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Sonographic Study of Adnexal Masses Using Gynecologic Imaging-Reporting and Data System (GI-RADS)

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ABSTRACT:

Background and Objective: The Gynecology Reporting and Data System (GI-RADS) is a standardized framework designed to improve adnexal mass characterization and streamline clinician-radiologist communication. By utilizing morphological features and Doppler vascularity, GI-RADS reduce subjectivity in ultrasound interpretation. This study evaluated its diagnostic performance in predicting malignancy risk and providing clear clinical pathways for patient management.

Methodology: A clinical study was conducted at Al-Auda Medical Center, Saudi Arabia, The study included 300 female patients (ages 17+) undergoing ultrasound evaluation for adnexal lesions. Data were analyzed using SPSS version 20.

Results: The mean age was 35.7±10.3 years. Masses were most prevalent in premenopausal married women aged 26–45 (58%), with pelvic pain as the primary indicator (61.3%). Analysis showed 85% of masses had regular capsules and 93.7% were well-defined. Septation occurred in 13.3%, while posterior shadowing and vascularization were noted in 40.3% and 25.7%, respectively. A strong significant correlation (P=0.000) was found between GI-RADS grades and sonographic parameters. Simple ovarian cysts were the most frequent diagnosis (25%), while malignant outcomes were minimal (1.3%). Distribution showed GI-RADS 3 was most frequent (51.7%), followed by GI-RADS 2 (36.3%), GI-RADS 4 (8%), GI-RADS 5 (2%), and GI-RADS 1 (2%).

Conclusion: GI-RADS is a reliable tool for preoperative assessment, effectively distinguishing benign (GI-RADS 2/3) from suspicious (GI-RADS 4/5) lesions. Implementing this standardized language enhances diagnostic accuracy and optimizes surgical management. The researcher recommends mandatory inclusion of GI-RADS scores in all pelvic ultrasound reports to guide clinical decision-making.

KEY WORDS: Adnexal Masses, GI-RADS, Primenposual

INTRODUCTION

Adnexal masses encompass a broad clinical spectrum, ranging from benign cysts to aggressive malignancies. Each type requires a distinct therapeutic strategy and carries a vastly different prognosis [1]. Malignant ovarian tumors are the most lethal gynecological cancers, necessitating prompt referral to specialists for comprehensive surgical staging and adjuvant chemotherapy [2]. However, treatment is not one-size-fits-all: nearly half of borderline tumors occur in women of reproductive age, for whom fertility-sparing surgery is the gold standard, preserving future pregnancy potential without compromising survival [3]. Conversely, benign lesions are often managed conservatively to avoid the risks and costs of overtreatment. Consequently, a simple binary distinction of "benign vs. malignant" is insufficient; precise, multi-class classification is essential for individualized care and maintaining patient quality of life.

Ultrasound serves as the primary non-invasive diagnostic tool for these assessments. It is used to categorize lesions as benign, borderline, or malignant and to identify specific histological subtypes that dictate different clinical outcomes [4]. Despite its utility, sonographic diagnosis is hindered by the high complexity and morphological diversity of these masses. This challenge is particularly acute with borderline tumors, which often lack unique visual markers and share overlapping features with both benign and invasive malignant growths [5].

To address these diagnostic ambiguities and standardize reporting, the Gynecologic Image Reporting and Data System (GI-RADS) was established. Modeled after successful systems like BI-RADS (breast) and LI-RADS (liver), GI-RADS stratifies adnexal masses into five distinct categories based on predefined morphological and Doppler ultrasound criteria [6, 7].

While the efficacy of GI-RADS has been documented in European and Asian cohorts, there is a significant lack of data regarding its performance in Middle Eastern populations, specifically within Saudi Arabia. Regional variations in disease prevalence, imaging infrastructure, and demographic age distributions make it vital to evaluate the system's local applicability [8]. Furthermore, clinical factors such as menopausal status significantly influence lesion type and malignancy risk; for instance, cystic lesions in postmenopausal women require more rigorous scrutiny due to the lower hormonal activity of the ovaries [9]. Integrating these clinical variables may enhance the accuracy and efficiency of the GI-RADS framework.

