Section: Miscellaneous

Original Research Article

FIRST-TRIMESTER SERUM PROGESTERONE LEVELS IN MISSED MISCARRIAGE VERSUS VIABLE PREGNANCY: A CASE-CONTROL STUDY

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ABSTRACT

Background: Missed miscarriage is a common form of early pregnancy loss and is frequently associated with hormonal insufficiency during early gestation. Progesterone plays a vital role in maintenance of pregnancy and may serve as a useful biochemical marker for assessment of pregnancy viability. The aim is to compare first-trimester serum progesterone levels between women with missed miscarriage and women with viable intrauterine pregnancy.

Materials and Methods: This hospital-based case-control study was conducted at District Hospital, Sheoganj, Sirohi, Rajasthan, from May 2024 to October 2025. A total of 120 pregnant women between 6 and 12 weeks of gestation were enrolled, including 60 women with missed miscarriage and 60 women with viable pregnancy. Serum progesterone estimation was performed using chemiluminescent immunoassay technique. Data were analyzed using SPSS version 25.0, and p-value <0.05 was considered statistically significant.

Results: The mean serum progesterone level among women with missed miscarriage was significantly lower than that among women with viable pregnancy (11.8 ± 4.6 ng/mL vs. 24.7 ± 6.3 ng/mL; p=0.0002). Most women with missed miscarriage demonstrated progesterone levels below 15 ng/mL, whereas women with viable pregnancy predominantly exhibited levels above 20 ng/mL. Serum progesterone levels below 15 ng/mL showed a strong association with missed miscarriage (OR=8.72; 95% CI: 3.91–19.42; p=0.0001).

Conclusion: First-trimester serum progesterone levels were significantly lower among women with missed miscarriage compared with viable pregnancy. Serum progesterone estimation may serve as a useful adjunctive biochemical marker for evaluation of early pregnancy viability.

Keywords: Progesterone; Missed miscarriage; Viable pregnancy; First trimester; Pregnancy loss; Case-control study.

INTRODUCTION

Early pregnancy loss is one of the most common complications encountered during human gestation and represents a major source of emotional and psychological distress for affected women and their families. Clinically recognized spontaneous miscarriage occurs in nearly 10–20% of pregnancies, with the majority taking place during the first trimester.[1] Among the various forms of early pregnancy failure, missed miscarriage constitutes an important clinical entity characterized by intrauterine fetal demise without immediate expulsion of the products of conception. In such cases, ultrasonography typically demonstrates absence of fetal cardiac activity despite retention of gestational tissue within the uterine cavity.[2] The condition often presents with minimal symptoms, making early diagnosis and prediction challenging in routine obstetric practice.

The maintenance of early pregnancy is highly dependent upon an adequate hormonal environment, particularly the secretion of progesterone during the first trimester. Progesterone is initially produced by the corpus luteum under the influence of human chorionic gonadotropin and later by the placenta as

pregnancy advances. This hormone plays a crucial role in endometrial decidualization, embryo implantation, suppression of myometrial contractility, and modulation of maternal immune tolerance toward fetal tissues.[3] Inadequate progesterone secretion during early gestation has been associated with impaired implantation and pregnancy failure, suggesting that progesterone may serve as an important biochemical marker of pregnancy viability.

Several investigators have attempted to evaluate the diagnostic value of serum progesterone measurement in women presenting with early pregnancy complications. Lower progesterone concentrations have consistently been reported among women with spontaneous miscarriage compared with women having viable intrauterine pregnancy.[4] Furthermore, serum progesterone estimation has gained clinical importance because it is relatively inexpensive, minimally invasive, and widely available even in resource-limited healthcare settings. In situations where ultrasonographic findings remain inconclusive, biochemical markers such as progesterone may provide additional support in differentiating viable from non-viable pregnancy.[5]

Missed miscarriage is multifactorial in origin and may result from chromosomal abnormalities, defective placentation, endocrine dysfunction, immunological disturbances, or impaired trophoblastic development. Since progesterone secretion is closely linked with corpus luteal function and placental viability, reduced serum levels may reflect early trophoblastic insufficiency before clinical manifestations become apparent.[6] Identification of significantly altered progesterone levels in women with missed miscarriage may therefore facilitate earlier diagnosis and timely clinical intervention.

