

## Evaluation of Early Pregnancy Failure with Transvaginal Sonography: A Prospective Observational Study

Rajib Pal<sup>1</sup>, Anwshka Kumari<sup>2</sup>, Mrinalkanti Ghosh<sup>3</sup>

<sup>1</sup>Associate Professor, Department of Obstetrics & Gynecology, Deben Mahata Government Medical College, Purulia, West Bengal, India.

<sup>2</sup>Senior Resident, Department of Obstetrics & Gynecology, Raghunathpur Superspeciality Hospital, Purulia, West Bengal, India.

<sup>3</sup>Professor & Head, Department of Radiology & Imaging, Burdwan Medical College, Burdwan, West Bengal, India.

---

Received: 25-06-2022 / Revised: 25-07-2022 / Accepted: 10-08-2022

Corresponding author: Dr. Rajib Pal

Conflict of interest: Nil

---

### Abstract

**Background:** Spontaneous miscarriage is one of the common complications in pregnancy. It occurs in up to 20% of clinical pregnancies. In the first trimester with transvaginal ultrasonography a series of measurements like embryonic crown-rump length (CRL), embryonic heart rate (EHR), gestational sac diameter (GSD) and yolk sac diameter (YSD) were taken. The objective of this study is to evaluate early pregnancy developmental changes in first trimester ultrasound screening also to identify abnormal ultrasound parameters and correlate the ultrasound findings with the clinical outcomes.

**Materials & Methods:** The study included 100 pregnant women attending antenatal clinic at 5-12 weeks of gestation fulfilling inclusion and exclusion criteria. They were subjected to TVS. Mean Gestational Sac Diameter (MGSD), Yolk Sac Diameter (YSD), morphology of yolk sac, Crown rump length (CRL), Retroplacental or Perisac Collection, Embryonic Heart Rate (EHR) were noted.

**Results:** In our study, 34% patients had abnormal pregnancy. Maximum patients belonged to the age group 26-30. Majority of abortions occurred before 12 weeks of gestation. Threatened abortion was noted in 23% of patients. 50% of patients with abnormally large yolk sac, 94% of patients with MSD>25 mm with absent embryo, 100% of patients with CRL>9mm and 100% with EHR<100bpm aborted.

**Conclusion:** TVS can help in early diagnosis of EPF in asymptomatic patients. Timely appearance of parameters like Gestational Sac, CRL, EHR, Yolk Sac and evaluation of retroplacental and perisac area can be used to predict pregnancy outcome.

**Keywords:** Ultrasound, first trimester, pregnancy failure.

---

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

---

## Introduction

Early pregnancy units (EPUs) have developed with the aim of providing a one-stop outpatient service to women with abdominal pain, vaginal bleeding or anxiety, as to the location and viability of their pregnancy [1]. In such EPUs the patients are examined both clinically and by pelvic ultrasound for prompt and accurate diagnosis of extrauterine and failed intrauterine pregnancy [2]. However, in the majority of women there is a normal intrauterine pregnancy. In the presence of live embryos, a series of measurements are taken, including embryonic crown-rump length (CRL), embryonic heart rate (EHR), gestational sac diameter (GSD) and yolk sac diameter (YSD). With transvaginal ultrasound, it is possible to identify the sac by 4 weeks and 3 days gestation when the mean diameter is 2 to 3 mm [3]. Approximately 12-24% of all pregnancies suffer miscarriages and 80% of all cases of pregnancy loss occur within the first trimester and most of the early miscarriages are caused by chromosomal abnormalities [3]. Ultrasound has become an essential diagnostic imaging modality in the field of obstetrics and is being extensively used for evaluation of pregnancy [4]. Being noninvasive, safe and without hazards of radiation, USG has gained wide acceptability, as an integral part of basic investigative procedures [4]. Early pregnancy failure may present with vaginal bleeding and (or) abdominal pain. Differential diagnoses include threatened, inevitable, and missed abortion. The latter can be further subdivided into anembryonic pregnancy (blighted ovum) or embryonic demise. Other differential diagnoses include ectopic and molar pregnancy. TVS findings can be conclusive of early pregnancy failure (EPF) or can be suggestive. This study is aimed to assess the early pregnancy developmental changes in first trimester ultrasound screening also to identify abnormal ultrasound parameters and correlate the ultrasound findings with the clinical outcomes.

