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Original Research Article

Ultrasound vs. CT in the Assessment of Suspicious Ovarian Masses: A Comparative Study

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Abstract:

Background: The distinction between benign and malignant ovarian masses is essential for optimal clinical management. This research evaluates the diagnostic effectiveness of ultrasound (USG) versus computed tomography (CT) in the assessment of ovarian lesions.

Aim: This study evaluates and compares the accuracy of ultrasound and computed tomography in differentiating ovarian masses, thereby facilitating clinical decision-making.

Methods: This study a comparative observational at Department of Radiology, Patna Medical College and Hospital, India, involving 65 female patients who underwent both ultrasound and CT imaging. Lesion characteristics such as size, wall features, papillary projections, capsular infiltration, and ascites were analyzed utilizing SPSS version 27.

Results: The predominant age group among patients was 41–50 years, comprising 35.4% of the total population. Benign tumors were prevalent, accounting for 78.5%, with mucinous cystadenoma representing the most common type at 49.2%. Malignant tumors constituted 21.5%, with papillary serous cystadenocarcinoma representing 6.2% of the cases. CT exhibited enhanced sensitivity (97.1% for benign lesions, 89.3% for malignant lesions) and specificity (95.2% for benign lesions, 94% for malignant lesions) in comparison to USG, which had a sensitivity of 85.2% for benign lesions and 64.8% for malignant lesions, and a specificity of 66.5% for benign lesions and 89.1% for malignant lesions.

Conclusion: CT demonstrates superior sensitivity and specificity in differentiating ovarian masses, establishing it as a more dependable diagnostic instrument. USG is a crucial first-line screening method because of its cost-effectiveness and availability. A combined approach increases diagnostic confidence, facilitating early detection and treatment planning.

Keywords: Ovarian mass, Ultrasound, Computed tomography, Benign tumors, Malignant tumors, Diagnostic accuracy, Imaging.

Introduction

Adnexal lesions, especially ovarian masses, are commonly observed in women across various age groups and socioeconomic backgrounds. The wide range of diagnostic variations complicates the differentiation between benign and malignant masses for gynecologists and radiologists. Benign ovarian tumors are typically managed conservatively, whereas malignant neoplastic lesions generally necessitate comprehensive surgical and oncological treatment [1]. Ovarian cancer is a major health issue, primarily due to its late-stage diagnosis, which contributes to its status as one of the most deadly gynecological cancers. The five-year survival rate for ovarian cancer is around 45%, positioning it as the second most prevalent gynecological cancer in India, following cervical cancer, and it also exhibits a notable global incidence. In 2020, around 313,959 women were diagnosed with ovarian cancer globally, resulting in 207,252 deaths [2,3].

Ovarian cancer ranks as the third most prevalent malignancy within the female genital tract, succeeding cervical and endometrial cancers, and constitutes approximately 30% of all gynecological malignancies. The ovaries, with dimensions of approximately 4 x 2.5 x 1.5 cm, are bilateral structures situated adjacent to the lateral pelvic wall [4]. Their participation in the ovulatory cycle subjects them to monthly endocrine and mechanical stress, increasing their susceptibility to tumor development. Ovarian tumors demonstrate significant histological diversity among various age groups and ethnicities. Approximately 50% of ovarian tumors are classified as benign, with 90% of malignant cases arising from epithelial cells and the remaining 10% stemming from metastatic disease. Although ovarian cancer is associated with significant mortality, the combined mortality risk of endometrial and cervical carcinoma is reportedly greater [5,6].

Ovarian cysts frequently occur and are typically benign fluid-filled sacs located within the ovary. Most ovarian cysts are asymptomatic; however, they can occasionally manifest symptoms including lower abdominal pain, back pain, or pelvic inflammatory disease. Ovarian cysts are categorized into four main types: follicular, corpus luteum, dermoid, and cystadenomas [7]. The diagnostic assessment of ovarian cysts generally includes ultrasound imaging and laboratory tests. Typically, conservative management utilizing analgesics like ibuprofen or paracetamol is adequate; however, larger cysts may necessitate surgical intervention. Approximately 8% of women are estimated to develop ovarian cysts prior to menopause, with some cases potentially resulting in complications. Additionally, around 16% of women diagnosed with ovarian cysts may exhibit an elevated risk of developing ovarian cancer. Consequently, timely and precise radiological assessment of ovarian masses is essential for distinguishing benign from malignant lesions and informing suitable treatment approaches [8].

