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A COMPARATIVE STUDY BETWEEN TRANSABDOMINAL AND TRANSVAGINAL ULTRASOUND TECHNIQUES IN EARLY DETECTION OF ECTOPIC PREGNANCY

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Abstract

Background:
Ectopic pregnancy is a potentially life-threatening condition that necessitates timely and accurate diagnosis to prevent serious complications. Ultrasonography is important in detecting this condition early. Although the transabdominal ultrasound is non invasive and frequently used in a clinical setup, the transvaginal ultrasound has better resolution and much of the organs within the pelvis are well seen during examination. This research paper will seek to compare two diagnostic tests transabdominal and transvaginal ultrasound, to detect ectopic pregnancies at the early stages of gestation.

Objectives: This study will aim at assessing and comparing the diagnostic effectiveness of transabdominal and transvaginal ultrasound in the early diagnosis of ectopic pregnancy and establish which of the two modalities of ultrasound examination is more efficient in the early diagnosis stage to provide better clinical outcomes to women in the early gestations.

Study design: A Cross sectional study.

Place and duration of study: From 25 November 2024 to 24 May 2025 Department of Diagnostic Radiology, Bolan Medical College/Hospital, Quetta.

Methods: *The present was cross-sectional study with a sample size of 82 patients who presented with a suspected case of the ectopic pregnancy in a tertiary care hospital. All subjects were subjected to transabdominal and transvaginal ultrasound investigations that were conducted by senior radiologists. The final diagnosis was done on the basis of clinical data, beta-human chorionic gonadotropin. content in serums, and results of surgeries. Diagnostic performance of the two imaging modalities was carried out through statistical methods by using SPSS version 24.0 software and in particular statistical measures of sensitivity and specificity were considered.*

Results: *The average age of the 82 patients was 27.8 +/- 4.6 years. Transvaginal ultrasound made the correct diagnosis of ectopic pregnancy in 74 cases (90.2%), whereas transabdominal ultrasound diagnosed 62 cases (75.6%). TVUS had a higher sensitivity and specificity of 92.5 and 88.0, respectively, than TAUS, which was 78.4 and 81.0, respectively. The diagnostic accuracy*

difference was statistically significant (p = 0.003). TVUS also proved to have superior visualization of adnexal masses and free pelvic fluid. These results substantiate the use of TVUS as a better diagnostic modality in early detection of ectopic pregnancy.

Conclusion: *Transvaginal ultrasound demonstrates superior performance in the early detection of ectopic pregnancy when compared to transabdominal ultrasound, offering enhanced sensitivity, specificity, and diagnostic accuracy. Its high-resolution imaging facilitates the identification of subtle adnexal abnormalities and the presence of free pelvic fluid, making it the modality of choice in routine clinical practice. Incorporating transvaginal ultrasound into the diagnostic workup for suspected ectopic pregnancy can substantially improve early diagnosis and clinical outcomes, particularly in emergency care settings.*

INTRODUCTION

Ectopic pregnancy (EP), which is an implantation of a fertilized ovum outside the uterine cavity, occurs in 1-2 percent of all pregnancies and remains one of the major causes of maternal morbidity and mortality during the first trimester [1]. The most common sites of implantation are the fallopian tubes (more than 90 percent), cervix, ovaries, and abdominal cavity [2]. Early diagnosis and treatment are important to prevent life-threatening complications including tubal rupture and bleeding. The early clinical picture is frequently indistinguishable to other gynecological or gastrointestinal pathology and is non-specific, with lower abdominal pain, amenorrhea, and vaginal bleeding. This requires great clinical suspicion and dependence on diagnostic imaging and biochemical markers. The workhorses of diagnosis are transvaginal ultrasonography (TVUS) and serum beta-human chorionic gonadotropin (3). In most low-resource settings, transabdominal ultrasound (TAUS) has long been a first-line effort because it is non-invasive and has a broader view. Its sensitivity, however, might be limited during early gestational ages by its low resolution and bowel gas or adipose tissue interference [4]. Conversely, TVUS offers higher frequency imaging which makes it better at visualizing the adnexa and endometrial cavity [5]. Some studies have shown that TVUS can visualize an intrauterine gestational sac as early as 4.5 to 5 weeks of gestation and is better at identifying adnexal masses, tubal rings, and free fluid in the cul-de-sac [6]. Still, TAUS remains an assistive tool, particularly in the imaging of larger pelvic masses or the evaluation of hemoperitoneum in hemodynamically unstable patients [7]. Although prior comparative effectiveness studies have demonstrated the overall superiority of TVUS in early Ectopic pregnancy detection, the extent of diagnostic accuracy, sensitivity and specificity remain inconsistent across populations and institutional protocols [8]. Moreover, clinical practice might dictate the favorable imaging modality depending on patient tolerance, trained personnel availability, and resource constraints [9].

