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Comparison of Diagnostic Accuracy of Transvaginal with Transabdominal Ultrasound for Ectopic Pregnancy

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ABSTRACT

Introduction: Ectopic pregnancy (EP) has remained a significant source of maternal morbidity and mortality over the years. Proper identification of this disease is crucial to avoid or lessen the effects. A recent imaging technique used to assess the parametria is transvaginal ultrasound, which is more accurate than transabdominal ultrasound. **Objectives:** To establish the performance of TVS and TAUS in diagnosing EP about laparotomy, the reference technique. **Study Design and Settings:** This cross-sectional study was conducted at the Department of Radiology in Lady Reading Hospital, Peshawar, Pakistan from 11th July, 2024 to 10th January, 2025. **Materials and Methods:** This was a cross-sectional study involving 279 women aged 15–45 with suspected EP. All participants underwent TVS, TAUS, and laparotomy for confirmation. Sensitivity, specificity, and PPV, as well as NPV, for both modalities were computed. **Results:** The TVS was found to have a better sensitivity of 93.8% as compared to an assay of 78.6% by TAUS, better specificity of 82.4% as compared to the assay of 64.9% by TAUS, better PPV of 95.1% as compared to the assay of 85.3% by TAUS and better accuracy of 91.4%. **Conclusion:** The study shows that TVS is more accurate than TAUS in diagnosing EP and its confirmatory role in imaging.

INTRODUCTION

An increase in the occurrence rate of EPs in the decades has corresponded to the rise in diagnostic procedures. It is important to note that despite changes in morbidity and mortality of maternal related to EP, early diagnosis plays a significant role in sparing complications (1). In the past, diagnostic laparoscopy was the only modality used to visualize the ectopic pregnancy directly. Nevertheless, it has shortcomings as it has false positive and false negative percentage ratios of about 5% & 34%, respectively (2). Since using transvaginal ultrasound (TVS), early and accurate EP diagnosis changed the diagnostic course and shifted away from invasive procedures (3).

TVS has emerged as an initial imaging of choice in suspected EP, with a satisfactory sensitivity of 74% and a specificity of 99.9% to identify ectopic gestations (4). Its accuracy is given by a finding such as an extrauterine mass or, rarely, a live embryo outside the uterus, which remains the only pathognomonic finding (5). Variability of the ultrasonographic signs is well accounted for by this, demonstrating that a large part is related to skill and scrutiny of the findings. For instance, an investigation revealed that about 87-99% of situations of tubal pregnancy can be diagnosed by the use of TVS, making diagnosis by TVS very reliable (6). Transabdominal ultrasound (TAUS), unlike the other techniques, is less sensitive in some clinical situations, although it gives an overview.

Ectopic pregnancy is a major life-threatening obstetric emergency which calls for appropriate diagnostic and therapeutic intervention if the maternal health of the woman is to be preserved. Compliance with adherence to such studies has remained a key issue in delaying the detection of various diseases that cause maternal morbidity and mortality (6). Since there is increased use of ultrasound across healthcare facilities due to the high incidence of ectopic pregnancies and the fact that early diagnosis of the condition is critical, this paper seeks to determine the diagnostic efficiency of transvaginal and transabdominal ultrasound. In this way, this research aims to clarify the value and inconveniences of each

strategy in order to make a positive impact on the medical community and help educate people about the benefits of early diagnosis for those afflicted with illness. For example, obesity, inadequate bladder filling and poor visualization of the pelvic structures delay the diagnosis of EP through the TAUS (7). These can fail to identify specific diseases or cause poor identification, which may be because the disease involved is complex. Nevertheless, TAUS remains clinically useful when TVS is not possible for some reasons, including patient preference, contraindication, or limitations to access. A more detailed analysis of comparative studies showed a significant difference in efficiency between the two modes of operation, with TAUS sensitivity of only 73.1% and accuracy of 73.3%, compared to TVS with sensitivity of 92.3% and accuracy of 90 (8). These results underscore the importance of incorporating TVS whenever possible to increase diagnostic accuracy and the value of TAUS in overall pelvic examinations.

The above statistics again prove that TVS is better than TAUS as it also has a higher sensitivity (96.1%) and PPV (98.6%) than TAUS (77.9% and 95.2%) in identifying EP. The reproduction of the TVS across various populations and different EP practices reinforces its importance in managing EP. Similarly, comparative studies stress the roles of both methods in providing mutual reinforcement and reducing false negative results (10). The selection of the diagnostic approach sometimes mirrors clinical conditions, the stability of the patient, and the availability of certain facilities. They expressed that TVS provides better visualization of structures such as tubal rings, adnexal mass, and free fluid in Douglas's pouch, making the diagnosis precise. (11). However, it is essential to present that in cases that pose a diagnostic challenge even in clinical practice, such as cesarean scar pregnancies, TVS's advantages over TAUS become even more evident. Such cases were compared to feature both methods, and the results indicate inherent advantages of TVS, including higher sensitivity due to the ability to distinguish between subtle variations in anatomy (12). Nevertheless, TAUS remains useful for general pelvic examinations with extensive adhesions or distorted pelvic anatomy.

