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Original Research Article

Prevalence and diagnostic efficacy of trans-abdominal and trans-vaginal ultrasound for ectopic pregnancies: a longitudinal study

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ABSTRACT

Background: Reducing maternal mortality and morbidity requires an accurate diagnosis of ectopic pregnancy. The fallopian tube is the most frequent location for ectopic pregnancy.

Methods: This study was based on a longitudinal analytical design conducted at tertiary care hospitals in Pakistan. Patients in the reproductive age range (20 to 32 years) who underwent clinical examination and investigations and were diagnosed with ectopic pregnancy were included in this study. The ultrasound results of all the patients were evaluated, and data was collected on the existence and positioning of an ectopic pregnancy.

Results: In the study, 198 women underwent TVS and TAS. At the time of diagnosis, the age range was 20-32 years old. Our study found that 2.5% of pregnancies resulted in an ectopic pregnancy. 20 women had symptomatic EP that was confirmed. For the initial TVUS, the sensitivity and specificity of ultrasonography were 88.5% and 96.5%, respectively, and with a second rescan, they were 93.1% and 95.7%.

Conclusions: Our study showed that an excellent method for identifying ectopic pregnancy is trans-abdominal ultrasonography. Regarding diagnostic accuracy metrics, however, it falls short of trans-vaginal ultrasound. To avoid missing any cases of ectopic pregnancy, early detection can significantly reduce morbidity and mortality. We should employ both ultrasonography modalities sequentially, with TAS being used first.

Keywords: Ectopic pregnancy, Pregnancy of unknown location, Trans-abdominal ultrasound, Trans-vaginal ultrasound

INTRODUCTION

The Greek term *ektopos*, which means out of position, is the source of the English phrase *ectopic*. Pregnancy implantation that takes place outside of the uterine cavity is known as an ectopic pregnancy. The two primary kinds of ectopic pregnancy are tubal and non-tubal. Ninety-five percent of cases of ectopic pregnancy have tubal origins. The tiny group of non-tubal forms, which make up about 5% of all cases, is strongly linked to their associated morbidity and mortality. Ruptured EP is responsible for 6% of maternal deaths in the first trimester. A first-trimester pregnancy problem, known as ectopic or extra-uterine pregnancy (EP), affects 1.3-2.4% of all

pregnancies. Some EPs have the potential to cause significant maternal morbidity, and prompt diagnosis is essential to facilitate timely intervention.¹ The list of non-tubal locations includes the scar from a prior caesarean section, the cervix, the ovary, and the uterine interstitium (cornual or angular). Pregnancies that occur both intrauterine and extra-uterine can occur in the uncommon occurrence of heterotopic pregnancy. Reducing maternal death and morbidity in the first trimester is largely dependent on the early and accurate identification of an ectopic pregnancy. An ectopic pregnancy is characterized by pain, vaginal bleeding, and improperly increased β -human chorionic gonadotropin (HCG) in the early stages of pregnancy. By ruling out pregnancy within the uterus

and finding an ectopic mass, TVS helps in finding that the pregnancy is ectopic. If the woman has neither an intrauterine nor an observation of an extra-uterine pregnancy on TVS, a pregnancy of unknown location (PUL) is reported for her. From that point on, she is observed until the end of the pregnancy is identified. Roughly 7% to 20% of women may go on to have an ectopic pregnancy detected, according to data from specialized ultrasound-based centres, even though the majority of them will have a failed PUL or an intrauterine pregnancy.² The condition known as ectopic pregnancy poses a serious threat to women's fertility in Mosul City. Therefore, it is imperative to diagnose the condition as soon as possible to minimize complications. This can be achieved by performing two types of ultrasound exams on the patient: a less invasive trans-abdominal ultrasound and a more invasive but more diagnostic endovaginally ultrasound.

