Health Matters

Sonic Health Attacks by Pulsed Microwaves in Havana Revisited

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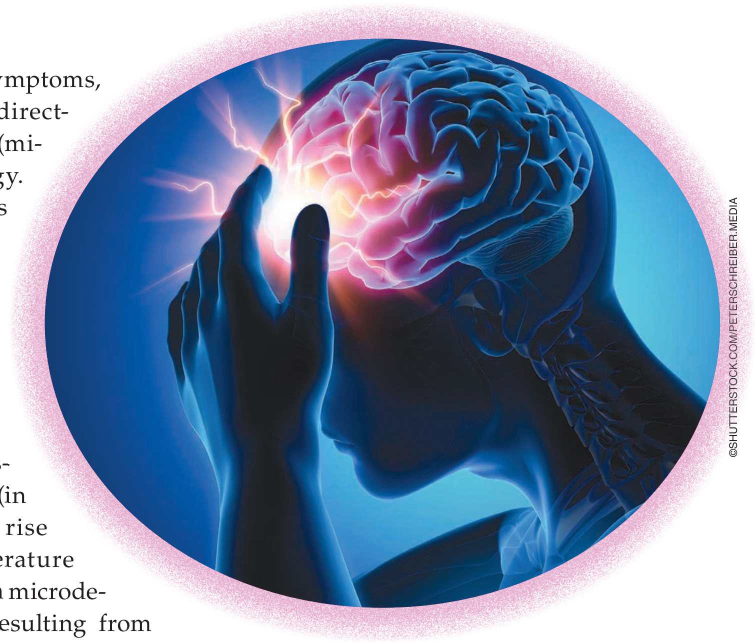

The U.S. National Academies of Sciences, Engineering, and Medicine (NASEM) recently released its study report "An Assessment of Illness in U.S. Government Employees and Their Families at Overseas Embassies" [1]. As I write this in December 2020, it is almost exactly three years since the publication of my article "Strange Reports of Weaponized Sound in Cuba" [2]. There, it was first hypothesized that "[a]ssuming that the reported events are reliable, there is actually a scientific explanation for the source of sonic energy. It could well be from a targeted beam of high-power microwave pulse radiation" [2].

In examining plausible causes of the described illnesses, the NASEM report [1] makes that point that, among the mechanisms the study committee considered, the most plausible mechanism to explain these cases, especially in individuals with distinct early symptoms, appears to be directed, pulsed RF (microwave) energy. The hypothesis of the microwave auditory effect [2] was based on years of published laboratory and theoretical research. A minuscule but rapid (in microseconds) rise in tissue temperature (on the order of a microdegree Celsius), resulting from the absorption of pulsed microwave energy, creates a thermoelastic expansion of brain matter. This small, theoretical elevation is hardly detectable by any currently available temperature sensors, let alone felt as a thermal sensation or heat. Nevertheless, it can launch an acoustic wave of pressure that travels inside the head to the inner ear. There, it activates the hair-cell nerves in the cochlea, which then relay it to the central auditory system for perception via the same process involved in normal sound hearing [3]–[5]. Depending on the power of the impinging microwave pulses, the level of induced sound pressure could be considerably above the threshold of auditory perception at the cochlea—approaching or exceeding levels of discomfort (including the reported headaches, ringing in the ears, nausea, and problems with balance or vertigo) and even causing potential brain-tissue injury.

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It is important to note that recent clinical magnetic resonance imaging (MRI) examinations of brains of personnel in Havana, compared to those of individuals not experiencing the loud bursts of sound, revealed significant differences in whole-brain white matter volume, regional gray and white matter volumes, cerebellar tissue microstructural integrity, and functional connectivity in the auditory and visuospatial subnetworks but not in the executive control subnetwork [6]. However, the clinical importance of these disparities is not definitive. A high-power, microwave-pulse-generated acoustic pressure wave can be initiated in the brain and then reverberate inside the head, potentially reinforcing the initial pressure and causing injury to the brain matters [5].

Furthermore, while the clinical symptoms presented are concussion like, the MRI images did not resemble the usual presentations of traumatic brain injury or concussion. However, clinical experiences with concussion are derived mostly from externally inflicted impact wounds, such as a blow to the head when hitting the ground or another rigid body, which may set brain tissues into violent motion against the skull. A high-power, microwave-pulse-generated acoustic pressure wave could be initiated in the brain and then resonate inside the head (see the results of the computer simulations in [5]), potentially reinforcing the initial pressure and resulting in injury to the brain matter. Thus, it is conceivable that the MRI images associated with high-power, microwave-induced pressure or shock waves may indicate entirely different manifestations of the brain injury or concussion. The clinical importance of these differences is uncertain at present and may command future study for clarification.