The extent of this result significantly impacts healthcare since it means that improved diagnostic tools cannot always yield better results in disease diagnosis, especially in developing nations. The incorporation of TVS into standard diagnostic tools and algorithms for suspected EP can result in the significant enhancement of outcomes by facilitating early management (13). Additionally, comparative studies in the clinical algorithms employing both techniques have shown that the two work synergistically to increase diagnostic accuracy (14). Tremendous importance should be given to early, accurate diagnosis in populations with high-risk factors for EP, such as those with prior pelvic infections or prior EP. Since EP continues to be a significant cause of first-trimester maternal mortality, the appropriate use of TVS and TAUS becomes critical in enhancing maternal health outcomes (15). Further work should also expand upon these diagnostic modalities, analyzing newer technology and the clinical application of these techniques.

Objective

To establish the sensitivity of transvaginal ultrasound and transabdominal ultrasound in diagnosing ectopic pregnancy as against transabdominal ultrasound and laparotomy findings.

MATERIALS AND METHODS

Study Design: Cross-sectional study

Study setting: This cross-sectional study was conducted at the Department of Radiology in Lady Reading Hospital, Peshawar, Pakistan.

Duration of the study: The data were collected for the six months starting from 11th July, 2024 to 10th January, 2025, regarding the patients who have undergone PPCI in this period.

Inclusion Criteria

- Women aged 15 to 45 years with positive pregnancy tests and symptoms of abdominal pain or vaginal bleeding.
- Beta-hCG levels exceeding 25 mIU/mL.
- Patients in the first trimester of pregnancy.

Exclusion Criteria

- Women with confirmed intrauterine or molar pregnancies.
- Cases of tubo-ovarian masses identified on ultrasonography.

Methods

After completing a written consent form, we include all patients presenting to the outpatient department with features of suspected EP. Every patient had TVS and TAUS by one radiologist with at least 5 years of experience. After both modalities, findings were noted, such as an adnexal mass, fetal cardiac activity, free fluid in the pouch of Douglas, or a tubal ring. After the ultrasound test, all patients underwent laparotomy by an expert in obstetrics to corroborate the diagnosis of EP. The findings made through laparotomy were used as a benchmark for comparison. Structured proforma based on the previous design was employed to record patient details, findings, ultrasound reports and laparotomy reports. Data collection was performed systematically to minimize inter-observer variability. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.

RESULTS

The study targeted 279 women aged between 15 and 45

years. The mean age of participants was 28.6 years, and the standard deviation was ± 5.4. A slightly higher proportion of the patients, 62%, came from urban backgrounds, while the remaining 38% were from rural backgrounds. Almost all the women (67%) had prior pregnancies with an average parity of 2.1 (SD ± 1.3). The authors concluded that in the sample, the prevalence of EP was confirmed in 192 patients (68.8%) using laparotomy.

Comparison of Diagnostic Accuracy

The value of TVS and TAUS for diagnosing ectopic pregnancy was assessed using the parameters of sensitivity, specificity, PPV, NPV, and accuracy of each method with reference to laparotomy results. TVS showed superior diagnostic accuracy in distinguishing EP from TAUS in the study.

Table 1

Diagnostic Parameter	TVS (%)	TAUS (%)
Sensitivity	93.8	78.6
Specificity	82.4	64.9
Positive Predictive Value	95.1	89.3
Negative Predictive Value	77.1	44.7
Accuracy	91.4	72.0

Findings on Ultrasound

The significant ultrasound findings in the present study included the adnexal cysts, fetal cardiac movements, and fluid collection in Douglas's pouch, a band-like structure called the tubal ring. These detections of adnexal mass were significantly more common with TVS, which was identified in 89% of the EP cases, compared to 73% with TAUS. This shows the higher potential of TVS in defining essential structures of the pelvis. Moreover, fetal cardiac activity, which is characteristic of ectopic pregnancy, was noted in the present study in 18% of patients analyzed by TVS and in only 9% of patients by TAUS. These results explain the better performance of TVS over TAUS in identifying changes in web pages.

Table 2

Findings	TVS (%)	TAUS (%)
Adnexal Mass	89	73
Fetal Cardiac Activity	18	9
Free Fluid in Pouch of Douglas	52	36
Tubal Ring Appearance	46	31

Laparotomy Outcomes

Laparotomy confirmed 192 cases of EP and ruled out EP in 87 subjects within the study population, this being the golden standard in diagnosing EP. The diagnostic accuracy when using TVS was higher, successfully detecting EP in all 192 confirmed cases while using TAUS only in 151 cases. False negatives, where the method fails to detect EP, were less with TVS at 12 compared to TAUS at 41, which confirms that TVS has better sensitivity. False positives where EP was mimicked were also generally lower in TVS, with 15 instances compared with 30 in TAUS. These findings also strengthen TVS as a better diagnostic method to detect or rule out EP. Accordingly, TVS was found to be more accurate than TAUS in diagnosing ectopic pregnancy. These findings have implications for the clinical application of TVS.