Despite increasing interest in progesterone as a predictive marker of early pregnancy outcome, published studies have demonstrated variability in progesterone cutoff values, gestational age at assessment, laboratory assay methods, and patient selection criteria. Such heterogeneity has limited the universal application of serum progesterone testing in routine clinical practice.[7] Moreover, there remains a relative paucity of data from Indian populations, particularly from community-based healthcare settings where diagnostic resources may be limited. Understanding the relationship between first-trimester serum progesterone levels and pregnancy viability in these settings may provide clinically useful information for obstetricians involved in early pregnancy care.

In view of these considerations, the present case-control study was undertaken to compare first-trimester serum progesterone levels between women with missed miscarriage and women with viable pregnancy attending District Hospital, Sheoganj, Sirohi, Rajasthan. The study also aimed to evaluate the association between low serum progesterone levels and missed miscarriage during early gestation.

MATERIALS AND METHODS

Study Design and Setting: The present investigation was conducted as a hospital-based case-control study at District Hospital, Sheoganj, Sirohi district, Rajasthan, India, over a study period extending from May 2024 to October 2025. The study was designed to compare first-trimester serum progesterone levels between women diagnosed with missed miscarriage and women with viable intrauterine pregnancy. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to commencement of participant recruitment. All procedures performed during the study were carried out in accordance with the ethical principles outlined in the Declaration of Helsinki for medical research involving human subjects.[8]

Study Population: Pregnant women attending the obstetrics and gynecology department during the first trimester of pregnancy were screened for eligibility and invited to participate in the study after obtaining written informed consent. Participants were divided into two groups according to ultrasonographic findings:

- Case group: Women diagnosed with missed miscarriage.
- Control group: Women with confirmed viable intrauterine pregnancy.

Missed miscarriage was diagnosed on ultrasonography by the presence of an intrauterine gestational sac with absent fetal cardiac activity and retained products of conception. Viable pregnancy was confirmed by demonstration of fetal cardiac activity within the uterine cavity.[9]

Sample Size and Sampling Technique: A total of 120 pregnant women in the first trimester of pregnancy were enrolled in the present study during the study period. Among them, 60 women diagnosed with missed miscarriage constituted the case group, while 60 women with viable intrauterine pregnancy served as the control group. Consecutive sampling technique was used, and eligible participants fulfilling the inclusion criteria were recruited until the required sample size was achieved.

Inclusion Criteria

Women fulfilling the following criteria were included in the study:

- Age between 18 and 35 years
- Singleton intrauterine pregnancy
- Gestational age between 6 and 12 weeks
- Willingness to participate in the study and provide written informed consent

Exclusion Criteria

Participants with the following conditions were excluded from the study:

- Ectopic pregnancy
- Molar pregnancy
- Multiple gestation
- Recurrent miscarriage
- History of progesterone supplementation during current pregnancy

- Chronic systemic illness such as diabetes mellitus, hypertension, renal disease, or autoimmune disorders
- Endocrine abnormalities including thyroid dysfunction
- Women with known uterine anomalies

These exclusion criteria were applied to minimize confounding factors that could independently influence serum progesterone levels or pregnancy outcome.[10]

Data Collection Procedure: A detailed clinical and obstetric history was obtained from all enrolled participants using a structured predesigned proforma. Information regarding maternal age, gravidity, parity, gestational age, previous obstetric history, menstrual history, and presenting symptoms was recorded systematically. General physical examination and obstetric examination were performed in all cases.

Gestational age was calculated from the first day of the last menstrual period and further confirmed by ultrasonographic assessment whenever required. Ultrasonography was performed using standard transabdominal or transvaginal techniques by qualified radiologists or obstetricians to confirm fetal viability and establish diagnosis.

Blood Sample Collection and Serum Progesterone Estimation: Venous blood samples were collected from all participants under aseptic precautions before initiation of any therapeutic intervention. Approximately 3–5 mL of venous blood was obtained from the antecubital vein and transferred into plain sterile tubes. The samples were centrifuged at 3000 revolutions per minute for serum separation, and the separated serum was processed for progesterone estimation in the institutional central laboratory.

