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Original Research Article

Study of Ultra-Sonographic Parameters in Predicting Miscarriage in Patients between 6 to 12 Weeks of Gestation

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Abstract:

Aim: To study the association of early pregnancy Ultra Sonographic (USG) parameters, maternal factors in the present pregnancy and the history of previous pregnancy in predicting early miscarriage.

Materials and Methods: A prospective cohort study was conducted in the Department of Obstetrics and Gynecology (OBG) at Chalmeda Anand Rao Institute of Medical Sciences (CAIMS). 100 pregnant women who presented between 6-12 weeks to OBG Out Patient Department (OPD) for routine Ante Natal Care (ANC) or with complaints of pain abdomen/bleeding per vaginum (PV)were subjected to Ultra Sonographic examination where the parameters such as Crown Rump Length (CRL), Mean Sac Diameter (MSD), Yolk Sac Diameter (YSD), and Fetal Heart Rate (FHR) were documented and were followed up to 24 weeks.

Results: Among the pregnant women with complaints of pain abdomen/spotting/bleeding, chance of miscarriage was found to be 47%. MSD-CRL < 5mm was a significant predictor of early pregnancy loss with sensitivity of 70% and specificity of 92.5%. Abnormal YSD was found to be a statistically significant predictor of miscarriage (sensitivity – 50% and specificity – 78.7%). The sensitivity of fetal bradycardia in predicting miscarriage was 60% and specificity was 98%.

Conclusion: Among all the Ultrasound scan parameters fetal bradycardia had a better sensitivity in predicting impending miscarriage. Whenever a pregnant woman presents in early pregnancy, between 6 – 12 weeks of gestation, maternal age and a thorough history of previous pregnancy should be noted, and an ultrasound should be advised.

Keywords: Miscarriage, Early pregnancy, USG Parameters, Bleeding Per Vagina.

Introduction

Miscarriage is defined as involuntary termination of pregnancy before 20th week of gestation. Approximately 12 to 24 percent of all pregnancies suffer miscarriages, among these 70% of miscarriages occur in first 12 weeks. The women who are at risk of having miscarriage can be assessed by the changes seen in the first trimester scan. First trimester of pregnancy is the most important period of human development in which single cell transforms into a recognizable human being [1]. The Advent of Ultrasound Trans Vaginal Sonography/ Trans Abdominal Sonography (TVS/TAS) has revolutionized role in assessing establishment and evaluation of early pregnancy. It also helps in diagnosing any untoward events in the early pregnancy and may guide its appropriate management. Therefore, ultrasound is an easily available tool to differentiate normal from abnormal pregnancy. First trimester scan has been used as dating scan in which CRL is considered as accurate method of assessing the gestational age.

Various studies have shown that the pregnancy loss before 20 weeks is associated with abnormalities in large yolk sac diameter, mean sac diameter-smaller sac size, embryonic bradycardia and MSD-CRL<5. But in first trimester there is no single ultrasound measurement of any anatomical feature to show high predictive value in determining early pregnancy outcome. The objective of this prospective study was to assess accuracy of the first trimester USG markers such as MSD, YSD and FHR corrected for CRL between 6 to 12 weeks along with maternal factors like: maternal age, obstetric history, occurrence of vaginal bleeding and subchorionic bleed etc., to predict the risk of pregnancy failure.

Methodology

A prospective cohort study was carried out by ultrasonography as the main modality in 100 pregnant women between 6 to 12 weeks of gestation with intra-uterine singleton pregnancies who came for regular follow-up and/or with

complaints of bleeding P/V, spotting P/V and pain abdomen to Chalmeda Anand Rao Institute Of Medical Sciences from December 2017 to June 2019. These patients were subjected to routine ultrasonographic examination (TAS/TVS) and parameters like CRL, YSD, MSD and FHR were measured.