DISCUSSION

This indicates the need to diagnose EP accurately and in its early stages to avoid the high rate of maternal morbidity and mortality. The study also sought to determine the diagnostic accuracy of transvaginal sonography (TVS) and transabdominal sonography (TAS) in diagnosing EP when compared to laparotomy. In the present study, it was shown that TVS had better sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy as compared to TAUS. They are in agreement with Hu et al. (2023), where authors also observed the greater accuracy of TVS over that of TAUS in the diagnosis of EPI. Some of the better performance of TVS has again been attributed to the visualization of pelvic organs and structures, especially in obese patients or those with inadequate bladder filling. This made it much higher than the observed sensitivity of 78.6% when using TAUS. This is in line with the study done by Al-Falaki and Ahmed (2024) that showed the advantage of TVS over TAUS in terms of diagnostic accuracy. Enhancement in the definition capacity of transvaginal sonography (TVS) enables the demonstrative visualization and depiction of some anatomic structures in clinical practice, such as the adnexal masses and tubal rings, which are inherent to the diagnosis of ectopic pregnancy.

Sensitivity, or the ability of the tests to rule out patients with the disease, was also improved in TVS by 82.4%, while in TAUS, it was 64.9%. This results in higher specificity and, as such, reduces this incidence of false positives, which are especially rife in TAUS as the method has a relatively low resolution as well as a wide field of view. This is consistent with Sattar and Khan (2024), who also pointed out the limits of TAUS in the matter of specificity. However, when used in a clinical context, the low specificity of TA US leads to follow-up investigations and exacerbation of the patient's anxiety. This increase in specificity, therefore, equals increased patient outcomes and overall decreased costs associated with healthcare as compared with those from CXR. PPV for TVS was very high, at 95.1%, and NPV at a high, 77.1% as well, but PPV for TAUS was only 89.3%, and NPV was only 44.7%. These observations are in concordance with Sheth and Shah's (2024) ineffective TVS for confirmation of EP. TVS was able to locate adnexal masses in 89% of the cases in this series, while TAUS was able to locate them in 73% of the cases. Likewise, TVS was higher in identifying FCA, with 18%, compared to TAUS, which was 9%. These findings

are in concordance with the study by Das et al. (2021), which compared the sensitivity of TVS with TBA and got similar results with higher efficacy of TVS for diagnosing parenteral pathognomonic signs-EFCA. Additionally, TVS had better specificity when compared with TAUS in diagnosing free fluid in the pouch of Douglas and tubal ring appearances, which is in agreement with the study by Shrestha et al. (2022).

Still, as a result of these constraints, it can prove useful in particular circumstances to apply TAUS as a diagnostic tool. For instance, where TVS is not possible due to patient intolerance or if equipment is not available, TAUS may be used. Furthermore, this approach helps imagine the whole pelvic and abdominal. Analogously, TAUS can be utilized as an adjunct imaging modality. However, similarly to Wang and Jing (2022) and Yu et al. (2021) have proved, TAUS should be considered as the initial imaging modality for suspected EP instead of TVS. TVS also has other important functions for diagnosis, particularly in developing countries, which is evidenced by high diagnostic accuracy. Several other works pointed out this fact, like Mohammed (2024) and Sallam et al. (2022); TVS is a labor-intensive technology that calls for a specialized workforce and special tools. Although there are limitations, its accuracy in the identification of EP does avoid the use of invasive examinations such as diagnostic laparoscopy. This is well-illustrated in the developing world, where patients face the challenge of access to surgical facilities and, therefore, benefit from timely diagnosis. The incorporation of TVS in diagnostic algorithms applied to EP has the propensity to enhance the quality of care and standard of maternal health and decrease the minority health disparity.

The advantages of the current study include a comparison of the two effective methods (TVS and TAUS) and the involvement of 279 patients with laparotomy as the gold standard. Such studies include the one done by Thom et al. (2023) and Malik et al. (2024), as they provide support to these conclusions, contributing towards the generalization of the results. Nevertheless, it is important to note that the study has several shortcomings that have to be taken into account. The main research was done at a single center, which may affect the study's transportability. However, the sample used in this study employed the help of skilled and specialized radiologists and obstetricians. Hence, the results of this study might not be generalized to the general, less specialized centers.

CONCLUSION

In conclusion, this study shows that TVS exhibits higher diagnostic accuracy compared to TAUS when diagnosing ectopic pregnancy. These features of TVS made it possible to diagnose the critical findings, such as adnexal masses and tubal rings, at an earlier and more accurate stage than the B-mode USG. However, due to its lower resolution, TAUS may delay diagnosis and increase maternal morbidity in assessing the pelvis. It is recommended that TVS should be adopted as the initial method of evaluation in the management of women with suspected ectopic pregnancy in order to improve patient outcomes and decrease the cost of maternal health care.

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