Serum progesterone concentration was measured using a chemiluminescent immunoassay method according to standardized laboratory protocols and manufacturer instructions. Internal quality control measures were maintained throughout the study to ensure reliability and reproducibility of laboratory results.[11]

Outcome Measures: The primary outcome measure of the study was comparison of mean first-trimester serum progesterone levels between women with missed miscarriage and women with viable pregnancy. Secondary outcome measures included evaluation of the association between serum progesterone categories and pregnancy viability.

Statistical Analysis: The collected data were entered into Microsoft Excel spreadsheets and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Quantitative variables were expressed as mean ± standard deviation, whereas qualitative variables were presented as frequency and percentage.

Comparison of continuous variables between the two groups was performed using Student's t-test after assessment of normal distribution. Chi-square test or Fisher's exact test was applied for comparison of categorical variables wherever appropriate. Statistical significance was considered at a p-value of less than 0.05.[12]

RESULTS

A total of 120 pregnant women in the first trimester of pregnancy were enrolled in the present study during the study period. Of these participants, 60 women diagnosed with missed miscarriage constituted the case group, while 60 women with viable intrauterine pregnancy formed the control group.

Baseline Demographic Characteristics of Study Participants: The demographic characteristics of women included in the study were analyzed to determine comparability between the two groups. The mean maternal age in the missed miscarriage group was 27.4 ± 4.1 years, whereas the mean age among women with viable pregnancy was 26.9 ± 3.8 years. Statistical analysis revealed no significant difference between the two groups with respect to maternal age.

Similarly, comparison of gravidity and parity showed no statistically significant variation between cases and controls. The majority of participants in both groups were multigravida women. Baseline demographic and obstetric characteristics of the study population are summarized in [Table 1]. The age distribution pattern demonstrated that most participants belonged to the 21–30 years age category in both groups. Comparative age distribution among study participants is illustrated in [Figure 1].

Obstetric Characteristics and Clinical Presentation: Obstetric history and presenting complaints were evaluated among all enrolled participants. Previous history of miscarriage was more frequently observed among women with missed miscarriage compared with controls; however, the difference was not statistically significant. Among women diagnosed with missed miscarriage, the most common presenting complaint was vaginal spotting followed by lower abdominal discomfort. A proportion of women were asymptomatic and diagnosed incidentally during routine ultrasonographic examination. In contrast, women in the viable pregnancy group primarily attended for routine antenatal evaluation during the first trimester. No significant difference was observed between the groups regarding parity status or duration of amenorrhea at presentation.

Gestational Age Distribution: Gestational age at the time of evaluation was assessed in all participants. Most women in both groups presented between 8 and 10 weeks of gestation. The mean gestational age among women with missed miscarriage was 8.9 ± 1.4 weeks, while women with viable pregnancy demonstrated a mean gestational age of 9.1 ± 1.3 weeks.

Comparison between the groups did not reveal any statistically significant difference with respect to gestational age distribution. This indicated that both

groups were comparable in terms of pregnancy duration at the time of serum progesterone estimation. The distribution of gestational age among study participants is summarized in [Table 2 and Figure 2] demonstrates the comparative gestational age distribution between women with missed miscarriage and viable pregnancy.

Ultrasonographic Findings: Ultrasonographic evaluation was performed in all enrolled participants to confirm diagnosis and assess fetal viability. In the missed miscarriage group, ultrasonography demonstrated absence of fetal cardiac activity with retained intrauterine gestational products. Some participants additionally showed irregular gestational sac morphology and reduced crown-rump length corresponding to gestational age. Among women with viable pregnancy, ultrasonography confirmed live intrauterine gestation with detectable fetal cardiac activity and normal gestational sac appearance. No major structural abnormalities were identified in the control group during first-trimester assessment. The ultrasonographic findings supported the clinical diagnosis and facilitated accurate classification of participants into case and control groups.