## Materials & Methods:

This prospective observational study was carried out in a tertiary health care facility Burdwan Medical College, Burdwan, West Bengal, from June 2018 to June 2019 for a period of one year, after receiving approval from the Ethical Committee of this Institution. The study was conducted for a period of one year. The study included 100 pregnant women attending antenatal clinic of this Institution at 5-12 weeks of gestation fulfilling inclusion and exclusion criteria. They were subjected to TVS after proper informed consent. Normal embryonic development and signs of early pregnancy failure were identified. All the patients were followed up to 20 weeks to see the outcome. Any age, any parity, single intrauterine pregnancy with estimated gestational age of 5-12 weeks with accurate last menstrual period (LMP) with previous history of regular cycle and any subject of threatened abortion were included in this study. Multiple pregnancies, known fetal or uterine abnormalities, chronic diseases in pregnant women like heart disease, diabetes, chronic hypertension etc. women not willing to participate in study were excluded. Philips HD7 USG machine with transvaginal probe of frequency 5-7.5 MHz was used for study purposes. Mean Gestational Sac Diameter (MGSD), Yolk Sac Diameter (YSD), morphology of yolk sac, Crown rump length (CRL), Retroplacental or Perisac Collection, Embryonic Heart Rate (EHR). All USG was done and reviewed by a single radiologist in obstetric sonography to reduce the observational bias. All the cases were subjected to detailed history, general physical, and systemic as well as obstetrical examination at the time of their antenatal visit and at the time of admission. Gestational age was calculated by modified Naegele's rule. LMP derived gestational age was compared with ultrasound derived gestational age using CRL and marked discrepancy of one or more

weeks led to exclusion of participants from the study. MGSD was assessed by averaging three dimensions (longitudinal, anteroposterior and transverse). Sac was measured from inside of the sac to the inside of the decidual reaction, excluding the latter in the measurement. Yolk Sac (YS) was determined by placing calipers on the inner limits of the longer diameter. Size of the sac, shape, echogenicity of the rim and centre of sac, its number and degenerative changes such as calcification was evaluated. Yolk Sac having diameter between 3-6 mm, rounded shape, absence of degenerative changes, presence of echogenic rim and hypoechoic centre was considered normal. Any deviation from above parameters was considered abnormal. Crown Rump Length (CRL) was measured in sagittal plane of the embryo avoiding inclusion of YS. CRL >4 mm in TVS who fail to demonstrate heartbeat were judged non-viable and CRL <4 mm without a visible heart beat returned for repeat TVS after 7 days. EHR of less than 100 beats per minute at 8 weeks or earlier was classified as

slow. Presence of any perisac collection or haemorrhage in or around sac or placenta were noted. All the patients were followed upto 20 weeks to see whether there was any spontaneous loss or any other early pregnancy complication or if the pregnancy is continued normally as suggested by previous TVS findings.

### Statistical Analysis

Statistical significance of the result was evaluated by Percentage, Predictive value. Comparison of groups was done by using Pearson's Chi Square test for Independence of Attributes/ Fisher's Exact Test as appropriate. A value of  $p < 0.05$  was considered statistically significant.

### Results:

This prospective observational study was performed to evaluate the early pregnancy developmental changes in first trimester ultrasound screening and also to identify abnormal ultrasound parameters and correlate the findings with the clinical outcomes.

**Table 1: Demography of study subjects**

Age Distribution	<b>Age (years)</b>		
	<=20	21-25	26-30
	>30		
Parity Distribution	15(15%)	23(23%)	39(39%)
	23(23%)		
	<b>Parity</b>		
Total number of abortion in relation to maternal age (n=34)	P0+0	P0+1-P0+5	P1+0- P2+0
	P3+0		
	49(49%)	22(22%)	21(21%)
Total number of abortion in relation to parity (n=34)	8(8%)		
	<b>Age (years)</b>		
	<=20	21-25	26-30
Total number of abortion in relation to parity (n=34)	>30		
	4(11.76%)	8(23.53%)	11(32.35%)
	11(32.35%)		
Total number of abortion in relation to parity (n=34)	<b>Parity</b>		
	P0+0	P0+1-P0+5	P1+0-P2+0
	P3+0		
Total number of abortion in relation to parity (n=34)	14(41.17%)	11(32.35%)	8(23.52%)
	1(2.94%)		

