2025 KHALID NAZIR SU91-MSAHW-S23-019 FAHS

# Uterine Artery Doppler Findings in Patients with Suspicion of Adnexal Masses

SUPERIOR UNIVERSITY

**Thesis Submitted to**

**The Superior University Lahore**

**In Partial Fulfillment of the**

**Requirement for the Degree of**

**Master of Science in Allied Health Sciences**

**By**

**KHALID NAZIR**

**Roll No. SU91-MSAHW-S23-019**

**Session: 2023-2025**

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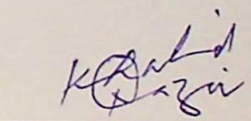
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Supervisor Name: Dr. Tauseef Qamar
Designation: MBBS, DMRD, Assistant Professor

## Certificate of Approval

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No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the Faculty of Allied Health Sciences, The Superior University, Lahore in partial fulfillment of the requirements for the degree of Master of Sciences in the field of "**Allied Health Sciences**" in Faculty of Allied Health Sciences at The Superior University, Lahore.

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# DEDICATION

This thesis is dedicated to my parents, whose unconditional love, support, and belief in me have been the foundation of my journey. Their encouragement has been a constant source of strength, and their sacrifices have motivated me to push beyond my limits. To my teachers, who have imparted their knowledge, wisdom, and passion for learning, I am deeply grateful for their guidance and the inspiration they have provided throughout my academic journey. I would also like to express my sincere gratitude to my supervisor, **Dr. Tauseef Qamar**, whose expert advice, patience, and unwavering support have been instrumental in shaping this research. This thesis is a reflection of the invaluable contributions of all those who have been a part of my academic and personal growth.

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In the name of Allah, the most Gracious, the most Merciful.

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In the end, I would like to extend my deepest gratitude to my family members. Without their encouragement, I would not have been able to complete this endeavor.

**Khalid Nazir**

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# LIST OF ABBREVATIONS

| | |
|---|---|
| **RI** | Resistivity Index |
| **PI** | Pulstility Index |
| **PSV** | Peak Systolic Velocity |
| **IOTA** | International Ovarian Tumor Analysis |
| **RMI** | Risk of Malignancy Index |
| **GI-RADS** | Gyencological Imaging Reporting & Data System |
| **B-HCG** | Beta Human Chorionic Gonadotrophin |
| **LDH** | Lactate Dehydrogenase |
| **AFP** | Alfa Feto Protein |
| **PCOS** | Polycystic Ovaries |

# ABSTRACT

**Background:** Adnexal masses are common in gynecologic practice, encompassing both benign and malignant lesions, with ovarian cancer being the most serious concern due to its late diagnosis and high mortality. Accurate preoperative differentiation is essential to guide timely and appropriate management. Uterine artery Doppler parameters—Resistance Index (RI), Pulsatility Index (PI), and Peak Systolic Velocity (PSV) provide non-invasive diagnostic insight into the vascular nature of these masses.

**Objective:** To evaluate uterine artery Doppler parameters and assess their diagnostic accuracy in differentiating benign from malignant adnexal masses.

**Methods:** This descriptive study included 385 women aged 18–65 years with suspected adnexal masses who underwent transabdominal Doppler ultrasound between August and December 2024 at Sammar Diagnostic Lab, Lahore. Doppler parameters from bilateral uterine arteries were measured and correlated with adnexal mass characteristics. Data were analyzed using SPSS 25.0 with Pearson correlation and t-tests; $p < 0.05$ was considered statistically significant.

**Results:** Among 385 patients evaluated, mixed-type adnexal masses were most common (24.2%), followed by malignant (20.5%) and solid or benign lesions (19.7% each). Pearson correlation analysis showed a significant negative correlation between malignancy and both Right Uterine Artery Resistance Index ($r = –0.503$) and Pulsatility Index ($r = –0.476$). The Left Uterine Artery RI also showed a moderate negative correlation ($r = –0.423$), while Peak Systolic Velocity was moderately positively correlated with malignancy ($r = 0.371$; $p < 0.001$). t-tests confirmed that the mean values of Doppler parameters were statistically significant ($p < 0.001$), supporting their diagnostic relevance.

**Conclusion:** Uterine artery Doppler parameters, particularly low RI and PI and elevated PSV, are significantly associated with malignant adnexal masses. These indices serve as valuable non-invasive markers for early malignancy detection, and can complement grayscale ultrasound in improving diagnostic accuracy.



**Keywords:** Adnexal Masses, Doppler Ultrasound, Resistance Index, Pulsatility Index, Peak Systolic Velocity, Ovarian Cancer

# Chapter 1

## INTRODUCTION

The process of new blood vessel formation, known as angiogenesis, is essential for both the development and deterioration of ovarian follicles and the corpus luteum. Therefore, analyzing vascular changes in the ovaries, follicles, and corpus luteum can offer important insights into normal ovarian function as well as various pathological conditions. Additionally, Doppler ultrasound of the uterine radial artery resistance index (URa-RI) serves as an effective method for monitoring changes in the reproductive system and can signal potential complications in early pregnancy. In recent years, focus has shifted toward interrogating uterine-artery doppler parameters—resistance index (RI), pulsatility index (PI), and flow velocity—as potential non-invasive biomarkers of adnexal-mass malignancy.

Ovarian cancer affects approximately 1.3 % of women over their lifetime. The 5-year survival rate dramatically decreases from 92.3 % for localized tumors to 29.2 % when cancer has spread to distant sites. Notably, around 59 % of ovarian cancer diagnoses occur after metastasis has developed. To assess the risk of malignancy in adnexal tumors before surgery, various methods can be employed, including pattern-recognition approaches, mathematical models developed by the International Ovarian Tumor Analysis (IOTA) group, simple ultrasound-based diagnostic rules, risk-of-malignancy index (RMI) models, and Gynecological Imaging Reporting and Data Systems (GI-RADS). These methods aid in evaluating the likelihood of malignancy, guiding clinical decision-making (1). However, most tools rely primarily on morphology; augmenting them with functional vascular data from uterine-artery doppler may improve diagnostic discrimination.

Nearly 20 % of women will acquire a pelvic mass at some point in their lives, making adnexal masses one of the most common diagnoses in gynaecological practice. The most dreaded diagnosis when dealing with an adnexal tumor is ovarian cancer, which is among the most deadly gynecologic cancers. This is mainly because it is detected too late, caused by a lack of an early symptomatic

phase and an ineffective screening method. About 314,000 women had an ovarian-cancer diagnosis in 2020, and the illness was responsible for 207,000 deaths, according to GLOBOCAN. Additionally, in terms of incidence and death among women worldwide, ovarian cancer ranks ninth in cancer prevalence (2). Early, cost-effective differentiation between benign and malignant adnexal masses is therefore crucial, particularly in resource-limited settings such as Pakistan.

Ovarian masses are predominantly benign (80 %), exhibiting varied characteristics such as cystic, solid, and mixed features, and generally having a favorable prognosis. In contrast, 20 % are malignant, highlighting the need for diagnostic tools that enable precise pre-operative classification. Nevertheless, reliance on morphological features alone for predicting malignancy can lead to overdiagnosis, due to the considerable overlap between benign and malignant masses (3). Uterine-artery doppler may address this gap by capturing tumor-induced angiogenesis in the peri-lesional vasculature.

