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Research Article

ROLE OF FIRST-TRIMESTER ULTRASOUND (UP TO 12 WEEKS) IN EARLY PREGNANCY CARE: A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Objectives: To evaluate the diagnostic and descriptive role of first-trimester ultrasound (FTU) in early pregnancy at a tertiary healthcare center.

Methods: A retrospective observational study was conducted in which 120 pregnant women who underwent FTU (≤12 weeks gestation) between March 2024 and February 2025. Archived imaging and hospital records were reviewed to analyze obstetric and ultrasound data. Outcomes assessed included gestational age confirmation, detection of fetal cardiac activity, yolk sac evaluation, and diagnosis of early pregnancy complications. Statistical analysis was performed using the Statistical Package for the Social Sciences v23.0.

Results: Of the 120 cases, 77.5% were viable singleton intrauterine pregnancies. Multifetal gestation was identified in 5.8% with chorionicity assessment possible in all twin pregnancies. Ectopic pregnancies and anembryonic gestations were each diagnosed in 5% of cases. Embryonic cardiac activity was present in 83.3% and yolk sac abnormalities were noted in 11.6%. The nuchal translucency was measured in 16.6% of cases (Mean NT 1.34±0.29 mm). Additional findings included subchorionic hematomas (3.3%) and adnexal masses (4.2%). Crown-rump length-based gestational dating closely agreed with last menstrual period-based estimates.

Conclusion: FTU plays an important role in early pregnancy care by ensuring early diagnosis of both normal as well as abnormal pregnancies. It improves obstetric decision-making through accurate dating, identification of viability, and early detection of complications.

Keywords: First-trimester ultrasound, Early pregnancy, Ectopic pregnancy, Gestational age, Prenatal diagnosis.

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INTRODUCTION

The first trimester of pregnancy (up to 12 weeks of gestation) is an important window for establishing the viability as well as the location of gestation. Timely obstetric assessment of pregnant women in early pregnancy is crucial in reducing maternal and neonatal morbidity and mortality. Many studies have recommended at least one ultrasound before 24 weeks of gestation and preferably in the first trimester. However, access to and utilization of first-trimester ultrasound (FTU) remain inconsistent across various healthcare settings, particularly in low- and middle-income countries where many women don't have the means to undergo any scan in early pregnancy [1]. Miscarriages, ectopic pregnancies, gestational trophoblastic disease, and embryonic anomalies are all potential complications that can be more effectively managed with early imaging. Despite this, in many clinical settings, ultrasound is still frequently reserved for the second-trimester or later, missing a critical opportunity for early intervention.

The diagnostic utility of FTU lies in its ability to confirm intrauterine pregnancy, determine gestational age (GA) with greater accuracy than later scans. It moreover can reliably detect multiple gestations and assess early fetal anatomy and cardiac activity. For instance, the crown-rump length (CRL) measurement calculated through early pregnancy scan is one of the most reliable parameters for estimation of GA with a very small margin of error when performed before 12 weeks [2]. Estimation of GA by fetal biometry becomes increasingly unreliable in later stages of pregnancy where fetal size may not accurately reflect chronological gestation due to pathological growth delay. Moreover, accurate dating is important for optimal management pregnancies with an uncertain last menstrual period (LMP) date. FTU also has a significant role in the diagnosis of conditions, such as anembryonic pregnancy, ectopic pregnancy, and missed abortions [3]. Early diagnosis of these conditions is important for prompt medical or surgical management. The early recognition of ectopic pregnancy (Usually by transvaginal ultrasound), in particular, can be life-saving and reduce the maternal mortality by preventing the consequences of late diagnosis of ectopic pregnancy [4]. Similarly, in cases of twin pregnancies, FTU also plays an important role in identifying chorionicity, which influences antenatal monitoring and delivery planning [5].

The identification of nuchal translucency (NT) thickness, which is typically assessed between 11 and 13 weeks of gestation, can act as a crucial marker for trisomy 21 and other aneuploidies [6]. While NT measurement falls slightly outside the <12-week scope, the foundational dating scan and anatomical overview obtained in earlier weeks provide essential context for such screening [7]. Increasingly later, FTU is being used to identify structural anomalies, such as anencephaly and gastroschisis [8]. A structured early ultrasound scan sets the stage for timely referrals and further testing when fetal anomalies are suspected. With the advent of high-resolution transvaginal probes application of FTU has expanded significantly, thereby improving visualization even before 6 weeks of gestation. This allows for the detection of a yolk sac and fetal pole in the earliest phases of embryonic development [9].