Imaging modalities are essential for the early detection and characterization of ovarian masses. Ultrasound (USG), computed tomography (CT), and magnetic resonance imaging (MRI) are frequently utilized for this objective. Ultrasound is frequently the initial imaging technique employed, owing to its broad accessibility, cost-effectiveness, and high precision in morphological evaluation. A significant number of ovarian tumors are indeterminate on ultrasound, requiring additional assessment via cross-sectional imaging methods. MRI offers enhanced anatomical detail and accurate lesion characterization, thereby significantly refining the differential diagnosis. In resource-limited settings, such as rural areas of India, the limited availability and high cost of MRI impede its routine application as a second-line modality following ultrasound [9].

CT imaging is widely accessible, cost-effective, and facilitates rapid image acquisition with an extensive field of view, enabling a thorough evaluation of the abdomen. This facilitates the identification of peritoneal spread, lymph node involvement, and metastatic disease, all of which are essential for treatment planning. CT scans offer critical insights into the tumor's composition, vascularity, and adjacent structures, thereby serving as an essential resource for preoperative staging and therapeutic decision-making [10,11].

The combination of USG and CT in clinical practice has enhanced the precision of diagnosing ovarian masses. Ultrasound (USG) is the primary imaging modality for initial assessment, owing to its real-time imaging capabilities and non-invasive characteristics. Computed tomography (CT) acts as a supplementary technique for cases requiring additional characterization. Research indicates that the sensitivity and specificity of CT in identifying malignant ovarian tumors surpass those of USG alone, especially in the detection of advanced-stage disease and extra-ovarian spread [12].

While these imaging modalities offer several benefits, they also have inherent limitations. Ultrasound guidance (USG) is significantly influenced by the operator's skill, leading to variability in diagnostic accuracy contingent upon the radiologist's expertise. This method is constrained in instances of obesity or when bowel gas disrupts image acquisition. CT provides significant diagnostic information; however, it subjects patients to ionizing radiation, raising concerns particularly for younger women and individuals needing multiple follow-up scans. Furthermore, contrast-enhanced CT may be inappropriate for individuals with renal impairment or allergies to contrast agents [13].

The development of multiparametric MRI and contrast-enhanced ultrasound (CEUS) are two recent developments in imaging technology that show promise for improving the diagnostic accuracy of ovarian tumors. CEUS has shown enhanced lesion characterization through real-time blood flow assessment, whereas MRI is considered the gold standard for the evaluation of complex adnexal masses due to its superior soft tissue contrast. This research compares the diagnostic efficacy of ultrasound and computed tomography in assessing ovarian masses, emphasizing their ability to differentiate between benign and malignant lesions and their influence on clinical management decisions.

Methodology

Study Design: This study was a comparative, observational study conducted to evaluate the effectiveness of ultrasound versus computed tomography (CT) in assessing suspicious ovarian masses.

Study Area: The study was carried out in the Department of Radiology, Patna Medical College and Hospital, Patna, Bihar, India.

Study Duration: The study was conducted over one year,

Sample Size: A total of 65 female patients with clinically suspected ovarian pathology were included in the study.

Data Collection: All patients underwent both ultrasound and CT imaging for comparative assessment. Data was recorded regarding location, size, wall characteristics, papillary projections, capsular infiltrations, solid sections and calcifications, ascites, lymph node enlargements, peritoneal fluid that is free, and omental caking of the lesion.

Inclusion Criteria:

- Participants in the study are willing patients.
- Patients with ovarian lesion investigations who were sent to the radiology department showed positive results.
- Accidentally diagnosed cases of ovarian lesions.

Exclusion Criteria:

- Patients are unwilling to undergo both ultrasound and CT examinations.
- Patients not providing written informed consent.

