THE EFFECT OF ULTROSONIC EXPOSURE ON LIVER FUNCTION TESTS

THESIS

Submitted In Partial Fulfilment

For The Degree Of

M. Sc.

General Medicine

BY

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M. B. B. Ch.

Supervisors

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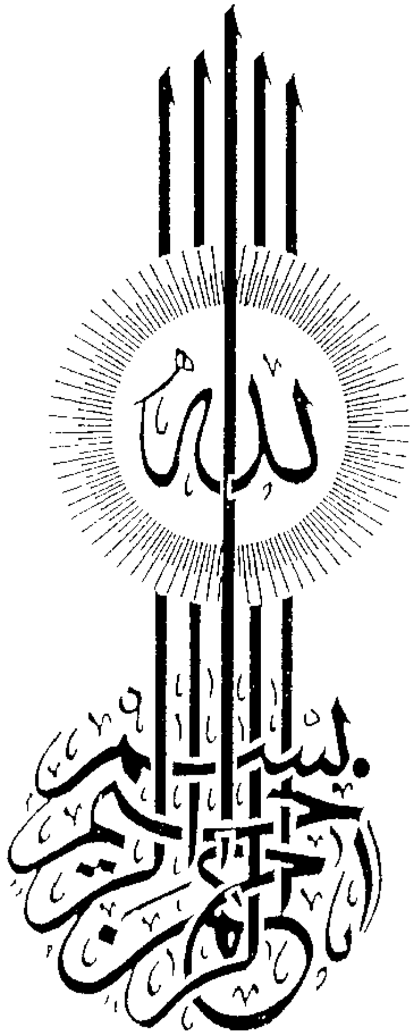
بسم الله الرحمن الرحيم

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T. ElBanna

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INTRODUCTION AND AIM OF THE WORK

Introduction:

The continuing use of ultrasonic techniques in various branches of clinical medicine has been followed up by considerable effort to establish whether or not insonation can be harmful. Although no deleterious effects have yet been established, some of these may not become apparent for one or more generations. For the present any harmful effects can only be investigated by means of animal experiments, chromosomes studies, and clinical observations (Taylor and Dyson, 1972).

Gold berg, (1975) reported that, "it has never been reported any adverse effect attributable to ultrasound," numerous studies showed that ultrasound is safe at intensities below 100 MW/sq.Cm.

Taylor and Newman (1972) found that expesure to ultrasound waves frequencies higher than that used for clinical diagnosis, causes modification of surface properties changes in membrane permeability or even cell rupture.

The aim of this work: Is to study liver function tests in patients with bilharzial liver fibrosis, before and after ultrasonic exposure.

REVIEW OF LITERATURE

1-ULTRASOUND

- Historical Review

- Physical Principles Of Ultrasound

- Types Of Ultrasound Display Modes

- Common Artifacts In Ultrasound Scanning

I) HISTORICAL REVIEW

Carlsen, 1975, reported that the curies in 1880 observed that a mechanical stress applied to a quartz crystal caused an electrical potential, conversely, when an electrical potential was applied across the crystal, the latter would deform slighty (Piezoelectric and reverse piezoelectric effect). The piezoelectric effect is the heart of the present ultrasound imaging systems. The first ultrasound instrument was the dog whistle developed in 1880.

Langevin, 1928, reported th use of high frequency sonic power for detection of submarines. Attempts were made to apply ultrasund for medical diagnosis just prior to the seoond world war.

Howry and Bliss, 1952, one of the pioneers of diagnosti ulrasound, developed the principles of compound canning. The echoes received were displayed as intensity modulated dots on a large phosphor screen.

Wild, 1952, one of the earliest pioneers, demonstrated that ultrasound could detect differences between normal tissues, benign and malignant tumours of the breast with 90% accuracy.

Donald et al., 1958, is responsible for the development of contact scanning concept, and for pioneering the extensive application of ultrasund in obstetrics and gynaecology.

Through efforts of these early investigators and others working with them and after them, diagnostic ultrasound has evolved into a highly useful tool of diverse clinical application (El-Bassioney, 1978).

II) PHYSICAL PRINCIPLES OF ULTRASOUND

Goldberg, 1975 defined sound waves as mechanical waves transmitted through molecular media by causing alternative condensations and rarefactions. One condensation and one rarefaction constitutes one cycle.