These patients based on specific ultrasonographic criteria, in each parameter were grouped as normal, increased or decreased. Cases with Extra uterine pregnancy, multiple pregnancy, cervical incompetence (previously diagnosed), endocrine disorders, uterine anomalies, pregnant women with history of chronic systemic illness and blighted ovum were excluded from the study. These cases were counselled and followed up to 24 weeks and the number of cases who had miscarriage and number of cases who continued pregnancy was noted. Data was analyzed using computer software, Statistical Package for Social Sciences (SPSS), version 25. Data was expressed in its frequency and percentage and compared with the different outcome groups. To explain the associations and comparisons between these two groups (x^2) Chi-square tests was used. For all statistical evaluations, a p value of <0.05 was considered significant. To identify the risk ratio of the variables logistic regression model was used.

Measurement of Ultrasonographic Parameters

1. Crown Rump Length

- CRL, the length of the fetus from top of its head to bottom of the buttocks, was measured in mm.
- It was measured by following certain features:

a) Fetus should be in neutral position.
b) Mid sagittal section.
c) Fetus should be horizontal.
d) Crown and rump should be clearly seen.
e) It was measured by placing the callipers between the outer borders of the skin overhead and rump.

- Gestational age was calculated using Crown Rump Length (CRL+4.2 gives gestational age in days).

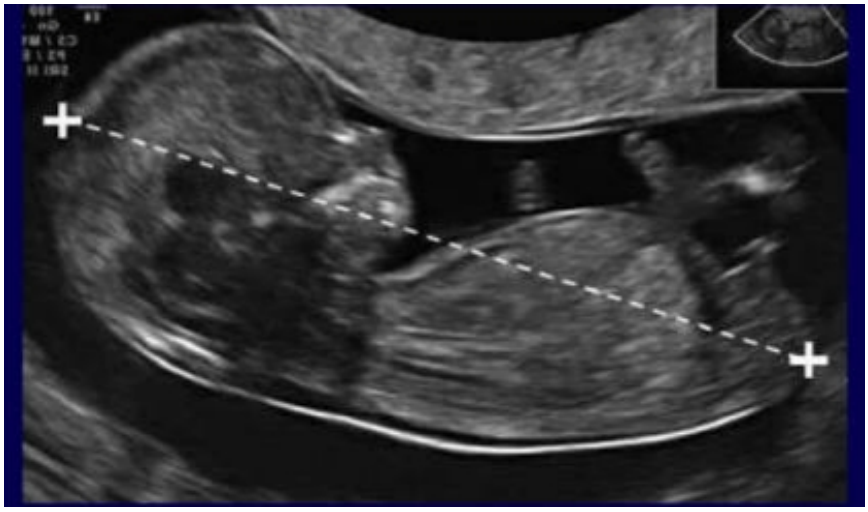

Figure 1: CRL Measurement

Table 1: Gestational Age and CRL

Gestational age in weeks	CRL (in mm)
6 weeks	4 mm
7 weeks	11 mm
8 weeks	17 mm
9 weeks	23 mm
10 weeks	34 mm
11 weeks	44 mm
12 weeks	57 mm

1. Mean Gestational SacDiameter

Mean Gestational Sac diameter was measured by taking the average of three perpendicular diameters of the gestational sac.

