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Temperature and Frequency Dependence of Ultrasonic Absorption in Tissue

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INTRODUCTION

The ultrasonic absorption coefficient per unit path length has been determined for mammalian central nervous tissue in the temperature range 2°C to 50°C at the acoustic frequencies 0.26, 0.5, 0.7 and 1 MHz.

EXPERIMENTAL PROCEDURE

A small calibrated thermocouple probe is imbedded in the tissue and the specimen is exposed to a rectangular acoustic pulse (approximately 1 sec duration) of known intensity. The absorption coefficient is given by

$$\alpha = \frac{\rho C_p}{2I}\left(\frac{dT}{dt}\right)_o$$

where ρC_p is the heat capacity per unit volume of the tissue, I is the acoustic intensity, and $(dT/dt)_o$ is the initial time rate of change of temperature associated with the phase of the response due to absorption of sound in the body of the material surrounding the thermocouple junction (1).

The young mouse 24 h after birth, an essentially poikilothermic animal, provides a convenient preparation (2).

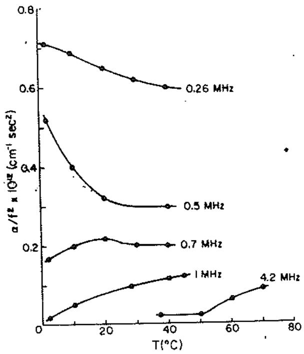

Fig. 1 Frequency-free ultrasonic absorption in tissue

RESULTS

Figure 1 shows the frequency-free ultrasonic absorption as a function of temperature, including data at 4.2 MHz (3) obtained on the adult cat brain, suggesting a family of curves whose maxima occur at increasing temperatures and decrease in magnitude as the frequency increases.

REFERENCES

(1) F. Dunn, J. Acoust. Soc. Am. (1962) 34 1545; (2) F. Dunn, Am. J. Phys. Med. (1958) 37 148; (3) T. C. Robinson and P. P. Lele, J. Acoust. Soc. Am. (1972) 51 1333.