introduction

It has been reported that repeated exposure of microwave radiation from mobile phones caused headaches and maximum temperature rise in the human brain [1, 2],

and increased expression of *c-fos* messenger RNA in the rat brain [3]. However, the effect of microwave radiation on allergic responses in atopic patients has not previously been reported. It has also been reported that in rats, substance P (SP) and vasoactive intestinal peptide (VIP) induce mast cell degranulation [4, 5]. Moreover, SP and VIP levels are elevated in nasal secretions in patients with allergic rhinitis [6]. These reports prompted the author to study the effect of microwave radiation in patients with atopic eczema/dermatitis syndrome (AEDS) to determine whether microwave radiation could alter their allergen-induced skin wheal responses and plasma levels of SP and VIP.

Methods

After obtaining informed consent, 26 patients with AEDS (14 women and 12 men, mean age 31 years, range 21–52) were studied. All of the patients were allergic to house dust mite (*Dermatophagoides pteronyssinus*) and Japanese cedar pollen. They took no medication for 72 h prior to the study. In the microwave radiation study, 26 patients viewed at 60-min video featuring weather information, while having 26 mobile phones calling for 60 min without sound. Since it was difficult to hold the mobile phone to the ear for 1 h, it was tied around the neck by string and consequently placed 4 cm below the chin. In the control study, 26 patients viewed a 60-min video featuring weather information, while having 26 mobile phones with-

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Correspondence to: Dr. Hajime Kimata
Department of Allergy, Unitika Central Hospital
24-1, Umonji, Uji, Uji City, Kyoto, 611-0021 (Japan)
Tel. +81 774 25 2500, Fax +81 774 25 2353
E-Mail unitikah@m12.alpha-net.ne.jp

Table 1. Effect of microwave radiation from mobile phones on patients with AEDS

	Control (n = 26)			Microwave radiation (n = 26)		
	before	after	p	before	after	p
Skin wheal responses, mm						
House dust mite ¹	6.1 ± 0.07	6.2 ± 0.08	NS	6.0 ± 0.07	7.5 ± 0.09	<0.01
Japanese cedar pollen	4.8 ± 0.05	5.0 ± 0.05	NS	4.9 ± 0.04	6.4 ± 0.06	<0.01
Control solution	0.0 ± 0.00	0.0 ± 0.00	NS	0.0 ± 0.00	0.0 ± 0.00	NS
Histamine	5.1 ± 0.05	5.3 ± 0.05	NS	5.2 ± 0.05	5.4 ± 0.06	NS
Plasma levels, pg/ml						
SP	55.9 ± 1.3	57.8 ± 1.2	NS	58.3 ± 1.2	74.1 ± 1.6	<0.01
VIP	17.5 ± 0.7	16.9 ± 0.6	NS	19.2 ± 0.7	27.5 ± 0.8	<0.01

Values are means ± SEM.

¹ *Dermatophagoides pteronyssinus*.

out calling. Before and after the study, skin prick tests were performed using commercial house dust mite allergen, Japanese cedar pollen allergen as well as control solution and histamine (10 mg/ml), and 15 min later wheal size was measured [7]. The concentration of allergen extract for skin prick tests was titrated by comparing histamine control of each patient, and optimal concentration was found to be an undiluted one. Therefore, undiluted allergen extract was used. All of the 26 patients were studied at the same time as a group, and first the microwave radiation study was conducted. After 1 week the control study was conducted. This was a single-blinded study. Patients were not told whether they had calling or not. The model of the mobile phones used were Toshiba C451T (n = 8), Kyocera 3001 (n = 7), Kokusai K0207 (n = 6), and Sony D501i (n = 5). Simultaneously, plasma levels of SP and VIP were measured by ELISA according to the manufacturer's protocol (Peninsula Laboratories, Inc., Calif., USA). Briefly, standard/samples, polyclonal antineuro-peptide antibody and biotinylated neuropeptides were incubated in 96-well precoated Protein A Immunoplates for 2 h at room temperature and were washed 5 times. Streptavidin-conjugated horseradish peroxidase was added and the wells were incubated for 1 h at room temperature and were washed 5 times. Then 3,3',5,5'-tetramethylbenzidine dihydrochloride was added and wells were incubated for 1 h at room temperature, and the reaction was terminated with 2 N HCl. Absorbance was read at 450 nm and results were calculated. The sensitivity of the assay was 10 pg/ml.

Results

As shown in table 1, the wheal responses induced by both house dust mite and Japanese cedar pollen allergens were not changed in the control study. In contrast, the responses were significantly enhanced by microwave radiation. This was not due to enhanced nonspecific irritation of the skin, as no enhancement of wheal responses was induced by control solution or by histamine in these

subjects. The enhancement of wheal responses was still significant ($p < 0.05$) after 2 h (means ± SEM; 6.9 ± 0.07 mm by house dust mite and 5.9 ± 0.5 mm by Japanese cedar pollen), but not after 4 h (6.1 ± 0.06 mm by house dust mite and 5.0 ± 0.05 mm by Japanese cedar pollen). Moreover, plasma levels of SP and VIP were elevated by microwave radiation but not in the control study (table 1). It is true that SP and VIP increase in stress reaction. However, the failure of increase of SP and VIP by control study without microwave radiation indicates that increase of these neuropeptides is caused by microwave radiation. However, it is possible that patients with AEDS may feel microwave radiation as stress.

Discussion

These results suggest that microwave radiation from mobile phones enhanced allergen-induced wheal responses in association with the release of SP and VIP. The exact mechanisms are currently under investigation. It should be pointed out that the way the mobile telephones were used in these experiments was different to the usual way, thus further investigations are necessary to draw definite conclusions. However, microwave radiation failed to enhance skin wheal responses by Japanese cedar pollen in patients with allergic rhinitis who were allergic to Japanese cedar pollen (n = 20); 8.2 ± 0.09 mm at baseline vs. 8.4 ± 0.09 mm after microwave radiation. These findings may be useful in elucidating the pathophysiology and treatment of AEDS.

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Erratum

Table 1 of the article entitled ‘The Multipotential Pseudoantigenicity of X-Ray Contrast Media’ by E.C. Lasser, published in *Int Arch Allergy Immunol* 2000;123:282–290, has been published with a substantial error. Please see below the correct table:

Table 1. PCA – Angiovisist 370 – 4 Sprague Dawley rats

Site No.	CM μ l	N. Saline μ l	Sensitized serum, μ l	Stain diameter ($\pm$ SE), mm/10
1	50	0	50	7.5 $\pm$ 7
2	40	10	50	10.0 $\pm$ 10
3	30	20	50	17.5 $\pm$ 10
4	20	30	50	62.5 $\pm$ 28
5	10	40	50	115.0 $\pm$ 60
6	0	50	50	87.5 $\pm$ 31

Controls with nonsensitized serum (3 rats) and 0, 25, and 50 μ l CM showed no stain. Controls (4 rats) with sensitized serum and 1.9% saline replacing CM produced no stain at site 1, and 55 mm/10 and 50 mm/10 av. stains at sites 3 and 5. Other sites were not tested.

Significant differences: 2 vs. 4 (0.004), 2 vs. 5 (0.0002), 2 vs. 6 (0.00004).