AN ESSAY ON EVALUATION OF ULTRASONOGRAPHIC STUDIES IN PEDIATRIC AGE GROUPS

THESIS

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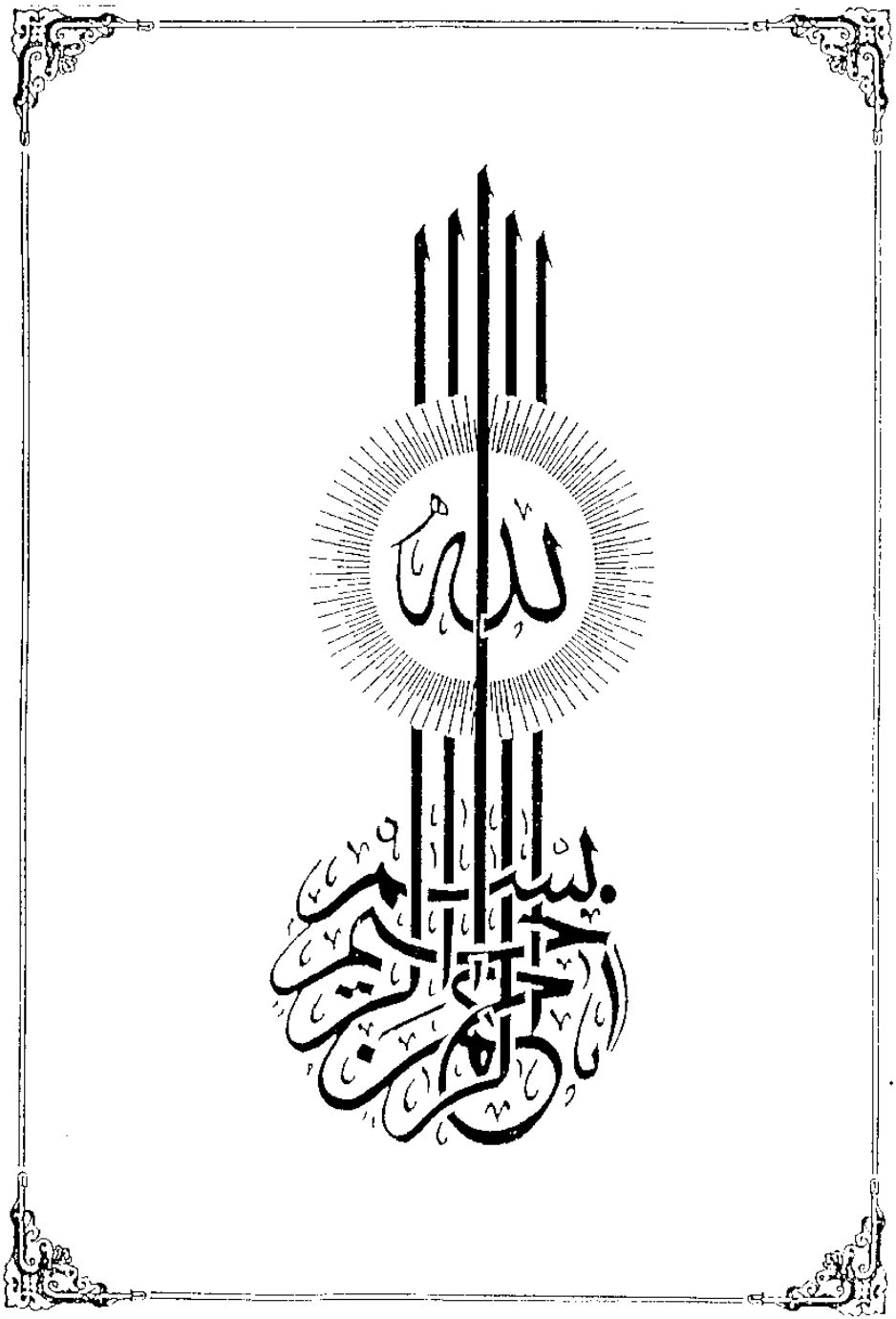

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I- INTRODUCTION

INTRODUCTION

Ultrasound is the name given to a class of mechanical pressure waves that can be propagated through liquids, solids and to some extent gases.