To evaluate an ectopic pregnancy, two ultrasonography techniques are available: the less invasive trans-abdominal technique and the more invasive but highly diagnostic endovaginal technique.³ The most typical site is the tubal, which is further divided into isthmic, ampullary, and fimbrial regions. Ten to fifteen percent of non-uterine pregnancies implant outside the tube, such as in the cervix, peritoneal cavity, ovary, interstitium, or scar from a caesarean section. A proper management strategy for a suspected ectopic pregnancy must weigh the risks of a delayed confirmation of the ectopic pregnancy, which could result in increased morbidity and mortality for the patient whose ectopic pregnancy ruptures, against the possibility of an incorrect early diagnosis that disrupts a normal, desired intrauterine pregnancy. For women who have had one ectopic pregnancy before, the chance of experiencing another one is about 10%, and for those who have had two or more, it can reach 25%.⁴ A noteworthy segment of miscarriages in EPs are tubal miscarriages. The accuracy of ultrasound diagnosis has been greatly improved by advancements in technology, especially with the introduction of TVS.

As a result, ultrasound is now a commonly used diagnostic tool for women who may have early pregnancy difficulties. The diagnosis of interstitial EP was made in women who experienced proximal endometrial pregnancy symptoms. When ovarian tissue was detachable from the pregnancy and the ipsilateral fallopian tube was intact, ovarian EP was identified. An abdominal EP was identified by the presence of a trophoblast or gestational sac that was directly linked to the peritoneal surface.⁵ A caesarean scar ectopic pregnancy (CSEP) is a developing pregnancy that was implanted in the myometrium of a previous C-section scar. Practitioners must be able to recognize and deal with CSP promptly, although it is still a relatively uncommon diagnosis. Undiagnosed CSP can lead to eventual infertility loss, uterine rupture, bleeding, and even mother death. Roughly 2% of pregnancies result in ectopic pregnancies. Ultrasound is a quick method of diagnosis.

We report a unique instance of ectopic pregnancy identified by trans-vaginal ultrasonography, resulting from a caesarean scar.⁶ About 2-4% of ectopic pregnancies result from interstitial pregnancy (IP).⁷ A diagnosis of ectopic pregnancy is not easy to come by. One estimate is that 40% of ectopic pregnancies are misdiagnosed at the time of presentation.⁸ First-trimester maternal death is primarily caused by ectopic pregnancies, which comprise 1% to 2% of all pregnancies.⁹ The incidence of ectopic pregnancy in emergency department (ED) patients has been demonstrated to be much greater, although the total frequency of ectopic pregnancy is about 2%. According to reports, ectopic pregnancy rates might reach 6-16% among patients who arrive at the emergency department (ED) complaining of either vaginal bleeding or stomach pain, or both. Maternal mortality rates from ectopic pregnancy continue to remain high, ranging from 3-6%, with hemorrhage accounting for the bulk of deaths.¹⁰ Of all pregnancies, 1% to 2% are ectopic, with the majority taking place in the fallopian tube.¹¹ The pregnancy in an unknown location could be a viable or nonviable intrauterine pregnancy, or it could resolve without ever being discovered. Pregnancy of unknown location is the diagnosis given to patients who test positive for beta-human chorionic gonadotropin (β -hCG) but do not exhibit ultrasound signs of an intra- or extra-uterine pregnancy.¹² Ectopic pregnancy (EP) ruptures account for 5%–10% of all pregnancy-related deaths and are the primary cause of maternal mortality during the first trimester of pregnancy, with a rate of 9%–14%. Up to 18% of women who come with this condition in the first trimester are seen in emergency rooms; nevertheless, they are often mistakenly identified as the clinical mimics already mentioned.¹³ One significant contributing factor to several maternal morbidities is ectopic pregnancy (EP). Pregnancies reported as EP comprise 2% of the total.¹⁴ The availability of quantitative beta-human chorionic gonadotropin (β -hCG) testing, trans-vaginal ultrasound, and laparoscopy, which enable early detection and care, has led to a dramatic decrease in maternal mortality associated with ectopic pregnancy throughout the past 20 years. There are discernible risk factors for just half of the women diagnosed with ectopic pregnancy.¹⁵ TVS is crucial for unruptured ectopic pregnancy at an early stage so that additional complications can be prevented.¹⁶ According to the location of blastocyst implantation, EP might exhibit a wide range of indications and symptoms. The most prevalent location, accounting for 98% of instances, is the fallopian tube. To prevent potentially fatal consequences, early diagnosis of an EP is essential.¹⁷ Preoperative diagnostic accuracy is quite difficult to achieve. Identification of an ovarian pregnancy has improved due to numerous developments in diagnostic methods, such as trans-vaginal ultrasonography. Infertility problems later on, fetal loss, repeat ectopic pregnancy, and severe maternal morbidity are the outcomes.¹⁸ In this study, we evaluate EP in ultrasound. Thus, the current study's objectives include a percentage and frequency analysis of the recorded situations in