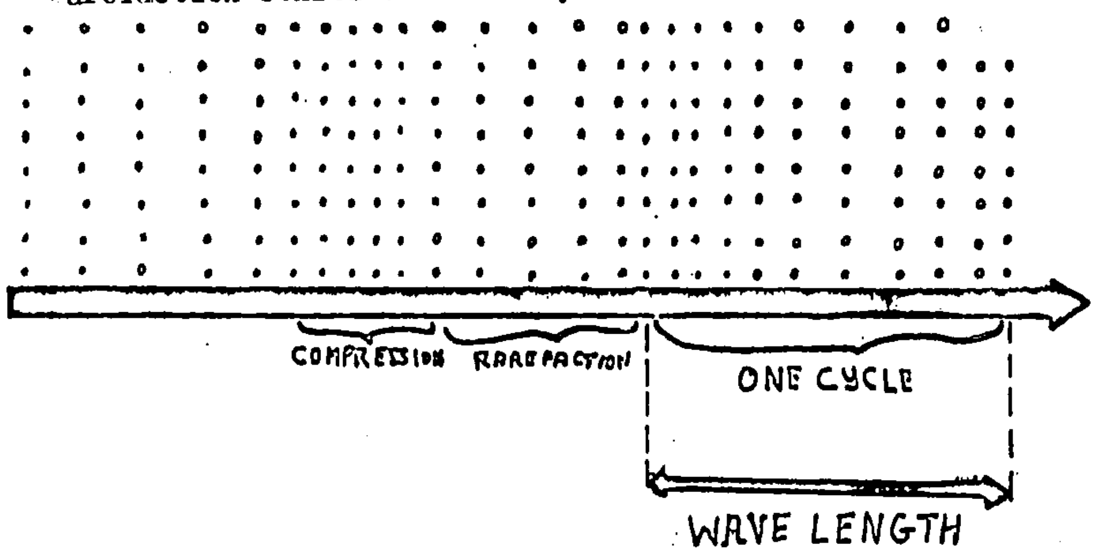

Figure (1): Ultrasound wave,consist of compressions and rarefactions propagated along the sound beam axis within a molecular medium. (Carlsen, 1975).

Wave Length : is defined as the distance from one pressure peak to the next pressure peak. Wave length in medical application ranges from 0.1-1.5 mm.

Frequency: The frequency of sound is defined as the number of waves per unit time and expressed in terms of Hertz (Cycles per second).

- Hertz = one cyle/sec.
- Kilo Hertz = 1000 cycles/sec. = K.Hertz.
- Mega Hertz = 1,000,000 cycle /sec. = M.Hertz = MHz.

The range for diagnostic ultrasound is about 0.5-20 MHz

Velocity: It equals the wavelength timed the frequency, which is constant.

Thus, in a given medium, the frequency is inversely proportional to the wave lenght (Baker, 1974).

The velocity is modified by the density and elesticity of the medium (Barnett and Morley, 1976).

The velocity is more in solids than in liquids, and is more in liquids than in gases. Thus air in the lung or gas in the bowel presents a barrier to ultrasonic examination.

Ultrasonic waves: Ultrasound is defined as a form of acoustic vibration with frequencies so high that it cannot be perceived by the human ear. The human ear can detect sounds with frequency ranging between 20 and 20,000 hertz. Ultrasounds have frequency higher than 20,000 while infrasounds have

