

Accuracy of Transabdominal Ultrasonography in Diagnosing Ectopic Pregnancy, Taking Surgical Findings as Gold Standard

Muhammad Asif Javed, Ayesha Niaz*, Uroosa Asim**

Department of Radiology, Combined Military Hospital, Sialkot/National University of Medical Sciences (NUMS) Pakistan, *Department of Radiology, Combined Military Hospital, Quetta/National University of Medical Sciences (NUMS) Pakistan, **Department of Radiology, Trauma Center, SMBBIT Karachi Pakistan

ABSTRACT

Objective: To determine the accuracy of transabdominal ultrasonography in diagnosing ectopic pregnancy taking surgical findings as the gold standard.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Radiology, Combined Military Hospital, Sialkot from October 2019 to April 2020.

Methodology: A total of 211 females with a suspicion of ectopic pregnancy between 18 to 40 years of age were included in this study who fulfilled the selection criteria. Transabdominal sonography was carried out in all patients. The females were then subjected to surgery for confirmation of diagnosis. The findings were noted down on the proforma and were subjected to statistical analysis.

Results: The mean age of the patients 28.38 ± 5.61 years, the mean gestational age was 7.56 ± 1.88 weeks and the mean parity was 2.02 ± 0.74 children. Ectopic pregnancy on ultrasound was diagnosed in 159 (75.4%) females and on surgery ectopic pregnancy was found in 157 (74.4%) females. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of abdominal ultrasound for detecting ectopic pregnancy was 97.4%, 89%, 96.3%, 92.3% and 95.2% respectively.

Conclusion: Transabdominal ultrasound had a high diagnostic accuracy for detecting ectopic pregnancy.

Keywords: Diagnosis, Ectopic pregnancy, Transabdominal ultrasonography.

How to Cite This Article: Javed MA, Niaz A, Asim U. Accuracy of Transabdominal Ultrasonography in Diagnosing Ectopic Pregnancy, Taking Surgical Findings as Gold Standard. *Pak Armed Forces Med J* 2024; 74(Suppl-2): S334-S338. DOI: <https://doi.org/10.51253/pafmj.v74iSUPPL-2.9077>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Ectopic pregnancy (EP) is characterised by implantation of the fertilised ovum outside the uterus.¹ It has been estimated that the rates of prevalence of EP range from 6% to 16%.² More than 95% of the ectopic pregnancies are in the fallopian tubes.² Within the fallopian tube, the commonest site of ectopic pregnancy is ampulla i.e. in 55% females, followed by isthmus in 25% and fimbrial end in 15%.² Other sites of ectopic pregnancy are the ovaries, c-section scar, cervix and abdominal cavity.² Pain in the abdominal, tenderness in the adnexa, mass in the adnexa, amenorrhea and atypical bleeding from the vagina are the most typical presenting complaints of patients.³ Without prompt diagnosis and treatment, ectopic pregnancy can turn into a life-threatening illness.³

According to reports, ectopic pregnancy is the main reason for maternal mortality in the first trimester.⁴ Despite significant advancements, identification of early ectopic pregnancy remains a

challenging endeavour for clinicians.⁴ When diagnosing a suspected ectopic pregnancy, ultrasonography is a low-cost, widely accessible, straightforward, quick and noninvasive diagnostic method.⁵ Modern ultrasound technology and the ability to measure serum Beta hCG level aid in the diagnosis of ectopic pregnancy. The diagnosis is still difficult, though. Obesity, poor bladder filling, and gas from the intestine can obscure pelvic structures and compromise the accuracy of abdominal ultrasonography.⁵ In order to determine whether an ectopic pregnancy was present, it was discovered that beta hCG and ultrasound screening worked very well together. When possible, a transvaginal sonography (TVS) or transperineal scan should be done if a transabdominal examination is inconclusive.⁶

With TVS, the pelvic structures could be seen clearly, and the image's resolution increased as a result. TVS has been advised for both extrauterine findings and early diagnosis of intrauterine pregnancy since the pelvic tissues can be seen well and the image's resolution is improved.⁷ A study revealed that the transabdominal ultrasound approach had a sensitivity of 77.9%, a specificity of 25%, a positive

