USES OF ULTRASONOGRAPHY IN DIAGNOSIS OF ABDOMINAL SWELLINGS

An Essay

SUBMITTED FOR PARTIAL FULFILMENT

OF THE MASTER DEGREE IN

(GENERAL SURGERY)

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الله

بسم الله الرحمن الرحيم

سبحانك
لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم
صدق الله العظيم

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DEDICATION

To My Parents

To My Wife

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ACKNOWLEDGMENT

First and foremost, thanks are due to GOD, the most Gracious, the most Merciful.

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C O N T E N T S

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INTRODUCTION

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INTRODUCTION

Abdominal swellings are of surgical importance for both senior and genior surgeons. All surgeons would like to have a proper and early diagnosis for their patients to avoid undue delay of their management.

Introduction of ultrasonography as a safe non invasive diagnostic modality was considered a revolutionary step in soft tissue imaging.

Ultrasonography as a diagnostic procedure has an increasing application to all fields of medical science because it is safe, simple, non invasive, inexpensive procedure and contrast agents are not needed. The diagnostic informations are obtained without discomfort or morbidity.

Uses of ultrasonography in diagnosis of abdominal swellings are the aim of this essay.

We hope that this essay will be a step in the evaluation of this new tool as a method of diagnosis in abdominal swellings.

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REVIEW OF LITERATURE

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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 slightly (Piezoelectric and reverse piezoelectric effect).

The piezoelectric effect is the heart of the present ultrasound imaging system.

The first ultrasound instrument was the dog whistle developed in 1880.

Langevin (1928) reported the use of high frequency sonic power for detection of submarines. Attempts were made to apply ultrasound for medical diagnosis just prior to the second world war.

Douglas Howry (1952) one of the pioneers of diagnostic ultrasound, developed the principles of compound scanning. The echoes received were displayed as intensity modulated dots on a large phosphor screen.

John Wild (1956), one of the earliest pioneers, demonstrated that ultrasound could detect differences

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between normal tissues, benign and malignant tumours of the breast with 90% accuracy.

Ian Donald (1958) is responsible for the development of contact scanning concept, and for pioneering the extensive application of ultrasound in obstetric and gynaecology.

Through the efforts of these early investigators and other working with them and after them, diagnostic ultrasound has evolved into a highly useful diagnostic tool of diverse clinical application.

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II- PHYSICAL PRINCIPLES OF ULTRASOUNDS

Goldberg (1975) defined sound waves as mechanical waves transmitted through molecular media by causing alternative condensation and rarefactions. One condensation and one rarefaction constitutes one cycle (Fig. 1).

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: is defined as the number of waves per unit time and is expressed in terms of Hertz (cycles/second).

Hertz = one cycle/sec.

Kilo Hertz = 1000 cycles/sec. = K. Hertz.

Mega Hertz = 1,000,000 cycles/sec. = M. Hertz = MHZ.

The range for diagnostic ultrasound is about 0.5 - 20 MHZ.

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

- Thus, in a given medium, the frequency is inversely proportional to the wave length (Baker, 1974).
- The velocity is modified by the density and elasticity of the medium (Barnett and Morley, 1971).
- The velocity is more in solids than in liquids and is