Despite its proven benefits, there is wide heterogeneity in existing protocols for FTU across clinical settings. For instance, in some countries, assessment by FTU is mandatorily performed for all pregnancies, while in others it is only advised in cases of bleeding, pain, or suspected ectopic pregnancy [10]. Evaluating the application of FTU in early pregnancy care is important for patient outcomes. This study aims to evaluate the role of FTU in early pregnancy care within a tertiary care healthcare setting.

METHODS

This was a retrospective observational study that analyzed archived imaging and hospital records of 120 patients who had FTUs at a tertiary care center from March 2024 to February 2025. This was a retrospective record-based study using anonymized data; hence, formal institutional ethics committee approval was not required. All relevant case records of 120 pregnant patients who underwent FTU scanning (before 12 completed weeks of gestation) during the defined study period were retrieved from the hospital's medical records. Demographic data, such as maternal age, gravidity, parity, and date of LMP were recorded. Socioeconomic status as well as basic anthropometric measurements at the time of the first visit were also documented from records.

Detailed obstetric history, including history of previous miscarriages, ectopic pregnancies, previous cesarean section, molar pregnancies, and use of any assisted reproductive techniques used (if applicable) was also collected from the records. Symptoms, such as abdominal pain, hyperemesis, vaginal bleeding, or brownish discharge, were included in data collection to analyze and correlate it with ultrasound findings. Any previous medical or surgical history, which was relevant to obstetric care was also documented. Clinical examination findings at the time of presentation, such as general physical condition, vitals, abdominal and pelvic findings, were also documented from medical records.

Details of the ultrasound examination (either transabdominal or transvaginal), including gestational sac (GS) location, presence or absence of yolk sac, CRL, fetal cardiac activity, number of fetuses, presence of subchorionic hematoma (SCH), adnexal masses, uterine anomalies, fibroids and other abnormalities, such as ectopic gestation or molar pregnancy were recorded from the ultrasound (USG) reports. Diagnosis was categorized into various clinical groups, such as viable pregnancy, blighted ovum, miscarriage, ectopic pregnancy, SCH, and fetal anomaly. Uterine artery pulsatility index (PI) values were recorded whenever available.

All the above collected demographic data, clinical history, ultrasound findings, and final diagnoses were analyzed to evaluate the role of first-trimester ultrasonography in early pregnancy care. The study aimed to correlate the sonographic findings with clinical presentation and highlight its utility in the timely diagnosis of both normal and complicated pregnancies.

Statistical analysis was done using the Statistical Package for the Social Sciences version 23.0. Quantitative variables, such as maternal age, GA and CRL were expressed as mean±standard deviation, while categorical data, including clinical symptoms, ultrasound findings, and final diagnosis (e.g., viable pregnancy, miscarriage, ectopic pregnancy), were presented as frequencies and percentages.

Inclusion criteria

1. Patients whose records indicate age above 18 years at the time of FTU
2. Pregnant women who underwent ultrasonography before 12 completed weeks of gestation (as confirmed by LMP or ultrasound findings)
3. Patients who had their first antenatal visit recorded along with a corresponding FTU
4. Availability of complete clinical and radiological documentation in the hospital records.

Exclusion criteria

1. Patient records showing age below 18 years at the time of FTU
2. Records lacking clear documentation of GA or ultrasonography details
3. Patients with known chronic medical conditions (e.g., overt diabetes mellitus, thyroid disorders)
4. Patients with previously documented uterine or adnexal pathology, such as fibroids and congenital uterine anomalies
5. Incomplete or illegible case records.