The ideal modality for the first assessment of adnexal lesions is ultrasonography (US) because of its low cost, broad availability, dynamic real-time nature, and lack of ionizing radiation. Most children and teenagers are better suited for the transabdominal US, which employs the bladder as an acoustic window, than for the more extensive endovaginal examination. Sexually active teens are evaluated with the endovaginal US following a failed transabdominal check (4).

Notwithstanding the fact that 2-D ultrasound was the initial diagnostic tool, 3-D ultrasound, color Doppler, and power Doppler are being utilized more often to assess endometrial health. A power Doppler is helpful in differentiating between benign and malignant endometrial tumors, according to many studies. Transvaginal sonography's sensitivity and specificity in identifying endometrial cancer are enhanced by colour Doppler ultrasonography. According to several studies, malignant conditions cause changes in the colour-Doppler parameters of the uterine arteries. Nevertheless, these investigations have not looked at the connection between uterine-artery Doppler readings and tissue histological variations (5). The present research will explore this connection specifically in patients with suspected adnexal masses.

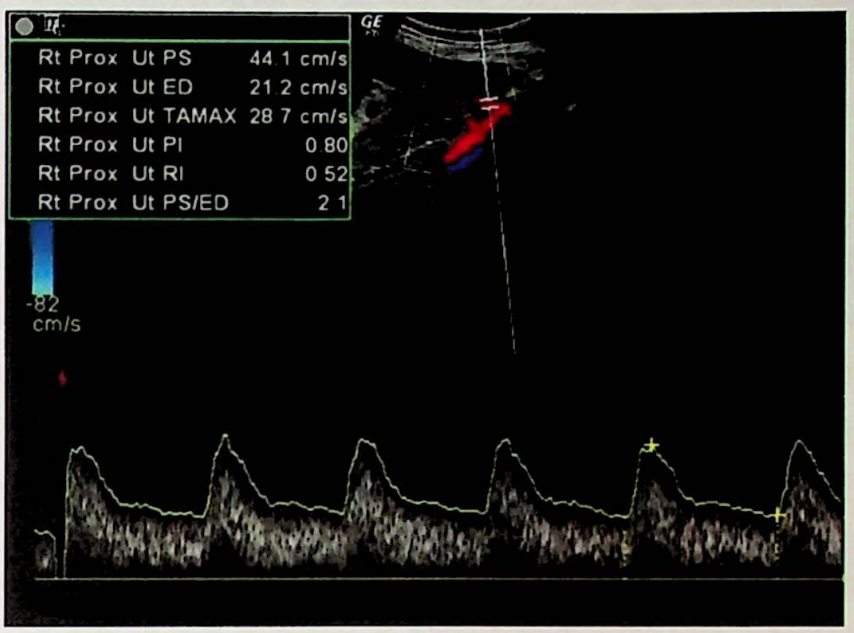



**Figure 1: Doppler ultrasound of the right proximal uterine artery showing normal waveform**

Arguably, the most common pathological condition in gynaecological practice is adnexal masses. An accurate diagnosis is required to decide on the best course of action. While benign masses can be treated conservatively or with less-invasive procedures, malignant masses should be referred to tertiary-care centers for comprehensive management. Adnexal tumors can be identified as benign or malignant using ultrasonography, a readily available and non-invasive method. It is possible to infer malignancy from ultrasound and colour-Doppler data, but a definitive diagnosis cannot be achieved. Doppler ultrasonography is commonly used with two-dimensional ultrasound assessment of adnexal lesions to more precisely predict malignancy by obtaining intratumoral blood-flow velocity waveforms to calculate RI (6). However, few studies have systematically quantified uterine-artery RI, PI, and flow velocity in this context.

Recently, various scoring systems have been developed to provide clear criteria for predicting the nature of ovarian tumors. These systems incorporate multiple variables, including nodularity, solid areas, internal echoes, septae, necrosis, and calcification border irregularity (7). Combining such morphological scores with uterine-artery doppler metrics could enhance risk stratification models.

The most useful serologic tumor indicators are β-human chorionic gonadotropin (β-HCG), lactate dehydrogenase (LDH), CA-125, and alpha-fetoprotein (AFP). Although blood levels of AFP or β-HCG are highly indicative of malignancy, they were elevated in only 50 % of malignant tumors (4). Accordingly, imaging-based biomarkers such as uterine-artery RI/pi remain critical.

Ovaries are sonographically hypoechoic compared with surrounding structures. Many morphological scoring systems on USG have been proposed, based on wall thickness, inner-wall structure, septal characteristics, and echogenicity (8). Colour Doppler ultrasound helps distinguish benign from malignant ovarian tumors by analyzing PI and RI indices (9).

Doppler ultrasound, when combined with gray-scale imaging, may enhance the accuracy of differentiating between benign and malignant adnexal masses compared to gray-scale imaging alone (10). Comparisons between gray-scale imaging and Doppler ultrasound were inconclusive due to the use of untested Doppler criteria in prospective testing (11). In Doppler ultrasound, higher malignancy risk in cystic tumors is linked to larger, more irregular solid components and increased tumour-outline irregularity and echogenicity, along with colour content and blood-flow velocity assessments (12).

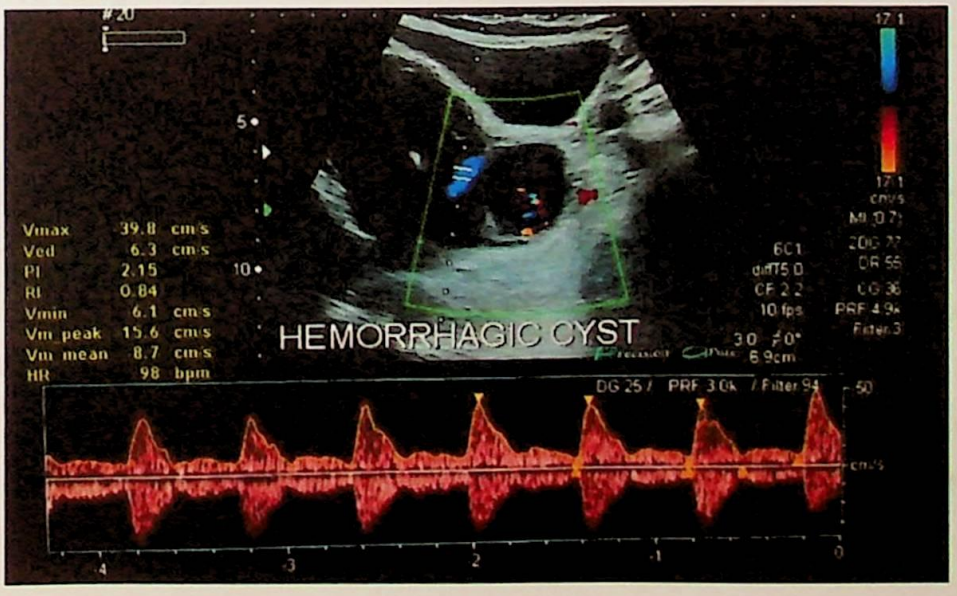



**Figure 1.2: Color and spectral Doppler evaluation of the uterine artery in a patient with a hemorrhagic ovarian cyst.**

Online calculations were made using the Doppler-shift spectra displayed on the ultrasound screen to determine pertinent blood-flow velocities. According to subjective assessment, high blood-flow rates and colour content were thought to increase malignancy risk. Exact blood-flow velocities were calculated offline; however, these values were not considered in the subjective assessment. An Acuson 128 XP ultrasound system with 4-MHz transabdominal and 7-MHz transvaginal transducers was used (13).

