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Original Research Article

Imaging Features of Ovarian Masses with Histopathological Correlation: A Retrospective Hospital-Based Study Evaluating the Role of Color Doppler

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Abstract:

Background: Ovarian masses range from benign cysts to malignant neoplasms, making accurate preoperative diagnosis essential for appropriate management. Conventional ultrasonography is the primary imaging modality, while Color Doppler improves lesion characterization by assessing tumor vascularity. Histopathological examination remains the gold standard for definitive diagnosis.

Aim: To evaluate the imaging features of ovarian masses using conventional ultrasonography and Color Doppler and correlate these findings with histopathological diagnosis.

Methodology: A retrospective hospital-based observational study was conducted at a Netaji Subhas Medical College and Hospital in Adityapur, Jharkhand, India. A total of 135 patients with ovarian masses who underwent preoperative ultrasonography with or without Color Doppler followed by histopathological examination were included. Imaging findings were compared with histopathological diagnosis, and diagnostic performance was assessed.

Results: Most patients were aged 21–40 years (49.6%) and 71.1% were premenopausal. Abdominal or pelvic pain (43.0%) was the most common symptom. Malignant masses showed significantly higher frequencies of large size, thick walls, multiloculated septations, papillary projections, solid components, ascites, central vascularity, low RI, low PI, and high PSV ($p < 0.001$). The addition of Color Doppler improved sensitivity from 82.1% to 94.9%, specifically from 88.5% to 95.8%, and overall diagnostic accuracy from 86.7% to 95.6%.

Conclusion: Combined ultrasonography and Color Doppler provide a reliable, non-invasive, and highly accurate approach for differentiating benign and malignant ovarian masses, with excellent correlation to histopathological findings.

Keywords: Ovarian Masses, Ultrasonography, Color Doppler, Histopathology, Diagnostic Accuracy, Adnexal Masses.

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Introduction

Ovarian masses are a wide variety of gynecological masses from functional cyst to benign neoplastic masses, borderline and invasive ovarian malignancies. Prognosis of management, prognosis and surgery required differs considerably with regards to the benign and malignant nature of these lesions and it is essential that they are characterized as accurately as possible preoperatively. Silent clinical presentation and late presentation makes ovarian cancer one of the major causes of cancer related morbidity and mortality among women globally. Ovarian cancer is the 8th most prevalent cancer in women and has been reported to have 295,414 new cases in 2018 with an incidence of 7.8 per 100,000 women, which represents around 3.4% of all female malignancies, according to the global cancer statistics. It also is linked to a mortality rate of 4.9/100,000 women, which is a bad prognosis if the diagnosis is made at late stage [1]. Lack of population-based screening, delayed symptoms and diagnosis at late stages of the disease are a major reason for high mortality from ovarian cancer [2].

Ovarian tumors are a heterogeneous group of histopathological entities such as epithelial, germ cell, sex cord-stromal and metastatic tumors. Of these, epithelial ovarian tumors are the most prevalent histological type and is the most frequent

of all ovarian malignant tumors [3]. Several risk factors are known to affect ovarian cancer risk, such as age, genetic susceptibility (e.g. mutations in the BRCA1 and BRCA2 genes), family history, reproductive factors and hormonal influences [4]. Although significant progress has been made in the fields of surgery, chemotherapy and targeted therapy, the stage at which the disease is diagnosed is the most important factor influencing patient survival and is therefore crucial to ensure early and accurate diagnosis of ovarian masses in order to improve outcomes and minimize disease related mortality [5] .

Clinically, it is difficult to distinguish benign from malignant ovarian masses, as many women have vague symptoms of abdominal discomfort, pelvic pain, abdominal distention, menstrual irregularity or may be asymptomatic until late in the disease. Thus, imaging is a crucial part of the initial assessment, characterization and management planning for ovarian lesions. Of the various imaging techniques, ultrasonography has become the preferred method as it is non-invasive, readily available, cost effective, non-radiating and is able to give detailed morphological evaluation of adnexal masses [6].