patients, as well as a sonographic (TAS and TVS) evaluation of the causes of ectopic pregnancy and its types. In Pakistan, where research on this subject is confined to a single type of ailment producing lower abdomen pain, the current investigation will make a significant literary contribution to EP clinical signs and symptoms. The study will also aid in separating the presence and absence of ectopic pregnancy and provide details on how the disease develops.

METHODS

This longitudinal analytical study was conducted in the Department of Radiology, General Hospital Lahore, and Nishtar Hospital Multan from March 1st, 2023, to September 28th, 2023. This study followed the Helsinki Declaration. Consent was formally acquired and informed. The sample size was determined to be 198, and the age range was 20 to 32, respectively, for which they showed different signs and symptoms. It was a convenient sampling approach. There were other requirements for inclusion, including that the patient must have pelvic pain or lower abdominal pain, amenorrhoea, thick echogenic endometrium, empty uterine cavity, decidua cast, pseudo-gestational sac when β -hCG is present, and experience discomfort caused by another physiology.

Other concerns, such as predominantly TVS-related recalcitrant patients, post-menopausal women, intrauterine pregnancy, or abortion cases, are included in the exclusion criteria. The participants were briefly informed about the TAS and TVS techniques after the patients' obstetrical history, clinical examination, and pertinent investigations, including pregnancy tests, were recorded. A low-frequency (3.5 MHz) probe was used in real-time scanners to do trans-abdominal scanning on patients with dilated bladders. Following a request for the patient to void, a high-frequency endovaginal probe (7.5 MHz) was employed. In the coronal and sagittal planes, scanning was carried out. Using a SIMENS Greyscale/Doppler trans-vaginal/trans-abdominal ultrasound system, all the patients were scanned. In this study, all individuals with the presence or absence of ectopic pregnancy are included.

They were referred by the OPD/ward at the General Hospital and Nishtar Hospital. During this time, 198 people were chosen based on their age, radiological findings, informed verbal consent, and the collection of ultrasound reports from the radiologist's office. Rules and regulations set by the ethical committee: Confidentiality was maintained for all information and data collected. All study participants maintained their anonymity. The individuals were advised that the study process carries no risks or downsides. They were additionally advised that they might leave the study at any point while it was being conducted. Keys were held in hand, and data was secured behind a lock and key. It was stored on a laptop with a password. Descriptive statistics were used to analyse the data using SPSS version 26. The chi-square test is used to ascertain the frequency of the data. Quantitative information about the age of the patient and different locations of ectopic pregnancy are given in this study.

The letter number of the ERC approval letter is Ref # AAI/OSA/2022.

RESULTS

The age ranges of the patients who participated in the study were 20 and 32, respectively. The common standard deviation was estimated to be around 3.19 in this study. The study shows the recent frequency of ectopic pregnancy is 2.5% in all pregnancies. Pregnancy of unknown location (PUL) was the most common in 6.6% of patients with different signs and symptoms such as amenorrhoea, light vaginal bleeding, shoulder tip pain, and lower abdominal cramping pain. The positive imaging of an adnexal mass with TVS should serve as the basis for the diagnosis of an ectopic pregnancy. Recent interstitial (tubal) ectopic pregnancy is present in 2.5% of all patients. When the first-trimester β -hCG level is as low as 1500 UI/l, ectopic pregnancy can be detected on trans-vaginal ultrasound. If it is misdiagnosed, it will be the cause of maternal death. In some cases, signs and symptoms show cervical ectopic pregnancy (0.5%) and caesarean scar ectopic pregnancies (0.5%).

Table 1: Ectopic pregnancy table among study cases (n=198).