As an easily accessible, non-invasive technique with high sensitivity for PCOS diagnosis, Doppler ultrasonography is useful. Research shows that PCOS patients have different patterns of blood flow in their uterine and ovarian arteries, especially those with lower peak systolic and end-diastolic velocities (14).

Various studies have investigated endometrial receptivity using diverse methods, including histological and genomic analysis of endometrial biopsies (15). While these are aligned with broader reproductive research, they underscore the versatility of uterine-artery doppler for gynaecological applications.

The high-pass filter had a 125 Hz cut-off frequency. The Doppler instrument's outgoing energy was no more than 500 mW $cm^{-2}$ (16). Tumor blood flow was analyzed using Doppler waveforms, characterized by peak-systolic velocity, PI, and RI (17). The impact of adding subjective Doppler assessment to gray-scale imaging was evaluated (18).

This study aims to explore the diagnostic significance of uterine artery Doppler parameters—specifically resistance index (RI), pulsatility index (PI), and flow velocity—in differentiating benign from malignant adnexal masses, a domain that remains under-investigated in the regional clinical context. This study seeks to address the lack of localized data and contribute novel insights into the potential role of uterine artery Doppler as a non-invasive, adjunctive diagnostic tool for adnexal mass characterization.

# Chapter 2

# LITERATURE REVIEW

In a study conducted by El-Mazny et al. in 2020, researchers aimed to determine the diagnostic precision of transvaginal Doppler ultrasound in distinguishing malignant from benign ovarian masses. This study, carried out at the Pakistan Institute of Medical Sciences, involved 100 patients aged 25-55 with ovarian masses identified through transabdominal ultrasonography. Patients with previous biopsy reports, chronic renal failure, or a history of ovarian mass surgery were excluded. The average age of the participants was 43.16 ± 8.20 years. The transvaginal Doppler ultrasound accurately identified malignant ovarian masses in 54 patients (54%), with histopathology confirming malignant ovarian tumors in 53 cases (53%) (20).

The ultrasound results yielded 50 true positives, 4 false positives, 3 false negatives, and 43 true negatives. The study demonstrated high diagnostic accuracy of transvaginal Doppler ultrasound, with:Sensitivity: 94.34%, Specificity: 91.49% Positive predictive value (PPV): 92.59%, Negative predictive value (NPV): 93.48%, and Diagnostic accuracy: 93.0%. The findings suggest that transvaginal Doppler ultrasonography is a reliable, non-invasive imaging modality for differentiating between benign and malignant ovarian tumors (21).

The most common symptoms among patients aged 12 to 20 were menorrhagia (33.3%) and abdominal discomfort (66.7%). The main complaints for patients between the ages of 21 and 30 were incidental findings during LSCS (11.1%), secondary infertility (7.4%), dysmenorrhea (11.1%), and abdominal discomfort (70.3%). The most common symptoms for individuals between the ages of 31 and 40 were abdominal discomfort (96%) and incidental findings during LSCS (4%). Menorrhagia and distension were the most common symptoms among individuals aged 41 to 50 (both 50%). Abdominal pain, dysmenorrhea, secondary infertility, menorrhagia, distension, polymenorrhea, and incidental findings are the main symptoms linked to these tumors. Depending on the nature and primary complaint, the proportion of patients with each form of adnexal mass ranges from 1% to 100% (22).

Oloyede OA et.al did his research in 2020, Ovarian masses are a prevalent reason for gynecological surgical interventions. As the first-line imaging technique, ultrasonography plays a crucial role in verifying the ovarian origin of a mass and distinguishing between benign and malignant lesions. During this study, fifty individuals who had fifty-three ovarian masses, three of whom had simultaneous masses presented. Outpatient as well as inpatient facilities were used to recruit patients. Every adnexal mass was thoroughly examined, beginning with a sono-morphological study and continuing with a blood flow examination utilizing sophisticated Doppler sonography strategies, such as color, spectral, and power Doppler. The Sassone score, which considers elements including the interior structure, wall thickness, presence of septae, solid components, and echogenicity, was used to measure the shape of the adnexal masses. All mass's least RI, greatest PSV, and PI were evaluated using spectral Doppler analysis. When RI < 0.6, PI < 1, and PSV > 15 cm/sec, malignancies were considered probable. Of the 53 masses, 22 were considered suspects for malignancy (Sassone score > 9), of which 7 had been benign and 15 were found to be malignant. On the other hand, two of the 31 non-suspicious tumors were cancerous, while 29 were benign. Because of abnormal arteries, malignant tumors usually have low blood flow opposition. Interestingly, RI < 0.6 was present in 94.11% of malignant tumors and 11.11% of benign tumors. Furthermore, PSV > 15 cm/sec was seen in 88.23% of malignant tumors compared to 5.55% of benign tumors. This research concludes by highlighting the significance of multi-parameter analysis, which combines spectral waveform analysis, vessel location, vessel organization, and morphologic grading to precisely distinguish between benign and malignant adnexal masses. Individuals with cancers that are malignant can benefit from prompt intervention thanks to this strategy. When color Doppler is used alongside standard sonography, specificity and positive predictive value are greatly increased (23).

In 2019, Khong SL et al. conducted a study to investigate the use of first-trimester uterine artery Doppler analysis in predicting later pregnancy complications. The study found that implantation and pregnancy rates, multiple pregnancy rates, and pregnancy outcomes were similar in both groups. In the

fibroid group, those who failed to conceive exhibited significantly lower pulsatility index (PI) and resistance index (RI) of the right uterine artery, as well as the average indices of both right and left uterine arteries, compared to those who subsequently conceived ($P < 0.001$). The study concluded that the presence of fibroids can affect these outcomes (24).

In 2019, Groom KM et al. conducted research to explore the patterns of change in uterine artery Doppler studies between 20 and 24 weeks of gestation and their impact on pregnancy outcomes. The study found that preeclampsia occurred in 116 women (5.3%) and 223 women (10.2%) delivered small-for-gestational-age (SGA) neonates. Abnormal Doppler readings, defined as a mean resistance index above the 90th percentile, were associated with higher rates of SGA across different groups: group 1 had 156 cases (8.4%), group 2 had 13 cases (11%), group 3 had 25 cases (19.5%), and group 4 had 29 cases (35.4%) ($P < .001$). Preeclampsia rates also varied, with group 1 at 85 cases (4.6%), group 2 at 9 cases (7.6%), group 3 at 7 cases (5.5%), and group 4 at 15 cases (18.3%) ($P < .001$). The study concluded that pregnancy outcomes for women with abnormal uterine artery Doppler results at either 20 or 24 weeks were intermediate between those with normal or consistently abnormal results at both time points. It was recommended that the addition of clinical data and biomarkers could improve overall test performance and that 20 weeks is the most appropriate time in the second trimester to conduct uterine artery Doppler studies (25).