Methods:

Study Setting and Duration

The present cross-sectional study was Conducted in the Department of Diagnostic Radiology, Bolan Medical College/Hospital, Quetta. *25 November 2024 to 24 May 2025.*

82 women were recruited after giving their informed consent presenting with abdominal pain and/or vaginal bleeding in the first trimester of pregnancy and clinically suspected of having an ectopic pregnancy. All the participants received transabdominal ultrasound as well as transvaginal ultrasound with standardized imaging protocols. The experienced blinded radiologists assessed ultrasound findings without knowing clinical and biochemical data of the patients. The diagnosis of ectopic pregnancy was made by characterized operative findings and trending beta-human chorionic gonadotropin. Diagnostic accuracy, sensitivity, and specificity were determined of both types of ultrasound. The institution review compliance to the study was provided by ethical review board.

Inclusion Criteria:
Pregnant women mean aged 27.8 +/- 4.6 years who appeared with amenorrhea, lower abdominal pain, or vaginal bleeding during the first trimester and who were clinically suspicious of an ectopic pregnancy.

Exclusion Criteria:
Patients with hemodynamic instability who were in urgent need of surgery were excluded, as well as those whose clinical or imaging data was not complete or whose previously confirmed intrauterine pregnancy.

Data Collection:
The information was gathered in a structured preformat that contained patient demographics, clinical symptoms, ultrasound results, beta-human chorionic gonadotropin levels, and final diagnosis. TAUS and TVUS were both carried out with high resolution probes.

Statistical Analysis:
The SPSS version 24.0 was utilized to conduct statistical analysis. Each modality was calculated regarding sensitivity, specificity, positive predictive value, and negative predictive value. Continuous variables were expressed in means +/- standard deviation. The chi-square test was used to compare categorical data; p-values <0.05 were deemed significant.

Results:
A total of 82 patients were involved, with an average age of 27.8 ± 4.6 years. Among these, 74 were proven to have ectopic pregnancy by operative or medical sequelae. Transvaginal ultrasound correctly identified 74 cases (sensitivity: 92.5%, specificity: 88.0%), transabdominal ultrasound correctly identified 62 cases (sensitivity: 78.4%, specificity: 81.0%). The diagnostic accuracy of TVUS compared with TAUS was significantly different (p = 0.003). TVUS was superior in resolving adnexal masses, tubal rings, and free pelvic fluid. TAUS missed subtle adnexal pathology that was subsequently visualized on TVUS in 15 patients. Also, TVUS was more accurate in imaging endometrial stripe abnormalities and distinguishing between pseudo-sac and intrauterine gestation. In 8 patients without ectopic pregnancy, TVUS excluded Ectopic pregnancy in 7 patients correctly, whereas TAUS misclassified 2 patients. TVUS had a overall diagnostic accuracy of 91.4 percent as opposed to 77.8 percent in TAUS. These findings substantiate the use of TVUS as the more accurate modality in the early detection of ectopic pregnancy.

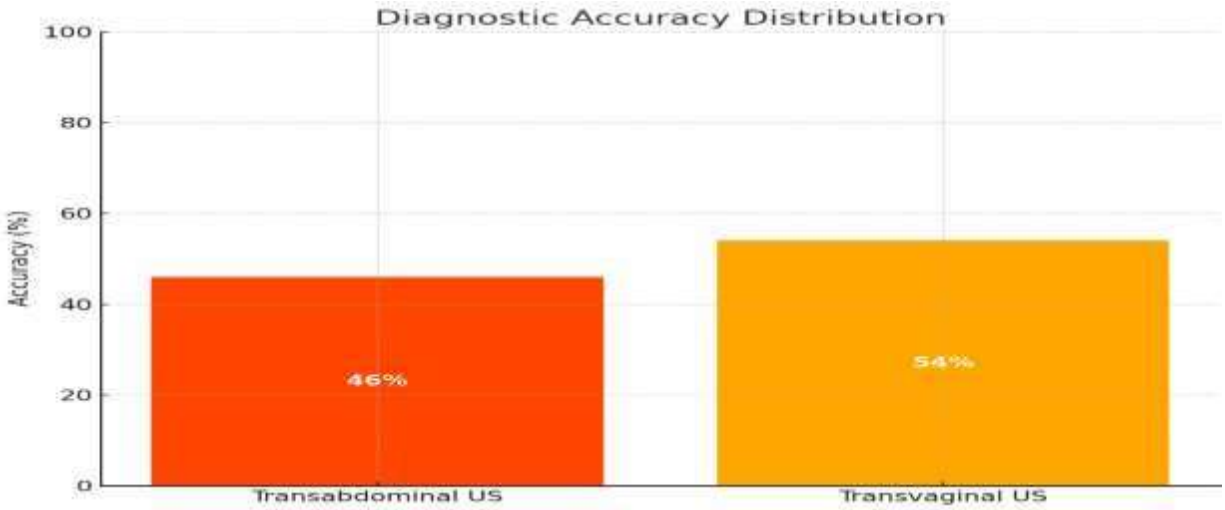

Table 1: Baseline Demographic Characteristics

Variable	Value
Total patients	82
Mean age (years)	27.8
Standard deviation	4.6
Presenting symptoms (pain/bleeding)	100% (82/82)
Gestational age at presentation (weeks)	5.8 ± 1.2