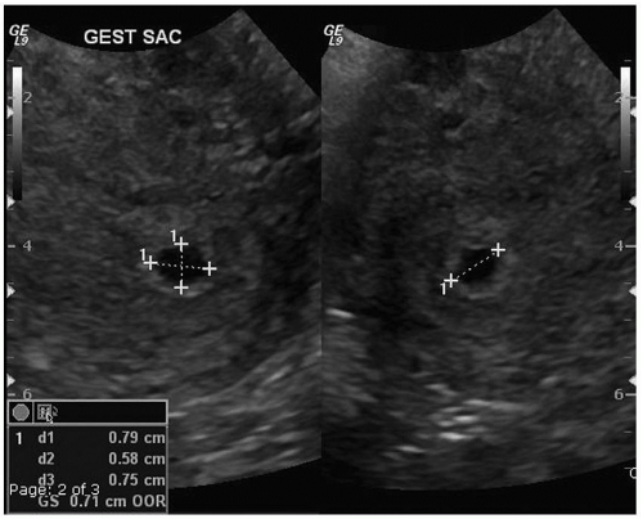

Figure 2: Mean Sac Diameter

Table 2: Gestational age and MSD

Gestational age (in weeks)	MSD (in cm)
6 to 6+6	1.7 – 2.3
7 to 7+6	2.4 – 3.0
8 to 8+6	3.1 – 3.7
9 to 9+6	3.8 – 4.4
10 to 10+6	4.5 – 5.1
11 to 11+6	5.2 – 5.8
12 to 12+6	5.9 – 6.3

After measuring MSD, it was classified into normal, increased or decreased MSD according to the above table.

2. Yolk Sac Diameter

Table 3: Gestational age and YSD

Gestational age (in weeks)	Yolk sac diameter (in mm)
6 weeks	2.3-3.8mm
7 weeks	3.1-4.9mm
8 weeks	4.0-5.4mm
9 weeks	4.6-5.9mm
10 weeks	5.3-6.5mm
11 weeks	4.5-6.2mm
12 weeks	3.5-5.1mm

It was measured by placing calipers on the inner limits of the longer diameter of the yolk sac. After measuring the size YSD, it was classified as normal, increased or decreased for that particular gestational age, according to the above table.

Figure 3: Yolk Sac diameter

3. Fetal Heart Rate

FHR was measured in patients between 6-12 weeks of gestation and was classified as normal, increased (tachycardia) or decreased (bradycardia) based on the table given below.

Table 4: Gestational age and FHR

Gestational age (in weeks)	FHR (in bpm)
6 weeks	112 -136
7 weeks	116 -140
8 weeks	126 -164
9 weeks	126 -151
10 weeks	126 -148
11 weeks	120 -160
12 weeks	120 -150

All the patients were followed up to 24 weeks and the outcome was assessed as those who:

- Continued pregnancy beyond 24weeks
- Spontaneous miscarriage
- Missed miscarriage

Results

1. Age and Gravida

Table 5: Distribution of Age and Gravida

Age (y)	Frequency	Age %	Gravida	Gravida %
Below 25	58	58	Gravida 1	40
26 – 30	32	32	Gravida 2	34
31 and above	10	10	Gravida ≥3	26
Total	100	100	Total	100

Out of 100 cases, most of the patients were in the age group of 21 – 25 (55.32%) years.Among 100 cases, 40 of them were primigravida, 34 of them were Gravida2 and 26 of them were Gravida≥3.

2. Distribution of Outcome

Table 6: Distribution of Outcome

Outcome	Frequency	Percentage
Continued Pregnancy beyond 24 weeks	80	80
Spontaneous miscarriage	13	13
Missed miscarriage	7	7
Total	100	100

Out of 100 cases, 80 cases continued pregnancy beyond 24 weeks, 20 ended in miscarriage. Among them, 13 had spontaneous miscarriage and 7 cases had missed miscarriage.

3. Presenting Complaints Vs Outcome

Table 7: Presenting Complaints Vs Outcome

Presenting complaints	Frequency	Percentage	Outcome			Total
			Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage	
Routine ANC No Complaints	66	66 %	62(93.93)	3(4.5)	1(1.5)	66(100)
Pain Abdomen	10	10 %	6(60)	2(20)	2(20)	10(100)
Spotting / bleeding P/V	15	15 %	8(53.33)	5(33.33)	2(13.3)	15(100)
Pain + bleeding P/V	9	9 %	4(44.44)	3(33.33)	2(22.22)	9(100)
Total	100	100 %	80	13	7	100(100)

P value: <0.001

- Out of 100 cases who came to CAIMS, 66 cases came for routine ANCvisit, 10 cases came with pain abdomen, 15 cases came with spotting /bleeding PV, 9 cases presented with both spotting and pain abdomen.
- Out of 66 cases of routine ANC, 93.93% (62) continued pregnancy beyond 24 weeks, 4.5% (3) had spontaneous miscarriage and 1.5% (1) had missed miscarriage.
- Out of 10 cases with pain abdomen, 60% (6)

had continued pregnancy beyond 24 weeks, 20% (2) had spontaneous and 20% (2) had missed miscarriage.