GI-RADS classify adnexal lesions into five categories based on morphological characteristics and Doppler findings [10]:

- GI-RADS 1: Normal ovaries with no identifiable adnexal mass, risk malignancy (0%)
- GI-RADS 2: Functional adnexal lesions, including follicles, corpus luteum, and hemorrhagic cysts, risk malignancy (<1%)
- GI-RADS 3: Probably benign neoplastic lesions such as endometrioma, mature cystic teratoma, simple cysts, hydrosalpinx, paraovarian cysts, pedunculated fibroids, or findings suggestive of pelvic inflammatory disease, risk malignancy (1–4%)
- GI-RADS 4: Suspicious adnexal lesions not classified as GI-RADS 1–3, with one or two features suggestive of malignancy, including thick septations, papillary projections, solid components, ascites, or vascularity within solid areas on Doppler imaging, risk malignancy (5–20%)
- GI-RADS 5: Highly suggestive of malignancy, with three or more suspicious features, risk malignancy (>20%)

Several studies have evaluated the diagnostic performance of GI-RADS and compared it with other established models such as the IOTA simple rules and subjective assessment, demonstrating good sensitivity and specificity in differentiating benign from malignant adnexal masses. Additionally, standardized systems such as O-RADS have been introduced to further refine risk stratification and reporting consistency [11].

Early and accurate diagnosis is crucial, as many malignant adnexal masses tend to grow rapidly and may remain asymptomatic in early stages. Prompt referral to a gynecologic oncologist, when malignancy is suspected, can significantly improve patient outcomes by enabling timely and appropriate management [12, 13]

The present study aims to evaluate the diagnostic performance of the GI-RADS classification system in the preoperative assessment of adnexal masses, with particular emphasis on its ability to differentiate benign from malignant lesions. Given the increasing prevalence of adnexal masses and the pivotal role of ultrasound in their management, this study aims to systematically assess adnexal lesions at the Al-Auda Medical Centre in Hafar Al-Batin, Saudi Arabia. By utilizing transabdominal and transvaginal ultrasonography in accordance with GI-RADS criteria, the study seeks to validate the system's effectiveness in a Saudi Arabian regional cohort.

PATIENTS AND METHODS

A retrospective study was conducted from December 2022 to December 2025 on all patients attending to Al-Auda Medical Center –HaferAlbaten-KSA, involving a total of three hundred patients. This was conducted at the ultrasound department. The study utilized an ultrasound mindray ultrasound system Model: DC-7years 2012 and Fujifilm ultrasound system Model: SN1WV029 year 2022 with curved linear arrays and an endovaginal transducer, All patients included in the study underwent a comprehensive medical history review.

Ultrasound methods such as Trans abdominal (TA) and Trans vaginal (TV) are frequently used to examine the female pelvis. To identify the uterus and adnexa as a summary of the other pelvic tissues, the TA examination is performed from the anterior abdominal wall using a curvilinear, or sector, transducer at frequencies of up to 5 MHz. The enlarged bladder is typically used as a "sonic" window for TA scans. If the protocol requires a TA trial to be conducted in addition to a TV study, not all institutions begin with

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the bladder fully dilated. Even when the bladder is empty or only slightly enlarged, a TA scan might be helpful as a comprehensive evaluation of the pelvic tissues. Higher transducer frequencies of 7.5 MHz or higher are employed, and the patient's bladder is empty during the TV examination. The enhanced near-field focusing and resolution of these higher frequencies allow for more detailed characterization of the uterus and adnexa [14]. To evaluate the female pelvis, transvaginal and transabdominal sonography are complementary techniques that are frequently employed. Both approaches should be utilized to identify anatomy and disease in at least two orthogonal planes, usually sagittal and axial or coronal and transverse.