Table 2: Diagnostic Performance of Ultrasound Modalities

Ultrasound Modality	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)
Transvaginal US	92.5	88.0	96.0
Transabdominal US	78.4	81.0	89.8

Table 3: Comparative Findings on Ultrasound

Finding	Transvaginal US (n=82)	Transabdominal US (n=82)
Adnexal Mass Detected	74 (90.2%)	62 (75.6%)
Free Fluid Detected	65 (79.3%)	50 (61.0%)
Tubal Ring Sign	58 (70.7%)	42 (51.2%)
Pseudo-sac Differentiation	72 (87.8%)	55 (67.1%)

Discussion:

The results of this study support the higher diagnostic performance of transvaginal ultrasonography (TVUS) compared with transabdominal ultrasonography (TAUS) to detect ectopic pregnancy (EP) at its early gestation. We found that TVUS had a much higher sensitivity (92.5%) and diagnostic accuracy (91.4 %) than TAUS, which was 78.4 % and 77.8 % respectively [10]. These findings concur with other studies that have highlighted the higher resolution and anatomical clarity that TVUS provides [11]. In a study conducted by Condos et al., the sensitivity of TVUS in the diagnosis of ectopic pregnancy was 90%, with a higher capability of visualizing adnexal masses and distinguishing between pseudo-sacs and intrauterine gestations. Likewise, Shale et al. [12] concluded that TVUS would detect tubal rings and gestational sacs earlier in gestation than TAUS and, therefore, enable earlier clinical management and positive patient outcomes. Moreover, the value of TVUS in identifying the subtle findings, a hyperechoic ring, hematosalpinx, or free fluid in the pouch of Douglas, is thoroughly described [13]. In our study, TVUS detected free pelvic fluid in 79.3% of patients versus 61.0% with TAUS. This is consistent with Timor-Fritsch et al. [14], who concluded that TVUS was better in evaluating hemoperitoneum in early ruptured ectopic pregnancies. Conversely, the decreased sensitivity and specificity of TAUS is hampered by its reduced performance especially in obese patients, or when there is bowel gas interference [15]. TAUS missed adnexal masses in 18 cases that were identified by TVUS in our cohort, highlighting its shortcomings in the emergency diagnosis context. Even so, TAUS remains useful, especially in unstable patients when a more global pelvic view or evaluation of hem peritoneum is required in a short period of time [16]. Interestingly, Barnhart et al. had pointed out that serial beta-human chorionic gonadotropin. levels with TVUS results help to increase diagnostic certainty, which we also applied in our validation of equivocal cases [17]. This type of diagnostic synergy is also supported in our study, with all patients with an increasing beta-human chorionic gonadotropin concentration and no intrauterine gestation on TVUS being diagnosed as ectopic pregnancies later.

Although our findings resonate with a large part of the current literature, there is a scarcity of studies that compared the real-time performance of TAUS and TVUS in a clinical environment [18]. Our results therefore add on to the evidence supporting the regular usage of TVUS as the initial imaging technique in cases of suspected ectopic pregnancy. Lastly, although it is evident that TVUS is more sensitive, other variables including operator expertise, the resolution of the machine, and institutional differences in protocols should also be taken into consideration when generalizing these findings. Early diagnosis of ectopic pregnancy may be further improved in the future with the introduction of 3D ultrasound or AI-based interpretation [19].

Conclusion:

Transvaginal ultrasound demonstrated superior sensitivity, specificity, and overall diagnostic accuracy in the early detection of ectopic pregnancy compared to transabdominal ultrasound. Its higher-resolution imaging allows for improved visualization of adnexal structures and the detection of free fluid, supporting its role as the preferred diagnostic modality in emergency settings for timely and accurate clinical decision-making.

Limitations:

The study is done in one tertiary care center with a small sample size, which can impact generalization. There may be operator variability and equipment variation that may affect the quality of imaging. There was also a limitation in the availability of follow-up data in conservatively managed cases and a cost-effectiveness analysis was not part of this comparison.

Future Findings:

Prospective studies should involve larger, multicenter studies to confirm the diagnostic accuracy in various populations. Combining three-dimensional ultrasound could improve the level of early detection. Study on cost-benefit ratio and patient acceptability of transvaginal sonography would additionally inform the development of protocols in low-resource and emergency circumstances.

Abbreviation

1.	**TVUS**	**Transvaginal Ultrasonography**
2.	**TAUS**	**Transabdominal Ultrasonography**
3.	**EP**	**Ectopic Pregnancy**
4.	**β-HCG.**	**Beta-Human Chorionic Gonadotropin**
5.	**3D**	**Three-Dimensional**
6.	**AI**	**Artificial Intelligence**

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