RESULTS

The analysis of the age-wise distribution of parity among the studied cases showed that the majority of participants (50.00%) were nulliparous (parity 0), with the highest representation in the 25–29 years age group (15.00%), followed by those aged 20–24 (10.83%) and 30–34 (7.50%). Women with parity 1 accounted for 35.00% of the total, with the most notable group being those aged 35–39 (10.83%) and ≥40 (6.67%). Parity 2 women constituted 9.17% of the total, with the largest proportions in the 20–24 years (3.33%) and 25–29 years (1.67%) age groups. Only 5.83% of women had parity 3 or more, mainly among the 25–29 and 30–34 age groups (2.50% and 1.67%, respectively) (Table 1).

The analysis of the GA window distribution as determined by LMP and ultrasound showed notable variations between the two methods. According to LMP, the most common GA window was 8 weeks 1 day–9 weeks, accounting for 23.3% of cases, followed by 7–8 weeks (20.0%) and 9 weeks 1 day–10 weeks (18.3%). By ultrasound, the highest proportion was also seen in the 8 weeks 1 day–9 weeks group (22.5%), closely followed by both the 9 weeks 1 day–10 weeks and 10 weeks 1 day–11 weeks groups (19.2% and 16.7%, respectively). The <7.0 weeks category had fewer cases in both methods, comprising 12.5% by LMP and only 8.3% by ultrasound (Table 2).

The analysis of the sonographic markers observed in FTU examinations showed that a normal yolk sac was the most common finding, seen in 106 cases (88.3%), while an enlarged yolk sac was noted in 10 cases (8.3%) and absence of the yolk sac was identified in 4 cases (3.3%). Cardiac activity was present in 100 cases (83.3%), whereas cardiac activity was absent or not yet detected in 20 cases (16.6%). NT measurement was performed in 20 patients (16.6%), and the mean NT value was found to be 1.34±0.29 mm (Table 3).

The analysis of the sonographic diagnoses in early pregnancy showed that the most common finding was a viable singleton intrauterine pregnancy (77.5%). Multifetal gestation was identified in 7 cases (5.8%). Out of 7 multifetal gestations, 4 (3.3%) were dichorionic diamniotic (DCDA) and 3 (2.5%) were monochorionic diamniotic (MCDA). There was no case of monochorionic monoamniotic twin pregnancy. Ectopic pregnancy and anembryonic or blighted ovum were

Table 1: Age-wise parity distribution in studied cases

Age group (years)	Parity 0		Parity 1		Parity 2		Parity 3+		Total	
	n	Percentage	n	Percentage	n	Percentage	n	Percentage	n	Percentage
<20	6	5.00	3	2.50	0	0.00	0	0.00	9	7.50
20–24	13	10.83	5	4.17	4	3.33	1	0.83	23	19.17
25–29	18	15.00	5	4.17	2	1.67	3	2.50	28	23.33
30–34	9	7.50	8	6.67	2	1.67	2	1.67	21	17.50
35–39	8	6.67	13	10.83	2	1.67	1	0.83	24	20.00
≥40	6	5.00	8	6.67	1	0.83	0	0.00	15	12.50
Total	60	50.00	42	35.00	11	9.17	7	5.83	120	100.00

Values represent number of cases (n) and percentages (%). Total n=120

each diagnosed in 6 cases (5.0%), while missed or incomplete abortion was seen in 4 cases (3.3%) (Table 4).

Uterine artery PI measurements were available in 46 cases. Mean PI was found to be of 1.20±0.51. Five ectopic pregnancies presented as adnexal masses showing a tubal ring or extra-uterine GS. In addition, five women had incidental simple ovarian cysts unrelated to ectopic pregnancy (Table 5). Among five cases of ectopic pregnancies, ultrasound findings directly guided patient management. Three women underwent laparoscopic salpingectomy, one received methotrexate therapy after confirmation of a small unruptured ectopic and one was managed expectantly with serial beta human chorionic gonadotropin (β HCG) monitoring. Among women with SCH and active bleeding, early ultrasound documentation enabled close follow-up and conservative management, avoiding unnecessary interventions.

The summary of findings showed that the mean maternal age was 28.3±5.4 years. Mean GA was 9.1±1.5 weeks by LMP and 8.9±1.2 weeks by ultrasound, showing close agreement between the two dating methods. The mean NT measured in 20 subjects was 1.34±0.29 mm, and the mean uterine artery PI in 46 cases was 1.20±0.51 (Table 6).