In 2019, Martins RS et al. investigated the sub-endometrial resistance and pulsatility index to evaluate endometrial receptivity in assisted reproductive technology (ART) cycles. The study found no significant differences between the two groups in terms of demographics and ART procedures. However, there were notable differences in uterine artery resistance and pulsatility index between the implantation and non-implantation groups. Additionally, significant differences were observed in sub-endometrial vascularization between the groups. The ratio of sub-endometrial to uterine artery flow showed lower values for flowmetric parameters in the sub-endometrial territory. The study concluded that serial sub-endometrial and uterine artery flowmetry could be a useful tool for clinicians in predicting endometrial receptivity and optimizing elective

embryo transfers within the same ART cycle (26).

In 2020, Madina SRI et al. studied the effectiveness of color and grayscale Doppler sonography in detecting accidental adnexal masses in the early stages of gestation. The purpose of the study was to ascertain how well different sonographic methods assessed adnexal masses during the first trimester. From July to December 2019, this cross-sectional study was carried out at the Jinnah Hospital's Department of Radiology in Lahore, Pakistan. Non- probabilistic convenience testing was used to choose the participants. Data was gathered by means of a survey. Out of the 68 participants in the research, 29 (96.7%) had benign disorders on their left side, while just 1 (3.3%) had a malignant condition recognized. Five (13.2%) of those diagnosed had malignant illnesses, whereas 33 (86.8%) had benign disorders on the right side. Forty-three individuals had cystic elements, fifteen had mixed elements, and four had solid elements out of the 62 patients with benign illnesses (91.2%). Six individuals had malignant illnesses, three of whom had solid elements and three of whom had mixed elements. Pregnancy-related adnexal lumps were generally benign and went away on their own. However, because of low-impedance flow, Doppler sonography has serious limits when it comes to differentiating between benign and malignant adnexal illnesses (27).

G. Premkumar et.al in 2022 stated in his study that in order to distinguish between malignant and benign adnexal masses, this study aims to evaluate the diagnostic accuracy of combined grey scale ultrasonography and Doppler flow imaging. The structure next to the uterus that includes the ovaries, fallopian tubes, and ligaments is called the adnexa (uterine appendages). Adnexal mass is an umbrella term for a variety of gynecological and non-gynecological disorders. It is regarded as the most prevalent condition in gynecology. From benign disorders like functioning cysts to malignant ones like ovarian cancer, there are many different types. In the current investigation, we concluded that the optimum method for differentiating between malignant and benign adnexal masses is a combination approach employing transabdominal and transvaginal ultrasound with Doppler (28).

Ali et.al in 2022 in his study to compare the uterine artery transvaginal Doppler indices between healthy and ectopic pregnancies that were confirmed by

maternal serum Beta-hCG stated that transvaginal sonography is frequently used to diagnose intrauterine pregnancy and ectopic conception because it produces high-resolution images with good reliability. Maternal mortality is mostly caused by extra-uterine pregnancy, which is 80 percent responsible for morbidity and mortality in the first trimester. A safe and non-invasive method for assessing the flow patterns of uterine arteries is a doppler ultrasound. It can compute numerical values for indices like the resistivity and pulsatility indices. In healthy intrauterine and extrauterine pregnancies, it is also seen that there are variations in the uterine artery indices. To compare them in healthy intrauterine and extrauterine pregnancies, nevertheless, is crucial. Ectopic conceptions had much higher uterine artery resistance indices than typical intrauterine pregnancies. However, there was no appreciable difference in the PI of ectopic and normal intrauterine pregnancies (29).

This study aims to investigate the operation of uterine artery Doppler indexes in carcinoma of the endometrium by juxtaposing them to those in endometrial hyperplasia without atypia, abnormal bleeding from the uterus caused by malfunctioning results in, or atypical hyperplasia/endometrial intraepithelial neoplasia (EIN). Endometrial cancer is the most common gynecological malignancy worldwide. Abnormal uterine bleeding is the main symptom and the first indication of the illness in about 75–90% of individuals. However, irregular uterine bleeding is a somewhat common symptom that can be caused by several factors, the majority of which are deemed benign. In comparison to atypical hyperplasia/endometrial intraepithelial neoplasia (EIN), abnormal uterine bleeding caused by ineffective causes, endometrial hyperplasia without atypia, and endometrial hyperplasia without atypia, endometrial cancer have a substantially reduced resistance index and pulsatility index. (30).

Out of the 90 instances that were examined, 78 (86.66%) of the adnexal masses were of ovarian origin, whereas 7 (11.66%) were of tubal origin. Ninety-one percent (82) of the 90 adnexal mass cases were benign, whereas four and a half percent (4.44%) were borderline and malignant. Serous cyst adenoma (20%) and endometriotic cyst (22.22%) were the most frequent ovarian causes of adnexal masses. A follicular cyst (87.5%) had the best sensitivity, followed by dermoid and serous cyst adenoma (83.33%). A sensitivity of 75% was achieved

by appropriately reporting 6 of the 8 instances in which malignancy was detected by USG (31).

On histology, 55% (44/80) of the 80 masses were found to be benign, whereas 45% were found to be malignant. SR has a sensitivity of 100 percent (95 percent confidence interval: 90.0–100) and a specificity of 97.1% (95 percent confidence interval: 84.7–99.9). Specificity was reduced to 75% (95 %CI:59.7–86.8) due to eleven masses (13.8 %) that were inconclusive. With a sensitivity of 86.1% (95 % CI: 70.5–95.3) and specificity of 90.9% (95 % CI: 78.3–97.5), the ideal cut-off for malignancy risk in ADNEX was 34.1%. For GIRADS 4–5 and ORADS 4–5, the sensitivity and specificity were 100% (95 %CI: 90.3–100) and 70.5% (95 %CI: 54.8–83.2), respectively, and were used as predictors of malignancy. Every reporting system was similar ($p = 0.7$). GIRADS/ORADS successfully categorized 27.2% (3/11) of instances, but ADNEX found 72.7% (8/11) of inconclusive cases. In the misclassified GIRADS/ORADS 4–5 group, ADNEX outperformed SR, properly categorizing 76.9% (10/13) of the masses, whereas SR only accurately identified 38.5% (5/13) of the masses (32).

# AIMS AND OBJECTIVE

i. To determine the uterine artery Doppler parameters (e.g., resistance index, pulsatility index, and flow velocity) in suspected adnexal masses to distinguish between benign & malignant masses

# Chapter 3

# METHODOLOGY

## 3.1 Research Design:

A **Descriptive study** was conducted to obtain uterine artery doppler findings in patients with suspicion of different adnexal masses.

