MICROWAVE OVEN BURN

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CASE REPORT

THE patient, H.F., a 51-year-old teacher, was cooking a casserole in a new microwave oven on July 29, 1977. When its bell rang, indicating the end of the cooking cycle, she opened the door with the oven light on and the cooking blower operating. She put both bare hands up to two thirds of her forearms into the oven to retrieve the casserole glass dish. This took about five seconds. While inside, she felt a hot pulsating sensation and burning in all fingers and finger nails, as well as a sensation of "needles" from forearms to fingers. Soon afterwards she noticed redness of the dorsa of both hands and forearms of a pink-orange hue as well as jabbing pain and swelling.

Because of the late hour (11:00 P.M.), she did not seek medical help until the next morning. She was treated subsequently by a number of dermatologists with oral cortisone, cortisone ointments, grenz rays, and ultrasound. Acupuncture was attempted for two months in 1980 without relief of symptoms and ultrasound was not tolerated.

She also was seen by several neurologists in 1980 and 1981 who could not substantiate a diagnosis of burn due to microwave radiation because edema and discoloration had disappeared and the ordinary neurological testing procedures did not yield a definite diagnosis. There was no evidence of psychological disability.

The patient was seen on several occasions because of intolerance to even small amounts of radiant energy (sunlight, heat lamp, desk lamp), characterized by burning pain and growing intolerance to the pressure of clothing in hands and forearms and to touch.

She was given a complete neurophysiological evaluation, which yielded the following data:

Motor conduction velocities of median, ulnar, and radial nerves were within normal limits bilaterally. *Sensory conduction velocities* of median,

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ulnar, and radial nerves were within normal limits bilaterally except that the sensory conduction velocity of the left radial nerve was not obtained because the proximal sensory latency could not be evoked. *The terminal motor latencies* were all within normal limits. *The terminal sensory latencies* were within normal limits; that of the radial nerve had a very small amplitude of 10 microvolts. *Electromyography* was done with teflon-coated monopolar electrodes. Denervation (fibrillations, positive sharp waves, high frequency discharges, polyphasics[15,23,25-28] was found in: Right abductor pollicis brevis (median nerve), abductor digiti quinti (ulnar nerve), flexor carpi ulnaris (ulnar nerve), brachioradialis (radial nerve), extensor digitorum communis (radial nerve); left abductor pollicis brevis (median nerve), 1st dorsal interosseus (ulnar nerve), extensor digitorum communis (radial nerve.)

It was concluded that the median, ulnar, and radial nerves on both sides had sustained injury to their A alpha fibers (motor.)

On September 23, 1981 a sensory examination disclosed:

Touch: intact in forearms and hands, dorsal and palmar surfaces (camels hair brush). *Pain:* sharp above elbows, dull below in forearms and hands (R), very depressed in ulnar side of hand (R) (pinwheel). *Vibration:* intact bilaterally (tuning fork). *Temperature:* (cold) intensely perceived (R) arm, perceived as warm in (R) forearm and poorly perceived in (R) fingers. (Warm) intense in (L) arm, decreasing as heat source was moved distally. Two point discrimination (Weber test):[4-6] Right finger pulp 5 mm. (N= 2-4), thenar and hypothenar eminences 10 mm., and dorsal forearm greater than 10 mm.

Pain threshold (square wave stimulus 1 msec.-1/sec.) constant current: above right elbow 4 ma., below right elbow 10 ma., palm of right hand 11.5 ma., right radial artery 11.5 ma. Moeberg's Ninhydrin Sweat Test[4,5,7] (Tri-Keto-Hydrinden hydrate) showed severe reduction in the number of active sweat glands in the finger pulps as compared to those in a randomly selected patient.

Discussion

The production of microwaves (2,456 megacycles 1=12.5 cm.) by a magnetron tube and their effects upon living tissue have been described in the literature[8-12,15] as have circuitry and safety standards.[24] In the case presented here, the lesions in the peripheral nervous system on both sides and the symptoms which have persisted over the past four and one half years are not due to leakage but to exposure to the full output of the magnetron (600W).

The initial pulsating sensation is due either to the action of the stirrer mechanism at the end of the waveguide, the function of which is to distribute the energy from the back to the front of the cavity. The distribution is in successive "sweeps" of energy, and may give a sensation of pulses, or the pulsating sensation is due to arterial pulsation strongly perceived because of the sensory nerve sensitivity.

The burning sensation is due to damage to A beta, A delta, and C fibers.[16,21] The resulting heat sensitivity, which persists until the present time, is due to heat sensitization of A beta, delta, and polymodal nociceptors (C fibers).[17-22] Such hypersensitivity to radiant energy is induced when the temperature of the skin is raised to 48.5 – 50°C, on one occasion only, which certainly occurred during the brief (5 second) exposure of the patient. This sensitivity will persist for a long time..

Degeneration of A alpha (motor fibers) is due either to the heat generated or perhaps to direct effects of irradiation.[8] Denervation is scattered over a wide field and requires patient search for detection. Major nerve trunks in this case did not sustain detectable damage except for the left radial nerve sensory fibres. Hence most conduction velocities and latencies were within normal limits. The destruction of A beta fibers (in the skin), as evidenced by the two-point discrimination (Weber) test, is permanent because endorgans (Pacinian corpuscles, Meissner corpuscles, Merkel cell complexes) which degenerate after denervation do not regenerate.[4]

Involvement of the sympathetic nervous system is shown by a marked reduction in the number of active sweat glands in the finger pulps of both hands (Ninhydrin test) and is a permanent lesion because their nerve supply has been destroyed. The initial hyperemia, vascular changes, and perivascular edema are also due to sympathetic dysfunction.[8] However, because fibers to the vascular structures do not have endorgans, repair has taken place and the visible skin changes have disappeared.

When last seen, on December 22, 1981, the patient reported an increase in pain and hypersensitivity as well as burning sensations in the dorsa of both hands and forearms upon exposure to radiant energy (heat).

Summary

Microwave oven burns have been reported,[1-3] but never properly documented. This paper attempts to document all aspects of radiation burn in a patient who stuck both hands and forearms into an active oven cavity for a few seconds to retrieve a food dish. She was exposed to the full output (600W) of the oven's magnetron tube. Questions about the safety of

microwave ovens are raised because of the lack of free-standing radiation detectors as integral components of all ovens on the market.

Addendum

1) Microwave ovens for home use operate on a fixed frequency of 2,456 megacycles ($\lambda = 12.5$cm.) This particular frequency is confined to the oven cavity by a door that also prevents leakage. The magnetron tube, however, produces harmonics that penetrate through this door and can be detected by any commercially available radar "sentry" at 12 or more feet distance. The effects of these harmonics on the human body are unknown and remain unexplored.

2) A microwave oven is a mechanical device, the safety of which depends on the intactness of its interlocks, circuitry, and operation indicators, such as light and bells, which turn off or sound off at the termination of a cooking cycle. They are all integral parts of the oven's circuitry.[13]

3) Mechanical devices *do* fail! An oven therefore can still be active when it appears to have shut off.

4) The industry does not provide any radiation detector totally independent of the oven's circuitry, such as a 20¢, free-standing neon bulb. When appropriately placed within the cavity, the gas is excited by the radiation and flashes, thus indicating its presence. A simple neon bulb adds to safety and should be incorporated into the oven. More elaborate and costly detectors, such as commercially available leakage detectors, could also be incorporated but must be free standing and modified to accommodate the large energy output. Any oven without some kind of radiation detector should be considered potentially dangerous even if it conforms to federal safety regulations in every other aspect.[14] Most ovens are of relatively recent vintage. But what will happen 10 years from now?

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