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Microwave-Induced Thermoelastic Pressure Wave Propagation in the Cat Brain

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This paper presents direct measurements of acoustic pressure wave propagation in cat brains irradiated with pulsed 2.45-GHz microwaves. Short rectangular microwave pulses (2 μs, 15 kW peak power) were applied singly through a direct-contact applicator located at the occipital pole of a cat's head. Acoustic pressure waves were detected by using a small hydrophone transducer, which was inserted stereotaxically into the brain of an anesthetized animal through a matrix of holes drilled on the skull. The measurements clearly indicate that pulsed microwaves induce acoustic pressure waves which propagate with an acoustic wave velocity of 1523 m/s.

Key words: microwave pulses, acoustic pressure, speed of propagation, attenuation coefficient, frequency spectrum

INTRODUCTION

The microwave auditory phenomenon [Frey and Messenger, 1973; Guy et al., 1975; Lin, 1978] has been widely recognized as one of the most interesting biological effects of microwave radiation. Short rectangular microwave pulse impinging on the heads of humans and animals has been shown to produce audible sounds. During the past decade, considerable efforts have been devoted to the study of the effect. It is generally accepted that the response stems from thermoelastic expansion of tissue in the head which absorbs pulsed microwave energy. When microwave impinges on the head, the absorbed energy is converted into heat, which produces a small but rapid rise of temperature. This temperature rise, occurring in a very short time, generates rapid thermoelastic expansion of tissues in the head, which then launches an acoustic wave of pressure that is detected by hair cells in the cochlea.

The thermoelastic theory of acoustic pressure wave generation in spherical models of a mammalian head exposed to rectangular microwave pulse energy has been presented previously [Lin, 1977a,b]. This theory describes the acoustic waves (i.e., frequency, pressure, and displacement) generated in the head as functions of sizes of brain spheres and characteristics of impinging and absorbed microwave energies. Furthermore, hydrophone measurement of pulsed microwave-induced acoustic signals in various-sized spherical head models filled with brain equivalent

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