## 3.2 Clinical Setting:

The study was conducted in Samar Diagnostic Lab, Baghbanpura, Lahore.

## 3.3 Sample Size:

Using the Fisher formula to calculate the sample size.

**Confidence Level (Z):** Typically, a 95% confidence level was used, corresponding to a value of 1.96.

**Proportion (p):** If no previous study available, a proportion of 0.5 (50%) was used to maximize the sample size.

**Margin of Error (d):** Commonly used margins of error are 0.05 (5%).

**Fisher Formula for Sample Size Calculation:**

$n = Z^2 \times p \times (1-p) / d^2$

**n** was the sample size

**Z** was the Z value (1.96 for 95% confidence),

**p** was the estimated proportion (0.5 if unknown),

**d** was the margin of error (0.05).

**Calculation:**

$n = (1.96)^2 \times 0.5 \times (1-0.5) / (0.05)^2$ $n = 3.8416 \times 0.25 / 0.0025$

$n = 0.9604 / 0.0025$

$n = 384.16$

## 3.4 Sampling Technique:

The sampling technique employed in this study was **convenience sampling**, which was chosen due to the practical feasibility of including patients who presented with suspected adnexal masses during the study period and met the inclusion criteria.

## 3.5 Duration of study:

The duration of the study was 4 months, from August 2024 to December 2024.

## 3.6 Selection Criteria:

### 3.6.1 Inclusion Criteria

- Patients of all age groups between 18-65 years.
- Patients with clinically suspected adnexal mass.
- Patients with Clinical symptoms such as infertility, pelvic pain, or irregular menstrual cycle.

### 3.6.2. Exclusion criteria:

- Patients who are already undergoing treatment will be excluded.
- Any other Abnormality than adnexal.
- Previous Surgical history.

## 3.7 Ethical Consideration:

The ethical authorization for the study was obtained from the Ethics and Research Committee of the diagnostic center, and informed consent in writing was gained from all participants. Participants received comprehensive advice regarding the confidentiality of the data. All the data collected from the participants was kept in a password-protected folder. All participants were given specific IDs for the research duration, and their names during data collection, analysis, and reporting remained anonymous.

## 3.8 Data collection procedure:

- Eligible patients were identified based on the study's inclusion and exclusion

criteria.

- Informed consent was obtained from each patient before they are enrolled in the study.
- Patient confidentiality was maintained throughout the study in compliance with ethical guidelines.
- Basic demographic information, including age, menopausal status, and relevant medical history, was recorded.
- Pelvic Ultrasound was performed

### 3.8.1 Scanning Technique:

Patients were instructed to have a full bladder to facilitate the trans-abdominal ultrasound examination. The procedure was explained to each patient, and they were positioned supine on the examination table. The transabdominal ultrasound was used to assess the adnexal mass, focusing on its size, location, morphology, and echogenicity. Uterine artery Doppler imaging was then performed by identifying the uterine arteries bilaterally at the level of the internal cervical os, using the transducer to visualize the vessels along the lateral wall of the uterus. Color Doppler was activated to capture blood flow within the uterine arteries, and Doppler waveforms were recorded. The Pulsatility Index (PI), Resistance Index (RI), Peak Systolic Velocity (PSV), and End Diastolic Velocity (EDV) were measured from at least three cardiac cycles, with the average values documented for analysis. Particular attention was paid to any abnormal vascular patterns or increased resistance indices that may indicate malignancy. High-quality images of the uterine arteries and the adnexal mass, along with the Doppler measurements, were saved and stored in the patient's electronic medical record for subsequent analysis.

## 3.9 Data analysis:

- The statistical analysis for this study was conducted using IBM SPSS Statistics version 25. Descriptive statistics were employed to summarize the demographic profile of participants and to present key ultrasound and Doppler findings, including mean values and standard deviations for continuous variables such as age, resistance index (RI), pulsatility index (PI), & peak systolic velocity (PSV).

- Frequency and percentage distributions were calculated for categorical variables like adnexal mass type, uterine position, and endometrial thickness. To evaluate associations between Doppler parameters and adnexal mass characteristics, Pearson correlation analysis was performed.
- Group comparisons (e.g., benign vs malignant masses) were conducted using independent sample t-tests and one-way ANOVA where applicable. Statistical significance was set at $p < 0.05$, and all tests were two-tailed. This analytical approach ensured robust evaluation of vascular differences between various types of adnexal masses, supporting the study's objective of assessing the diagnostic value of uterine artery Doppler parameters.

# Chapter 4

## RESULTS

Descriptive statistics were performed to describe demographic characteristics among participants of the study. Age is a continuous variable that was analyzed to indicate the mean and spread of the sample. Also, the frequency and percentage distribution of study variables such as types of adnexal mass, endometrial thickness, uterine appearance, and the Doppler parameters. These descriptive statistics detail the characteristics of the study population and allow further analysis of the data. These demographics provide a simple view of the ages, which is important to give context to the population being studied.

**Table 4.1: Descriptive Statistics of Participant Age**

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | **N** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Age | 385 | 18.00 | 64.00 | 41.4156 | 13.41131 |

**Table 4.1** presents the descriptive statistics for the age of participants included in the study. The ages ranged from 18 to 64 years, with a mean age of 41.42 years (SD = 13.41), indicating a moderate spread around the mean. This wide age range reflects the diverse demographic characteristics of the study population and is appropriate given the inclusion of patients with various types of adnexal masses. These demographic findings establish a solid foundation for further statistical analyses related to adnexal pathology.

**Table 4.2: Frequency Distribution of Adnexal Mass Types, Endometrial Thickness, and Uterine Orientation**

| Parameter | Category | Frequency | Percentage (%) |
|---|---|---|---|
| **Adnexal Mass** | Benign | 76 | 19.74 |
| | Malignant | 79 | 20.52 |
| | Cystic | 61 | 15.84 |
| | Solid | 76 | 19.74 |
| | Mixed | 93 | 24.16 |
| **Endometrial Thickness** | <7-11mm | 192 | 49.87 |
| | >7-11mm | 193 | 50.13 |
| **Uterus Appearance** | Retroverted | 103 | 26.75 |
| | Anteflexed | 96 | 24.94 |
| | Retroflexed | 94 | 24.42 |
| | Anteverted | 92 | 23.90 |

**Table 4.2** presents the frequency and percentage distribution of key clinical variables in the study population, including types of adnexal masses, endometrial thickness, and uterine orientation. Among adnexal masses, mixed-type lesions were the most common (24.16%), followed by malignant (20.52%), solid (19.74%), and benign (19.74%) masses. Cystic masses were the least frequent, accounting for 15.84% of the cases. This distribution highlights the heterogeneity of adnexal mass presentations among the study participants, with a significant proportion exhibiting mixed pathology.

Endometrial thickness was nearly evenly distributed across the cohort, with

49.87% of participants having a thickness of <7–11 mm and 50.13% showing values >7–11 mm. This balance suggests that endometrial thickness did not display a marked skew in the study population.