Correspondence: Dr Ayesha Niaz, Department of Radiology, Combined Military Hospital, Quetta Pakistan

Received: 24 Jul 2022; revision received: 15 Jul 2023; accepted: 18 Jul 2023

Diagnosing Ectopic Pregnancy

predictive value of 95.2%, a negative predictive value of 5.5%, and an accuracy of 75.3% for early identification of probable ectopic pregnancy. Contrarily, transvaginal ultrasound was found to have 95.1% accuracy, 98.6% positive predictive value, 75.5% specificity, and 96.1% sensitivity.⁸ In another study, transabdominal ultrasound had a sensitivity of 90%, specificity of 64%, accuracy of 87.1%, 96% positive predictive value, and 41% negative predictive values for the diagnosis of ectopic pregnancy.⁹

Although TVS has been shown to have higher accuracy in terms of detecting ectopic pregnancies, it has a drawback. For TVS, a separate transducer is needed for TVS, and these may not be easily accessible in clinical settings, particularly in developing nations. As a result, the doctor must rely on the results of the clinical examination, the pregnancy test results, and the abdominal ultrasound for establishing the diagnosis of ectopic pregnancy.¹⁰

Keeping in mind that transvaginal ultrasound cannot be routinely used in practice, there is a need to establish the accuracy of abdominal ultrasonography for detecting ectopic pregnancy as limited local studies are available to define its accuracy. Therefore, the current study aimed to evaluate the accuracy of transabdominal ultrasound in ectopic pregnancy diagnosis using surgical findings as the gold standard. If it is determined that the diagnostic accuracy of this modality is high, it can be used consistently in our general practice for these specific patients to accurately and promptly diagnose ectopic pregnancy, providing our community with a simple, effective, and safe technique. Based on the findings of our study, a procedure can be created for early detection and identification of ectopic pregnancy in these specific patients, which will aid medical professionals in choosing the best course of action to lower morbidity.

METHODOLOGY

This cross-sectional study was carried out at the Department of Radiology, CMH Sialkot from October 10 to April 9, 2020 after taking approval from the Ethical Review Board of the institution (ERC number 11/2020).

Inclusion Criteria: Females of childbearing age with gestational age of less than 12 weeks (determined using the date of last menstrual period: LMP) who had a suspicion of ectopic pregnancy as was indicated by a history of amenorrhea and a positive beta-HCG test in which the levels of beta-HCG correlated with the duration of amenorrhea and the females had a recent

onset of pain in the lower abdomen were included in the study.

Exclusion Criteria: Patients with hemodynamic instability, coexisting viable intrauterine pregnancies, suspected mass in the adnexa with a negative serum beta HCG levels, patients with an existing diagnosis of EP or those who were on follow up for it and patients who did not have surgery at CMH, Sialkot were excluded from consideration.

The sample size of 211 females was calculated keeping the expected percentage of ectopic pregnancy as 16%,⁴ as calculated by the formula:

$$n = Z^2 \times P(1-P) / d^2$$

Where n is the sample size, Z is the statistic corresponding to level of confidence, P is expected prevalence and d is precision (corresponding to effect size).

Sampling technique used was non-probability consecutive sampling.

Informed consent was taken from all patients who fulfilled the selection criteria. Demographic detail, clinical history and examination of all patients was carried out and findings were noted down on a predesigned proforma. All females then underwent transabdominal ultrasonography using both curvilinear and high-frequency linear transducers. Two consultant radiologists performed each ultrasound and checked for ectopic pregnancies before surgery in each case. Abdominal scanning was done using the Siemens Acuson X600 and Siemens Acuson X 300 machines with transabdominal probe C6-2. The standard procedure was to capture at least three images during the first trimester ultrasound scan: one of the uterus in a strictly midsagittal plane from the uterine cervix to the fundus; and one of each ovary in their larger diameter. One or more photographs were taken in the event of an aberrant extrauterine discovery. For the aim of the study, a single radiologist again thoroughly analysed every ultrasound. The findings of the ultrasound were noted down. On ultrasonography, ectopic pregnancy was labelled if there was presence of fluid in the pouch of douglas or extrauterine sac/adnexal mass and negative in presence of intrauterine gestational sac and normal pelvis. Presence of hemoperitoneum i.e. presence of blood in the peritoneal cavity was assessed and was categorised as mild if the blood was ≤ 500 ml, moderate if the blood was >500 to 1000 ml and severe if the blood was >1000 ml in the peritoneal cavity. All