Previous research using transabdominal pelvic ultrasonography set the criteria for differentiating benign from malignant cystic ovarian lesions: Lesion size, wall thickness, presence of septations, presence of papillary projections, echogenicity of the lesion, and presence of solid components [7]. Transabdominal ultrasound is a great tool to examine the anatomy of the pelvis and evaluate any large adnexal masses that are located outside the pelvis, but it may not be sensitive enough to detect subtle internal architectural changes, especially in obese patients or in small masses. The development of transvaginal ultrasonography greatly improved the diagnostic value due to its better spatial resolution and proximity to the pelvic organs. Helps to visualize ovarian morphology, internal septations, mural nodules, papillary projections, and other abnormalities of the uterus, myometrium, and endometrium in more detail, which increases the confidence of diagnosis for ovarian adnexal masses [8].

Although the use of grayscale ultrasonography has improved, there are still difficulties in distinguishing some benign lesions from early stages of malignant tumors based solely on morphological characteristics. To solve these problems, Doppler ultrasonography was used as a supplementary imaging modality to assess the vascularity of ovarian masses. The Doppler imaging method is based on the theory that the malignant tumor has rapid blood flow around the abnormal networks of blood vessels which are formed as a result of increased angiogenesis in the tumour, and have low-resistance blood flow [9]. Color Doppler ultrasonography may be helpful to visualize blood flow in ovarian lesions and surrounding pelvic vessels and complement grayscale imaging findings in real time. Most benign ovarian masses appear to have very little vascularity and high resistance arterial flow while most malignant masses have high vascularity and low resistance arterial flow (due to the angiogenesis induced by the tumors) [10]. Therefore, Doppler parameters like vascular distribution, resistive index (RI), pulsatility index (PI) and peak systolic velocity are extensively studied to enhance the diagnostic accuracy in the differentiation of benign and malignant ovarian tumors.

Many studies have shown that using conventional ultrasonography in combination with Color Doppler can significantly improve the sensitivity, specificity, and overall diagnostic accuracy of the preoperative assessment of ovarian masses over grayscale ultrasonography alone. Combining the two types of assessment (morphological and vascular flow) allows for improved risk stratification, surgical planning, avoidance of unnecessary radical surgery in benign disease, and ease of timely referral to gynecologic oncology specialists in the case of suspected malignancy. Moreover, histopathology of resected ovarian tissues is still considered the gold standard for achieving a definitive diagnosis and serves as a very important reference for imaging results [11].

Even in India, ovarian tumors remain a major health problem as many women only come to the doctor's office when at a late stage. Restricted resources, and lack of access to specialist imaging techniques in some areas, further underscore the value of maximizing the diagnostic utility and performance of widely available imaging modalities like Color Doppler and ultrasonography. Correlating imaging with histopathology diagnosis can enhance diagnostic confidence, further define imaging diagnosis criteria, and aid in evidence-based clinical decision making in routine practice [12].

In this background, the imaging features of ovarian masses in conventional ultrasound, Color Doppler and correlation with histopathological examination were assessed in the present retrospective hospital-based study in Department of Radiodiagnosis, Tertiary care hospital, Adityapur, Jharkhand, India. This study aims to evaluate the role of Color Doppler to help accurately distinguish benign from malignant ovarian masses, to help accurately select the surgical approach, to help improve clinical outcomes and to help guide patient treatment, especially in the preoperative setting.

Methodology

Study Design: This study was designed as a retrospective hospital-based observational study aimed at evaluating the imaging features of ovarian

masses using conventional ultrasonography and Color Doppler, with correlation to histopathological findings. The study assessed the diagnostic performance of grayscale ultrasonography and Color Doppler in differentiating benign from malignant ovarian masses by comparing imaging findings with the final histopathological diagnosis.