Uterine orientation varied slightly across four categories: retroverted uterus was most prevalent (26.75%), followed by anteflexed (24.94%), retroflexed (24.42%), and anteverted (23.90%) orientations. The fairly even distribution of uterine positions supports the anatomical diversity of the sample group.

Overall, this table provides essential baseline information that supports further interpretation of Doppler findings and adnexal mass characteristics in the study.

**Table 4.3: Frequency Distribution of Uterine Artery Doppler Parameters**

| Parameter | Category | Frequency | Percentage (%) |
|---|---|---|---|
| **Right Uterine Artery RI Value** | <0.37-1.16 | 206 | 53.51 |
| | >0.37-1.16 | 179 | 46.49 |
| **Left Uterine Artery RI Value** | >0.41-0.82 | 200 | 51.95 |
| | <0.41-0.82 | 185 | 48.05 |
| **Right Uterine Artery PI Value** | <0.53-1.58 | 193 | 50.13 |
| | >0.53-1.58 | 192 | 49.87 |
| **Left Uterine Artery PI Value** | >0.58-1.83 | 206 | 53.51 |
| | <0.58-1.83 | 179 | 46.49 |
| **PSV** | <60cm/s | 192 | 49.87 |
| | >60cm/s | 193 | 50.13 |

**Table 4.3** presents the frequency and percentage distribution of uterine artery Doppler parameters among the study population. The data reveal a nearly equal distribution across all categories, indicating a heterogeneous vascular profile in patients with adnexal masses.

For the **Right Uterine Artery Resistance Index(RI)**,53.51%of participants had values in the lower range(0.37–1.16), while 46.49%fell in the higher range. A similar trend was observed for the **Left Uterine Artery RI**, where 51.95%of participants showed higher values(>0.41–0.82), and 48.05%had lower readings. This near-equal distribution suggests that variations in vascular resistance are widespread across the sample.

The **Pulsatility Index(PI)**values for both right and left uterine arteries also exhibited balanced distributions. Specifically,50.13%had lower PI values(0.53–1.58)in the right uterine artery and 49.87%higher; conversely,53.51%had higher PI values in the left artery(>0.58–1.83), with 46.49%falling below this range. This reflects substantial variability in vascular impedance within the cohort.

The **Peak Systolic Velocity(PSV)**showed an almost exact split, with 49.87%of participants recording values below 60 cm/s and 50.13%above, reinforcing the presence of a diverse hemodynamic profile.

Overall, the distribution of Doppler parameters indicates that uterine artery flow characteristics differ significantly among individuals with adnexal masses. This heterogeneity is clinically important, as it may reflect underlying pathological differences and supports the utility of Doppler indices in the diagnostic evaluation of adnexal lesions.

**Correlation Analysis of Doppler Parameters with Adnexal Masses**

To explore the diagnostic utility of uterine artery Doppler indices in characterizing adnexal masses, a correlation analysis was conducted between Doppler parameters and mass types. The parameters assessed included Resistance Index (RI), Pulsatility Index (PI), and Peak Systolic Velocity (PSV) for both the right and left uterine arteries. The strength and direction of associations between these parameters and the nature of adnexal masses were evaluated using Pearson's correlation coefficients.

**Table 4.4: Correlation Matrix Between Uterine Artery Doppler Parameters and Adnexal Masses**

| Variables | Adnexal Mass | Right Uterine Artery RI | Left Uterine Artery RI | Right Uterine Artery PI | Left Uterine Artery PI | PSV |
|---|---|---|---|---|---|---|
| **Adnexal Mass** | 1 | | | | | |
| **Right Uterine Artery RI** | -0.503 | 1 | | | | |
| **Left Uterine Artery RI** | -0.423 | -0.398 | 1 | | | |
| **Right Uterine Artery PI** | -0.476 | 0.452 | 0.472 | 1 | | |
| **Left Uterine Artery PI** | 0.342 | 0.316 | -0.285 | -0.254 | 1 | |
| **PSV** | 0.371 | 0.290 | 0.360 | 0.290 | -0.210 | 1 |

Table 4.4 reveals several significant correlations between uterine artery Doppler parameters and adnexal mass characteristics. A **moderate negative correlation** was found between adnexal mass type and **Right Uterine Artery RI(r=-0.503),** suggesting that lower resistance values are associated with malignancy. A similar, though slightly weaker, negative correlation was observed for the **Left Uterine Artery RI(r=-0.423)**. These findings support existing evidence that malignant masses often exhibit lower vascular resistance due to neovascularization.

The **Pulsatility Index(PI)**on the right side also showed a **moderate negative correlation** with adnexal masses(r=-0.476), again indicative of reduced vascular impedance in malignant lesions. In contrast, the **Left Uterine Artery PI** demonstrated a **low positive correlation**(r=0.342), suggesting asymmetric vascular behavior between the two arteries, potentially influenced by anatomical or pathological variability.

The **Peak Systolic Velocity(PSV)**displayed a **moderate positive correlation** with adnexal mass type(r=0.371), indicating increased flow velocities in more suspicious or malignant masses—an expected finding in tumors with higher metabolic demands and vascularity.

Additionally, there were strong intercorrelations between the doppler indices themselves. For example, Right and Left Uterine Artery PI values were positively correlated(r=0.472), reflecting consistent pulsatility patterns bilaterally. A **moderate negative correlation** between Right and Left RI values(r=-0.398)may suggest hemodynamic independence between the two arteries.

Overall, these findings support the role of Doppler ultrasound as a non-invasive, adjunctive diagnostic modality in distinguishing benign from malignant adnexal masses. The observed patterns highlight the utility of combined evaluation of RI, PI, and PSV for improved diagnostic accuracy.

**T-Test Analysis**

A one-sample t-test was performed to evaluate whether the mean values of Doppler parameters and adnexal mass scores significantly differ from a hypothetical test value of zero. This statistical approach helps determine the relevance of these parameters in the context of adnexal mass evaluation by identifying whether their observed means are statistically significant and not due to random variation.

**Table 4.5: Descriptive Statistics of uterine artery Doppler parameters**

| Descriptive Statistics | | | | |
|---|---|---|---|---|
| | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| **Right Uterine Artery RI Value** | 385 | 1.4649 | .49942 | .02545 |
| **Left Uterine Artery RI Value** | 385 | 1.5195 | .50027 | .02550 |
| **Right Uterine Artery PI Value** | 385 | 1.4987 | .50065 | .02552 |
| **Left Uterine Artery PI Value** | 385 | 1.5325 | .49959 | .02546 |
| **Adnexal Mass** | 385 | 3.0805 | 1.46886 | .07486 |

**Table 4.5** presents the descriptive statistics of uterine artery Doppler indices and adnexal mass scores. The mean **Right Uterine Artery RI** was 1.4649(SD=0.49942), indicating a moderately dispersed distribution around the mean. The **Left Uterine Artery RI** had a slightly higher mean of 1.5195 with a comparable standard deviation, reflecting consistent resistance measurements on both sides.