Procedure

Before the CT scan, assessments of renal function tests and allergy history were conducted, and non-ionic contrast was utilized. Ultrasound and CT scans were employed to assess lesion characteristics such as Ascites, solid components, calcifications, wall characteristics, location, size, and papillary projections. Lymph node enlargement, free peritoneal fluid, and omental caking were observed as indicators of malignancy.

Trans-abdominal ultrasonography was conducted utilizing 3.5 and 5 MHz curvilinear and linear transducers on an Esaote MyLab X5 ultrasound system. Scanning was performed in Sagittal, oblique, and transverse planes to evaluate the characterization of ovarian tumors. The pelvic CT scan utilized a Toshiba 16-slice scanner, acquiring both pre- and post-intravenous contrast images, in addition to oral contrast administration. Thin sections measuring 1 mm in thickness were obtained from the area of interest. Before the CT scan, a comprehensive allergy history and renal function assessments were performed, and non-ionic contrast was administered.

Statistical Analysis: The gathered data was entered into MS Excel and analyzed using SPSS version 20. Percentages were computed within the framework of descriptive statistics to facilitate a comparison of ultrasound and CT outcomes in the assessment of ovarian masses.

Result

Table 1 presents the age distribution of 65 patients, with the highest percentage in the 41–50 years range, which includes 23 patients (35.4%). The next largest group is the 31–40 years category with 16 patients (24.6%), followed by the 51–60 years group, which comprises 13 patients (20%). Patients aged 61–70 years account for 5 individuals (7.7%), and those over 70 years constitute 4 patients (6.2%). The youngest groups are much smaller, with 3 patients (4.6%) in the 21–30 years range and only 1 patient (1.5%) under 21 years old.

Table 1: Patients' Age Distribution

Age	N (65)	%
> 70	4	6.2
61-70	5	7.7
51-60	13	20
41-50	23	35.4
31-40	16	24.6
21-30	3	4.6
< 21	1	1.5

Table 2 shows the distribution of mass types among patients, with the majority being benign. Out of 65 cases, 51 (78.5%) were classified as benign, while 14 cases (21.5%) were identified as malignant. This indicates that benign masses are significantly more common than malignant ones in the studied population.

Table 2: Different kinds of masses

Mass Types	N	%
Malignant	14	21.5
Benign	51	78.5

Table 3 presents the distribution of symptoms among patients, with the most common being a palpable abdominal mass, reported in 29 cases (44.6%). Abdominal pain was the second most frequent symptom, occurring in 18 patients (27.7%), followed by abdominal distension in 14 cases (21.5%). Pressure symptoms were observed in 3 patients (4.6%), while loss of appetite was the least common symptom, reported in only 1 case (1.5%).

Table 3: Signs and symptoms		
Symptom	**N**	**%**
Loss of Appetite	1	1.5
Pressure Symptoms	3	4.6
Abdominal Distension	14	21.5
Pain Abdomen	18	27.7
Mass Abdomen	29	44.6

Table 4 categorizes the types of benign and malignant tumors among patients. Among benign tumors, mucinous cystadenoma was the most common, affecting 32 patients (49.2%), followed by serous cystadenoma in 12 cases (18.5%). Dermoid tumors were observed in 5 patients (7.7%), while fibro thecoma appeared in 3 cases (4.6%). Less common benign tumors included fibroma and granulosa cell tumor, each affecting 1 patient (1.5%). Among malignant tumors, papillary serous cystadenocarcinoma was the most frequent, found in 4 patients (6.2%), while mucinous and serous cystadenocarcinoma were each observed in 2 cases (3.1%). Additionally, borderline malignant tumors included serous, mucinous, and dysgerminoma, each occurring in 1 patient (1.5%).