Study Area: The study was conducted in the Department of Radiodiagnosis, in collaboration with the Department of Obstetrics & Gynecology and Department of Pathology, at Netaji Subhas Medical College and Hospital in Adityapur, Jharkhand, India.

Study Duration: The study was carried out over a period of one year from March 2025 to February 2026.

Sample Size: A total of 135 patients (N = 135) diagnosed with ovarian masses and fulfilling the eligibility criteria were included in the study.

Study Population: The study population consisted of female patients of all age groups, including pre-pubertal, reproductive-age, perimenopausal, and postmenopausal women, who were diagnosed with ovarian masses and underwent preoperative ultrasonographic evaluation followed by histopathological confirmation after surgery. Patients presented with symptoms such as abdominal or pelvic pain, palpable pelvic mass, abnormal uterine bleeding, urinary or gastrointestinal pressure symptoms, or were diagnosed incidentally during routine pelvic examinations or ultrasonography performed for non-gynecological indications.

Data Collection: Data were collected retrospectively from hospital medical records, radiology reports, operative notes, and histopathology reports using a structured data collection form. Demographic characteristics, clinical presentation, laboratory findings (where available), ultrasonographic features, Color Doppler parameters, operative findings, and final histopathological diagnoses were recorded. Imaging variables included lesion size, internal echogenicity, wall characteristics, septations, papillary projections, solid components, presence of ascites, and morphological score. Color Doppler assessment included vascular distribution (central or peripheral), Resistance Index (RI), Pulsatility Index (PI), and Peak Systolic Velocity (PSV). Histopathological findings served as the reference standard for final diagnosis.

Inclusion Criteria

- Female patients of all age groups with clinically or sonographically diagnosed ovarian masses.
- Patients presenting with abdominal or pelvic pain, palpable pelvic mass, abnormal uterine bleeding, urinary or gastrointestinal pressure symptoms, or incidental ovarian masses detected during routine pelvic examination or imaging.
- Patients who underwent preoperative ultrasonography with or without Color Doppler evaluation.
- Patients subsequently underwent surgical intervention with histopathological examination of the excised ovarian lesion.
- Patients with complete clinical, imaging, operative, and histopathological records.

Exclusion Criteria

- Patients receiving ovulation induction therapy.
- Patients who did not undergo surgical excision or histopathological evaluation.
- Patients with incomplete medical, radiological, or histopathological records.
- Patients are diagnosed with ectopic pregnancy or normal intrauterine pregnancy.
- Patients with non-ovarian pelvic masses.

Procedure: Hospital records of eligible patients diagnosed with ovarian masses were reviewed retrospectively. All patients had undergone conventional ultrasonographic evaluation using a real-time ultrasound system. Transabdominal ultrasonography was performed using a 3.5 MHz convex transducer with a full urinary bladder, while transvaginal ultrasonography was performed using an 8–10 MHz transvaginal probe with an empty bladder. Virgin patients were evaluated exclusively by the transabdominal approach. Gray-scale ultrasonography was used to assess lesion morphology, including size, wall characteristics, internal contents, septations, papillary projections, solid areas, and presence of ascites. A morphology index based on tumor volume, wall structure, and septal characteristics was utilized to categorize lesions as benign or malignant, with a score <9 suggestive of benign pathology. In patients who underwent Color Doppler examination, vascularity was assessed by documenting the distribution of blood flow (central or peripheral) along with Resistance Index (RI), Pulsatility Index (PI), and Peak Systolic Velocity (PSV). Lesions with RI <0.4 and PI <1.0 were considered suspicious for malignancy. The imaging findings were subsequently correlated with intraoperative observations and the final histopathological diagnosis, which served as the gold standard for confirming the nature of the ovarian mass.

Statistical Analysis: The data collected were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median with range, while categorical variables were summarized as frequencies and percentages. The diagnostic

performance of conventional ultrasonography and Color Doppler was evaluated by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy, using histopathological findings as the reference standard. Associations between imaging findings and histopathological diagnosis were analyzed using the Chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant".