Thus, the pulses may approach or exceed levels of discomfort or result in brain-tissue injury.

The known near-zone thresholds determined under controlled laboratory conditions for the peak microwave power density of auditory perception in human subjects with normal hearing are listed in Table 1. Note that, while there are wide variations in measured threshold values over the range of 1–70 µs of pulsewidths involved, the subset of data for 10–32 µs falls within a narrower range. Considering that the ambient noise levels in all three experiments were essentially the same, it may be reasonable to conclude that the averaged threshold power densities of 2.1–40 kW/m^2, or 14 kW/m^2, is a realistic threshold peak power density for the induction of the microwave auditory effect in the near field of 1,250–3,000-MHz microwaves with pulsewidths between 10 and 30 µs. In other words, the 14-kW/m^2-per-pulse peak power density generates a barely audible sound level of 0 dB. Generating sound at 60 dB (the audible level for normal conversation) requires a 1,000-fold higher power density per pulse. To generate a tissue-injuring level of sound at 120 dB would take another 1,000-fold increase in required peak power density, or 14 GW/m^2 per pulse. The corresponding theoretical temperature elevation would be about 1 °C, which is safe by current protection guidelines.

TABLE 1. Thresholds of microwave-induced auditory sensation in adult humans with normal hearing determined in controlled laboratory studies.

Frequency (MHz)	Pulsewidth (µs)	Peak Power Density (kW/m^2)	Ambient Noise Level (dB)	Reference
1,245	10–70	0.9–6.3	45*	[7]
2,450	1–32	12.5–400	45	[8], [9]
3,000	10–15	2.25–20	45**	[10]
Pulsewidth Between 10 and 32 µs				
1,245	10–30	2.1–6.3	45*	[7]
2,450	10–32	12.5–40	45	[8], [9]
3,000	10–15	2.25–20	45**	[10]

*Typical sound pressure level for microwave anechoic chambers lined with absorbing materials.
**With plastic foam earmuffs.

For plane-wave equivalent exposures, the available computations provide two sets of data that are suitable for comparison with the results described previously. In one case, the reported threshold peak incident power density for an anatomical head model is 3 kW/m^2 for 20-µs pulses at 915 MHz [11]. For the other, the threshold is about 50 kW/m^2 for 20-µs pulses at 2,450 MHz [12]. The corresponding peak incident power densities at the 120-dB injury level are therefore between 3 and 50 GW/m^2 per pulse, which bracket the value of 14 GW/m^2 per pulse from the previous calculation for near-zone exposures. These peak power densities are close to and encompass the 23.8-GW/m^2 value for the dielectric breakdown of air. As the dielectric permittivity of all biological and physical materials is greater than that of air or free space, their intrinsic impedances are always smaller than that of air. The breakdown peak power density in skin, muscle, and brain tissues, for example, would be a factor of six to seven higher, or 142–166 GW/m^2 for a microwave pulse at 1,000–3,000 MHz.

Thus, if the microwave auditory effect is weaponized at sufficiently high powers for either lethal or nonlethal applications, the pulses are likely to injure the brain or auditory pathway nervous tissues through the reverberating sonic shock waves. The damage would not be caused by microwave pulse-induced hyperthermia through excessive temperature elevation in the brain or by a dielectric breakdown of brain, muscle, or skin tissues. Note that the units of measure of kW/m^2 or GW/m^2 per pulse refer to power per square meter, not the total output power of any source. In summary, depending on the power of the impinging microwave pulses, the level of induced sound pressure in the brain could be considerably higher than the threshold of auditory perception. Thus, the pulses may approach or exceed levels of discomfort or result in brain-tissue injury. A high-power, microwave-pulse-generated acoustic pressure wave initiated in the brain and reverberating inside the head could bolster the initial pressure and cause damage to the brain matters.

Postscript

The author of this article was invited by the NASEM study committee to present on "Multidisciplinary Analysis of Microwave Pulse-Induced Sound and Pressure in Human Heads." The talk was based on his extensive research on the microwave auditory effect.

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