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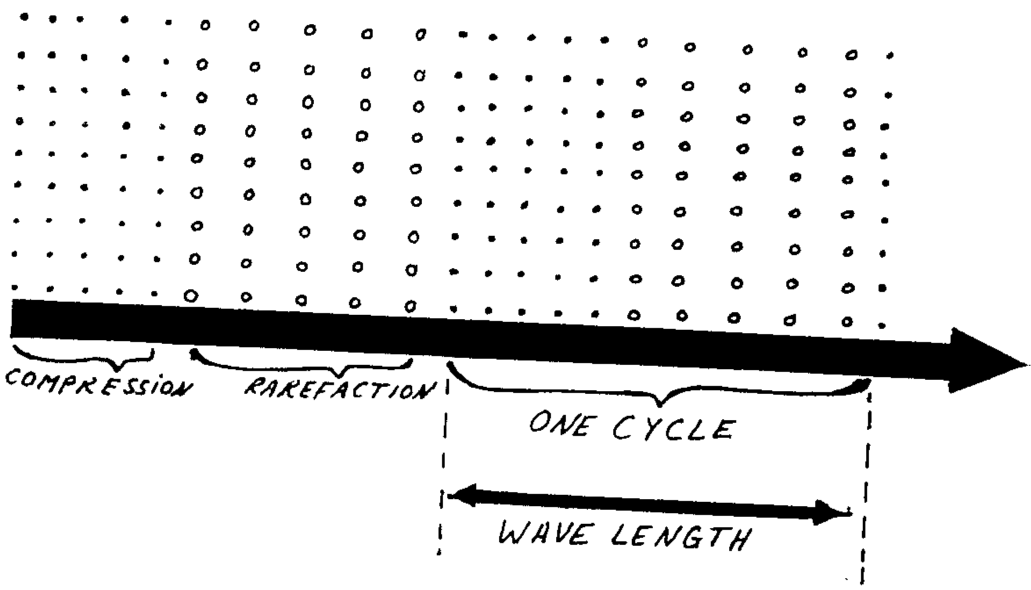

Fig. (1): Ultrasound waves consist of compressions and rarefactions propagated along the sound beam axis within a molecular medium. (Carlsen, 1975).

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more in liquids than in gases. Thus air in the lung or gas in the bowel presents a barrier to ultrasonic examination.

Ultrasonic waves:

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

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 of rapidly, while lower frequencies have excellent transmission (penetration) but poor resolution (Baker, 1974).

- If the ultrasound system has a resolution capability of 3 mm, it means that two small interfaces spaced 3 mm apart will appear as two separate echoes in the image (Hassani, 1976).

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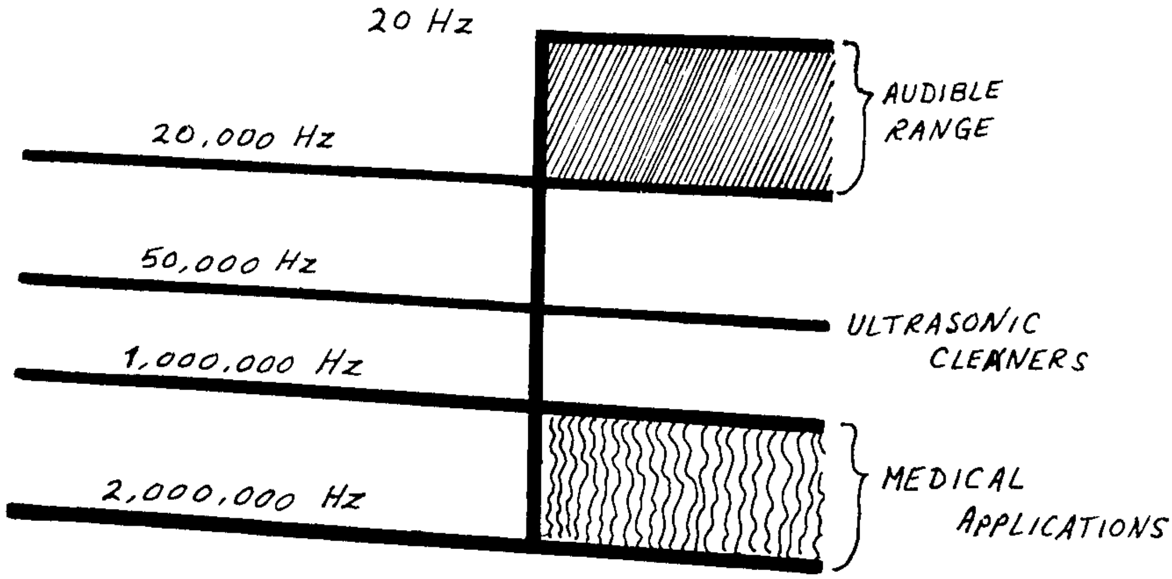

Fig. (2): Ultrasound is sound above the detection of the human ear. The frequency range for medical applications is in mega Hertz range. (Carlsen, 1975).

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