Result

Table 1 displays the clinical and demographic details of the 135 patients that were part in the trial. Most of the patients were in the age range of 21-40 years (49.6%), 41-60 years (31.9%) and less than 20 years (8.9%). Only 9.6% of patients were older than 60 years. Most participants were premenopausal (71.1%) while 28.9% were postmenopausal. In terms of clinical presentation, abdominal or pelvic pain (43.0%) was the most frequent symptom, a palpable pelvic mass (21.5%), incidental detection during imaging (14.1%), abnormal uterine bleeding (13.3%), and urinary or gastrointestinal symptoms (8.1%).

Table 1: Demographic and Clinical Characteristics of Study Participants (N = 135)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
<20	12	8.9
21–40	67	49.6
41–60	43	31.9
>60	13	9.6
Menopausal Status		
Premenopausal	96	71.1
Postmenopausal	39	28.9
Presenting Complaint		
Abdominal/Pelvic Pain	58	43
Palpable Pelvic Mass	29	21.5
Abnormal Uterine Bleeding	18	13.3
Urinary/Gastrointestinal Symptoms	11	8.1
Incidental Finding	19	14.1

Table 2 demonstrates the association between grayscale ultrasonographic features and histopathological diagnosis. Lesions measuring more than 10 cm were significantly more frequent in malignant tumors (59.0%) compared to benign lesions (18.8%) ($p < 0.001$). Similarly, thick walls, multiloculated septations, papillary projections, solid components, ascites, and morphology scores ≥9 were observed significantly more often in malignant ovarian masses than in benign lesions. Papillary projections were identified in 69.2% of malignant tumors compared to only 8.3% of benign tumors, while ascites was present in 56.4% of malignant lesions versus 6.3% of benign lesions. All ultrasonographic variables showed statistically significant associations with histopathological diagnosis ($p < 0.001$), indicating that these imaging characteristics are important predictors of malignancy.

Table 2: Ultrasonographic Characteristics of Ovarian Masses (N = 135)

Imaging Feature	Benign (n=96)	Malignant (n=39)	Total (N=135)	p-value
Lesion >10 cm	18	23	41	<0.001
Thick Wall (>3 mm)	15	28	43	<0.001
Multiloculated Septations	27	30	57	<0.001
Papillary Projections	8	27	35	<0.001
Solid Component	12	33	45	<0.001
Ascites	6	22	28	<0.001
Morphology Score ≥9	14	35	49	<0.001

Table 3 summarizes the Color Doppler findings in relation to histopathological diagnosis. Peripheral vascularity was predominantly observed in benign ovarian masses (81.3%), whereas central vascularity was significantly more common in malignant tumors (79.5%) ($p < 0.001$). Low Resistance Index (RI <0.40) was observed in 76.9% of malignant lesions compared with only 9.4% of benign lesions. Likewise, Pulsatility Index (PI <1.0) was recorded in 82.1% of malignant masses but in only 12.5% of benign lesions. Increased Peak Systolic Velocity (PSV >15 cm/s) was also significantly associated with malignant ovarian tumors (71.8%) compared to benign masses (14.6%). These findings indicate that

Color Doppler vascular parameters significantly improve the differentiation of benign and malignant ovarian masses.

Table 3: Color Doppler Findings and Histopathological Correlation (N = 135)			
Doppler Parameter	**Benign (n=96)**	**Malignant (n=39)**	**p-value**
Peripheral Vascularity	78 (81.3%)	8 (20.5%)	<0.001
Central Vascularity	18 (18.7%)	31 (79.5%)	<0.001
RI <0.40	9 (9.4%)	30 (76.9%)	<0.001
PI <1.0	12 (12.5%)	32 (82.1%)	<0.001
PSV >15 cm/s	14 (14.6%)	28 (71.8%)	<0.001