Diagnosing Ectopic Pregnancy

females were then subjected to surgical intervention and presence or absence of ectopic pregnancy was labelled by direct observation during laparotomy (gold standard). The surgical results of the operated patients were noted down on the proforma.

Cases were defined as true positive (TP) if ectopic pregnancy was present both on abdominal ultrasound and surgery, false positive (FP) if ectopic pregnancy was present on abdominal ultrasound but absent of surgery, true negative (TN) if ectopic pregnancy was absent both on abdominal ultrasound and surgery and false negative if ectopic pregnancy was absent on abdominal ultrasound but present on surgery.

Data was analysed using Statistical Package for Social Sciences (SPSS) 25:00. Quantitative variables such as age, gestational age and parity were presented as mean and standard deviation. Qualitative variables such as side of fallopian tube involved, site of fallopian tube involved, presence of hemoperitoneum, severity of hemoperitoneum, ectopic pregnancy on transabdominal sonography and surgical findings (present/absent) were presented as frequency and percentage. 2x2 table was used for determining the SN, SP, PPV, NPV and the accuracy of transabdominal ultrasound in detecting ectopic pregnancy, taking surgical findings as the gold standard.

RESULTS

A total of 211 females were enrolled. The mean age of the patients 28.38 ± 5.61 years, the mean gestational age was 7.56 ± 1.88 weeks and the mean parity was 2.02 ± 0.74 (Table-I). With respect to age, 149 (70.6%) females were of young age and 62 (29.4%) females were of middle age group. With regards to the gestational age category, 68 (32.2%) were of less than or equal to 6 weeks gestation and 143 (67.8%) were of 7 to 12 weeks gestation and the parity category of less than or equal to 2 was seen in 178(84.4%) females and parity of more than 2 was reported in 33 (15.6%). Right side of the fallopian tube was involved in 98(46.4%) females and the left side was involved in 113(53.6%) females. Ampulla of fallopian tube was involved in 162 (76.8%) females, isthmus in 34(16.1%) and fimbrial end in 15(7.1%) females. Hemoperitoneum was present in 34(16.1%) females, out of which mild hemoperitoneum was seen in 17(8.1%), moderate hemoperitoneum occurred in 13(6.1%) and severe hemoperitoneum was seen in 4(1.9%) females (Table-II).

Ectopic pregnancy on ultrasound was diagnosed in 159(75.4%) females and on surgery ectopic

pregnancy was found in 157(74.4%) females (Table-III).

The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of abdominal ultrasound for detecting ectopic pregnancy was 97.4%, 89%, 96.3%, 92.3% and 95.2% respectively (Table-IV).

Table-I: Mean of Quantitative Variables (n=211)

Quantitative Variables	n=211 Mean±Standard Deviation
Age (in years)	28.38±5.61
Gestational age (in weeks)	7.56±1.88
Parity (in terms of number of children)	2.02±0.74

Table-II: Frequency of Qualitative Variables (n=211)

Variables	FREQUENCY(%)
Age Group	
Young age (18 to 30 years)	149(70.6%)
Middle age (31 to 45 years)	62(29.4%)
Gestational Age Category	
≤6 weeks	68 (32.2%)
7-12 weeks	143 (67.8%)
Parity Category	
≤2	178 (84.4%)
>2	33 (15.6%)
Side of Fallopian Tube	
Right side	98 (46.4%)
Left side	113 (53.6%)
Site of fallopian tube	
Ampulla	162 (76.8%)
Isthmus	34 (16.1%)
Fimbrial end	15 (7.1%)
Presence of hemoperitoneum	
Yes	34 (16.1%)
No	177 (83.9%)
Severity of hemoperitoneum	
No Hemoperitoneum	177(83.9%)
Mild	17(8.1%)
Moderate	13(6.1%)
Severe	4(1.9%)