Ectopic pregnancy		Frequency	Percent	Valid percent	Cumulative percent
Valid	Interstitial (tubal) ectopic pregnancy	5	2.5	2.5	2.5
	Pregnancy of unknown location	13	6.6	6.6	9.1
	Cervical ectopic pregnancy	1	0.5	0.5	9.6
	Cesarean scar ectopic pregnancy	1	0.5	0.5	10.1
	(Normal) intera-uterine pregnancy	178	89.9	89.9	100.0
	Total	198	100.0	100.0	

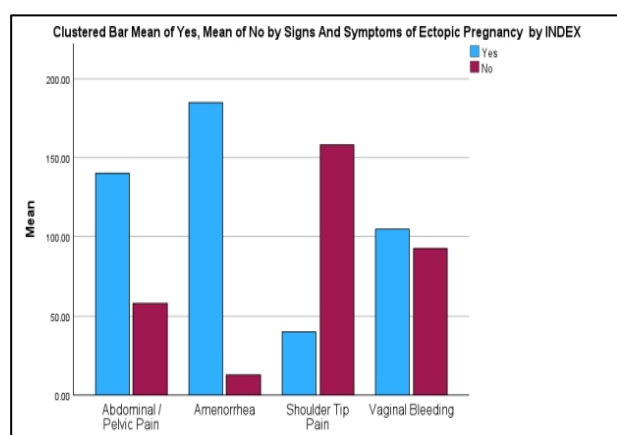


Figure 1: Signs and symptoms table of ectopic pregnancy.

Table 1 depicts the ectopic pregnancy frequency among the 198 female patients. It defines the data-analysis of the presence of ectopic pregnancy on different locations. It explains that the interstitial (tubal) ectopic pregnancy is 2.5% among the 198 patients with the frequency of 5, valid percentage of 2.5% and cumulative percent of 2.5%. The percentage of pregnancy of unknown location is 6.6% with a frequency of 13, valid percent (6.6%) and cumulative percentage of 9.1%. It also explains about the percentage of cervical ectopic pregnancy; frequency 1, percentage 0.5%, valid percentage 0.5% and cumulative percent of 9.6%. The data analysis of caesarean scar ectopic pregnancy is; frequency 1%, percentage 0.5%, valid percentage 0.5%, and cumulative percentage of 10.1%. The analysis of normal pregnancy (Intra- uterine pregnancy) is Frequency 178/198, percentage 89.9%, valid percent 89.9% and cumulative percentage 100%.

Figure 1 shows the signs and symptoms of ectopic pregnancy. The patients who are experiencing these symptoms are represented by the mean values, which represent an average analysis. On the x-axis, the most common signs and symptoms are explained that are present among the patients. In clustered-bar 1, the lower abdominal/pelvic pain patients have the mean analysis of approximately 140 averages. Mostly patients have the lower abdominal/pelvic pain symptom. Amenorrhea patients average analysis is shown by second clustered bar which shows that approximately 180 average patients suffer from this symptom. It also shows that mostly patients experience the amenorrhea symptom. The third clustered bar shows the shoulder-tip pain patients. It shows that most patients have no symptoms of shoulder-tip pain. The data-comparison of these symptoms shows, that mostly patients do not experience the shoulder-tip pain symptom while the remaining patients show this symptom. Vaginal bleeding symptom is explained by 4th clustered bar. Almost half patients show the vaginal bleeding symptom and the other half do not show the vaginal bleeding symptom.

Table 2-5 depict the demographic characteristics of the patients. In Table 3, majority (60%, 120/198) of the patients were in the age group of 29-32 years followed by 63/198 (31.80%) in the age group of 25-28 years. The remaining 15/198 (8%) patients are present in the 20-24 years age group.

Table 2: Age wise distribution of ectopic pregnancy.

Age (in years)	Number (n=198)	Percentage
20-24	15	8%
>24-28	63	31.80%
>29-32	120	60.60%

Table 4 based on the clinical profile. Majority of the patients 184/198 (92.90%) shows the lower abdominal/pelvic pain symptoms. 138/198 (69.70%) shows the amenorrhoea symptom. Vaginal bleeding symptom is shown by 145/198 (73.20%) patients. The least common symptom present among the ectopic pregnancy patients is shoulder tip pain 34/198 (17.20%).