Similarly, the **Right and Left Uterine Artery PI values** had means of 1.4987 and 1.5325, respectively, both with nearly identical standard deviations(~0.50), indicating stable and symmetric pulsatility measurements across the sample. This stability in RI and PI values across the uterine arteries suggests reliable Doppler measurements within the study population.

The **mean score for adnexal masses** was 3.0805(SD=1.46886), reflecting a broader variation among the types of adnexal masses observed (e.g., benign, malignant, cystic, solid, mixed). The relatively high standard deviation here supports the clinical diversity of adnexal masses included in the study, which is essential for examining Doppler parameter associations across different lesion types.

These descriptive results provide the statistical foundation for the subsequent one-sample t-test(see Table 4.6), aimed at confirming the significance of these observed means in relation to the study objectives.

**Table 4.6: T-Test Results of uterine artery Doppler parameters**

| T- Test Results | | | | | | |
|---|---|---|---|---|---|---|
| | Test Value = 0 | | | | | |
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| **Right Uterine Artery RI Value** | 57.555 | 384 | .000 | 1.46494 | 1.4149 | 1.5150 |
| **Left Uterine Artery RI Value** | 59.596 | 384 | .000 | 1.51948 | 1.4694 | 1.5696 |
| **Right Uterine Artery PI Value** | 58.737 | 384 | .000 | 1.49870 | 1.4485 | 1.5489 |
| **Left Uterine Artery PI Value** | 60.187 | 384 | .000 | 1.53247 | 1.4824 | 1.5825 |
| **Adnexal Mass** | 41.150 | 384 | .000 | 3.08052 | 2.9333 | 3.2277 |

**Table 4.6** presents the results of the one-sample t-test conducted to determine whether the observed mean values of Doppler parameters and adnexal mass scores significantly differ from a hypothetical baseline value (zero). The results reveal that all variables under study are statistically significant, as indicated by **very high t-values** and **p-values less than 0.001**, confirming the non-random nature of the observed measurements.

- The **Right Uterine Artery RI** demonstrated a t-statistic of 57.555, with a mean difference of 1.46494 and a 95% confidence interval (CI) ranging from 1.4149 to 1.5150.
- The **Left Uterine Artery RI** had a slightly higher mean difference (1.51948) and an even stronger t-value of 59.596.
- The **Pulsatility Index (PI)** values for both arteries followed similar patterns, with high t-values of 58.737 (right) and 60.187 (left), and narrow CIs, indicating reliable and consistent measurements.
- The **adnexal mass score** had a mean of 3.08052 and a t-value of 41.150, with a relatively wider confidence interval (2.9333–3.2277), reflecting the heterogeneous nature of the adnexal lesions in the study population.

These highly significant results suggest that uterine artery Doppler indices (RI, PI, and PSV) are robust and meaningful variables in the context of adnexal mass evaluation. The strong statistical significance and tight confidence intervals further support their diagnostic utility. Collectively, these findings reinforce the hypothesis that Doppler parameters can serve as valuable, non-invasive indicators for differentiating between types of adnexal masses based on their vascular characteristics.

# Chapter 5

## DISCUSSION

The findings of this study provide strong evidence for the diagnostic utility of Doppler indices in the evaluation of adnexal masses. Resistance index (RI), pulsatility index (PI), and peak systolic velocity (PSV) showed statistically significant relations with adnexal masses consistent with previously known features of vascularity in benign and malignant disease. Also, the moderate negative correlations between RI values and adnexal masses confirm the results of previous studies that showed that abnormally increased vascularity leads to malignancy owing to abnormal angiogenesis, which is a hallmark of malignancy (33). Right Uterine Artery RI- r= -0.503, indicating that lower RI values are consistent with malignancy, corroborates (21).

The negative correlation of the Left Uterine Artery RI value was (-0.423) with adnexal masses. This conclusion is consistent with the findings of Zanetta et al. (1994) stated that RI values of malignant tissues are generally lower than normal tissues owing to immature, chaotic, and dysplastic vascular architecture. Such behavior mimics the physiological adaptations in malignancies, where the vascular resistance decreases to fulfill the increased demand for blood flow and poorly formed vessels (34).

Pulsatility Index (PI) values mirrored this pattern, with the Right Uterine Artery PI also showing the same moderate negative correlation (-0.476) with adnexal masses. This observation corroborates previous studies highlighting the diagnostic significance of lower pulsatility within malignant tissues, where the disorganized vascular architecture within malignancies causes an alteration of normal pulsatility patterns (23).

The weak positive correlation (0.342) between the Left Uterine Artery PI is in contrast to the above anatomical variability or side differences in uterine blood flow, as a possibility documented by (24). We conclude that the presence and quality of the Doppler signal from one /or the other uterine artery can provide important diagnostic information for the diagnosis of adnexal masses.

The moderate positive correlation between PSV and adnexal masses (0.371) is in accordance with the results by (25) and increased systolic velocities in malignant

lesions due to increased vascular activity. Particularly, malignant tissues impose increased metabolic demands, and hyper-vascularization is often observed in tumors, leading to higher PSV (26). The correlation strengthens PSV as an adjunct parameter to the standard diagnosis, especially for discriminating between benign and malignant adnexal masses.

The one-sample t-test results for Doppler indices truly reinforced their statistical significance in distinguishing between the two groups of adnexal masses. The t-values were high with narrow confidence intervals for all parameters, indicating that these were different from baseline values. The mean difference (mean ±sd) for the RI value of the Right Uterine Artery was 1.4649, showing high precision and reproducibility for this parameter (27). Other parameters also showed similar trends and confirmed their prognostic value.

In particular, descriptive statistics reflected that this study population made the same observations in their study, which also confirms that the characteristics of adnexal masses and their vascularity are heterogeneous; the balanced distribution of Doppler indices is a testament to this. The frequency distribution showed that heterogeneous masses were the most frequent (24.16%), followed by malignant masses (20.52%) (Table 4.3). The finding of a large proportion of complex and malignant adnexal masses in our clinical population is consistent with previous studies (26).

When reviewing the literature, multiple studies have established threshold values for Resistance Index (RI) and Pulsatility Index (PI) to differentiate between benign and malignant adnexal masses. The operational definitions used in this study—RI values less than 0.6 and PI values less than 1.0 being indicative of malignancy—are consistent with findings by **Kurjak et al. (1992)**, **Alcázar et al. (1995)**, and **Kouam et al. (1997)**, among others (35,36,37). These thresholds have been widely accepted as reliable indicators of malignant ovarian pathology. Doppler ultrasonography, when combined with clinical examination and gray-scale imaging, significantly enhances diagnostic accuracy in evaluating adnexal masses (38,39).

The findings of the present study reinforce the validity of Doppler parameters (RI, PI, and PSV) as non-invasive, cost-effective, and widely available diagnostic tools. They contribute further evidence supporting their inclusion in

standard gynecologic imaging protocols. This study builds upon previous work by validating the utility of these vascular parameters and encourages their incorporation into future multi-parametric diagnostic models for adnexal lesions.