Fig 1: Transvaginal ultrasound image for a 38-year-old married who presented with acute abdomen pain, shows a left ovarian endometrioma with blood flow measuring (3 x 2.9 cm)

Fig 2: Trans abdominal ultrasound image fo37Y married with heavy cycle show right ovarian hemorrhagic cyst (7.41 x 7.4 x 5.62 cm)

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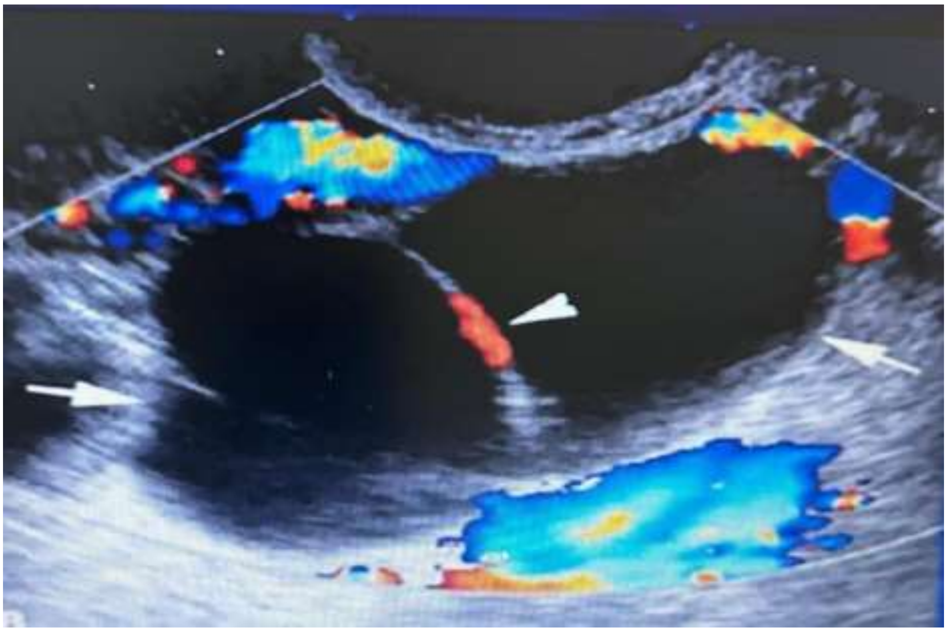

Fig 3: Trans abdominal ultrasound image for 42 years marreid who presented with pelvis pain Lt ovarain cyst with thick septation and vascularity measure (7.07 x 6.74cm) .

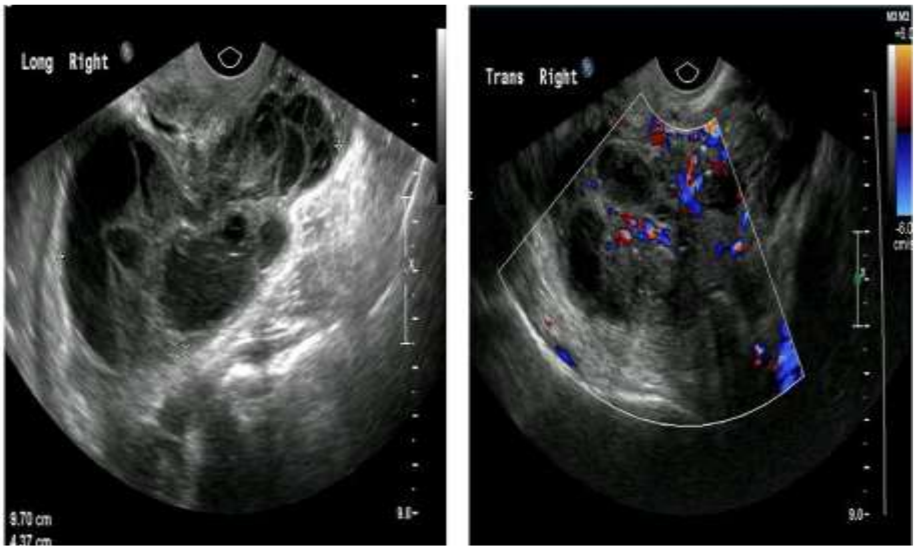

Fig4: Trans vaginal ultrasound image for 34 years married showed complex solid and cystic mass with internal vascularity in tubo ovarian abscess

METHODOLOGY AND STATISTICAL ANALYSIS

Data Collection Framework:

The research utilized a structured data collection instrument categorized into four primary domains; clinical Profiles which focused on participant demographics (age) and patient status, clinical Presentation showed detailed patient medical history alongside presenting signs and symptoms, Sonographic Morphology that documented the specific appearance of adnexal masses, and lastly diagnostic Findings: Recorded comprehensive ultrasound results.