- Out of 15 cases with Spotting or bleeding PV, 53.33% (8) had continued pregnancy beyond 24 weeks, 33.33% (5) had spontaneous and 13.3% (2) had missed miscarriage.
- Out of 9 cases with pain + bleeding PV, 44.44% (4) had continued pregnancy beyond 24 weeks, 33.33% (3) had spontaneous and 22.22% (2) had missed miscarriage.

4. MSD and YSD Vs Outcome

Table 8: MSD & YSD Vs Outcome

	MSD Frequency %	YSD Frequency %	MSD Outcome			YSD Outcome		
			Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage	Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage
Normal	75%	73%	63(84)	10(13.33)	2(2.6)	63(86.3)	6(8.2)	4(5.4)
Reduced	21%	9%	13(61.9)	3(14.2)	5(23.8)	8(88.88)	0(0)	1(11.11)
Increased	4%	18%	4(100)	0(0)	0(0)	9(50)	7(38.8)	2(11.11)
Total	100%	100%	80	13	7	80	13	100(100)

p value: 0.014 (significance at 5%) for MSD and p Value: 0.006 (Significant 1%) for YSD

- Out of 100 cases, 75 women had normal mean sac diameter for that gestational age, 21 women had reduced and 4 women had increased MSD.
- Out of 75 cases who had normal MSD, 84% (63) had continued pregnancy beyond 24 weeks, 13.33% (10) had spontaneous miscarriage and 2.6% (2) ended in missed miscarriage.
- Out of 21 cases who had reduced MSD, 61.9% (13) had continued pregnancy beyond 24 weeks, 14.2% (3) had spontaneous miscarriage and 23.8% (5) ended in missed miscarriage Out of 4 cases in Increased MSD, 100% (4) had continued pregnancy beyond 24 weeks.
- Out of 100 cases, 73 women had normal Yolk sac diameter for that gestational age, 9 women had reduced and 18 women had increased MSD.
- Out of 73 cases with normal YSD, 86.3% (63) continued pregnancy beyond 24 weeks, 8.2% (6) had spontaneous miscarriage and 5.4% (4) had missed miscarriage.
- Out of 9 cases with Reduced YSD, 88.8% (8) continued pregnancy beyond 24 weeks, 0% (0) had spontaneous miscarriage and 11.11% (1) had missed miscarriage.
- Out of 18 cases with Increased YSD, 50% (9) continued pregnancy beyond 24 weeks, 38.8% (7) had spontaneous miscarriage and 11.11% (2) had missed miscarriage.

5. FHR Vs Outcome

Table 9: Fetal Heart Rate Vs Outcome

FHR	Frequency	Percentage	Outcome			Total
			Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage	
Normal	64	64%	56 (87.5)	6 (9.3)	2 (3.1)	64 (100)
Reduced	13	13%	1 (7.6)	7 (53.8)	5 (38.4)	13 (100)
Increased	23	23 %	23 (100)	0 (0)	0 (0)	23 (100)
Total	100	100 %	80	13	7	100 (100)

p Value: <0.001

- Out of 100 cases, 64 cases had normal FHR for that particular gestational age, 13 had bradycardia and 23 had tachycardia.
- Out of 64 cases with Normal FHR, 87.5% (56) continued pregnancy beyond 24 weeks, 9.3% (6) had spontaneous miscarriage and 3.1% (2) had missed miscarriage.
- Out of 13 cases with Reduced FHR, 7.6% (1) continued pregnancy beyond 24 weeks, 53.8% (7) had spontaneous miscarriage and 38.4% (5) had missed miscarriage.
- Out of 23 cases with Increased FHR, 100% (23) continued pregnancy beyond 24 weeks.