These data should be further **investigated** in future research that integrates Doppler indices with advanced imaging modalities such as MRI or 3D ultrasonography. Additionally, larger multi-center studies would help validate these results and refine diagnostic criteria for better stratification of adnexal masses (40).

# CONCLUSION

This study confirms the diagnostic value of Doppler ultrasound parameters-Resistance Index (RI), Pulsatility Index (PI), and Peak Systolic Velocity (PSV)—in differentiating benign from malignant adnexal masses. Lower RI and PI, along with higher PSV, were significantly associated with malignancy, reflecting underlying tumor vascularity. These findings support the integration of Doppler indices into routine sonographic evaluation to enhance the accuracy of adnexal mass diagnosis.

## Limitations

- The relatively small sample (385 patients) may limit the generalizability of the results to the broader population.
- This study was conducted at a single center; the study's external validity is limited. Multi-center studies could provide more diverse and representative data.
- The study did not compare Doppler findings with advanced imaging techniques such as MRI or 3D ultrasound, which could have strengthened diagnostic validation.

## Recommendations

- Conduct multi-center studies with larger, more diverse populations to enhance generalizability.
- Integrate Doppler parameters into standardized multi-parametric diagnostic protocols.
- Compare Doppler findings with other imaging modalities (e.g., MRI, 3D ultrasonography) to further refine the diagnostic algorithm for adnexal masses.

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# APPENDICES

## CONSENT FORM

**Description of the Research and Your Participation**

**You are invited to participate in a research study conducted for the purpose to evaluate the "UTERINE ARTERY DOPPLER FINDINGS IN PATIENT WITH SUSPICION OF ADNEXAL MASSES".**

**Risks and Discomforts**

There is no risk or discomfort.

**Potential Benefits**

There is great potential of this research to provide details about the menstrual phase cycle in adult females and ovarian doppler.

**Protection of Confidentiality**

We will do everything we can to protect your privacy. Your identity will not be revealed in any publication resulting from this study.

**Voluntary Participation**

Your participation in this research study is voluntary. You may choose not to participate, and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not you participate or to withdraw from this study.

**CONSENT**

**I have read this consent form and have been allowed to ask questions. I give my consent to participate in this study.**

Participant's Signature_____Date: _____

Researcher's Signature_____Date: _____

# APPENDICES-1

## QUESTIONNAIRE

**Patient ID:** _____ **Date:** _____

**1. Age:** _____

**2. Menopausal Status:**

☐ Premenopausal ☐ Postmenopausal

**3. Presenting Symptoms (tick all that apply):**

☐ Pelvic pain ☐ Irregular menstrual cycles

☐ Infertility ☐ Abdominal distension

**4. Type of Adnexal Mass (on ultrasound):**

☐ Cystic ☐ Solid ☐ Mixed

☐ Benign (suspected) ☐ Malignant (suspected)

**5. Uterine Orientation:**

☐ Anteverted ☐ Retroverted ☐ Anteflexed ☐ Retroflexed

**6. Endometrial Thickness (mm):** _____

**Doppler Ultrasound Parameters**

**7. Right Uterine Artery:**

Resistance Index (RI): _____

Pulsatility Index (PI): _____

Peak Systolic Velocity (PSV, cm/s): _____

**8. Left Uterine Artery:**

Resistance Index (RI): _____

Pulsatility Index (PI): _____

Peak Systolic Velocity (PSV, cm/s): _____

# PERMISSION LETTER

## SAMAR DIAGNOSTIC CENTRE

Digital X-ray, ECG, Ultra Sound & OPG

**PERMISSION LETTER FOR DATA COLLECTION**

To,

Dr. Zahid Nazir,

Consultant Radiologist

Samar Diagnostic Centre

**Subject: Permission for Data Collection for Master's Research**

Respected Sir,

I hope this letter finds you well. I am writing to formally seek your permission to collect data for my master's research titled **"Uterine Artery Doppler findings in patients with suspicion of adnexal masses"** As this study is being conducted within Samar Diagnostic Centre, your approval and support would be invaluable in ensuring the smooth execution of data collection.

The research will involve analyzing Doppler ultrasound findings in patients meeting the inclusion criteria, following all ethical and professional guidelines. All data will be handled with strict confidentiality, and patient consent will be obtained as required.

I would appreciate your formal approval to proceed with the data collection under your supervision. Kindly let me know if you require any additional details regarding the study.

Looking forward to your positive response.

Sincerely,

**Dr. Khalid Nazir**

Master of Allied Health Sciences Student

The Superior University, Lahore

03334229468

**Approval:**

Dr. Zahid Nazir

Consultant Radiologist

Signature:

Date: 01-09-2024

DR. ZAHID NAZIR
M.B.B.S DMRT MCPS FCPS (Radiology)
Consultant Radiologist
Govt. Kot Khawaja Saeed Teaching
Hospital KEMU Lahore

PNRA Reg. # x205 (133) PINSTECH:- Reg # 3862 PHC:- Reg.# 6619 PHC:- Lic # PHC/L &A/LiC 66119

Electronically Verified report No. Signature(s) required (NOT VALIF FOR COURT)

| | | | |
|---|---|---|---|
| **DR. KHALID NAZIR** | **DR. MUHAMMAD SIDDIQUE** | **DR. ZAHID NAZIR** | **DR. MUHAMMAD SHAFIQUE** |
| **BSc, MD, MID, MSc, PGD** | **M.B.B.S DCP M.PHILL** | **M.B.B.S DMRT MCPS FCPS** | **M.B.B.S, D.A, M.S.ORTHO** |
| **Doctor of Medical Imaging** | **CLINICAL PATHOLOGIST** | **Radiology)** | **SENIOR CONSULTANT** |
| **Director Samar Diagnostic Centre** | | **Consultant Radiologist** | **ORTHOPAEDIC SURGEON** |

***Please*** Note that this report is *NOT* final diagnosis and like all other tests the *final diagnosis* should be made after correlation with other clinical and Lab Findings, X-Rays, ECG, Etc.

Opp. Govt Hospital, Kot Khawaja Saeed Scheme No. 2, Shadbagh, Lahore.
Cell: 0333-4229468, 0321-9441668 Email: samar_lab@yahoo.com

# ETHICS COMMITTEE LETTER

OFFICE OF THE DEAN-FAHS

SUPERIOR UNIVERSITY

Ref.: IRB /FAHS/Allied-HS/10/24/MS/RS-3565

Date: 29th October 2024

Name: Khalid Nazir (MS Allied Health Sciences)

Registration: SU19-MSAHW-S23-019

**Subject: Ethical Approval Letter**

The Research Ethical Committee convened on Dated: **17th October, 2024** to discuss your protocol titled **"Uterine artery doppler findings in patient with suspicion of different adnexal masses"**

No further corrections and recommendations were suggested. The above-mentioned protocol has been approved after considering various research issues including ethical concerns with condition that the researcher will submit completion report at the end of his/her research.

**Prof. Dr. Muhammad Naveed Babur**
**Dean/Convener REC**
**Faculty of Allied Health Sciences**
**Superior University, Lahore**

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| 01 | Research objective simplify & concise | Changes done as indicated | 14 |
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