Table 3: Presenting symptoms.

Symptoms	Number (n=198)	%
Lower abdominal/pelvic pain	184	92.90
Amenorrhea	138	69.70
Bleeding	145	73.20
Shoulder tip pain	34	17.20

Table 5 Risk factor analysis shows that ruptured ectopic pregnancy is present among 8/198 patients (4.04%). Majority of the patients (25/198) shows the infertility risk factor (12.62%). 14/198 (7.07%) patients show the unexplained risk factor. The previous ectopic pregnancy is present in 4/198 patients (2.02%).

Table 4: Risk factors.

Risk factors	Number (n=198)	%
Ruptured ectopic pregnancy	8	4.0
Unexplained	14	7.07%
Previous ectopic pregnancy	4	2.02
Infertility	25	12.62

Table 6 explains the area of distribution of the patients. Mostly patients belong to the urban population 130/198 (65.65%). The remaining patients 68/198 (34.34%) belong to the rural area.

Table 5: Area distribution.

Areas	Number (n=198)	%
Rural	68	34.34
Urban	130	65.65

Figure 2 explains the ectopic pregnancy among the study cases, 198 patients. Most of the patients presents with ectopic pregnancy (Highest frequency among the patients). However, some patients present with ectopic pregnancy, pregnancy of unknown location, ampullary ectopic pregnancy, cervical ectopic pregnancy, and caesarean scar ectopic pregnancy, extra-uterine pregnancy. The least frequency is for the interstitial ectopic pregnancy.

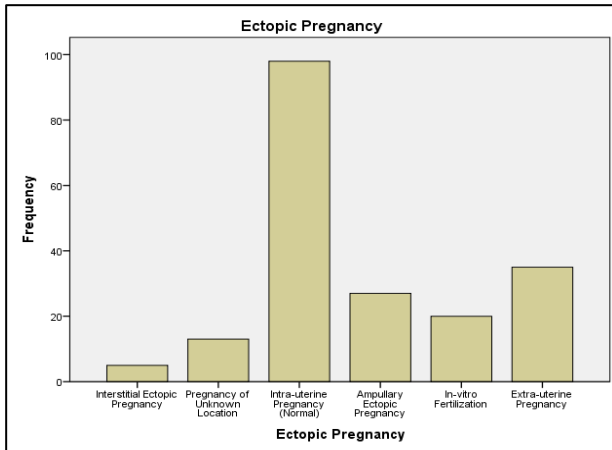


Figure 2: Patients present with intrauterine pregnancy, and some patients present with ectopic pregnancy, pregnancy of unknown location, tubal ectopic pregnancy, cervical ectopic pregnancy, and caesarean scar ectopic pregnancy.

DISCUSSION

This study unequivocally shows that trans-vaginal ultrasonography, when utilized as a stand-alone diagnostic, may successfully detect an ectopic pregnancy when one is present. Our findings imply that ultrasound is a useful diagnostic technique, even if few doctors would consider ultrasound evidence of extra-uterine pregnancy as the primary method to detect ectopic pregnancies. It is commonly acknowledged that ectopic pregnancy diagnosis relies heavily on ultrasonography. The ultrasonography results in this investigation have a few noteworthy features. In contrast to a GS, the existence of an echogenic mass typically suggests a distinct stage of conception. I interpret all the results in the discussion section of my existing literature on the frequency of ectopic pregnancy. According to the results of this investigation, cervical ectopic pregnancy occurs in 0.5% of pregnancies. The result of the current study is consistent with a prior study in 2020 by Taryn Hoffman, who presented in his study that caesarean scar ectopic pregnancies account for less than 1% of pregnancies, making them uncommon. The rising number of caesarean sections performed has led to a rise in the incidence in recent years. Ultrasonography is the initial imaging test of choice for the diagnosis of caesarean scar ectopic pregnancy, with 86.4% sensitivity.⁶