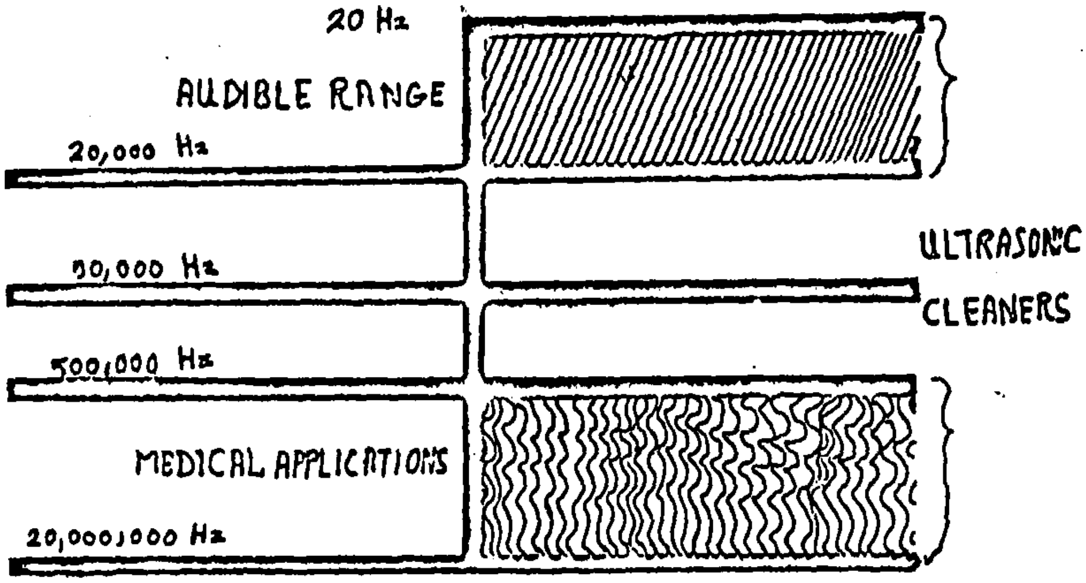

Figure (2) Ultrasound is sound above the detection of the human ear. The frequency range for medical application is in the megaHertz range. (Carlsen, 1975).

frequency less than 20 Hertz, both cannot be heard (Figure 2) This is an arbitary physiologic definition, since man exhibits great variations in the upper limits of his acoustic perception (Carlsen, 1975).

Intensity: Is defined as the power per unit area, measured in milliwatts per square surface area (M.w/sq.cm). The power is the rate at which energy is propagated past an imaginary surface perpendicular to the sound beam, it is expressed in watts.

Attenuation: is the decrease in intensity of a sound beam passing through a medium. It is expressed as "half value layer" which is the distance that sound can travel before its initial intensity is reduced to the half. Bone has a smaller value than fluid, so bone attenuation is greater than fluids.

Attenuation is caused by many factors as absorption of sound energy by tissue, divergence of incident beam on interfaces by refraction and scattering. Attenuation depends on the properties of the medium and the frequency of the wave (Baker, 1974).

Acoustic impedance: It expresses the overall transmission of ultrasounds in a given medium, and equals the velocity times the density of the medium (Baker, 1974).

Reflection and refraction of sound wave: Reflection occurs at the interface between two media having different acoustic impedance (Figure 3). It is expressed as "pressure amplitude co-efficent " (R)

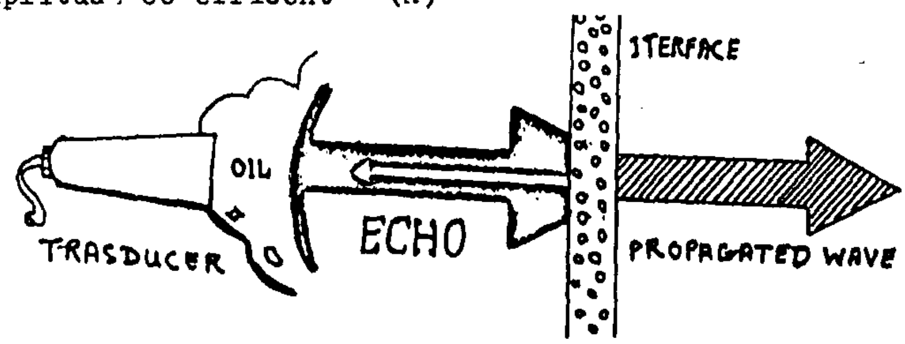

Figure (3); At theboundary between two media having different acoustical densities a reflection will occur and a portion of the propagated wave will continue. (Carlsen, 1975).

and depends on impedance mismatch the two media, At soft tissue-bone interface, great amount of ultrasonic energy is absorbed, depending on the calcium content of the bone also most the energy is reflected because of great mismatch in acoustic impedance (Garrett et al., I975). The remaining energy, from the propagated wave, will continue into the second medium as refracted wave.

Since uitrasound waves are directional in nature they resemble light and obey optical laws.

Resolution: It is the minimal distance between two point targets required to recognize each point distinctly. It depends on the sonic frequency, higher frequencies have better resolution but fall off rapidly, while lower frequencies have excellent transmission (Penetration) but poor resolution (Baker, I974).

There are two types of, resolution, lateral (azimuthat) which recognizes point targets in line perpendicular to the axis of sound beam, and it is inversely proportional to the beam width. The latter depends on the diameter of sound source (crysta), the frequency and the distance from the source (Baker, I974).

The second type of resolution is the axial (or depth) one, distinguishing point targets on a line parallel to the sound beam. Axial resolution depends on the wave length.

Piezoelectric Effect: (Figure 4). Is the heart of the present ultrasound imaging systems (Carlsen, I975).