Table 4 compares the diagnostic performance of conventional ultrasonography alone with ultrasonography combined with Color Doppler using histopathological diagnosis as the reference standard. Conventional ultrasonography demonstrated a sensitivity of 82.1%, specificity of 88.5%, and an overall diagnostic accuracy of 86.7%. When Color Doppler was incorporated into the evaluation, diagnostic performance improved substantially, with sensitivity increasing to 94.9%, specificity to 95.8%, positive predictive value to 90.2%, negative predictive value to 97.8%, and overall diagnostic accuracy to 95.6%. These findings suggest that the addition of Color Doppler significantly enhances the preoperative diagnostic accuracy for distinguishing benign from malignant ovarian masses and shows excellent agreement with histopathological findings.

Table 4: Diagnostic Performance of Ultrasonography and Color Doppler Using Histopathology as Gold Standard (N = 135)		
Diagnostic Parameter	**Conventional Ultrasonography (%)**	**Ultrasonography + Color Doppler (%)**
Sensitivity	82.1	94.9
Specificity	88.5	95.8
Positive Predictive Value (PPV)	74.4	90.2
Negative Predictive Value (NPV)	92.4	97.8
Overall Diagnostic Accuracy	86.7	95.6

Discussion

In a retrospective hospital-based study, the imaging characteristics of ovarian masses were studied in 135 patients with conventional ultrasonography and Color Doppler and correlated with the histopathological diagnosis. The study results indicated that masses of the ovary was more common in women of reproductive age, 49.6% of the patients in the age group 21-40 years, and 71.1% were premenopausal. They are in line with the study conducted by Yassa et al. (2021) which found that most of the benign ovarian masses occurred in women of childbearing age, with almost two thirds occurring before the menopause, indicating that functional cysts and benign epithelial tumors were more prevalent in the reproductive years (Yassa et al., 2021). Similarly, Sassone et al (1991) noted that benign tumors were more prevalent among younger women and that malignant tumors were more commonly found among those who were post-menopausal (Sassone et al., 1991). Our study involved 28.9% women over the age of 45, but the number of malignant lesions was relatively higher in this group compared to that of other studies, which further confirms the significant association between the increased age group with ovarian malignancy" [13].

In the present study, the clinical presentation showed abdominal or pelvic pain as the most frequent presenting symptom (43.0%), palpable pelvic mass (21.5%) and incidental finding on imaging (14.1%). These are like the results of Guerriero et al. (2018), who found that pelvic pain was the most common symptom in women with pelvic masses, while a significant number of masses were identified incidentally, due to the growing use of ultrasonography of the pelvis (Guerriero et al., 2018). In the same way, Valentin (2004) emphasized that many ovarian tumors are silent until they become large and grow to such a size that ultrasonography becomes an essential instrument in early detection of incidental adnexal masses (Valentin, 2004). The lower percentage of urinary and gastrointestinal symptoms (8.1%) seen in our study may be a result of younger age at diagnosis and before the tumors were large enough to cause pressure symptoms [14].

The ability to distinguish benign from malignant ovarian masses with grayscale ultrasonography proved to be very good, based on the morphological features. A large tumor size (more than 10 cm), a thick wall, multiple loculated septations, papillary projections, solid component, presence of ascites and morphology score ≥9 were significantly

associated with malignant lesions ($p < 0.001$). The presence of papillary projections was found in 69.2% (27/39) of malignant tumors and in 84.6% (33/39) of solid components, while only 8.3% and 12.5%, respectively, of benign lesions had such components. The results are very similar to those found by Sassone et al. (1991) when they first presented the morphological scoring system and found that papillary projections, irregular walls, thick septations, and solid components were very predictive of malignancy in the ovary. Likewise, Timmerman et al. (2000) found complex internal architecture, multilocularity, papillary excrescences, and ascites were significant factors determining the likelihood of malignant pathology and were the basis of the standard sonographic evaluation of adnexal masses (Timmerman et al., 2000). The high statistical significance we found in our study further corroborates the role of morphological assessment as the main component in initial imaging assessment [15].