It might or might not exhibit vascularity at color doppler US according to its condition, which might be connected to the β -hCG level. Treatment selection is based on GA, baseline blood β -hCG level, existence of fetal heartbeat, vaginal bleeding, and desire to maintain fertility. A prevalent abdominal ailment in obstetrics is an ectopic pregnancy. The result of the current study indicates that, out of 198 patients, approximately 2.5% of pregnancies are ectopic. In more than 20% of cases, the symptoms, which include pelvic, abdominal, or chest discomfort, vaginal bleeding, intra-abdominal bleeding, hypovolemic shock, or uterine rupture, do not appear until beyond 12 gestational weeks. These findings are consistent with a prior study by Kampioni from 2023, which also noted that interstitial pregnancy (IP) is thought to account for 2-4 % of all ectopic pregnancies by most authors and may range from 6-8%, according to some studies. Because interstitial ectopic pregnancy lacks identifiable symptoms, it is an unusual and extremely hazardous form of ectopic pregnancy that can result in life-threatening complications. Therefore, early detection is critical.⁷ The results of the current study align with those of a previous examination, wherein it was observed that 6.6% of the total number of pregnancies were classified as pregnancies of unknown location (PUL). In 2020, Milman conducted a study in which the incidence of ectopic pregnancy ranges from 8% to 14% in pregnancies of unknown location, whereas the risk of rupture is minimal (between 2/1000 and 3/1000). An immediate evaluation is necessary for discomfort that is persistent or getting worse, hemodynamic compromise symptoms, or hemoperitoneum.¹²

Women with a PUL, in which no pregnancy is seen inside or outside the uterus, are not the same as this cohort of women whose ectopic pregnancy was detected on ultrasound examination. Similarly, another study by Pereira PP from 2023 coincides with the present result, which specializes in the follow-up of early gestation. PUL incidence ranges from 8% to 10%, and it is mostly based on how well the ultrasound scan was performed. This depends on the resolution of the instrument and the experience of the examiner. For early gestation units, the international consensus on ultrasound in obstetrics and gynecology states that the PUL rate should not exceed 15%.¹⁹ The findings of this investigation indicate that 0.5% of pregnancies result in a cervical ectopic pregnancy. In another study in 2020, Stabile presented the uncommon case of cervical pregnancy (CP), where the embryo implants and develops inside the endo-cervical canal, resulting in an ectopic pregnancy (EP). Between one in 1000 and one in 18,000 pregnancies, and 1% of EP have CP. Although the precise origin of cervical ectopic pregnancy is still unknown, dilatation and curettage during a previous pregnancy have been reported to be risk factors in about 70% of cases. Additional risk factors include endometritis, prior caesarean delivery, cervical surgery, intrauterine device use, and in-vitro fertilization (IVF). Less than 10% of all EPs are non-tubal, yet in recent years, their occurrence has increased overall.²⁰

Ultrasonography is a modified diagnostic technique used to identify ectopic pregnancy early symptoms. Nevertheless, compared to TAS, TVS is the ideal modality for ectopic pregnancy diagnosis. The inability to assess individuals with changed anatomy, corpulence, and operator competence deficiencies are all significant limitations of ultrasound. In patients with typical pelvic pain, vaginal bleeding, high HCG levels, thick echogenic endometrium, and other problems in some patients point out the evidence of pregnancy of unknown location. However, individuals with exacerbated diseases and illnesses require extra imaging to test for undiscovered and distinct ectopic pregnancy signs and symptoms. Given that this study focuses on ultrasound, the constraints already indicated are also the limitations of the study. Moreover, the study sample is confined to two hospitals of Punjab from where data is collected. As a result, statistics about the incidence of ectopic pregnancy are not properly applicable to the entire world's population.

CONCLUSION

This study highlights the diagnostic challenges and risks of ectopic pregnancy. Patients with a pregnancy of unknown location (PUL) present with various symptoms, such as amenorrhoea and abdominal pain. Ectopic pregnancy is detected on trans-vaginal ultrasound when β -hCG levels in the first trimester are as low as 1500 UI/l. Early and accurate diagnosis is crucial to preventing severe complications and maternal death. Although cervical, caesarean, and heterotopic and abdominal ectopic pregnancy are rare conditions, if misdiagnosed, they can lead to fertility loss and maternal death.

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