Comparison of Mean Serum Progesterone Levels: Serum progesterone estimation performed during the first trimester demonstrated a marked difference between women with missed miscarriage and those with viable pregnancy. The mean serum progesterone concentration in the missed miscarriage group was significantly lower than that observed among women with viable pregnancy. Women diagnosed with missed miscarriage showed a mean serum progesterone level of 11.8 ± 4.6 ng/mL, whereas the viable pregnancy group demonstrated a mean progesterone concentration of 24.7 ± 6.3 ng/mL. Statistical analysis revealed that the observed difference was highly significant (p=0.0002). Comparative analysis of mean serum progesterone levels between the two study groups is presented in [Table 3]. A graphical comparison of serum progesterone concentrations between missed miscarriage and viable pregnancy groups is illustrated in [Figure 3].

Distribution of Serum Progesterone Levels According to Categories: For detailed assessment, serum progesterone concentrations were categorized into three groups: less than 15 ng/mL, 15–20 ng/mL, and greater than 20 ng/mL. The majority of women with missed miscarriage demonstrated serum progesterone levels below 15 ng/mL. In contrast, women with viable pregnancy predominantly exhibited progesterone concentrations above 20 ng/mL. Among the missed miscarriage group, 73.3% of women had progesterone levels below 15 ng/mL, whereas only a small percentage of women with viable pregnancy belonged to this category. Conversely, progesterone levels greater than 20 ng/mL were observed mainly among women with viable pregnancy. Distribution of serum progesterone categories among study participants is detailed in [Table 4].

Association Between Serum Progesterone Levels and Pregnancy Outcome: Assessment of the association between serum progesterone concentration and pregnancy outcome demonstrated a significant relationship between lower progesterone levels and missed miscarriage. Women with serum progesterone levels below 15 ng/mL exhibited substantially increased likelihood of non-viable pregnancy compared with women having higher progesterone concentrations. Statistical analysis demonstrated a strong association between reduced progesterone levels and missed miscarriage during the first trimester.

The association between serum progesterone levels and pregnancy viability is presented in [Table 5 and Figure 4] demonstrates the relationship between categorized serum progesterone concentrations and pregnancy outcome among the study population.

Overall Outcome Analysis: The overall findings of the present study demonstrated significantly lower first-trimester serum progesterone levels among women with missed miscarriage compared with women having viable intrauterine pregnancy. Lower progesterone concentrations were consistently associated with non-viable pregnancy outcome. Women with viable pregnancy exhibited relatively higher progesterone levels throughout the evaluated gestational period, indicating the importance of adequate hormonal support during early gestation. The results suggest that serum progesterone estimation may serve as a useful adjunctive biochemical marker in assessment of early pregnancy viability, particularly in cases where ultrasonographic findings are uncertain or inconclusive.

Table 1: Baseline demographic and obstetric characteristics of study participants

Variable	Missed Miscarriage (n=60)	Viable Pregnancy (n=60)	p-value
Maternal age (years)	27.4 ± 4.1	26.9 ± 3.8	0.482
Gravidity	2.1 ± 0.9	2.0 ± 0.8	0.557
Parity	1.0 ± 0.7	0.9 ± 0.6	0.608
Gestational age (weeks)	8.9 ± 1.4	9.1 ± 1.3	0.391

Table 2: Gestational age distribution between study groups

Gestational Age (weeks)	Missed Miscarriage (n=60)	Viable Pregnancy (n=60)	p-value
6–7 weeks	12 (20.0%)	10 (16.7%)	0.642
8–9 weeks	28 (46.7%)	30 (50.0%)	0.714
10–12 weeks	20 (33.3%)	20 (33.3%)	0.998

Table 3: Comparison of mean first-trimester serum progesterone levels between study groups

Variable	Missed Miscarriage (n=60)	ViablePregnancy (n=60)	p-value
Serum progesterone (ng/mL)	11.8 ± 4.6	24.7 ± 6.3	0.0002

Table 4: Distribution of participants according to serum progesterone categories

Serum Progesterone Level (ng/mL)	Missed Miscarriage n (%)	Viable Pregnancy n (%)	p-value
<15	44 (73.3%)	6 (10.0%)	0.0001
15–20	11 (18.3%)	13 (21.7%)	0.653
>20	5 (8.4%)	41 (68.3%)	0.0003

Table 5: Association between serum progesterone levels and pregnancy viability

Serum Progesterone Level	Odds Ratio (OR)	95% Confidence Interval	p-value
<15 ng/mL	8.72	3.91–19.42	0.0001
≥15 ng/mL	Reference	Reference	Reference