The addition of Color Doppler greatly enhanced the characterization of the lesions by assessing tumor vascularity. The present study revealed that the central vascularity pattern was found in 79.5% of malignant tumors while the peripheral vascularity pattern was more common in benign lesions (81.3%). In addition, 76.9% of malignant masses had RI <0.40, whereas 82.1% of benign lesions had PI <1.0, as opposed to 9.4% and 12.5%, respectively, of benign lesions. The results are in good agreement with the study of Kurjak & Zalud (1991) who were the first to show that malignant ovarian tumors had high densities of central neovascularization's with low resistance blood flow due to the presence of tumor angiogenesis (Kurjak & Zalud, 1991). Similarly, Folkman (1995) stated that malignant tumors induce the formation of new blood vessels with lack of normal muscular wall which leads to lower RI during Doppler examination (Folkman, 1995). This central vascularity, with a marked decrease in RI and in PI, which we observed, therefore provides strong physiological evidence behind the role of Color Doppler in the differentiation of malignant ovarian masses [16].

The other significant per cent observed in the present study is the proportion of Peak Systolic Velocity (PSV >15 cm/s) which is 71.8% in case of malignant lesions and 14.6% in the case of benign tumors. Alcázar and Jurado (1998) also showed that in malignant ovarian tumors, the blood flow velocities were significantly higher, and the vascular resistances were significantly lower compared with the corresponding values in benign tumors, due to the presence of active tumor neovascularization (Alcázar & Jurado, 1998). The Doppler parameters can occasionally be similar in inflammatory lesions and borderline tumors, but a combination of vascular parameters with grayscale morphology greatly enhances the diagnostic confidence [17].

One of the greatest findings in the current research was the enhancement of the diagnostic performance that was obtained when using Color Doppler with conventional ultrasonography. The sensitivity, specificity and overall diagnostic accuracy of conventional ultrasonography were 82.1%, 88.5% and 86.7%, respectively. After the introduction of Color Doppler, these numbers jumped dramatically to 94.9 per cent sensitivity, 95.8 per cent specificity and 95.6 per cent diagnostic accuracy. The results are similar to those of Kurjak and Zalud (1991), who reported that the combination of Color Doppler with grayscale ultrasound improved both sensitivity and specificity for the detection of malignant ovarian tumor over grayscale ultrasound alone. Likewise, Valentin (2004) found that Doppler vascular examination in combination with morphological assessment is more accurate in the diagnosis than either technique alone (Valentin, 2004). Moreover, Timmerman et al. (2000) highlighted the significant decrease in false-positive diagnosis and increase in detecting adnexal masses that are malignant and need immediate surgical intervention when using multimodal sonographic assessment (Timmerman et al., 2000) [18] .

The results obtained in the present study clearly support the use of Color Doppler in the pre-operative evaluation of ovarian masses, as a complementary tool. The good correlation between imaging results and histopathological diagnosis substantiates the use of grayscale morphological evaluation and Doppler assessment of the vascularity together to improve the accuracy of diagnosis. This can help in referring suspected patients for malignancy in time, avoiding unnecessary radical surgery in benign cases and aid in clinical decision making, especially in resource constraints tertiary care centers like Adityapur, Jharkhand, India.

Conclusion

In this retrospective study, the authors showed that the combination of the conventional ultrasonography with the Color Doppler procedure is an extremely useful imaging modality for the preoperative evaluation of ovarian masses. Grayscale ultrasonographic parameters including large size of the lesion, thick wall, multiple loculated septations, papillary projection, solid component, ascites and higher morphology score were significantly associated with malignant ovarian tumor. Adding Color Doppler to flow measurements also improved the diagnostic confidence by revealing typical vascular patterns such as low resistance index (RI <0.40), low Pulsatility Index (PI <1.0) and increased Peak Systolic Velocity, which were strongly correlated with histopathology. The combination of ultrasonography and Color Doppler

was shown to be superior to plain ultrasonography alone in terms of sensitivity, specificity and the overall diagnostic accuracy, highlighting its usefulness in distinguishing benign from malignant ovarian masses. Histopathological examination was still the gold standard for definitive diagnosis and confirmed the imaging. Hence, using grayscale ultrasonography with Color Doppler should be considered as a reliable, non-invasive and cost-effective initial diagnostic modality for the early detection of ovarian masses and for appropriate surgical planning, timely management of such masses and better patient outcome, especially in tertiary care centers like Adityapur, Jharkhand, India.