Table-III: Diagnostic Parameters Table (n=211)

Diagnostic Parameters	Frequency (%)
Presence of ectopic pregnancy according to Ultrasound	
Yes	159 (75.4%)
No	52 (24.6%)
Presence of Ectopic Pregnancy According to Surgical Findings	
Yes	157 (74.4%)
No	54 (25.6%)

Diagnostic values

- Sensitivity=True Positive/True positive+False Negative=97.4%

Diagnosing Ectopic Pregnancy

- Specificity=True Negative/True Negative+False Positive=89%
- PPV=True Positive/True Positive+False Positive=96.3%
- NPV=True Negative/True Negative+False Negative=92.3%
- Diagnostic accuracy= (True Positive+True Negative)/(True Positive+False Positive+True Negative+False Negative)=95.2%

DISCUSSION

The results of the current study revealed that for detecting ectopic pregnancy abdominal ultrasound had a high diagnostic accuracy keeping surgical findings as gold standard i.e. 95.2%. Majority of the females were of young age group and had a gestation of 7 to 12 weeks. In majority of the cases the left side of the fallopian tube was involved and ampulla of the fallopian tube was the commonest site involved.

In a study conducted at Karachi, Lal *et al.* revealed that transabdominal ultrasound had a sensitivity of 89.6% and a specificity of 64.2% and was accurate in 87.1% patients for diagnosing ectopic pregnancy.⁹ In a study carried out in India, Agarwal *et al.* revealed that the sensitivity and specificity of transabdominal ultrasound for detecting ectopic pregnancy was 75% and 80% respectively.¹¹ Nahar *et al.* revealed that the sensitivity and specificity of abdominal ultrasound was 79.5% and 83.3% respectively and the accuracy was 80%.¹² In another study conducted in Iran, Salman *et al.* revealed that the sensitivity and specificity of transabdominal ultrasound for detecting ectopic pregnancy was 77.9% and 25% respectively and accuracy of 75.3%.¹³ Thapa and Dwa revealed a sensitivity and specificity of 100% and 99.9% of abdominal ultrasound for detecting ectopic pregnancy.¹⁴ Obajimi *et al.* revealed that transabdominal ultrasound had a sensitivity and specificity of 88.4% and 37.5% respectively for diagnosing ectopic pregnancy.¹⁵ Majority of the studies revealed that abdominal ultrasound had a higher sensitivity for detecting ectopic pregnancy which is in line with current study findings which similarly revealed that abdominal ultrasound was highly sensitive for detecting ectopic pregnancy. The variation in the rates of specificity of abdominal ultrasound for ruling out ectopic pregnancy may be because of different sample size used in different studies and the expertise of the ultrasonologists might have differed as well. Furthermore, there may be

differences with respect to the gestational age at which the females presented as in few studies the females might have presented far earlier whereas in our study majority of the population was of more than 7 weeks of gestation.

The mean age of the females in our study was 28 years. Similar age of the patients was revealed by Obajimi *et al.*,¹⁵ i.e. 29 years and Thapa and Dwa revealed it to be 28 years.¹⁴ With respect to the site of fallopian tube involved, our study revealed that the commonest site was ampulla followed by isthmus of fallopian tube i.e. 76.8% and 16.1% respectively. Thapa and Dwa similarly revealed that ampulla and isthmus were the commonest site involved.¹⁴

In our study hemoperitoneum was present in 16.1% patients. Thapa and Dwa showed that 83.3% females had hemoperitoneum who had ectopic pregnancy.¹⁴ Obajimi *et al.* revealed that 65% had hemoperitoneum in their study population. Our study revealed much lesser rates of hemoperitoneum, this may be because studies conducted in the past mainly involved females who had ruptured tubal pregnancies and also the sample size of these studies was small.