6. MSD less CRL

Table 10: MSD – CRL Vs Outcome

MSD CRL	Frequency	Percentage	Outcome			Total
			Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage	
< 5	20	20 %	6 (30)	8 (40)	6 (30)	20(100)
> 5	80	80 %	74 (92.5)	5(6.25)	1(1.25)	80(100)
Total	100	100 %	80	13	7	100(100)

p Value: <0.001

- Out of 100 cases, 20 of the cases had MSD-C RL < 5 and 80 of cases had MSD-CRL > 5.
- Out of 20 cases with MSD - CRL <5, 30% (6) continued pregnancy beyond 24 weeks, 40% (8) had spontaneous miscarriage and 30% (6) had missed miscarriage. Out of 80 cases with MSD - CRL >5, 92.5% (74) continued pregnancy beyond 24 weeks, 6.25% (5) had spontaneous miscarriage and 1.25% (1) had missed miscarriage.

7. Sub chorionic bleed Vs Outcome

Table 11: Subchorionic bleed Vs Outcome

Sub – Chorionic bleed	Frequency	Percentage	Outcome			Total
			Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage	
Yes	29	29 %	15 (51.7)	10 (34.4)	4 (13.7)	29(100)
No	71	71 %	65 (91.5)	3 (4.22)	3 (4.22)	71(100)
Total	100	100 %	80	13	7	100(100)

p value <0.001

- Out of 100 cases, 29 of the cases had Subchorionic bleed on USG examination and 71 of the cases had no subchorionic bleed.
- Out of 29 cases with Sub-chorionic bleed, 51.7% (15) continued pregnancy beyond 24 weeks, 34.4% (10) had spontaneous miscarriage and 13.7% (4) had missed miscarriage.
- Out of 71 cases with No Sub-chorionic bleed, 91.5% (65) continued pregnancy beyond 24 weeks, 4.22% (3) had spontaneous miscarriage and 4.22% (3) had missed miscarriage.

8. Number of miscarriages in Previous Pregnancies VS Outcome

Table 12: Number of miscarriages in Previous Pregnancies Vs Outcome

No. of miscarriages in previous pregnancies	Frequency	Percentage	Outcome			Total
			Continued Pregnancy beyond 24 weeks	Spontaneous miscarriage	Missed miscarriage	
Nil	72	72%	64 (88.8)	6 (8.3)	2 (4.16)	72 (100)
1	21	21%	14 (66.66)	5 (23.8)	2 (9.5)	21 (100)
2	4	4%	1 (25)	2 (50)	1 (25)	4 (100)
≥ 3	3	3%	1 (33.33)	0 (0)	2 (66.66)	3 (100)
Total	100	100%	80	13	7	100 (100)

p value: <0.001

Out of 100 cases, 72% had no miscarriage, 21% had 1 miscarriage, 4% had 2 miscarriages and 3% had ≥ 3 miscarriages.

Outcome

- Out of 72 cases with no miscarriages in the past, 88.8% (64) continued pregnancy beyond 24 weeks, 8.3% (6) had spontaneous miscarriages and 4.16% (2) had missed miscarriage.
- Out of 21 cases with 1 miscarriage in the past, 66.66% (14) continued pregnancy beyond 24 weeks, 23.8% (5) had spontaneous miscarriages and 9.5% (2) had missed miscarriage.
- Out of 4 cases with 2 miscarriages in the past, 25% (1) continued pregnancy beyond 24 weeks, 50% (2) had spontaneous miscarriages and 25% (1) had missed miscarriage.
- Out of 3 cases with ≥ 3 miscarriage in the past, 33.33% (1) continued pregnancy beyond 24 weeks, 0 (0) had spontaneous miscarriages and 66.66% (2) had missed miscarriage.