Table 2: Comparison of GA by LMP and first-trimester ultrasound

GA window (weeks)	By last menstrual period date n (%)	By ultrasound n (%)
<7.0 weeks	15 (12.5)	10 (8.3)
7–8 weeks	24 (20.0)	20 (16.7)
8 weeks 1 day–9 weeks	28 (23.3)	27 (22.5)
9 weeks 1 day–10 weeks	22 (18.3)	23 (19.2)
10 weeks 1 day–11 weeks	15 (12.5)	20 (16.7)
11 weeks 1 day–12 weeks	16 (13.3)	20 (16.7)
Total	120 (100)	120 (100)

GA: Gestational age, LMP: Last menstrual period, SD: Standard deviation. Values represent number of cases (n) and percentages (%). Mean±SD gestational age: 9.1±1.5 weeks by LMP and 8.9±1.2 weeks by ultrasound (n=120)

Table 3: Sonographic markers seen in first-trimester ultrasound

A. Sonographic markers	n	Percentage
Yolk sac – Normal	106	88.3
Yolk sac – Enlarged	10	8.3
Yolk sac – Absent	4	3.3
Embryonic heartbeat – Present	100	83.3
Embryonic heartbeat – Absent/Not appeared yet	20	16.6
Nuchal translucency measured	20	16.6
Mean NT (mm) 1.34±0.29 mm		

Values represent number of cases (n) and percentages (%). Data for nuchal translucency (NT) are expressed as mean±standard deviation; NT measured in 20 subjects (n=20, mean 1.34±0.29 mm). Total n=120

Table 4: Ultrasound diagnosis in first-trimester ultrasound

Sonographic diagnoses	n	Percentage
Viable singleton intrauterine pregnancy	93	77.5
Multifetal gestation (presence of heartbeat in both fetuses, in case of twin pregnancy, was counted as one for statistical purposes)	7	5.8
– DCDA	4	3.3
– MCDA	3	2.5
Ectopic pregnancy	6	5.0
Anembryonic/blighted ovum	6	5.0
Missed/incomplete abortion	4	3.3

DCDA: Dichorionic diamniotic, MCDA: Monochorionic diamniotic. Values represent number of cases (n) and percentages (%). Total n=120

DISCUSSION

The findings of this study confirm the critical role of FTU in early pregnancy care in accurately confirming viability and GA. In this study, 77.5% of pregnancies were classified as viable intrauterine pregnancies. CRL was reliably used to date gestation as compared to LMP estimates. Similar accuracy in dating of early gestational has also been reported by Majola *et al*. who demonstrated that CRL measurement between 7 and 10 weeks offers superior precision compared to second-trimester biparietal diameter estimates. The study also concluded that early pregnancy scans reduce the incidence of misclassification of GA and associated complications in obstetric management [11]. Similarly, Salomon *et al*. also underlined the importance of early scan in multicentric cohortsemphasizing the role of FTU in standardizing pregnancy dating, particularly in cases where LMP is uncertain [12]. In our study, minor discrepancies between LMP and USG-based GA estimation were observed. These findings underscore the importance of sonographic assessment for accurate dating in early pregnancy, particularly in women with irregular cycles.

Our study demonstrates that FTU can reliably diagnose early pregnancy complications. The incidence of ectopic pregnancies (5.0%) and anembryonic gestations (5.0%) in our cohort is notably higher than the 1–2% and 2–3% rates reported in general obstetric populations. This elevation likely reflects the tertiary-care referral nature of our center. In agreement with Kirk *et al*. who reported that transvaginal ultrasonography can detect the majority of ectopic pregnancies before rupture, our findings reaffirm the important role of early imaging in reducing maternal morbidity and mortality [13]. Similarly, Condous *et al*. emphasized the complementary role of serial ultrasonography with quantitative β-hCG estimation in equivocal cases, facilitating timely diagnosis and avoiding unnecessary interventions [14]. The identification of adnexal masses in our study further underscores the potential of first-trimester ultrasonography in guiding early and appropriate clinical management.

In this study, multifetal gestations were identified in 5.8% of cases. Early determination of chorionicity was possible in all twin pregnancies.