Table 4: Malignant and Benign Tumors		
Tumors	**N**	**%**
Benign		
Granulosa Cell Tumor	1	1.5
Fibroma	1	1.5
Fibro Thecoma	3	4.6
Dermoid	5	7.7
Serous Cystadenoma	12	18.5
Mucinous Cystadenoma	32	49.2
Malignant		
Serous Cystadeno Carcinoma	2	3.1
Mucinous Cystadeno Carcinoma	2	3.1
Papillary Serous Cystadeno Carcinoma	4	6.2
Borderline Malignant		
Dysgerminoma	1	1.5
Mucinous	1	1.5
Serous	1	1.5

Table 5 compares the test performance characteristics of ultrasound (US) and CT scans in detecting benign and malignant tumors. CT scans showed higher sensitivity for both benign (97.1%) and malignant (89.3%) cases compared to ultrasound, which had sensitivities of 85.2% and 64.8%, respectively. CT also demonstrated superior specificity, with 95.2% for benign and 94% for malignant tumors, whereas ultrasound had lower specificity at 66.5% and 89.1%. The positive predictive value (PPV) was higher for CT (97.5% benign, 79.8% malignant) than for ultrasound (86.3% benign, 67.2% malignant). Similarly, CT had better negative predictive values (NPV) of 94.8% for benign and 96.2% for malignant cases, compared to ultrasound's NPV of 67.1% and 84.7%, respectively. Overall, CT scans performed better in diagnosing both benign and malignant tumors.

Table 5: US and CT scan test performance characteristics				
Test Parameter	**CT (Benign)**	**Ultrasound (Malignant)**	**Ultrasound (Benign)**	**CT (Malignant)**
Negative Predictive Value	94.8	84.7	67.1	96.2
Positive Predictive Value	97.5	67.2	86.3	79.8
Specificity	95.2	89.1	66.5	94
Sensitivity	97.1	64.8	85.2	89.3

Discussion

The findings of our study reveal that the predominant age group for ovarian mass cases is 41-50 years, comprising 35.4% of cases, followed by the 31-40 years category at 24.6%. This indicates a greater prevalence among middle-aged individuals, potentially attributable to hormonal changes and factors related to reproductive health. The research conducted by Karki and Bogati (2019) [14] and Goyal et al. (2022) [15] indicated peak incidences in younger age groups, specifically 20-29 years and 31-40 years, respectively. The observed differences may be ascribed to variations in study populations, geographical factors, or sample sizes. The elevated mean age reported in the study by Danish et al. (2024) [16] corresponds with our findings, indicating that the prevalence of ovarian masses in middle-aged populations may differ across various regions and study cohorts.

Benign tumors represent the majority of masses at 78.5%, whereas malignant tumors comprise 21.5%. This indicates that most ovarian masses are benign; however, a notable percentage may be malignant, underscoring the need for appropriate diagnostic assessments and management approaches. Numerous comparative studies have assessed the efficacy of ultrasound (US) and computed tomography (CT) in the evaluation of ovarian masses, supporting our results that benign tumors represent the majority at 78.5%, whereas malignant cases comprise 21.5%. Danish et al. (2024) [16] demonstrated that CT showed superior sensitivity, specificity, and diagnostic accuracy compared to US in detecting malignancies, which is consistent with our observation that a substantial number of ovarian masses necessitate thorough evaluation.

Walsh et al. (1978) [17] found that both US and CT yielded comparable results, although they were not necessarily complementary, indicating that either modality could be used effectively. Kavali and Devi (2018) [18] noted that CT excels in tumor characterization, ultrasound is favored as the initial screening method because of its accessibility and high sensitivity. The studies collectively validate our findings, indicating that although the majority of ovarian masses are benign, precise diagnostic differentiation is essential for effective management and treatment planning.

The study identified abdominal mass as the most prevalent symptom of suspicious ovarian masses, occurring in 44.6% of cases, followed by abdominal pain at 27.7% and abdominal distension at 21.5%. Pressure symptoms and loss of appetite were significantly less common. This is consistent with the findings of Timmerman et al. (2008) [19], who highlighted that ovarian tumors frequently remain asymptomatic until they reach a size that allows for clinical detection, underscoring the significance of early detection. Ultrasound, as noted by Fishman et al. (2005) [20], is the primary imaging modality due to its high sensitivity in assessing lesion morphology. In contrast, CT offers important supplementary information regarding disease extent, especially in cases with an abdominal mass. Alcazar et al. (2019) [21] demonstrated that CT is essential in preoperative planning by evaluating extraovarian spread, thereby complementing ultrasound in the assessment of advanced-stage tumors. The findings corroborate our observation that patients frequently pursue medical attention only after the tumor has reached a significant size, highlighting the necessity for enhanced screening and diagnostic strategies to facilitate earlier intervention.