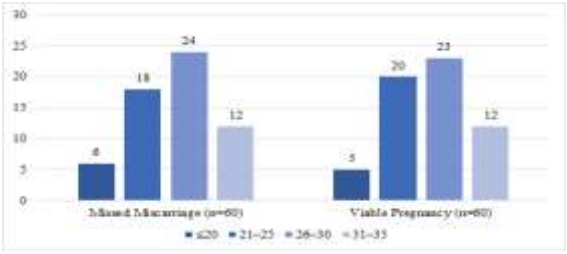

Figure 1: Distribution of Maternal Age Among Study Participants

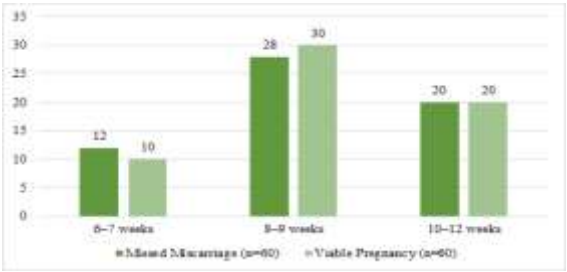

Figure 2: Distribution of Gestational Age Between Study Groups

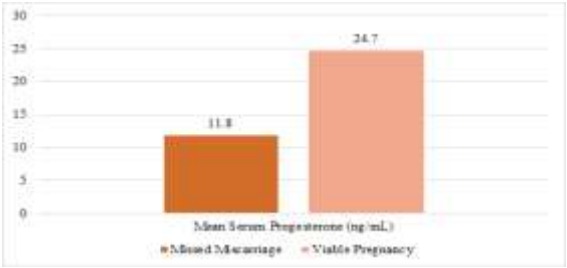

Figure 3: Comparison of Mean Serum Progesterone Levels in Missed Miscarriage and Viable Pregnancy

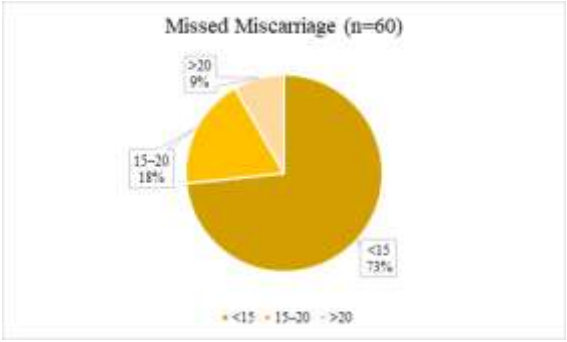

Figure 4: Association Between Serum Progesterone Categories and Pregnancy Outcome

DISCUSSION

The present case-control study was conducted to compare first-trimester serum progesterone levels between women with missed miscarriage and women with viable intrauterine pregnancy. The findings demonstrated significantly lower serum progesterone concentrations among women diagnosed with missed miscarriage compared with women having viable pregnancy. In addition, lower progesterone levels showed a strong association with non-viable pregnancy outcome during the first trimester.

Progesterone plays an essential role in the establishment and maintenance of pregnancy. During early gestation, adequate progesterone secretion is necessary for endometrial decidualization, embryo implantation, maintenance of uterine quiescence, and maternal immunological adaptation to fetal tissues. Deficiency of progesterone has long been associated with pregnancy failure and spontaneous miscarriage.[13] The significantly lower progesterone levels observed in the present study support the concept that inadequate hormonal support contributes to early pregnancy loss.

The findings of the current study are comparable with those reported in previous literature. Verhaegen et al. demonstrated that low serum progesterone concentration was strongly associated with non-viable pregnancy outcomes and could be useful in predicting early pregnancy failure.[14] Similarly, Ku et al. reported significantly reduced progesterone levels among pregnancies complicated by miscarriage compared with viable pregnancies during the first trimester.[15] The results of the present study further strengthen the evidence supporting serum progesterone estimation as an adjunctive biochemical marker of pregnancy viability.