Statistical Approach:
Quantitative analysis was performed using SPSS (Version 20). Continuous variables, such as demographic information and adnexal dimensions, were expressed as mean ± standard deviation. Categorical variables—including sonographic features and Doppler measurements—were analyzed using the chi-squared (X^2) test to identify significant correlations or differences.

ETHICAL CONSIDERATIONS AND DATA SECURITY
Institutional Approval and Consent the research commenced following formal clearance from the Institutional Review Board (IRB) and the ethics committee at the College of Graduate Studies and Scientific Research, Sudan University for science and Technology in Khartoum, Sudan. Every participant provided informed consent, explicitly agreeing to the use of their data for research analysis and academic publication.

RESULT
This retrospective analysis involved the sonographic evaluation of 300 pelvic ultrasound examinations. Adnexal masses were assessed and categorized based on specific morphological features using the Gynecologic Imaging Reporting and Data System (GI-RADS) classification.

Table 4-1 Demographic Distribution of the Study Population:

Category	**Characteristic**	**Frequency (n)**	**Percentage (%)**
Age Group	17–25 years	60	20.0%
	26–45 years	174	58.0%
	46–52 years	58	19.3%
	More than 52 years	8	2.7%
Marital Status	Married	252	84.0%
	Unmarried	48	16.0%
Total		300	100.0%

The demographic profile of the study cohort (n = 300) revealed a predominantly young to middle-aged and married population. Analysis of age distribution showed that the majority of participants fell within the 26–45 age (58.0%, n = 174), followed by the 17–25 age group (20.0%, n = 60). The remaining distribution was comprised of the 46–52 age group (19.3%, n = 58) and those over 52 years (2.7%, n = 8), resulting in a mean age of (35.7 ±10.3) years. In terms of marital status, the vast majority of the participants were married, accounting for 84.0% (n = 252) of the total cohort, while the remaining 16.0% (n = 48) were unmarried. These findings suggest that the clinical presentation of adnexal masses in this study was most prevalent among married women in their peak reproductive and early post-reproductive years.

Table 4-2 Frequency distribution of signs, symptoms, and history:

Category	**Clinical Variable**	**Frequency (n)**	**Percentage (%)**
Signs & Symptoms	Pelvic pain	184	61.3%
	Asymptomatic	33	11.0%
	Vaginal discharge	18	6.0%
	Abdominal pain	16	5.3%

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	Difficult urination	15	5.0%
	Amonarrhgia	10	3.3%
	Vaginal bleeding	9	3.0%
	Bloating	8	2.7%
	Irregular period	7	2.3%
	Total	300	100.0%
Patient History	No relevant history	184	61.3%
	Post-operative status	58	19.3%
	Miscarriage	27	9.0%
	Ectopic pregnancy	13	4.3%
	Breast cancer	11	3.7%
	Hysterectomy	7	2.3%
	Total	300	100.0%

Table 4-2 frequency distribution of signs, symptoms, and history

The clinical findings, summarized in Table 4-2, indicate that pelvic pain was the most frequent symptom, reported by 61.3% of the participants. A significant portion of the cohort (11.0%) was asymptomatic, while other complaints included vaginal discharge (6.0%), abdominal pain (5.3%), and dysuria (5.0%). Less common symptoms included amenorrhea (3.3%), vaginal bleeding (3.0%), bloating (2.7%), and menstrual irregularities (2.3%).