Table 5: Additional findings in first-trimester ultrasound

Vascular/additional findings	Number of cases	Percentage
Uterine artery PI available (mean ± SD)	46	38.33
Adnexal mass (Other than due to ectopic pregnancy)	5	4.2
Adnexal mass due to Ectopic pregnancy	5	4.2
Small subchorionic hematoma	4	3.3

Values represent number of cases (n) and percentages (%). Uterine artery pulsatility index (PI) values are expressed as mean ± SD (n = 46, mean 1.20 ± 0.51). Total n = 120. SD: Standard deviation

Table 6: Summary of demographic and ultrasound features in studied cases

Parameter	n	Mean±standard deviation
Maternal age (years)	120	28.3±5.4
Gestational age by ultrasound (weeks)	120	8.9±1.2
Gestational age by LMP (weeks)	120	9.1±1.5
Nuchal translucency, NT (mm)	20	1.34±0.29
Uterine artery Pulsatality index (PI)	46	1.20±0.51

Data are expressed as mean±standard deviation. n=120 for maternal age and gestational age, n=20 for NT: Nuchal translucency, and n=46 for uterine artery PI: Pulsatility index

It's important to determine chorionicity as it significantly influences perinatal outcomes and guides antenatal monitoring. In our series, 3 cases were MCDA and 4 cases were DCDA. This is consistent with the findings of Dias *et al*. who reported that accurate determination of chorionicity before 14 weeks is feasible and highly reliable with a high concordance with placental pathology [15]. Similarly, Denbow *et al*. reported that early detection of MCDA pregnancies allows for timely screening for complications, such as twin-twin transfusion syndrome, thus improving outcomes through earlier referral to higher centres if need arises [16]. Our findings confirm these findings and support universal early ultrasound screening to stratify risk in multifetal pregnancies.

Another relevant dimension of our analysis is the role of FTU in structural and embryonic assessments of the embryo. In this study, embryonic cardiac activity was detected in 83.3% of cases. An enlarged yolk sac was noted in 8.3%, which can signal a poor pregnancy prognosis. Lindsay *et al*. demonstrated that yolk sac abnormalities – including enlargement or absence – are associated with early pregnancy failure and the authors advocated close follow-up in such cases [17]. In addition, NT was measured in 16.6% of patients in our study with a mean value within normal limits. Although the NT measurement is optimally performed between 11 and 13 weeks, it is often complemented by an earlier scan that provides critical baseline parameters. Nicolaides *et al*. also emphasized the importance of need for combining early CRL measurements with NT screening for optimal first-trimester aneuploidy risk assessment [18]. Our findings support integrating NT measurement into a broader FTU protocol when the GA window permits, and highlight the foundational role of early scans in guiding timing of further screening.

Finally, the detection of SCH in 4 (3.3%) cases in our study further reinforces the utility of FTU in identifying incidental findings that may have potential clinical implications. These observations align with the study by Johns *et al*., which found that even small subchorionic collections were associated with increased risk of first-trimester bleeding and miscarriages [19]. Similarly, Condous *et al*. reported that the presence of findings, such as corpus luteum cysts as well as adnexal pathology, was more common among patients presenting with pain or bleeding [20]. Collectively, these findings strengthen the case for routine early ultrasonography as part of standard antenatal care, particularly in high-risk populations.

The present study has certain limitations. Being retrospective in design, it depended on the completeness and accuracy of hospital recordswhich may have introduced selection and information bias. Furthermore, the study was conducted at a single tertiary-care center, thereby limiting the generalizability of the findings.

CONCLUSION

First-trimester ultrasonography is an important component of modern obstetric care. It provides reliable information about confirmation of pregnancy viability, precise gestational dating, and early detection of complications that can significantly affect maternal and fetal outcomes. It also enables the timely diagnosis of ectopic and anembryonic pregnancies and multifetal gestations. Therefore, FTU should be offered routinely to all pregnant women, not merely those with symptoms, as it is a cost-effective, non-invasive, and reliable tool for pregnancy assessment. Routine use of FTU will optimize antenatal care and improve overall pregnancy outcomes.

AUTHOR'S CONTRIBUTION

Dr Munagala Sahithi – Concept and design of the study, prepared first draft of manuscript, interpreted the results, reviewed the literature and manuscript preparation; Dr Gautam Muthu - Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript.

CONFLICT OF INTEREST

None.

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None.

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