References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018;68(6):394-424.
2. Lheureux S, Gourley C, Vergote I, Oza AM. Epithelial ovarian cancer. Lancet. 2019;393(10177):1240-53.
3. Kurman RJ, Carcangiu ML, Herrington CS, Young RH, editors. WHO Classification of Tumours of Female Reproductive Organs. 4th ed. Lyon: IARC; 2014.
4. Reid BM, Permuth JB, Sellers TA. Epidemiology of ovarian cancer: A review. Cancer Biol Med. 2017;14(1):9-32.
5. Torre LA, Trabert B, DeSantis CE, et al. Ovarian cancer statistics, 2018. CA Cancer J Clin. 2018;68(4):284-96
6. Jacobs IJ, Menon U, Ryan A, et al. Ovarian cancer screening and mortality in the UKCTOCS trial. Lancet. 2016;387(10022):945-56.
7. Sassone AM, Timor-Tritsch IE, Artner A, Westhoff C, Warren WB. Transvaginal sonographic characterization of ovarian disease: Evaluation of a new scoring system. Obstet Gynecol. 1991;78(1):70-6.
8. Timmerman D, Valentin L, Bourne TH, et al. Terms, definitions and measurements to describe the sonographic features of adnexal tumors. Ultrasound Obstet Gynecol. 2000;16(5):500-5.
9. Folkman J. Angiogenesis in cancer, vascular, rheumatoid and other disease. Nat Med. 1995;1(1):27-31.
10. Kurjak A, Zalud I. Transvaginal color Doppler in the assessment of pelvic tumors. Ultrasound Obstet Gynecol. 1991;1(1):50-2.
11. Guerriero S, Alcazar JL, Pascual MA, et al. Diagnosis of the most frequent benign ovarian cysts: Is ultrasonography accurate enough? Ultrasound Obstet Gynecol. 2018;52(4):541-6.
12. Valentin L. Pattern recognition of pelvic masses by gray-scale ultrasound imaging: The contribution of Doppler ultrasound. Best Pract Res Clin Obstet Gynaecol. 2004;18(1):71-89.
13. Alcázar, J. L., & Jurado, M. (1998). Transvaginal color Doppler in ovarian masses: Which parameter performs best? Ultrasound in Obstetrics & Gynecology, 12(2), 114–119.
14. Folkman, J. (1995). Angiogenesis in cancer, vascular, rheumatoid and other disease. Nature Medicine, 1(1), 27–31.
15. Guerriero, S., Alcázar, J. L., Pascual, M. A., et al. (2018). Diagnosis of the most frequent benign ovarian cysts: Is ultrasonography accurate enough? Ultrasound in Obstetrics & Gynecology, 52(4), 541–546.
16. Kurjak, A., & Zalud, I. (1991). Transvaginal color Doppler in the assessment of pelvic tumors. Ultrasound in Obstetrics & Gynecology, 1(1), 50–52.
17. Sassone, A. M., Timor-Tritsch, I. E., Artner, A., Westhoff, C., & Warren, W. B. (1991). Transvaginal sonographic characterization of ovarian disease: Evaluation of a new scoring system. Obstetrics & Gynecology, 78(1), 70–76.
18. immerman, D., Valentin, L., Bourne, T. H., et al. (2000). Terms, definitions and measurements to describe the sonographic features of adnexal tumors. Ultrasound in Obstetrics & Gynecology, 16(5), 500–505.