Evaluation of patient backgrounds revealed that a majority (61.3%) had no relevant medical history. Among the remaining participants, 19.3% were post-operative, 9.0% had a history of miscarriage, and 4.3% had experienced an ectopic pregnancy. Furthermore, histories of breast cancer and hysterectomy were recorded in 3.7% and 2.3% of cases, respectively.

Table 4-3 Sonographic Characteristics of Adnexal Masses:

Sonographic Variable	**Category**	**Frequency (n)**	**Percentage (%)**
Sonographic Appearance	Complex	138	46.0%
	Cystic	96	32.0%
	Solid	66	22.0%
Echogenicity	Hyperechoic	138	46.0%
	Anechoic	106	35.3%
	Hypoechoic	56	18.7%
Echo Texture	Homogenous	244	81.3%
	Heterogenous	56	18.7%
Lesion Capsule	Regular	255	85.0%
	Irregular	30	10.0%
	Thick	15	5.0%

Lesion Margin	Well-defined	281	93.7%
	Ill-defined	19	6.3%
Total		300	100.0%

Table 4-3 frequency distribution of Sonographic Characteristics of Adnexal Mass

The sonographic evaluation of the study population (n=300) highlights several predominant features across five key variables. Regarding Sonographic Appearance, nearly half of the identified masses were classified as Complex (46.0%), followed by Cystic (32.0%) and Solid (22.0%) types. In terms of Echogenicity, Hyperechoic patterns were the most frequent at 46.0%, while Anechoic and Hypoechoic patterns accounted for 35.3% and 18.7%, respectively.

The structural integrity and boundary of the lesions showed high levels of uniformity; the vast majority of masses exhibited a Homogenous echo texture (81.3%) and possessed Well-defined margins (93.7%). Furthermore, the Lesion Capsule was found to be regular in 85.0% of cases, with Irregular (10.0%) and Thick (5.0%) capsules being significantly less common. Collectively, these data suggest that while the internal appearance of the masses is often complex and hyperechoic, the external boundaries typically remain well-defined and regular within this cohort.

Table 4-4 Specific Sonographic Findings:

Sonographic Diagnosis	Frequency (n)	Percentage (%)
Ovarian cyst	75	25.0%
Dermoid cyst	42	14.0%
Hemorrhagic cyst	39	13.0%
Endometrioma	35	11.7%
Para-ovarian cyst	19	6.3%
Cyst adenofibroma	15	5.0%
Leiomyoma	15	5.0%
Serous cyst adenoma	13	4.3%
Tubo-ovarian abscess	13	4.3%
Peritoneal cyst	12	4.0%
Mucinous cyst adenoma	10	3.3%
Fibroma	8	2.7%
Cyst adenocarcinoma	4	1.3%
Total	300	100.0%

The diagnostic spectrum of the study population (n=300) was characterized by a high prevalence of benign functional and germ cell lesions. Ovarian cysts emerged as the most frequent finding, representing exactly one-quarter of the total cases (25.0%, n=75). This was followed by Dermoid cysts (14.0%) and Hemorrhagic cysts (13.0%), indicating that nearly half of the cohort presented with these three conditions alone. Endometriomas also constituted a significant portion of the diagnoses at 11.7%.

Interestingly, while benign lesions dominated the findings, the data also captured rarer pathologies, including Tubo-ovarian abscesses (4.3%) and Mucinous cyst adenomas (3.3%). Malignancy was notably infrequent within this specific group, with Cyst adenocarcinoma accounting for the lowest percentage of cases at 1.3% (n=4). Overall, the results demonstrate a diverse clinical profile where simple cysts and benign neoplastic growths are the primary drivers of adnexal mass presentations.