The distribution of benign and malignant tumors exemplifies the prevalence of various histological types. Mucinous cystadenoma (49.2%) and serous cystadenoma (18.5%) are the most prevalent benign tumors, whereas dermoid cysts (7.7%), fibrothecoma (4.6%), and fibroma (1.5%) are less commonly observed. Among malignant tumors, papillary serous cystadenocarcinoma constitutes 6.2%, making it the most prevalent, followed by mucinous cystadenocarcinoma and serous cystadenocarcinoma, each at 3.1%. Borderline malignant tumors and dysgerminoma each constitute a minor proportion, specifically 1.5%. The findings underscore the prevalence of epithelial ovarian tumors and the necessity of histopathological evaluation for accurate classification and treatment.

Numerous studies support our findings concerning the prevalence of epithelial ovarian tumors and the diagnostic effectiveness of imaging techniques. Timmerman et al. (2008) [19] demonstrated that ultrasound-based criteria effectively differentiate between benign and malignant ovarian masses, supporting our findings that mucinous cystadenoma (49.2%) and serous cystadenoma (18.5%) are the most prevalent benign tumors. Bala (2006) [22] compared transvaginal ultrasound, CT, and MRI, highlighting ultrasound as the primary imaging tool for initial assessment and acknowledging CT's role in staging, which corresponds with the focus of our study on modality comparison. The diagnostic performance of ultrasound is corroborated by Kinkel et al. (2000) [23], who established its high sensitivity and specificity in distinguishing ovarian carcinomas, aligning with our results that indicate papillary serous cystadenocarcinoma (6.2%) as the most prevalent malignant tumor. The studies demonstrate the reliability of ultrasound in characterizing ovarian masses and underscore the importance of histopathological evaluation for precise classification and treatment planning, as noted in our research.

The results of our investigation show that CT scans are more effective than ultrasonography at identifying both benign and malignant tumors. CT demonstrates superior sensitivity (97.1% for benign and 89.3% for malignant) and specificity (95.2% and 94%, respectively) when compared to ultrasound, which exhibits reduced sensitivity for malignancy (64.8%) and lower specificity for benign lesions (66.5%). Positive predictive values (PPV) and negative predictive values (NPV) support the superiority of CT as a diagnostic tool. Ultrasound remains an essential first-line screening tool due to its cost-effectiveness before advanced imaging techniques. Togashi et al. (2003) [24] highlights that CT offers superior diagnostic accuracy, ultrasound continues to serve as a crucial first-line, cost-effective screening method. Timmerman et al. (2008) [19] provides additional evidence that ultrasound can be optimized for malignancy detection through standardized protocols, although its accuracy is inferior than CT. The findings collectively support the conclusion that CT demonstrates superior sensitivity, specificity, and predictive values compared to ultrasound, the latter remains essential for the initial assessment of ovarian masses prior to the use of advanced imaging techniques.

These findings offer important insights into demographic distribution, types of ovarian masses, symptomatology, tumor characteristics, and the diagnostic accuracy of imaging modalities, which are crucial for enhancing patient outcomes via early detection and effective management strategies.

Conclusion

A comparative analysis of ultrasound and CT scan in evaluating suspicious ovarian masses indicates significant differences in diagnostic efficacy. The CT scan demonstrated superior sensitivity, specificity, and predictive values in differentiating benign from malignant masses, establishing it as a more dependable imaging technique for definitive diagnosis. Ultrasound is a crucial first-line tool owing to its accessibility, cost-effectiveness, and non-invasiveness. However, its lower specificity and sensitivity in identifying malignancies indicate that it may not be adequate as a standalone diagnostic method. The findings highlight the complementary functions of imaging techniques, with ultrasound acting as an effective initial screening tool and CT scan offering enhanced accuracy in characterizing ovarian masses, especially malignant lesions. This study emphasizes the necessity of an integrated diagnostic approach that combines imaging modalities to enhance early detection, improve diagnostic confidence, and facilitate better treatment planning for patients with suspicious ovarian masses.

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