The purpose of a system is to transmit a short ultrasonic pulse and detect all returning echoes. As the transmitted pulse traverses the body, some of its energy is reflected backwards at each tissue interface.

The echo arising at each tissue interface is similar in shape to the incident pulse but smaller in amplitude.

The recent establishment of ultrasonographic techniques and the echoes detected by the transducer are converted into an electrical signal and displayed on an oscilloscope which can be applied safely and accurately for many organs of the body to detect any disease in these organs.

REVIEW OF LITERATURE

I/ ULTRASOUND

Historical Data:

Ultrasound is not a new subject, Galton, 1883, made a study for the acoustic spectrum perceived by humans, he made a whistle which can be looked for as the first known transducer, but it has no application at that time except being used as a dog whistle.

During the first world war "1914-1918", a great interest in the subject has developed and Lanegevin in france developed the use of quartz transducer for transmitting and receiving ultrasonic waves in water.

Pierce, 1925, used quartz and nickel transducer for generating ultrasound of "Mega Hertz". (Blitz, 1971).

Hartman and Trolle, 1927, made an ultrasonic waves in fluids. (King, 1974).

Attempts were done to use ultrasound in medical diagnosis just prior to the second world war "1942-1946", Dussik thought to visualize the cerebral ventricles by

measuring attenuation of ultrasound beams transmitted through the head. (Kossoff, 1974).

Douglass Howry "1952" discovered the principle of compound scanning recording , the echoes on a large phosphorus screen.

John wild "1952" stated that by using ultrasound, the difference between normal tissues and benign or malignant tumour of the breast can be detected in 90% of cases.

Ian Donalns "1958" developed the contact scanning concept and had a major application of ultrasound in obstetrics and gynaecology .(King, 1974).

The progress achieved over the last 25 years was the result of cooperation of a large group of physicians and engineers working as a team, the continuation of this effort should yeild new and improved methods and applications of diagnostic ultrasound.

Physical Properties of ultrasound:

Nature of ultrasound:

Ultrasound can not be detected by the human ear and this depends on the frequency of the sound waves, the human ear can detect sounds with frequency of 16.000-20.000 Hertz "cycle/second". sound of a frequency above 20.000 Hertz is called "ultrasound" and sounds below 16.000 Hertz is called "infrasound".

Types of sound waves:

According to the type of the motion of particles, sound waves are divided to:

A. Longitudinal waves:

When the particle motion is in the direction of sound propagation, this type is supported by all material.

B. Transverse waves:

When the particle motion is perpendicular to the direction of sound propagation, this type is supported by solids only except bones.

Characteristics of sound waves:

1- Wave length:

Wave length is the distance from one pressure peak to the next pressure peak, in medical applications; wave length range is 0.1 - 1.5 mm.

2- Velocity:

Velocity is the speed of the wave, In human tissue at 37°C the velocity is 1540 meter/second, in the liver the velocity is 1549 meter/second, and in the spleen it is 1566 meter/second.(Goldberg, 1975).

3- Frequency:

Frequency is the number of complete periodic cycles undergone in unit time, the unit of frequency is the Hertz (cycle/second), and expressed as:

Kilo Hertz = 1000 cycles/second "KHZ"

Mega Hertz = 1.000.000 cycles/second "MHZ"

Giga Hertz = 1.000.000.000 cycles/second "GHZ"

In medical diagnosis, the frequency commonly used varies from 1-15 MHZ.

4- Amplitude:

Amplitude is the height of the waves, is the measure of strength or loudness of the sound wave.

5- The period:

The period is the time taken by the wave to complete a single cycle.