Total number of abortion in relation to period of gestation (n=34)	<b>Period of Gestation (weeks)</b>	
	<8	8-12
	18(52.94%)	16(47.06%)

**Table 2: Pregnancy Outcome in the study population**

OUTCOME	Frequency	Percent
N	66	66.0
EPF/LPF	34	34.0
Total	100	100.0

**Table 3: Distribution of patients as per gestational age (in weeks)**

GEST AGE(WEEKS)	Frequency	Percent
<8	25	25.0
8-12	75	75.0
Total	100	100.0

**Table 4: Incidence of Abnormal Parameters in TVS**

Incidence of Abnormal Parameters	Number	%
MSD>25 with No Embryo	14	14.0
YSD > 6 mm	4	4.0
Abnormal Morphology of YS	3	3.0
CRL> 4 mm with No Cardiac Activity	8	8.0
SCH or PGH	4	4.0
EHR <100 bpm	3	3.0

**Table 5: Relationship between TVS parameters and pregnancy outcome**

TVS parameters	Live	Dead	Total	p value
MGSD > 25 mm and Embryo Absent	0	14	14	<0.001
MGSD > 25 mm and Embryo Present	50	13	63	
CRL > 4 mm and Cardiac Activity Absent	2	6	8	
CRL > 4 mm and Cardiac Activity Present	60	13	73	
YSD>6 mm	0	4	4	<0.001
YSD<=6 mm	66	30	96	
EHR <= 100 min	1	2	3	0.067
EHR > 100 min	57	11	68	
SCH or PGH Present	2	2	4	0.513
SCH or PGH Absent	64	32	96	

**Table 6: Inter-relationship of different TVS parameters and prediction value (n=34)**

TVS Parameters	TP	TN	FP	FN	PPV	NPV	Diagnostic accuracy
MSD > 25 mm and Embryo Absent	14	50	0	13	100.00	79.37	83.12
CRL >4 mm and Cardiac Activity Absent	6	60	2	13	75.00	82.19	81.48
YSD>6 mm	4	66	0	30	100.00	68.75	70.00
EHR <= 100 min	2	57	1	11	66.67	83.82	83.10
SCH (subchorionic) or PGH (perigestational hemorrhage) Present	2	64	2	32	50.00	66.67	66.00
Abnormal USG: Threatened Abortion Predictive	19	7	4	0	82.61	100.00	86.67
Abnormal USG	13	12	0	19	100.00	38.71	56.82
	32	54	12	2	72.73	96.43	86.00

**Table 7: Relationship of TVS parameters with Pregnancy Outcome in Threatened Abortion**

TVS parameters	Live	Dead	Total	P value
MGSD > 25 mm and Embryo Absent	0	8	8	0.020
MGSD > 25 mm and Embryo Present	4	11	15	
CRL > 4 mm and Cardiac Activity Absent	1	4	5	
CRL > 4 mm and Cardiac Activity Present	3	15	18	
Abnormal Yolk Sac	0	5	5	0.023
Not	4	14	18	
SCH or PGH	2	2	4	0.129
Neither	2	17	19	

**Table 8: Inter-relationship between different abnormal parameters in threatened abortion and prediction value**

TVS Parameters	TP	TN	FP	FN	PPV	NPV	Diagnostic Accuracy
MSD > 25 mm and Embryo Absent	8	4	0	11	100	26.67	52.17
CRL > 4 mm and Cardiac Activity Absent	4	3	1	15	80	16.67	30.43
Abnormal Yolk Sac	5	4	0	14	100	22.22	39.13
SCH or PGH	2	2	2	17	50	10.53	17.39

**Discussion:**

The study was conducted for one year. One hundred pregnant women attending antenatal clinic of this Institution at 5-12 weeks of gestation were included. In this study, 34% patients had abnormal pregnancy. Maximum patients belonged to the age group 26-30

which is 39. There were equal number of patients in the age group 21-25 and >30 which is 23 and there were 15 patients from ≤20 yrs. The increased risk with advancing maternal age has been attributed to the increasing risk of aneuploidies [5,6]. Buss L et al also reported that increasing maternal age has been found to be a risk factor for