Ectopic pregnancy is one such life-threatening disorder where the prevalence rises as mortality falls.¹⁶ In addition to being difficult to diagnose, ectopic pregnancy presents a medical emergency.¹⁷ The fact that it remains asymptomatic in the first few weeks of pregnancy makes diagnosis challenging.¹⁸ Since ultrasonography was first used in clinical settings, it has completely changed how ectopic pregnancy is diagnosed and treated.¹⁹ In addition to detecting a normal pregnancy, ultrasound can also detect the gestational sac and foetal heart activity.¹⁹ Both transvaginal and transabdominal sonography are useful diagnostic tools for ectopic pregnancy.¹⁹ However, keeping in view limitations of using transvaginal ultrasonography in local settings, the current study recommends the use of abdominal ultrasound for detecting cases of ectopic pregnancy in order to establish prompt diagnosis and make quick decisions regarding managing it in order to reduce further morbidity and mortality associated with it.

The current study had certain limitations. Firstly, it was carried out at a single centre so there is an issue of generalizability of results. Secondly, the comparison with transvaginal ultrasound could not be made so it cannot be how they both differ in terms of accuracy. Lastly, the cases detected as negative on surgery were

Diagnosing Ectopic Pregnancy

not referred for histopathological evaluation for further confirmation.

CONCLUSION

This study concluded that for establishing the diagnosis of ectopic pregnancy transabdominal ultrasonography had a high accuracy rate and was highly sensitive and hence it is recommended to use it in routine clinical practice for screening such patients. Establishing the diagnosis of ectopic pregnancy promptly by this readily available and easily accessible diagnostic tool, the clinicians can choose the best course of action to lower the risk of morbidity and potential mortality associated with delayed or misdiagnosis in these patients.

Conflict of interest: None.

Funding Source: None.

Muhammad Asif Javed, Ayesha Niaz*, Uroosa Asim

Authors' Contribution

The following authors have made substantial contributions to the manuscript as under:

MAJ & AN: Data acquisition, data analysis, critical review, approval of the final version to be published.

