# EVALUATION OF THE DOPPLER INDICES OF THE UTERINE ARTERIES TO DIFFERENTIATE BETWEEN BENIGN AND MALIGNANT ENDOMETRIAL LESIONS IN WOMEN WITH POSTMENOPAUSAL BLEEDING

**Thesis**

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# LIST OF ABBREVIATIONS

**CBC**: complete blood count.
**CW**: continuous wave Doppler.
**D&C**: dilatation and curettage.
**ET**: endometrial thickness.
**IB**: bound.
**LSD**: least significant difference.
**MEDV**: maximum end diastolic velocity.
**MHz**: mille hertz.
**MLH** gene: multi-homolog gene.
**NCI**: national cancer institute.
**NPV**: negative predictive value.
**P Value**: significant value.
**PI**: Pulsatility index.
**PID**: pelvic inflammatory disease.
**PMB**: postmenopausal bleeding.
**PPV**: positive predictive value.
**PSV**: peak systolic velocity.
**PTENgene**: phosphate and tensin homolog gene.
**PW**: pulsed wave Doppler.
**RI**: resistance index.
**ROC** curve: receiver operator characteristic curve.
**SD**: standard deviation.
**SPSS**: statistical program for social science.
**TAMXV:** time averaged maximum velocity.
**TVCD**: trans-vaginal color Doppler
**TVS**: trans-vaginal sonography.
**U|S**: ultrasound.

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# Introduction

The differential diagnosis of postmenopausal bleeding is wide and includes atrophic endometritis, endometrial hyperplasia, endometrial polyp, endometrial carcinoma, cervical cancer and uterine leiomyosarcoma. Approximately ٧٠ % of the perimenopausal and postmenopausal patients that gynecologists see in their office are suffering from abnormal genital tract bleeding ***(Brasic et al., ٢٠١٠).***

It is estimated that ١٠-١٥٪ of patients who presented with postmenopausal bleeding end up having endometrial carcinoma and the endometrial carcinoma is the most common gynecological cancer in western population ***(Alcazar et al., ٢٠٠٩)***.

Numerous investigational and diagnostic tools are available to evaluate patients with postmenopausal bleeding, including endometrial biopsy, transvaginal ultrasound, saline infusion sonography (SIS), color Doppler ultrasound and ٣D ultrasound. Endometrial carcinoma is perceived as (curable cancer) given that the pathology is met with prompt detection and intervention ***(Bradley, ٢٠٠٨).***

The American cancer society revealed in their cancer facts and figures for ٢٠١١, that in ٢٠١١ alone there are estimated to be approximately ٤٦،٦١٧٠ new cases of

uterine corpus cancer and ٨،١٢٠ deaths as well as ١٢،٧١٠ new cases of cervical cancer and ٤,٢٩٠ deaths ***(American cancer society, ٢٠١١).***

The introduction of ultrasonography to gynecological diagnostics has improved the precision with which the endometrium can be evaluated in physiological and pathological states ***(Epstein et al., ٢٠٠٢).***

Ultrasonography is non-invasive and is currently one of the most frequently used diagnostic techniques for evaluating the endometrium. Thus, ultrasonography has become an important supplement to a routine gynecological examination, and clinical procedures are often based on the results of this examination ***(Warming, ٢٠٠٢)***.

Doppler examination of uterine arteries is also very useful in evaluating the degree of infiltration before an operation ***(Stachowicz et al., ٢٠٠٢).***

For many years resistance index (RI) is widely used as an important parameter to assess flow in uterine arteries, however recently there are other parameters used to evaluate flow in uterine arteries such as time-averaged maximum velocity (TAMXV), maximum end diastolic velocity of blood flow (MEDV), peak systolic velocity of blood flow (PSV) ***(Samulak et al., ٢٠١١).***

Using of time-averaged maximum velocity of blood flow (TAMXV) in evaluating uterine arteries in women with abnormal postmenopausal bleeding; Englert-Golon et al obtained significantly higher values of this parameter in the group of endometrial carcinoma in comparison with the group of proliferations of the endometrium ***(Englert-Golon et al., ٢٠٠٥)***.

Although carcinoma of the endometrium does not show typical ultrasonographic features, ultrasonographic examination with a transvaginal probe is typically used to detect these neoplasms ***(Lynch, ١٩٩٩).***

# Aim of the Work

Evaluate the utility of ultrasonographic examinations, such as the Doppler technique in differentiation between benign and malignant endometrial lesions in women with postmenopausal bleeding among women attending Ain Shams university maternity hospital.

**Chapter ١**

# Doppler Ultrasound

## *Introduction:*

Ultrasound technology has evolved from only producing images of the Pregnancy to now include methods for measurement of both maternal and fetal circulatory functions. The phenomenon of Doppler Shift of ultrasonic echoes forms the technical basis for acquisition of information on the maternal-fetal hemodynamic circulations ***(Nicolaides et al., ٢٠٠٤).***

In ١٨٤٢, an Austrian professor of mathematics and geometry ***Dr. Christian Johan Doppler*** first described in detail the effect that now bears the name.

