THEORETICAL ANALYSIS OF MICROWAVE-GENERATED AUDITORY EFFECTS IN ANIMALS AND MAN

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ABSTRACT

While there is considerable evidence for the human ability to hear pulse modulated microwave radiation, a number of questions remain regarding the mechanism responsible for the phenomenon. One explanation which seems most likely is that the impinging microwave pulses produce heating as a result of energy absorption. A rapid thermal expansion of the brain material follows. The stress associated with thermal expansion launches an acoustic vibration which is detected by the inner ear. This paper presents a theoretical analysis of the stress and displacement generated by impinging microwave pulses in a spherical model of the mammalian cranial structure. Assuming homogeneity of the brain material, the absorbed energy pattern obtained from the electromagnetic wave equation is used as the source function for the equation of heat conduction in the spherical head. The displacement is found by solving the thermoelastic motion equation with stress free boundary conditions. Initial numerical results (based on a 10 microsecond pulse) obtained for the frequency and acoustic pressure agree well with previous experimental observations.

INTRODUCTION

Pulsed microwave radiation impinging on the head of animals and human subjects produces an audible sound. It appears as a clicking, ticking, knocking, chirping or buzzing sound, localized within or immediately behind the head [1-4]. When Frey [1] first reported the auditory response, he suggested that the auditory system might be directly responsive to electromagnetic energy over a limited spectrum, since the response is instantaneous and occurs at low average power densities. In fact, the effects have been induced with average power densities at least a couple of orders of magnitude below the current safety standard for continuous exposure to microwave radiation.

Although the possibility of the auditory system responding directly to electromagnetic energy has now been discounted, the mechanism underlying the auditory sensation generated in man and animals by pulsed microwave radiation continues to be a subject of considerable debate [4,5,6]. Recent investigations have shown that evoked auditory activities may be recorded from the brain of cats, chinchillas, and guinea pigs [4,7,8]. Responses elicited by both conventional acoustic inputs and pulsed microwave stimuli disappear following destruction of the cat cochlea [9], which suggests that the microwave induced auditory sensation is transduced by a mechanism similar to conventional acoustic inputs and that the site of primary interaction resides somewhere peripheral to