# TRANSVAGINAL SONOGRAPHY

Essay

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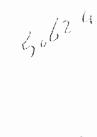
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بسم الله الرحمن الرحيم

# انما يخشي الله من عباحه العلماء

صدق الله العظيم سورة فاطر الايه ٢٨



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Introduction

Introduction

## INTRODUCTION

In the last few years ultrasonography has achieved a very important role in the obstetrical and gynaecological diagnosis.

The introduction of vaginal probes has substantially improved the quality of the images.

The endovaginal ultrasound presents several advantages over transabdominal scanning:

- Patient discomfort is minimum because full bladder is not mandatory.
- Imaging resolution is better and morphologic details are clearly seen because the transducer is in close contact with pelvic viscera (Volpi, 1989).
- Results do not evident any significant difference in uterine measurement either with transabdominal or transvaginal rout.
- The statistical difference in ovarian volume was not significant either (Nazario, 1991).

Vaginal sonography has brought tremendous advantages in the diagnosis of early pregnancy both for the patient and the physician:

In the first place it is easier to perform than abdominal sonography, secondly the intrauterine location of pregnancy can be diagnosed as early as the 37<sup>th</sup> day of first

### Introduction

day of last menstrual period (Fossum, 1988), thirdly, the diagnosis of a disturbed intra-uterine or extra-uterine pregnancy is possible earlier than abdominal approach, (Shapiro *et al.*, 1988).

Aim of the Work

#### AIM OF THE WORK

- To review the role of transvaginal sonography (T.V.S.) in obstetrics and gynaecology.
- To review the physics of sonography.
- Review the technique of T.V.S.
- T.V.S. versus transabdominal sonography (T.A.S.).
- Possible future development and applications.

# Review of Literature

### TRANSVAGINAL SONOGRAPHY

#### PHYSICAL CONSIDERATIONS

#### Historical Introduction:

In 1880 (15 years before the discovery of Xrays) Pierre and Jaques Curie discovered the Piezoelectronic properties of crystals and demonstrated that an electronic charge will be developed when mechanical energy is applied across their surface (Gottesfeld *et al.*, 1978).

In the early 1950s, Wild and Howry, working independently (Wild, 1950 and Howry and Bless, 1952) used the information to develop medical diagnostic instruments. Much of the original work with diagnostic ultrasound in field of obstetrics and gynaecology was undertaken by Donald in Scotland (Donald and Abdulla, 1967; Donald, 1969).

#### Definitions:

Sound waves are mechanical oscillations which are transmitted by Particules in gas, liquid or solid media but not in vacuum. Audible sound has a frequency from 16 to 16,000 cycle per second (C.P.S = Hertz.) and the term ultrasound refers to sound waves beyond the upper end of this range. In medical applications, a range of 1 to 10 million C.P.S. (1 to 10 megahertz = 1 to 10 MHz) is used.

Frequency: is a number of complete oscillations a particle performs per second (sound with frequency of 20 KHz or higher is termed ultrasound).

Wave length: is the length of space over which one cycle occur.

Propagation speed: is the velocity of the sound wave moving through a medium.

Velocity = frequency x wave length

$$V=Fx\lambda$$

The higher the frequency, the smaller the wave length, and the result is better image detail.

Amplitude of an ultrasound wave: is the maximum change in pressure caused by the wave itself and is related to the intensity of the ultrasonic radiation.

Intensity: is the rate at which energy flows through the unit area.

$$Intensity(w/cm^2) = \frac{Power(w)}{area(cm^2)}$$

Power: is the energy flow rate through the whole cross section of the beam.

#### Imaging process:

- The imaging process consists of sending short pulses of ultrasound into the body and using reflections received from various tissues and organs to produce an image of internal structures.
- Atypical source is a crystal, electrically driven to vibrate, that is placed in contact with the outside surface of medium. Interactions occur between the source and the particles of the surface of the medium, causing them to vibrate.

  These particles, in turn, cause their adjacent neighbours to start oscillating, and in a similar manner the mechanical vibrations pass very quickly through the material (Thaler, 1991).

#### Axial and Lateral resolution:

Axial resolution is the minimum reflector separation required along the direction of sound travel so that separate reflections will be produced.

The important parameter in determining axial resolution is the ultrasonic pulse length (Spatial Pulse length)

Axial resolution = Spatial pulse length/2

Spatial pulse length can be decreased by increasing the frequency and/or reducing the number of cycles in each pulse. The useful frequency range in the medical imaging

is 2 to 10 MHz. The closer the object of interest, the higher the frequency that can be utilized and therefore, the better the axial resolution.

Lateral resolution is the minimum separation in the direction perpendicular to the direction of the ultrasonic beam. This is the minimal distance between two reflectors that will produce two separate reflections when the beam is scanned across them. Lateral resolutions is directly proportional to the beam diameter. It may be improved by reducing beam diameter, which is achieved by increasing the frequency; however, the primary means for reducing beam diameter is focusing, (Schaaps, 1989).

#### Image formation:

After an ultrasonic pulse has been emitted, the transducer serves as a 'Listening' device by detecting echoes from reflectors and scatteres. Echo signals picked up by the transducer are sent to the reciever where amplification and signal processing are performed.

The next stage is perhaps the most important one from the operator's point of view-the display of information.