Discussion

The Advent of Ultrasound (TVS/TAS) has revolutionized role in assessing establishment and evaluation of early pregnancy. It also helps in diagnosing any untoward events in the early pregnancy and may guide its appropriate management. Therefore, ultrasound is an easily available tool to differentiate normal from abnormal pregnancy. First trimester has been used as dating scan in which CRL is considered as accurate method of assessing the gestational age. Various studies have shown that the pregnancy loss before 20 weeks is associated with abnormalities in large yolk sac diameter, mean sac diameter-smaller sac size, embryonic bradycardia and MSD-CRL<5. But in first trimester there is no single ultrasound measurement of any anatomical feature to show high predictive value in determining early pregnancy outcome.

In this study, majority were in the age group of 21 to 25 years (52%). This correlates with the study by Cleary Goldman, where majority of cases were < 30 years (79%).

In our study, the risk of miscarriage was 60% when maternal age is ≥ 30 years and the risk of miscarriage was 10% when the maternal age is < 30 years. Hence, the chance of miscarriage increases as the age advances. These findings correlate with Maria C Magnus et al[2] and, Anderson A et al [3].According to the study by Maria C Magnus, the risk of miscarriage was lowest among women aged 25 to 29 (10%) and rose rapidly after age 30 reaching 53% among women aged 45 years and over. According to study by Anderson A et al, the risk of miscarriage was 8.9% when maternal age is between 20 – 24 years and 74.7% when maternal age is more than 45 years.

In our study, number of Primigravida were 40 and number of Multigravida were 60. The percentage of miscarriage was 40% in Primigravida and 60% in Multigravida. Therefore, more number of miscarriages were seen in the higher order of gravida. These findings were similar to study by Saima Naz et al [4], in which 45% of miscarriages were in primigravida and 55% of miscarriages were seen in multigravida.

As the number of miscarriages in previous pregnancy increased, the chance of miscarriage in subsequent pregnancies also increased. In this study, those who had ≥3 miscarriages in previous pregnancies had 66.6% chance of miscarriage in the present pregnancy. But odds ratio in this study was not statistically significant because p value = 0.76. In this study, the odds ratio for women with ≥ 3 is 3 (Confidence Interval 95% 0.24, 37.67). According to Maria C Magnus, the odds ratio for women with ≥ 3 is 3.97 (Confidence Interval 95% 3.24, 4.78). According to Baba S etal [5], the odds ratio for women with ≥ 3 was 8.7 (Confidence Interval 95% 5.2, 4.6).

The chance of miscarriage, when a woman came to the hospital with complaints of spotting / bleeding per vaginum and pain abdomen was found to be 50% which was statistically significant (p value < 0.008). Among these complaints, spotting or bleeding per vaginum had a higher risk of miscarriage than pain abdomen with odds ratio of 4.8 (95% Confidence interval 1.49 – 15.62).

Reem Hasan et al [6], found that any bleeding P/V, including episodes of only spotting, the unadjusted relative odds ratio of miscarriage was 1.1 (95% Confidence interval 0.9–1.3).

In this study 25% of cases with abnormal MSD had early pregnancy loss. When MSD was smaller for that particular gestational age, the chance of miscarriage was more (p value < 0.014). Out of overall cases with smaller MSD 38.09% resulted in miscarriages, with a sensitivity of 40% and specificity of 82.8%. According to Snigdha Kumari et al [7], 50% of the cases with smaller Mean sac diameter ended in miscarriage.

These results were similar to study by Husnu Alptekin et al [8], where the mean gestation sac diameter was smaller and had significance in predicting miscarriage (p-value < 0.001). The sensitivity of this study was 50% and the specificity was 90%

These results were similar to the studies by Nazari et al [9], where mean sac diameter was smaller than expected and the ability to predict miscarriage was 71%.

These results were similar to the studies by Serif Fathil El-Mekkawai et al [10], where they showed

that an MSD of <14mm, predicts miscarriage with a sensitivity and specificity of 96% and 74%, respectively [4].