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Table 4- 5 Sonographic Finding and GI- RADS Score:

Category	Sonographic Finding / Classification	Frequency (n)	Percentage (%)
Sonographic Diagnosis	Ovarian cyst	75	25.0%
	Dermoid cyst	42	14.0%
	Hemorrhagic cyst	39	13.0%
	Endometrioma	35	11.7%
	Para-ovarian cyst	19	6.3%
	Cyst adenofibroma	15	5.0%
	Leiomyoma	15	5.0%
	Serous cyst adenoma	13	4.3%
	Tubo-ovarian abscess	13	4.3%
	Peritoneal cyst	12	4.0%
	Mucinous cyst adenoma	10	3.3%
	Fibroma	8	2.7%
	Cyst adenocarcinoma	4	1.3%
GI-RADS Score	GI-RADS 1 (Normal/Definitive Benign)	6	2.0%
	GI-RADS 2 (Benign)	109	36.3%
	GI-RADS 3 (Probably Benign)	155	51.7%
	GI-RADS 4 (Probably Malignant)	24	8.0%
	GI-RADS 5 (Malignant)	6	2.0%
Total		300	100.0%

There is strong correlation between benign sonographic findings and low-risk classification scores. Ovarian cysts (25.0%), Dermoid cysts (14.0%), and Hemorrhagic cysts (13.0%) were identified as the most prevalent pathologies, aligning with the GI-RADS classification data where the vast majority of cases were categorized as low-risk. Specifically, GI-RADS 3 (Probably Benign) was the most frequent assessment, accounting for 51.7% (n=155) of the population, followed by GI-RADS 2 (Benign) at 36.3%. Conversely, findings suspicious for malignancy were rare; Cyst adenocarcinoma was recorded in only 1.3% of cases, which consistent with the low frequency of GI-RADS 5 (Malignant) scores (2.0%). This distribution underscores that while adnexal masses are common in this demographic, the overwhelming majority are benign functional or neoplastic growths requiring conservative or minimally invasive management.

Table 4-5 Cross tabulation between GI-RADS and demographic age, history signs & symptoms and diagnosis

Clinical Variable	Category	GI-RADS					Total	P value	Chi^2	Cramer's V
		GI-RADS 1	GI-RADS 2	GI-RADS 3	GI-RADS 4	GI-RADS 5				
Age Group	17-25 years	4	39	15	1	1	60	.000	64.808	0.268
	26-45 years	2	64	94	12	2	174			
	46-52 years	0	4	42	10	2	58			

	> 52 years	0	2	4	1	1	8			
Medical History	No-history	6	98	66	12	2	184	.000	99.22	0.288
	Post-operation	0	4	47	5	2	58			
	Breast Cancer	0	0	9	2	0	11			
	Ectopic pregnancy	0	3	9	1	0	13			
	Miscarriage	0	2	21	4	0	27			
	Hysterectomy	0	2	3	0	2	7			
Signs & Symptoms	abd pain	0	2	13	1	0	16	.002	59.185	0.222
	amonarrhgia	1	3	4	2	0	10			
	Asymptomatic	1	13	17	1	1	33			
	bloating	1	2	4	0	1	8			
	Difficult urination	0	2	9	3	1	15			
	Irregular period	1	2	3	1	0	7			
	Pelvic pain	2	76	94	11	1	184			
	Vaginal bleeding	0	6	2	1	0	9			
	Vaginal Discharge	0	3	9	4	2	18			
Sonographic findings	Cystadenocarcinoma	0	0	0	3	1	4	.000	356.61	0.545
	Cystadenofibroma	0	0	10	5	0	15			
	Dermoid cyst	0	0	34	8	0	42			
	Endometrioma	0	7	28	0	0	35			
	Fibroma	0	0	6	2	0	8			
	Hemorrhagic cyst	0	33	6	0	0	39			
	Leiomyoma	0	0	14	0	1	15			
	Mucinous Cystadenoma	0	0	9	1	0	10			
	Ovarain cyst	6	69	0	0	0	75			
	Para-ovarian cyst	0	0	19	0	0	19			
	Peritoneal cyst	0	0	12	0	0	12			
	Serous Cystadenoma	0	0	9	2	2	13			
	Tubo-ovarian abscess	0	0	8	3	2	13			