miscarriage [7]. In our study 49% patients were primigravida and rests were parous. In their study Kumari et al<sup>3</sup> reported 30 % were primigravida patient and 32% of abortion occur in more than 30 years. There were increases tendency of early miscarriage (40%) among those who had previous history of abortion. Maximum abortion occurred before 12 weeks (72% between 8-12weeks) and <4% abortion occurred after 12 weeks of gestation. 50% of patients with abnormally large yolk sac, 94% of patients with MSD>25 mm with absent embryo, 100% of patients with CRL>9mm and 100% with EHR<100bpm aborted. Brigham S et al [8] reported that initial period of conception is most vital as majority of the abortions occur before 12 weeks gestational age and fewer than 5% occur after identification of fetal heart activity. Second trimester loss, between 12-24 weeks, occurs less frequently and constitutes <4% of pregnancy outcomes [9]. Gestational sac (GS) is the first definitive landmark of pregnancy which is consistently visible by 5 weeks of gestation, even with TAS (Transabdominal Pregnancy), GS should be at least 10 mm larger than the CRL [10]. Higher rate of pregnancy loss is noted with a difference of less than 5 mm between GS and CRL [10]. In our study those who have abnormally large yolk sac aborted. In their study Jarjour et al.[11] reported 100% of patients with empty gestational sac aborted. We showed relationship between MGSD and pregnancy outcome. The p value is <0.001 which is significant. Hence this shows positive correlation with MSD>25 mm with absent embryo with early pregnancy failure. Embryo should be present where MSD is >25 mm. Approximately 94% of EPF occur in MSD>25 mm without an embryo [12]. Our study showed 100% abortion rate with MSD >25 mm without an embryo which signifies a very high positive correlation between MSD >25 mm without an embryo and incidence of early abortion. Fetal cardiac activity is the earliest proof of a viable pregnancy. The

cutoff CRL for detecting cardiac activity by TVS is 4 mm and by TAS is 9 mm [12, 13]. Our study showed relationship between CRL and pregnancy outcome. The p value was <0.001 which was significant. Therefore, CRL >4mm with no embryo is an important predictive factor of early pregnancy failure. In our study 75% with CRL>4mm with absent cardiac activity aborted. The findings were correlated with study done by Pennell RG et al and Levi CS et al [12,13]. Chittachoen A et al documented that a slow EHR at 7-9 weeks gestation is associated with high rate of first trimester pregnancy demise [14]. In our study 66.67% with EHR<100bpm aborted. So, evaluation of EHR as soon as possible in all pregnancies because regardless of the presence of symptoms, it is a consistent parameter in the outcome of pregnancy. Study done by Nuaim LA et al on the effects of intrauterine hemorrhage on pregnancy outcome showed that out of 92 (8.5%) patients with IUH, 20.70% patients aborted in the late first and early 2nd trimester of pregnancy [15]. In our study out of 4, where subchorionic and perigestational hemorrhage present 2 suffered from EPF and out of 96 where SCH and PGH absent 32 were aborted. We have not measured the size of hematoma in this study. But when outcome was assessed in relation to size of hematoma, 7 of 37 patients (19%) who had small hematoma (13.1cm<sup>2</sup>) aborted, compared with 12 (21.8%) of 55 patients with large hematoma (13.2cm<sup>2</sup>)<sup>15</sup>. In their study Preisler et al<sup>16</sup> reported 100% specificity of MSD>25 mm with no embryo, 100% with CRL>7mm with absent cardiac activity. In this study PPV of MSD>25mm with absent embryo is 100% and CRL>4mm with absent cardiac activity is 75%.

In our study out of 100 patients 23 suffered from threatened abortion and we have also shown the relationship between MGSD, CRL, morphology of yolk sac, PGH and pregnancy outcome in cases of threatened abortion. In cases of threatened abortion, there was 100%

PPV of MSD>25mm with no embryo, 80% of CRL>4mm with absent cardiac activity, 100% of abnormal yolk sac which was in association with study done by Kumari et al [3]. In this study 82.6% (19 out of 23) of patients with threatened abortion with abnormal TVS parameters aborted. In study done by Chritiansen et al [17], larger yolk sac was associated with increased odds of spontaneous abortion (OR=4.37, 95% CI 1.33-14.32; p=0.0149). In this study 100% of patients with large yolk sac aborted (p<0.001) and 100% of patients with abnormal morphology of yolk sac aborted (p=0.023). [18]

### Conclusion

The first trimester of pregnancy is very important as 80% pregnancy loss occurs during this period. Transvaginal Sonography (TVS) with high resolution is superior to Transabdominal Sonography (TAS). TVS can help in early diagnosis of EPF in asymptomatic patients. Timely appearance of parameters like Gestational Sac, CRL, EHR, Yolk Sac and evaluation of retroplacental and perisac area can be used to predict pregnancy outcome. It can also help in taking decision whether to continue, abort or follow conservative management. TVS is an important diagnostic tool in diagnosis and management of EPF. It can reduce the number of unnecessary terminations of pregnancy in patients with symptoms of EPF and can diagnose EPF in asymptomatic patients.

### References

1. Edey K, Draycott T, Akande V. Early pregnancy assessment units. *Clin Obstet Gynecol* 2007; 50:146– 153.
2. Goldstein S. Early detection of pathologic pregnancy by transvaginal sonography. *J Clin Ultrasound* 1990; 18:262–73.
3. Kumari S, Roychowdhury J, Biswas S. Prediction of early pregnancy failure by use of first trimester ultrasound screening.

- Int J Reprod Contracept Obstet Gynecol 2016; 5:2135-40.
4. Kaur A, Kaur A; Transvaginal ultrasonography in first trimester of pregnancy and its comparison with transabdominal ultrasonography; *Journal of Pharmacy and Bioallied Sciences*; 2011; Vol 3; 329-338.
5. Blohm F, Fridén B, Milsom I. A prospective longitudinal population-based study of clinical miscarriage in an urban Swedish population. *BJOG* 2008; 115:176– 183.
6. Martin RH. Meiotic errors in human oogenesis and spermatogenesis. *Reprod Biomed Online* 2008; 16:523 – 531.
7. Buss L, Tolstrup J, Munk C, Bergholt T, Ottesen B, Gronbaek M, Kjaer SK. Spontaneous abortion: a prospective cohort study of younger women from the general population in Denmark. Validation, occurrence and risk determinants. *Acta Obstet Gynecol Scand.* 2006; 85(4):467-75.
8. Brigham S, Conlon C, Farquharson RG. A longitudinal study of pregnancy outcome following idiopathic recurring miscarriage. *Hum Reprod.* 1999; 14:2868-71.
9. Ugwumadu A, Manyonda I, Reid F, Hay P. Effect of early oral clindamycin on late miscarriage and preterm delivery in asymptomatic women with abnormal vaginal flora and bacterial vaginosis; a randomized controlled trial. *Lancet.* 2003; 361:983-8.
10. Bisset RA. Differential diagnosis in obstetrics and gynecologic ultrasound. Elsevier Health Sciences; 2013 Nov 28.
11. Jarjour L, Kletzky OA. Reliability of transvaginal ultrasound in detecting first trimester pregnancy abnormalities. *Fertil Steril*; 1991; Vol 56;202-207.
12. Pennell RG, Needelman L, Pajak T. Prospective comparison of vaginal and abdominal sonography in normal early

- pregnancy. J Ultrasound Med. 1991; 10:63-7.
13. Levi CS, Lyons EA, Zheng XH. Transvaginal US: Demonstration of cardiac activity in embryos less than 5.0 mm in crown-rump length. Radiology. 1990; 176:71-4.
  14. Chittachoen A, Herabutya Y. Slow fetal heart rate may predict pregnancy outcome I first trimester threatened abortion. Fertil Steril. 2004; 82:227-9.
  15. Nuaim LA, Chowdhury N, Adelusi B. Subchorionic hematoma in threatened abortion: sonographic evaluation and significance. Ann Saudi Med. 1996;16(6):650-3.
  16. Preisler J, Kopeika J, Ismail L, Vathanan V, Farren J, Abdallah Y, et al. Defining safe criteria to diagnose miscarriage: prospective observational multicentre study. BMJ. 2015;351:h4579. pmid:26400869.
  17. Christiansen, M & Francillon, L.I. & Ikwuezunma, G.B. & Gordon, J & Goedecke, Patricia & Bursac, Z & Detti, Laura. (2017). Prediction of first trimester miscarriage by ultrasound. Fertility and Sterility. 108. e383-e384. 10.1016/j.fertnstert.2017.07.1113.
  18. Wijegunasekara, H. Reproductive Health Management Information System in Sri Lanka: Reflective writing. Journal of Medical Research and Health Sciences, 2021;4(9), 1456–1460.