In this study, 37.03% of abnormal YSD had early pregnancy loss, out of which 90% had increased YSD. Hence an abnormal YSD is statistically significant in predicting miscarriage (p value = 0.006, which is statistically significant).

This correlates with the results of the study by Geetanjali Srivastava et al [11] where abnormal size of YSD was statistically significant (p < 0.006) in predicting spontaneous miscarriage. The findings of this study are consistent with the study by Adija P et al [12] where miscarriages due to abnormal yolk sac size occurred in 35.7% cases and 80% of these miscarriages were due to enlarged yolk sac.

This study correlates with the study of Stampson C et al [13], where abnormal size was statistically significant of YSD (p < 0.001) in predicting miscarriage; with sensitivity of 68.7% and specificity of 99%.

But Reece EA et al and Husnu Alptekin et al in their study, showed that the size of yolk sac was not a sensitive predictor of embryonic integrity and pregnancy outcome.

Fetal bradycardia between 6 – 12 weeks was a good predictor of miscarriage. In this study, 36% of the cases had abnormal FHR. Out of the cases which had fetal bradycardia, 92% had a miscarriage. This was statistically significant with p value= 0.001 and the sensitivity was 60% and specificity was 98.2%.

These results correlated with the studies of Husnu Alptekin et al [8], with fetal bradycardia (< 112 bpm) predicts miscarriage of 61.5% and which is statistically significant with p value <0.001.

Alin Basgul [14] showed that, slow fetal heart rate which is less than 85 beats per minute was associated with poor prognosis. FHR at < 85bpm at more than 7 weeks gestation with MSD – CRL < 5mm, with enlarged or abnormally shaped yolk sac and sub–chorionic hematoma had a pregnancy loss rate of 9%.

In our study when MSD – CRL was <5mm, 70% (20 cases) had miscarriages. This was statistically significant (p value <0.001).

Nazari et al [9] in their study MSD – CRL < 5mm, showed miscarriage with sensitivity of 56% and specificity of 82%.

But CHOONG et al [15], in their study showed that the separate univariate analysis of MSD – CRL had a significantly smaller ROC area (0.65) than did the multivariate model (combining MSD+YSD+FHR+MSD-CRL<5) (p<0.01), hence MSD-CRL was individually not predictive of miscarriage.

Presence of subchorionic bleed is a good predictor of miscarriage in early pregnancy. In this study out of 29 cases with subchorionic bleed, 48.2% had miscarriage, which was statistically significant with p value <0.001.

This correlated with the study done by Yavuz et al [16] they had 29.5% pregnancies with sub-chorionic hematoma ended in miscarriage whereas, 12.6% pregnancies without sub-chorionic hematoma resulted in miscarriage (p value = 0.010). But the study by Pederson et al [17], between 9 to 20 weeks of gestation, showed that the rate of spontaneous miscarriage was the same in patients with and without hematoma, 11% and 10% respectively.

According to Johns et al [18], first trimester vaginal bleeding is associated with adverse pregnancy outcome by presence of sub–chorionic hematoma had no effect on prognosis.

Conclusion

Among all the Ultrasound scan parameters fetal bradycardia had a better sensitivity in predicting impending miscarriage. Increased YSD and small MSD have similar sensitivity and specificity. Maternal factors such as increased age, parity and history of ≥3 miscarriages in the past increases the chance of miscarriage in the present pregnancy.

Whenever a pregnant woman presents in early pregnancy, between 6 – 12 weeks of gestation, maternal age and a thorough history of previous pregnancy should be noted and an ultrasound should be advised. In the ultrasound examination - CRL, MSD, YSD and FHR should be measured and any abnormality, especially a smaller MSD, larger YSD, fetal bradycardia and presence of subchorionic hematoma should be noted. Patients with any of these abnormalities will require more frequent follow-up and counselling regarding the chance of poor pregnancy outcome.

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