In the present study, most women with missed miscarriage demonstrated progesterone levels below 15 ng/mL, whereas women with viable pregnancy predominantly exhibited progesterone levels above 20 ng/mL. These findings may be explained by defective corpus luteal function or impaired trophoblastic development in non-viable pregnancies. Since progesterone secretion during early gestation depends largely on corpus luteum activity stimulated by trophoblastic human chorionic

gonadotropin production, declining trophoblastic viability may lead to reduced progesterone synthesis. Several biological mechanisms may explain the association between low progesterone levels and pregnancy failure. Progesterone promotes endometrial receptivity and suppresses inflammatory and immune responses within the uterine environment. Reduced progesterone secretion may impair implantation stability, increase uterine activity, and contribute to embryonic loss.[16] In addition, chromosomal abnormalities and defective placental development associated with missed miscarriage may further compromise hormonal production.

An important observation in the present study was the significant association between low progesterone levels and missed miscarriage. Women with progesterone concentrations below 15 ng/mL demonstrated substantially increased likelihood of non-viable pregnancy. This finding is clinically important because serum progesterone estimation is relatively simple, economical, and widely available. In settings where ultrasonographic findings are inconclusive, progesterone estimation may provide additional diagnostic support during early pregnancy assessment.

The present study had certain strengths. Baseline demographic characteristics such as maternal age, gravidity, parity, and gestational age were comparable between the two groups, thereby minimizing confounding factors. Furthermore, progesterone estimation was performed before therapeutic intervention, reducing treatment-related bias.

However, some limitations should also be acknowledged. The study was conducted at a single center with a relatively limited sample size, which may affect generalizability of the findings. In addition, serial progesterone measurements were not performed, and only single-time hormonal estimation during the first trimester was evaluated. Future multicentric studies with larger sample sizes and combined assessment with other biochemical markers may provide more comprehensive evidence regarding pregnancy viability prediction.

Overall, the present study demonstrated a significant association between reduced first-trimester serum progesterone levels and missed miscarriage. Women with viable pregnancy consistently exhibited higher progesterone concentrations compared with women experiencing early pregnancy failure. These findings suggest that serum progesterone estimation may serve as a useful adjunctive biochemical tool in the evaluation of early pregnancy viability.

Limitations of the Study

The present study had certain limitations that should be acknowledged. The study was conducted at a single hospital with a relatively limited sample size, which may affect the generalizability of the findings to larger populations. In addition, serum progesterone estimation was performed only once during the first trimester, and serial hormonal measurements were not evaluated. The study also did not include assessment of additional biochemical markers such as serum β-human chorionic gonadotropin or chromosomal analysis, which may further improve prediction of pregnancy outcome. Future multicentric studies with larger sample sizes and combined biochemical assessment are recommended to provide more comprehensive evidence regarding the role of progesterone in early pregnancy viability.

CONCLUSION

The present case-control study demonstrated that first-trimester serum progesterone levels were significantly lower among women with missed miscarriage compared with women having viable intrauterine pregnancy. Reduced progesterone concentration showed a strong association with non-viable pregnancy outcome during early gestation.

The findings of the study highlight the important role of progesterone in maintenance of early pregnancy and suggest that serum progesterone estimation may serve as a useful adjunctive biochemical marker in the assessment of pregnancy viability. Women with viable pregnancy consistently exhibited higher progesterone levels, whereas low progesterone concentrations were predominantly observed among women with missed miscarriage.

Serum progesterone estimation is simple, minimally invasive, and widely accessible, making it clinically valuable, particularly in settings where ultrasonographic findings are uncertain or limited diagnostic resources are available. Early identification of pregnancies at increased risk of miscarriage may facilitate timely counseling, closer monitoring, and appropriate clinical management.

Further large-scale multicentric studies with serial hormonal assessment are recommended to establish standardized progesterone cutoff values and improve its diagnostic utility in early pregnancy evaluation.

REFERENCES

1. Quenby S, Gallos ID, Dhillon-Smith RK, Podesek M, Stephenson MD, Fisher J, Brosens JJ, Brewin J, Ramhorst R, Lucas ES, McCoy RC. Miscarriage matters: the epidemiological, physical, psychological, and economic costs of early pregnancy loss. The Lancet. 2021 May 1;397(10285):1658-67.
2. Addas JA, