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Original Article

Twists, Wrong Turns and Missed Beats: Role of Ultrasound in Diagnosing Reproductive Age Group Emergencies – A Retrospective Study

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ABSTRACT

Introduction: Ovarian torsion, ectopic pregnancy and early pregnancy failure are important causes of acute pelvic pain and bleeding in women of reproductive age. Delayed or missed diagnosis may result in loss of the ovary or fallopian tube, impaired fertility, hemorrhage and, rarely, death. Ultrasound is the first-line imaging modality in this setting, but its findings can be subtle, overlapping or transient, so that these emergencies are easily missed or misinterpreted.

Aim: To determine the role of ultrasound, including Doppler, in identifying major reproductive age group emergencies – ovarian torsion, ectopic pregnancy and early pregnancy failure – by analysing the sonographic features of confirmed cases.

Materials and Methods: This retrospective observational study was conducted in the Department of Radio-diagnosis of a tertiary care teaching institution between January 2024 and November 2025. Women of reproductive age who presented with acute pelvic pain and/or bleeding and were later confirmed to have ovarian torsion, ectopic pregnancy or early pregnancy failure were included. Cases with incomplete ultrasound data, indeterminate scans, or non-gynaecologic causes of pelvic pain were excluded. Ultrasound images and reports were retrieved from the picture archiving and communication system (PACS) and reviewed for morphological and Doppler features characteristic of each condition. Data were analysed descriptively for frequency distribution and pattern recognition of key sonographic signs.

Results: A total of 68 cases were analysed: 28 (41.2%) ectopic pregnancies, 22 (32.4%) cases of ovarian torsion and 18 (26.5%) cases of early pregnancy failure. Ovarian torsion was characterised by an enlarged ovary with a peripheral follicular pattern, stromal oedema, a twisted vascular pedicle (whirlpool sign) and absent or reduced Doppler flow. Ectopic pregnancy showed an adnexal gestational sac

separate from the ovary, the tubal ring sign, “ring of fire” vascularity and an empty uterine cavity, with hemoperitoneum in ruptured cases. Early pregnancy failure was diagnosed on absent cardiac activity beyond the expected gestational age, an empty gestational sac, or a discrepancy between gestational age and embryonic development. Ultrasound findings correlated strongly with the final clinical diagnosis in all three groups.

Conclusion: Ultrasound is indispensable in evaluating reproductive age group emergencies. Doppler adds specificity in suspected ovarian torsion, and transvaginal sonography is highly sensitive for ectopic pregnancy. Standardized criteria allow confident diagnosis of early pregnancy failure. Ultrasound should remain the frontline modality in acute gynaecologic imaging, enabling rapid diagnosis and fertility-preserving intervention.

Keywords: Ovarian Torsion; Pregnancy, Ectopic; Abortion, Spontaneous; Ultrasonography, Doppler; Emergency Imaging.

INTRODUCTION

Acute pelvic pain and abnormal bleeding are among the commonest reasons for emergency presentation in women of reproductive age. Within this group, three conditions demand particular urgency: ovarian torsion, ectopic pregnancy and early pregnancy failure. Each can produce a similar clinical picture of pain, bleeding and a positive pregnancy test or adnexal tenderness, yet each differs sharply in its time-sensitivity and its consequences if the diagnosis is delayed.

Ovarian torsion is the fifth most common gynaecologic surgical emergency, with a reported prevalence of 2.7% to 3%. Early diagnosis is important to prevent loss of the adnexa or ovary and, more rarely, potentially fatal thrombophlebitis or peritonitis [1]. Clinical features are non-specific and frequently overlap with other causes of acute pelvic pain, so imaging has an important role in raising or excluding the diagnosis [2,3]. Conventional sonographic findings supplemented by Doppler flow studies can assist clinicians in reaching the diagnosis [1].

Any pregnancy implanted outside the endometrial cavity is defined as an ectopic pregnancy, and most are located within the fallopian tube. Diagnosis based on clinical signs of tubal rupture, such as hypovolaemic shock, is now uncommon, and transvaginal ultrasonography (TVS) is the primary diagnostic tool for clinically stable women with a suspected ectopic pregnancy [4]. Ectopic pregnancy accounts for roughly 2% of all pregnancies and remains a leading cause of pregnancy-related mortality in the first trimester [5].

Early pregnancy failure is the third entity in this triad. Antenatal ultrasonography has revolutionised its management, helps to diagnose untoward events in early pregnancy and may guide appropriate management, making it an easily available tool to differentiate normal from abnormal pregnancy [6]. Because a false diagnosis of non-viability can lead to the termination of a wanted pregnancy, standardised sonographic criteria are essential [7].

Ultrasound is non-invasive, rapid and widely available, and serves as the first-line investigation in these emergencies. The present retrospective study analyses the ultrasound findings in confirmed cases of ovarian torsion, ectopic pregnancy and early pregnancy failure, to highlight the role of ultrasound in guiding prompt clinical management.

Aims and Objectives

- To determine the role of ultrasound in identifying major reproductive age group emergencies, namely ovarian torsion, ectopic pregnancy and early pregnancy failure.
- To describe and compare the characteristic sonographic features of these three conditions in a tertiary care setting.

MATERIALS AND METHODS

This retrospective observational study was conducted in the Department of Radio-diagnosis, Sapthagiri Institute of Medical Sciences and Research Centre, Bengaluru, over a study period from January 2024 to November 2025. The study population comprised women of reproductive age who presented with acute pelvic pain and/or bleeding and who were later confirmed to have ovarian torsion, ectopic pregnancy or early pregnancy failure (Figure-1).

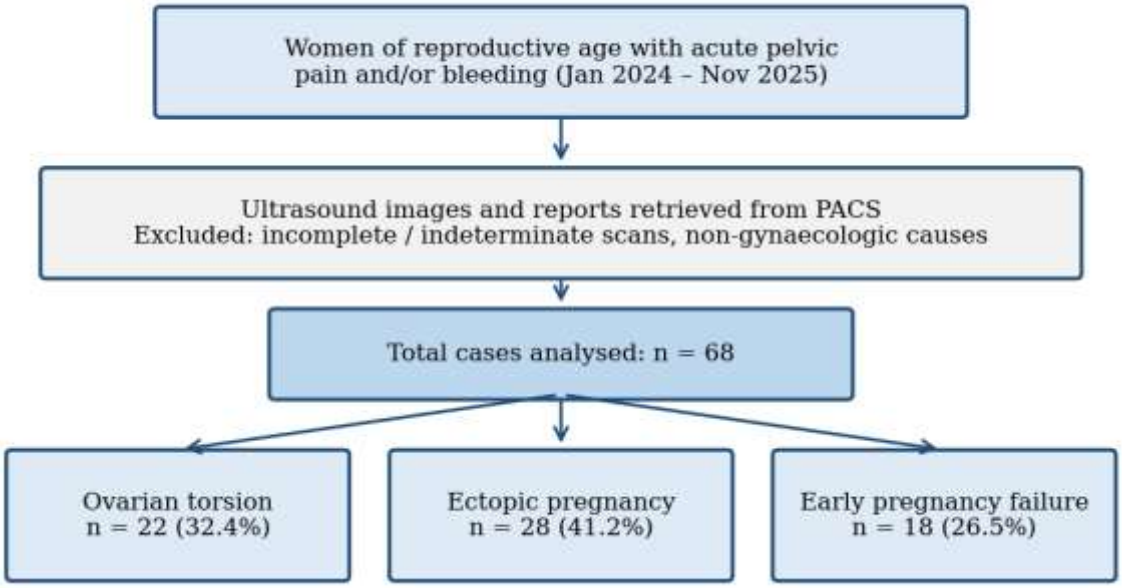


Figure-1: Study flow and case distribution (n=68)

Inclusion criteria: All cases in which ultrasound findings suggested ovarian torsion, ectopic pregnancy or early pregnancy failure, with a final clinical diagnosis recorded in the medical records.

Exclusion criteria: (1) Incomplete ultrasound data or indeterminate scans; (2) non-gynecologic causes of pelvic pain.

Data collection: Ultrasound images and reports were retrieved from the PACS archives and the corresponding medical records of the Department of Radio-diagnosis. Trans abdominal sonography (TAS) examinations were performed on a GE Voluson S8 ultrasound system using a C1-5 curvilinear and Transvaginal sonography (TVS) examinations were performed with RIC-5-9-W TVS probe with grey scale and colour doppler assessment. The findings were reviewed for the morphological and Doppler features characteristic of each condition.

Data analysis: The frequency distribution of key sonographic signs was tabulated and expressed as numbers and percentages. Diagnostic trends and imaging characteristics were summarized and compared across the three entities.

ANALYSIS AND RESULTS

A total of 68 women with ultrasound findings of a reproductive age group emergency, subsequently confirmed on final clinical diagnosis, were analyzed. Ectopic pregnancy was the most frequent diagnosis (28 cases, 41.2%), followed by ovarian torsion (22 cases, 32.4%) and early pregnancy failure (18 cases, 26.5%) (Table-1, Figure-2).

Diagnosis	Number of Cases	Percentage
Ectopic pregnancy	28	41.2%
Ovarian torsion	22	32.4%
Early pregnancy failure	18	26.5%
Total	68	100%

Table-1: Distribution of reproductive age group emergencies (n=68)

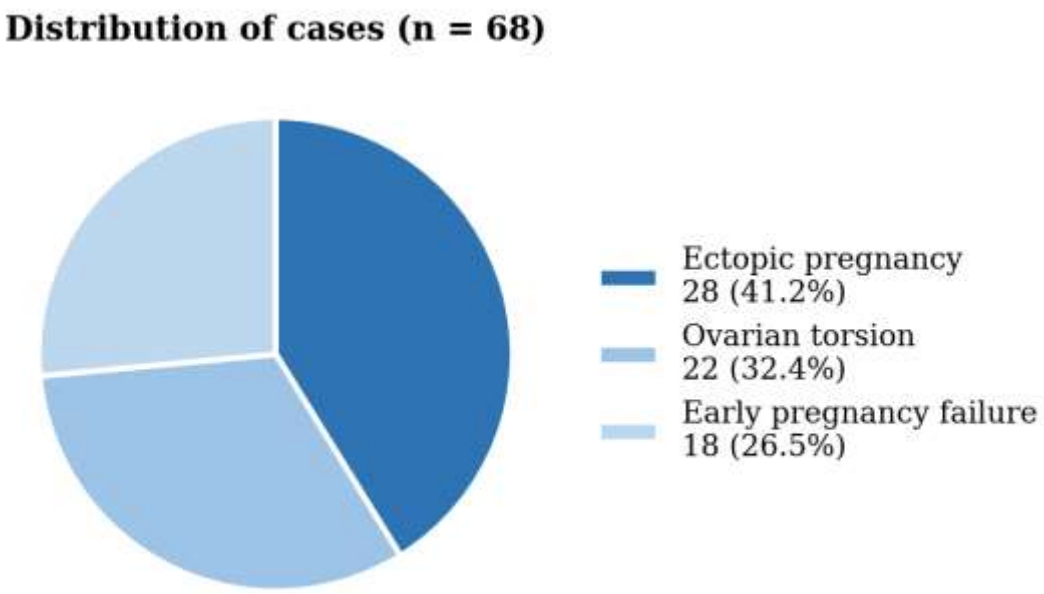


Figure-2: Case distribution by diagnosis (n=68)

In ovarian torsion, the commonest sonographic appearance was an enlarged ovary with a peripheral follicular pattern, accompanied by stromal oedema. A twisted vascular pedicle (the "whirlpool sign") and absent or reduced Doppler flow were the other key features, and free pelvic fluid was seen in some cases (Table-2).

Sonographic Feature	Description
Enlarged ovary with peripheral follicular pattern	Enlarged, oedematous ovary with follicles displaced to the periphery
Twisted vascular pedicle ("whirlpool sign")	Coiled, twisted vessels of the ovarian pedicle
Absent or reduced Doppler flow	Diminished or absent arterial and/or venous flow within the ovary
Stromal oedema	Thickened, heterogeneous ovarian stroma
Free fluid	Free pelvic fluid may be present

Table-2: Sonographic features of ovarian torsion

In ectopic pregnancy, the characteristic findings were an adnexal gestational sac separate from the ovary, "ring of fire" vascularity on Doppler, the tubal ring sign and an empty uterine cavity. Hemoperitoneum was identified in ruptured cases (Table-3).

Sonographic Feature	Description
Adnexal gestational sac separate from the ovary	Extra-ovarian adnexal sac/mass that moves independently of the ovary

Sonographic Feature	Description
“Ring of fire” vascularity	Peripheral hypervascularity around the adnexal mass on colour Doppler
Tubal ring sign	Echogenic ring surrounding an extra-uterine sac
Empty uterine cavity	No intra-uterine gestational sac in a woman with a positive pregnancy test
Hemoperitoneum	Free pelvic fluid with internal echoes in ruptured cases

Table-3: Sonographic features of ectopic pregnancy

Early pregnancy failure was diagnosed on the basis of absent fetal cardiac activity beyond the expected gestational age, an empty gestational sac (anembryonic pregnancy), an irregular sac or large yolk sac, and a discrepancy between gestational age and embryonic development (Table-4).

Sonographic Feature	Description
Absent fetal cardiac activity	No cardiac activity beyond the expected gestational age
Empty gestational sac	Anembryonic pregnancy
Irregular sac or large yolk sac	Abnormal sac contour or enlarged yolk sac
Gestational age–embryo discrepancy	Embryonic development inconsistent with gestational age

Table-4: Sonographic features of early pregnancy failure

Overall, ultrasound reliably identified all three major emergencies. Doppler greatly enhanced specificity in the diagnosis of ovarian torsion, TVS was highly sensitive for the detection of ectopic pregnancy, and early pregnancy failure could be diagnosed confidently using standardised criteria. There was a strong correlation between ultrasound findings and the final clinical diagnosis (Table-5).

Condition	Key Sonographic Tool / Sign	Principal Observation
Ovarian torsion (n=22)	Doppler; whirlpool sign	Doppler greatly enhanced specificity
Ectopic pregnancy (n=28)	Transvaginal sonography; tubal ring sign	TVS highly sensitive for detection
Early pregnancy failure (n=18)	Standardised sonographic criteria	Confident diagnosis based on criteria
All three conditions (n=68)	Ultrasound	Strong correlation with final clinical diagnosis

Table-5: Summary of key observations

Representative Cases

Case 1 (32 years, Female) – Ruptured ectopic pregnancy:

Transvaginal ultrasound in a case of ruptured ectopic pregnancy (Fig. 3): an extrauterine gestational sac containing a live fetus is seen in the left adnexal region, with crown–rump length corresponding to 6 weeks 2 days (A). Spectral Doppler

documents cardiac activity with a fetal heart rate of 147 bpm (B). Associated hemoperitoneum with blood clots is seen in the pouch of Douglas (C), consistent with a ruptured ectopic pregnancy.

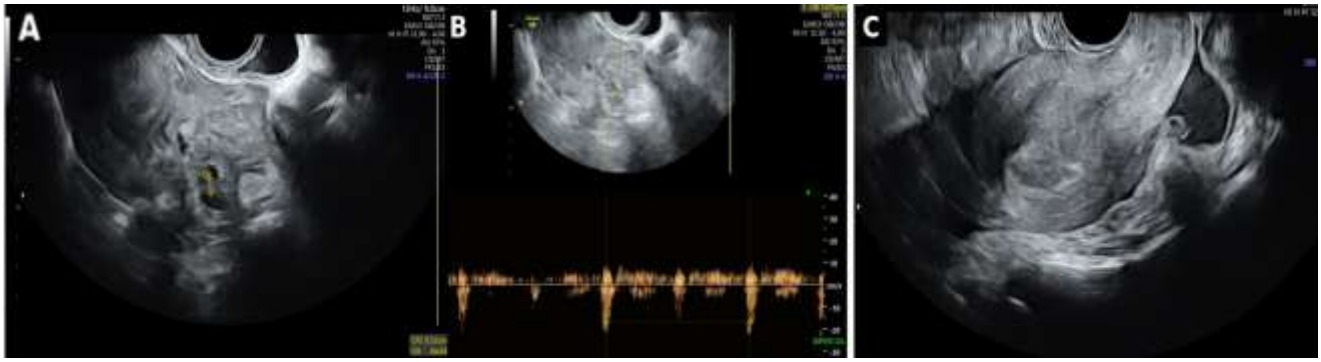


Fig. 3: Case 1-Ruptured ectopic pregnancy. TVS images show (A) Live extrauterine gestational sac in the left adnexa, CRL 6 weeks 2 days. (B) Spectral Doppler showing cardiac activity, FHR 147 bpm. (C) Hemoperitoneum with clots in the pouch of Douglas.



Fig. 4: Case 2 - Ruptured right tubal ectopic pregnancy. TAS show (A) Extrauterine gestational sac in the right adnexa. (B) Live embryo, CRL 6 weeks 6 days. (C) Cardiac activity on Doppler; moderate fluid in the pouch of Douglas.

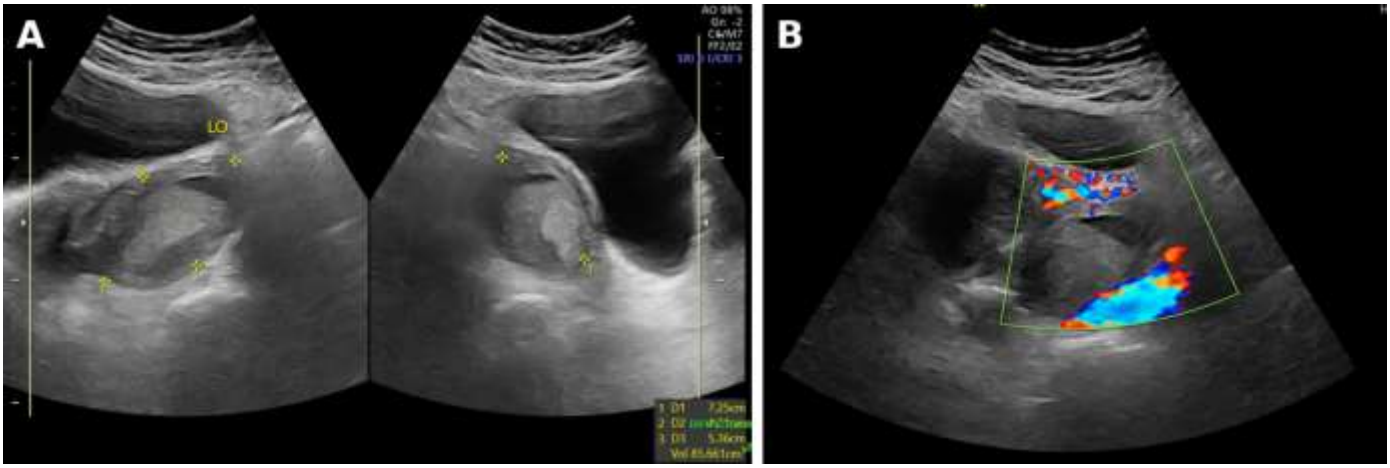


Fig. 5: Case 3 - Left ovarian torsion. TAS images show (A) Thick-walled cystic lesion with echogenic debris in the left ovary. (B) No internal vascularity on colour Doppler; twisting of vessels at its upper aspect (whirlpool sign).

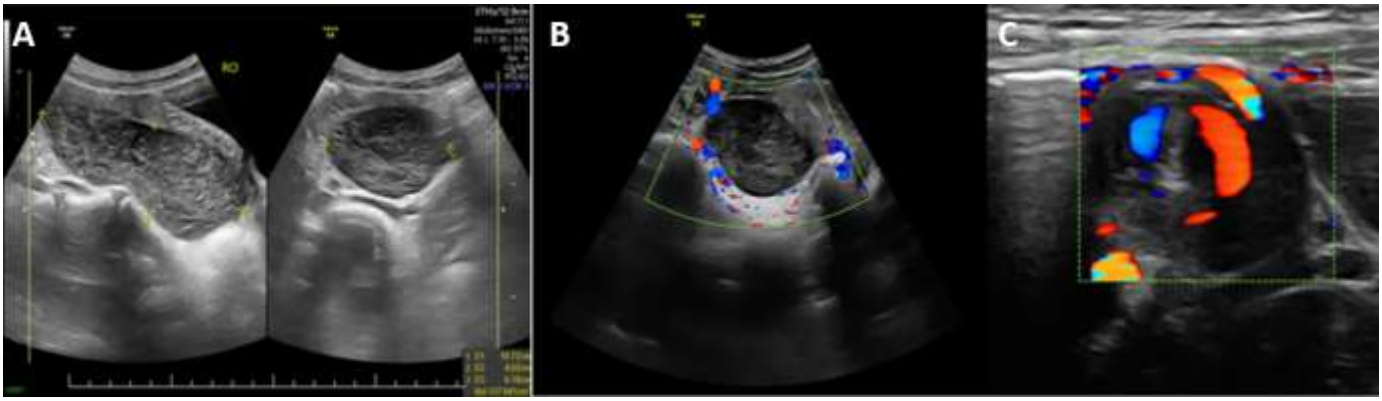


Fig. 6: Case 4 - Right ovarian torsion. TAS show (A) Bulky right ovary with heterogeneously hypoechoic stroma and peripherally displaced small follicles. (B) No colour uptake within the ovary on power Doppler. (C) Twisting of the pedicle (whirlpool sign) in the right adnexa and mild free fluid in the pouch of Douglas.

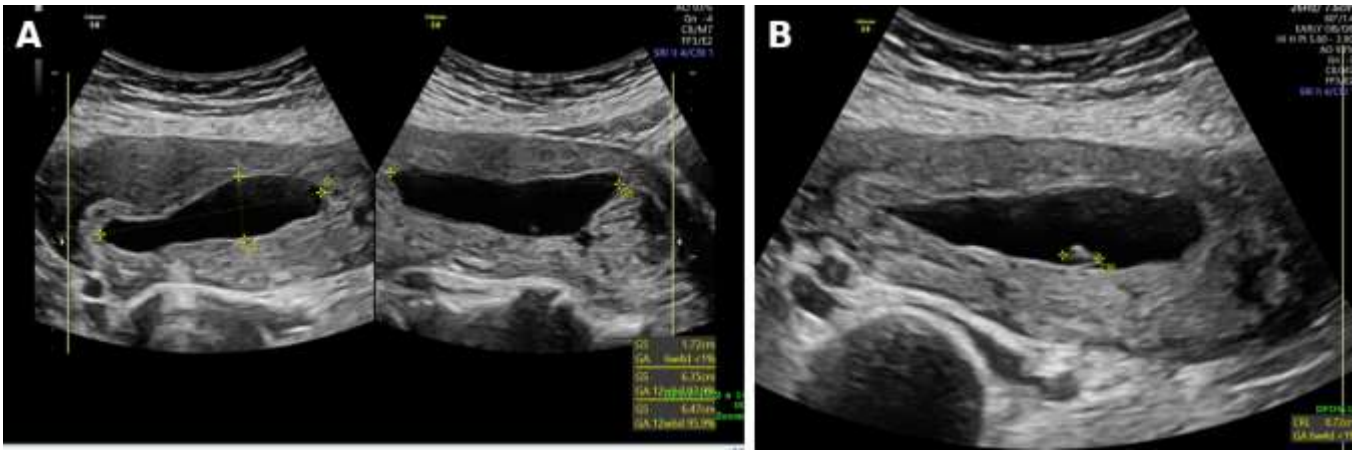


Fig. 7: Case 5 - Early pregnancy failure. TAS images show (A) Intrauterine gestational sac, mean sac diameter 48.5 mm (10 weeks 4 days). (B) Embryo with CRL 7.2 mm (6 weeks 4 days), no cardiac activity; calcified yolk sac. Findings meet SRU criteria for a non-viable pregnancy.

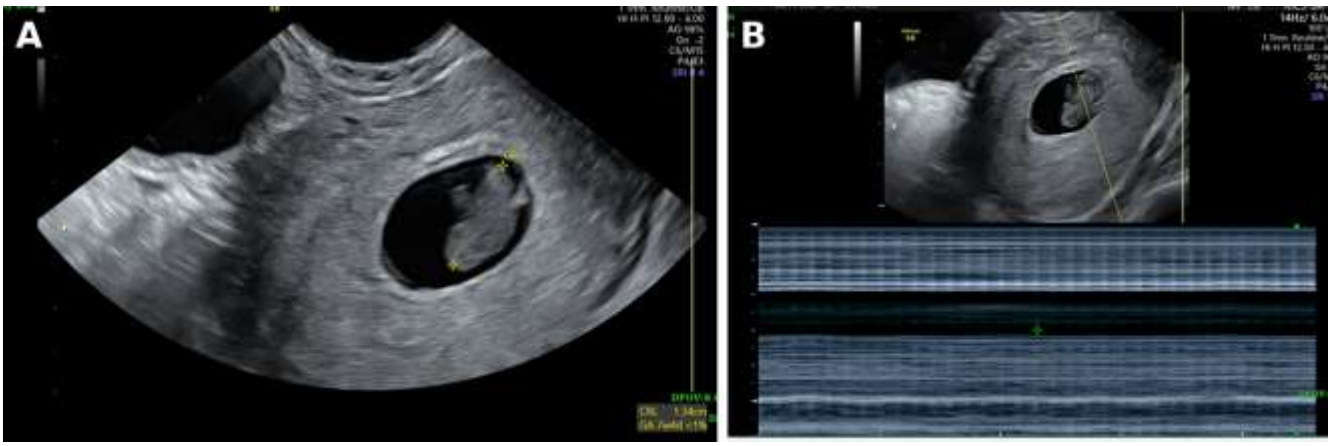


Fig. 8: Case 6 - Early pregnancy failure. TVS images show (A) Intrauterine gestation of about 7 weeks, CRL 13.4 mm. (B) M-mode showing no cardiac activity.

Case 2 (25 years, Female) – Ruptured tubal ectopic pregnancy:

Transabdominal ultrasound in a case of suspected ruptured right tubal ectopic pregnancy (Fig. 4): a single extrauterine gestational sac is seen in the right adnexa (A), with a live embryo corresponding to 6 weeks 6 days (B) and cardiac activity

on spectral Doppler (C). Moderate fluid is present in the pouch of Douglas, raising the possibility of a ruptured right tubal live ectopic pregnancy.

Case 3 (28 years, Female) – Left ovarian torsion:
Ultrasound in a case of possible left ovarian torsion (Fig. 5): a thick-walled cystic lesion with internal echogenic debris is seen in the left ovary (A). There is no internal vascularity on colour Doppler, and twisting of blood vessels is seen at the upper aspect of the lesion (B), suggestive of a twisted vascular pedicle.

Case 4 (25 years, Female) – Right ovarian torsion:
Ultrasound in a case of suspected right ovarian torsion (Fig. 6): the right ovary is bulky, with heterogeneously hypoechoic stroma and peripherally displaced small follicles (A). No colour uptake is demonstrable within the ovary even on power Doppler (B). Twisting of pedicles with "whirlpool sign" noted in right adnexa (C). Mild free fluid is present in the pouch of Douglas. The features are concerning for right ovarian torsion.

Case 5 (25 years, Female) – Early pregnancy failure:
Transabdominal ultrasound in a case of early pregnancy failure (Fig. 7): a single intrauterine gestation sac with a mean sac diameter of 48.5 mm, corresponding to 10 weeks 4 days (A). A single fetus is seen with a crown–rump length of 7.2 mm, corresponding to 6 weeks 4 days (B), with no cardiac activity and a calcified yolk sac. The findings fulfil the SRU criteria for a non-viable pregnancy [7].

Case 6 (21 years, Female) – Early pregnancy failure:
Transvaginal ultrasound in a case of early pregnancy failure (Fig. 8): a single intrauterine gestation of approximately 7 weeks, with a crown–rump length of 13.4 mm (A) and absence of cardiac activity on M-mode (B). The features are likely to represent early pregnancy failure.

DISCUSSION

This study examined the sonographic spectrum of three common reproductive age group emergencies in a tertiary care centre. Ectopic pregnancy formed the largest share of the 68 confirmed cases, followed by ovarian torsion and early pregnancy failure. All three share an acute, painful presentation, but their management – emergency surgery, expectant, medical or surgical treatment, or evacuation – differs sharply, which underlines the need for an imaging approach that is both rapid and discriminating.

In ovarian torsion, ultrasound findings are rarely pathognomonic in isolation. The most consistent grey-scale finding is an enlarged, oedematous ovary with follicles displaced to the periphery, which was the predominant appearance in our cohort, and is described in radiologic reviews as a key sign of the condition [2]. The twisted vascular pedicle, seen as a whirlpool of coiled vessels, was first described as a distinctive sign of torsion on grey-scale and colour Doppler [8]. Doppler assessment is helpful because absent or reduced flow supports the diagnosis and gave our reviewers greater diagnostic confidence. However, the dual ovarian blood supply means that preserved arterial or venous flow does not exclude torsion, and torsion remains a clinical and sonographic diagnosis in which Doppler findings should never be used alone to rule it out [3,9]. Intermittent torsion may also give a normal or near-normal appearance on a single examination, which explains why this entity features prominently among the "missed beats" of acute gynaecologic imaging.

For ectopic pregnancy, TVS remains the cornerstone of diagnosis. The adnexal gestational sac separate from the ovary, the echogenic tubal ring and the peripheral "ring of fire" vascularity seen in our series are the classic positive signs, and an empty uterine cavity in a woman with a positive pregnancy test should immediately raise suspicion [10]. Free fluid or hemoperitoneum in a patient with an adnexal mass signals rupture or impending rupture and calls for urgent management [5]. It is important to recognise, however, that a substantial proportion of ectopic pregnancies are not visualised on the initial scan and are classified as pregnancies of unknown location, which require serial scans and serum hCG follow-up [11]. Our series included only cases with a definite sonographic diagnosis, so such cases are not represented.

In early pregnancy failure, the cardinal sonographic criteria – absent cardiac activity in an embryo of adequate size, an empty gestational sac of sufficient diameter, and discrepancy between gestational age and embryonic development – are now standardised. The consensus criteria of the Society of Radiologists in Ultrasound (SRU) specify, for instance, no cardiac activity with a crown–rump length of 7 mm or more, or no embryo with a mean sac diameter of 25 mm or more, as diagnostic of a failed pregnancy [7]. Adherence to such thresholds is essential, because ultrasound has been recognised as an easily available tool for differentiating normal from abnormal pregnancy [6], yet misdiagnosis in the first weeks of

gestation carries the risk of interrupting a viable pregnancy. Once the diagnosis is secure, expectant, medical or surgical management can be offered according to patient preference and clinical stability [12].

Taken together, these observations support ultrasound as the frontline imaging modality in acute gynaecologic emergencies of reproductive age. Its advantages – bedside availability, absence of ionising radiation, real-time Doppler assessment and suitability for pregnant patients – are particularly relevant in these time-critical conditions. The strong correlation observed between ultrasound findings and final clinical diagnosis in our cohort reinforces the value of systematic pattern recognition, supported by Doppler and, where required, serial examination. Such an approach shortens the time to diagnosis, reduces morbidity and facilitates fertility-preserving interventions such as ovarian detorsion rather than oophorectomy, or tubal-conserving management of ectopic pregnancy where appropriate.

Limitations

- Retrospective, single-centre design, which limits generalisability.
- Only cases with a confirmed final diagnosis were included, and indeterminate scans were excluded; consequently, diagnostic sensitivity, specificity and predictive values could not be calculated, and pregnancies of unknown location were not represented.
- Ultrasound interpretation is operator-dependent, and inter-observer variability was not assessed.
- Features such as Doppler findings were analysed descriptively, without formal statistical comparison between the groups.

CONCLUSION

Ultrasound is indispensable in the evaluation of reproductive age group emergencies. It enables rapid diagnosis of ovarian torsion, ectopic pregnancy and early pregnancy failure, reduces morbidity, and assists in fertility-preserving interventions. Doppler enhances specificity in suspected ovarian torsion, TVS is highly sensitive for ectopic pregnancy, and standardised criteria permit confident diagnosis of early pregnancy failure. Ultrasound should remain the frontline modality in acute gynaecologic imaging.

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