6- Resolution :

Resolution is the ability to identify two objects as being distinct entities, we have:

- Lateral resolution: to distinguish object in a line perpendicular to the sound beam.
- Axial resolution: to distinguish two objects on a line parallel to the sound beam.

7- Intensity:

To propagate a sound wave, the particles of the material through which the sound is propagated should move, this movement needs energy, the unit of the power is the "watt". Intensity is defined as "power per unit area".

For medical diagnosis, intensity range of 1-50 MW/sq. cm. are commonly used. (Goldberg, 1975).

Mechanism of ultrasound production:

The piezo-electric effect: the term "piezo" is derived from a Greek word means pressure, so Piezo-electric translates into pressure electric and it refers to the property of certain crystals which causes them to emit electricity when pressed or deformed.

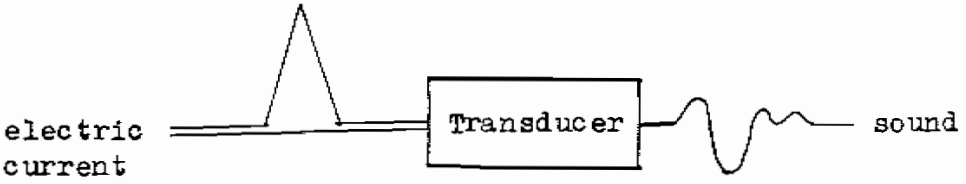

Figure (1)

Figure (1) illustrates the piezo-electric effect as it is utilized in an ultrasound transducer.

The reverse piezo-electric effect is the deformation which occur in certain crystals when they are affected by an electric current. The piezo-electric and reverse piezo-electric effect is the heart of ultrasound system "transducer". (Goldberg, 1975).

Instruments used in diagnostic ultrasound:

1- The transducer (Figure 2):

Is the heart of ultrasound, it depends on the piezo-electric principle and is composed of :

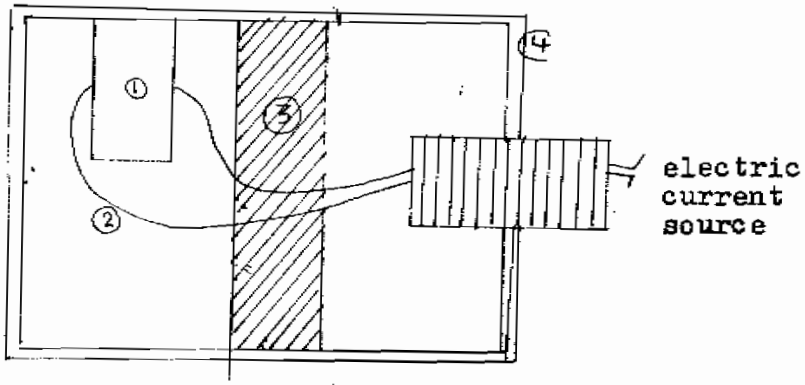

Figure (2) The transducer
(Hassani, 1976)

1- The piezo-electric crystal:
A small cylinderical element 1-2 cm wide and 1 mm. thickness.

2- 2 electrodes connected to the side of the crystal.

3- Damping material: act to absorb waves produced in inverted direction, thus provides a undirectional sound beam.

4- protective holder of durable plastic.

Generation of the ultrasound waves and detection of the returning echoes. The crystal vibrates by the effect of the electric current, it expands and

contract producing ultrasonic waves, the echoes when reflected from the tissue interfaces return back to the transducer crystal causing its vibrations and converting these echoes to electric impulses which are detected on the echographic oscilloscope.

2- Pulse generator:

There are a lot of generator that can be used e.g discharge circuit, silicon control capacitator and blocking oscillator, they are characterized by the property of generating very short electric voltage which will shock the crystal.

3- Amplifier:

Is an electric device, which enlarges and strengthens the signals fed to it without changing their shape.

4- Demodulation circuit:

Is an electrical circuit, the function of which is t eliminate the negative portion of the amplified wave,