UA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

- Nadim B, Infante F, Lu C, Sathasivam N, Condous G. Morphological ultrasound types known as 'blob' and 'bagel' signs should be reclassified from suggesting probable to indicating definite tubal ectopic pregnancy. *Ultrasound Obstet Gynecol* 2018; 51(4): 543-49. <https://doi.org/10.1002/uog.17355>
- Riaz RM, Williams TR, Craig BM, Myers DT. Caesarean scar ectopic pregnancy: imaging features, current treatment options, and clinical outcomes. *Abdom Imaging* 2015; 40(7): 2589-99. <https://doi.org/10.1007/s00261-015-0472-2>
- Rombauts L, McMaster R, Motteram C, Fernando S. Risk of ectopic pregnancy is linked to endometrial thickness in a retrospective cohort study of 8120 assisted reproduction technology cycles. *Hum Reprod* 2015; 30(12): 2846-52. <https://doi.org/10.1093/humrep/dev249>
- Imtiaz S. Diagnostic accuracy of transvaginal ultrasound in early (first trimester) detection of ectopic pregnancy and to exclude an alternative diagnosis. *Pak J Radiol* 2016; 26(3):212-7. <https://doi.org/10.1093/humrep/deh770>
- Richardson A, Gallos I, Dobson S, Campbell BK, Coomarasamy A, Raine-Fenning N. Accuracy of first-trimester ultrasound in the diagnosis of tubal ectopic pregnancy in the absence of an obvious extrauterine embryo: systematic review and meta-analysis. *Ultrasound Obstet Gynecol* 2016; 47(1): 28-37. <https://doi.org/10.1002/uog.14844>
- Levine D, McInnes M. Re: Accuracy of first-trimester ultrasound in the diagnosis of tubal ectopic pregnancy in the absence of an obvious extrauterine embryo: systematic review and meta-analysis. *Ultrasound Obstet Gynecol* 2016; 48(1): 129. <https://doi.org/10.1002/uog.15877>
- Salman KS, Atrah SK, Zwyeya S. A Comparative Study between Transabdominal and Transvaginal Ultrasound Techniques in Early Detection of Ectopic Pregnancy. *Ann Romanian Soc Cell Biol* 2021; 16128-36. <http://annalsofscrb.ro/index.php/journal/article/view/5354>
- Lal D, Ali M, Jesrani A, Mustansir S, Zaidi H. The diagnostic accuracy of transabdominal sonography (TAS) in early (first trimester) detection of ectopic pregnancy using histopathology as gold standard in high risk patients. *Pak J Radiol* 2016; 26(3): 206-11. <http://www.pakjr.com/ojs/index.php/PIR/article/view/57>
- Ong CL, Wong L, Yang Y, Chow SLC, Qi M, Morada E, et al. Accuracy of ultrasonography in detecting ectopic pregnancy. *Ultrasound Med Biol*. 2017; 43(S1): S140. <https://doi.org/10.1016/j.ultrasmedbio.2017.08.1449>
- Agarwal CK, Gupta B, Garg A, Singhal M. Evaluation of Diagnostic Accuracy of Transabdominal Ultrasound in Respect to Transvaginal Ultrasound in Diagnosing Ectopic Pregnancy Taking Histopathology as The Gold Standard at Tertiary Care Hospital. *Int J Pharm Clin Res* 2021; 13(6): 564-570. <https://doi.org/10.1016/j.ultrasmedbio.2017.08.1449>
- Nahar MN, Sattar A, Ara H, Rabbi AF, Shirin M, Kumu FK, et al. Role of transabdominal Ultrasonography in the evaluation of suspected ectopic pregnancy. *J Dhaka Med Coll* 2013; 22(2): 167-72. <https://doi.org/10.3329/jdmc.v22i2.21529>
- Salman, K.S., Atrah, S.K.A.A. and Zwyeya, S., 2021. A Comparative Study between Transabdominal and Transvaginal Ultrasound Techniques in Early Detection of Ectopic Pregnancy. *Ann Romanian Soc Cell Biol* 2021; 25(4): 16128-16136. <http://annalsofscrb.ro/index.php/journal/article/view/5354>
- Thapa NB, Dwa YP. Role of transabdominal ultrasound in detection of ectopic pregnancy. *J Coll Med Sci Nepal*. 2016; 12(1): 1-4. <https://doi.org/10.3126/jcmsn.v12i1.14397>
- Obajimi GO, Smart AE, Adekanmi AJ, Adeniji-Sofoluwe A, Jinadu FO. Correlation between transabdominal ultrasound features of ectopic gestation and surgical findings at the university college hospital, Ibadan: A preliminary review. *Trop J Obstet Gynaecol* 2019; 36(2): 265-70. https://doi.org/10.4103/TJOG.TJOG_39_18
- Shetty VH, Gowda S, Muralidhar L. Role of ultrasonography in diagnosis of ectopic pregnancy with clinical analysis and management in tertiary care hospital. *J Obstet Gynaecol India*. 2014; 64(5): 354-7. <https://doi.org/10.1007/s13224-014-0529-0>
- Scibetta EW, Han CS. Ultrasound in early pregnancy: viability, unknown locations, and ectopic pregnancies. *Obstet Gynecol Clin* 2019; 46(4): 783-95. <https://doi.org/10.1016/j.ogc.2019.07.013>
- Zanaboni A, Magee M, Gibbons RC, Costantino TG. Point-of-care ultrasound diagnosis of cesarean scar ectopic pregnancy: a case series. *J Emerg Med* 2021; 60(2): 216-9. <https://doi.org/10.1016/j.jemermed.2020.09.035>
- Dooley WM, Chaggar P, De Braud LV, Bottomley C, Jauniaux E, Jurkovic D. Effect of morphological type of extrauterine ectopic pregnancy on accuracy of preoperative ultrasound diagnosis. *Ultrasound Obstet Gynecol* 2019; 54(4): 538-44. <https://doi.org/10.1002/uog.20274>
- Feng H, Zheng Y, Ke Y. Ultrasound vs. histologic findings in 40 patients with special types of ectopic pregnancy. *Am J Transl Res* 2021; 13(7): 7829-7838.