Statistical analysis revealed that all evaluated clinical variables—Age Group, Medical History, Signs & Symptoms, and Diagnostic Findings—achieved statistical significance ($p < .05$) in relation to the final G-RADS classification. Among these, Diagnostic Findings emerged as the most influential determinant, exhibiting a highly strong association (Cramér's V = 0.545). This implies that the specific morphological characteristics of the lesion (such as distinguishing a simple cyst from a dermoid cyst) are the primary drivers of the scoring system. Consequently, simple cysts were predominantly categorized as G-RADS 2, whereas more complex findings yielded higher scores. Conversely, the remaining three variables demonstrated only a moderate strength of association. While Age Group (V = 0.268) indicated that certain age brackets correlate more frequently with specific risk levels, Medical History (V = 0.238) suggested that clinical background merely contributes secondary contextual value. Finally, Signs & Symptoms yielded the weakest association in the dataset (V = 0.222). This indicates that clinical symptoms like pelvic pain are highly prevalent, they lack the clinical specificity required to accurately predict precise G-RADS scores compared to direct imaging findings.

DISCUSSION

The study identified a strong significant correlation (P = 0.000) between the GI-RADS grade and parameters such as sonographic appearance, lesion capsule regularity, internal echogenicity, and vascularity. These findings align with the core diagnostic architecture of the GI-RADS system, which prioritized the identification of recognition patterns—specifically the presence of solid components, thick irregular walls, and blood flow detected via Doppler to stratify malignancy risk.

The study was agreed with the study of [15] demonstrated that the GI-RADS system showed strong interobserver agreement, making it highly reliable in clinical practice. Similarly, [16] found that GI-RADS had excellent diagnostic performance in distinguishing adnexal masses.

The study utilized the GI-RADS reporting system to stratify malignancy risk. The most prevalent diagnosis was the simple ovarian cyst (25%), followed by dermoid cysts (14%) and hemorrhagic cysts (13%). Malignant outcomes were minimal, with cystadenocarcinoma representing only 1.3% of the cases.The distribution of GI-RADS on this study ; GI-RADS 3 (Probably Benign) 51.7% (Most frequent), GI-RADS 2 (Benign) 36.3%, GI-RADS 4 (Suspicious) 8%, GI-RADS 5 (Highly Suspicious) 2% and GI-RADS 1 (Normal) 2%. The study was agreed with the study of Linder Diaz et al years 2017, External Validation of Gynecological Imaging and Reporting Data System for Sonographic Evaluation of Adnexal Masses that approved that most the cystic masses on his study were a benign addition to that he said GI-RADS shows a high diagnostic performance and is helpful for referring clinicians for taking clinical decisions.

CONCLUSION

The GI-RADS system is a highly effective and reliable method for the preoperative assessment of adnexal masses. It provides a standardized language that correlates well with the risk of malignancy, particularly in distinguishing between benign (GI-RADS 2/3) and suspicious (GI-RADS 4/5) lesions. Implementing this system in routine ultrasound practice can enhance diagnostic accuracy and optimize the surgical management of ovarian cancer.

The primary objective of this study was to evaluate the diagnostic performance of the GI-RADS classification in characterizing adnexal masses and predicting the risk of malignancy. By categorizing ultrasound findings into a standardized scale (GI-RADS 1 through 5), the researcher aimed to minimize subjective interpretation and provide a clearer clinical pathway for surgical vs. conservative management.

LIMITATIONS

While GI-RADS offers a structured reporting language, it remains operator-dependent. The differentiation between a "clot" in a hemorrhagic cyst and a "solid papillary projection" in a borderline tumor requires significant sonographic expertise. Despite this, the transition from descriptive reporting to a numerical risk score (GI-RADS) significantly improves the clarity of the recommendation for the referring clinician.

RECOMMENDATIONS

The researcher recommend the mandatory inclusion of a GI-RADS score in all pelvic ultrasound reports involving adnexal masses to guide clinical decision-making. Also for masses scored as GI-RADS 4, a multidisciplinary review involving oncology and MRI correlation is advised before surgical intervention. Beside that sonographers and radiologists should receive targeted training on the specific morphological "rules" of GI-RADS to reduce inter-observer variability, especially in distinguishing complex benign lesions from borderline tumors.

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