spondylosis, muscle and tendon strains and trophic ulcers. The biological effects of ultrasound are often separated into thermal and non-thermal mechanisms, although these should be viewed as operating at either end of a continuum and not as discrete phenomena. Non-thermal modes of ultrasound are currently attracting a great deal of attention and evidence is accumulating that some of the observed biological interactions are produced as a result of physical perturbation of cell membranes induced by cavitation and microstreaming.

We have examined the effect of low-level ultrasound (0.25 W/cm^2; 1.5 MHz; continuous wave) on the spontaneous release of acetylcholine at the frog neuromuscular junction. These events give rise to miniature end-plate potentials (MEPPs) which may be recorded intracellularly from the post-synaptic muscle cell. Using a simple chamber in which the muscle preparation was secured to a polyurethane resin baseplate it was found that 3 min of exposure to ultrasound of the stated parameters resulted in a significant increase in the frequency of MEPPs, with only small concomitant increases in temperature (1.0–1.6°C). Control experiments involving the same temperature rises gave only small increases in MEPP frequency and these results were similar to those reported by other investigators. However, these experiments were repeated using a more sophisticated exposure apparatus. In this device the muscle was suspended across a gap over an acoustically transparent window. The inner chamber was contained within a thermostatically controlled water bath, lined with an acoustically absorbent material. There was, thus, little possibility of reflection or standing-wave phenomena occurring. In this more controlled experiment we have *not* been able to demonstrate conclusively the effects shown in the earlier work, although the temperature increase recorded from a thermistor probe close to the muscle preparation was very similar in both magnitude and time course.

CORRELATION OF SONOLUMINESCENCE WITH THE STANDING-WAVE COMPONENT OF AN ACOUSTIC SOUND FIELD PRODUCED BY A THERAPEUTIC UNIT

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When small bubbles are subjected to ultrasound at sufficiently high intensities, unstable cavitation may occur. During the rarefactional part of the sound-wave cycle, the bubble radius increases to several times its original value. When the pressure gradient changes, the bubble collapses adiabatically and temperatures are attained at which free radicals are formed. When these free radicals recombine, light is emitted. This emission of light is known as sonoluminescence. It has been suggested that sonoluminescence occurs only in the presence of standing waves. This paper presents results of observations in aqueous systems, of the spatial distribution of sonoluminescence, as viewed by a high-gain image intensifier, when using different reflecting surfaces to establish ultrasound fields with different standing-wave ratios. For the experiments described, a physiotherapeutic ultrasound generator (Therasonic 1030, Electro-Medical Supplies), operating at 1 MHz in continuous-wave mode, was used. Measurements of the acoustic pressure variations on the axes of the sound fields were made using a needle hydrophone, and the resulting patterns of maxima and minima were compared with photographs of the spatial distributions of the light output from the image intensifier. The densities of the negatives were recorded using a microdensitometer (Joyce-Loebl). This enabled quantitative values of light intensity to be compared with standing-wave ratios. It was found that bands of maximum light corresponded extremely well with regions of maximum pressure variation as recorded by the hydrophone, demonstrating convincingly that sonoluminescence originates at pressure antinodes in a sound-wave field. Very little light was produced by progressive-wave fields. The extent to which these results support the hypothesis that in aqueous media sonoluminescence is produced only by standing waves is discussed. The results of experiments at room temperature and at 37°C were used to obtain information on the effect of temperature on sonoluminescence.

A STUDY OF ULTRASONIC PULSE-ECHO BEAM-HARDENING USING TISSUE-MIMICKING TEST OBJECTS

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The use of broad-band pulses in diagnostic ultrasound is imperative in order to ensure optimum resolution. However, because of the strong frequency dependence of attenuation coefficient, α, of soft tissue ($\alpha \propto f^{1.2}$), there is a preferential absorption of the higher-frequency components of the pulse and hence a "beam-hardening" effect. The result is that the effective frequency of the pulse decreases with increasing depth. The use of tissue-mimicking materials, such as in the Cardiff Test System, to measure scanner dynamic range relies upon the assumption that the effective frequency is depth-dependent. Observations on several scanners where observed dynamic range is depth-dependent suggests that this beam-hardening may be a real problem. We have attempted to quantify the beam-hardening effect using varying path lengths in tissue-mimicking material and to relate these measurements to the apparent change in dynamic range with depth. The results obtained from several commercial scanners show the important influence of the low-frequency components and the lack of correlation between dynamic range, centre frequency, penetration and resolution.

COMPUTER-CONTROLLED GAIN COMPENSATION IN ULTRASONIC IMAGING

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A simple form of automatic gain compensation has been shown to be of value in obstetric and abdominal ultrasound (Pye et al, 1983, 1985). A new computer-controlled gain-compensation system has been developed which can apply a different gain function to each beam direction in the image. For gain calculations, each beam direction is divided into 3 mm range intervals. Several algorithms have been developed for generating TGC functions. These are described and the results of using them clinically and with ultrasound test objects are presented.

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