Ultrasound transducers operate on the principle of piezoelectricity, by which certain materials produce a voltage when deformed by applied pressure and produce a pressure when voltage is applied. The frequency of sound, called resonance frequency is equal to the frequency of the driving voltage ***(Lees et al., ٢٠٠٣).***

For each pulse of ultrasound, a series of echoes are returned as the ultrasound pulse is reflected off objects at a greater or lesser distance. These echoes are received by the transducer and converted into electrical energy, which is processed electronically and displayed as a series of dots in

a single scan line on the display ***(Lees et al., ٢٠٠٣).***

Doppler technique has been introduced in medicine for many years, but only in the last decade, this diagnostic modality has gained an importance in obstetrics ***(Kurjak et al., ٢٠٠٤).***

## ***Doppler indices:***

Indices used to distinguish patterns associated with high and low resistance to blood flow are:

١. The systolic / Diastolic ratio (S/D) ratio.
٢. The pulsatility index (PI), also called the impedence index.
٣. The resistance index (RI), also called the Pourcelot ratio.

The S/D ratio is the simplest but it is irrelevant when diastolic velocities are absent, and the ratio becomes indefinite, Values above ٨,٠ are considered extremely high ***(Kupesic and Kurjak, ٢٠٠٤).***

### ***Definitions of (RI) and (PI) are as follows***

* Resistance index (RI) = S ─D/S
* PulsatiIity index (PI) = S─D/MEAN

These indices are ratios, independent of the angle between the ultrasound beam and the insonated blood vessel, and therefore not dependent on absolute measurement of true velocity. However, when the angle

approaches ٩٠, the measurement error increases rapidly.

The resistance index (RI) approaches ١,٠٠ when diastolic velocities are abnormally low and, therefore it reflects the relative impairment of flow by its high values.

The PulsatiIity index (PI) requires computer -assisted calculation of mean velocity, which still may be subjected to very large experimental error. So, (RI) is considered the ideal parameter as a Doppler index.

However, the (RI) must not be considered independent of changes in physiologic variables such as heart rate, cardiac contractility, blood pressure, and the other many determinants of flow ***(Kurjak et al., ٢٠٠٤).***

## ***Instrumentation for Doppler measurements:***

Four types of diagnostic Doppler instrument are usually distinguished.

I- Continuous wave Doppler (CW).

٢- Pulsed wave Doppler (PW).

٣- Duplex Doppler.

٤-Color Doppler imaging.

**١ - Continuous wave Doppler (CW):**

The (CW) system has no depth resolution so that the measurement results of all flows along the line of sight add together and mix. On the other hand this system measures well all (fast and slow) velocities. If there is only one blood vessel along the line-of- sight or one flow is dominant the (CW) system is very good for practice ***(Kurjak et al., ٢٠٠٤).***

**٢- Pulsed wave Doppler (PW):**

If, however, one must measure the flow in a single blood Vessel, the (PW) system can measure within a well – defined sensitive volume. The sensitive volume has a length that depends on the pulse length (in time) and a width that depend on the beam width (and focusing) ***(Kurjak et al., ٢٠٠٤).***

The combination of pulsed Doppler and real-time ultrasound is known as a duplex system, and allows simultaneous imaging at low pulse repetition frequently, usually less than ٢,٥ KHz (***Maulik et al., ١٩٩٠).***

**Aliasing:**

Aliasing is the most common artifact encountered in Doppler ultrasound. In which the peak of the velocity waveform appears below the baseline. Aliasing can be eliminated by increasing pulse repetition frequency, by increasing the Doppler angle, which decreases the Doppler shift for a given flow, or by baseline shifting ***(Kremkau, ١٩٩٢).***

**٣- Duplex method:**

In duplex system, the transmitted ultrasound frequency in the Doppler mode is often lower than that for B-mode. The low Doppler beam frequency is to enable higher velocities to be handled before aliasing occurs, while the high B-scan frequency is to optimize resolution in the image ***(McDicken et al., ٢٠٠٢).***

**٤- Power Doppler:**

a) ٢-D Power Doppler.

b) ٣-D Power Doppler.

It is another modality in which it displays areas with moving structures in colors. The color means that, there is flow in the area and the brightness of the color qualitatively indicates the quantity of moving erythrocytes, It does not define the direction of blood flow ***(Chen et al., ١٩٩٦).***

The virtue of that display mode is that, it shows about equally fast and slow flow, so that we can get the idea about general blood perfusion in some area ***(Chen et al., ١٩٩٦).***

**Methods of analysis:**

Doppler blood flow may be analyzed in three ways by:

١. Waveform.
٢. Resistance indices.
٣. Flow volume or velocity.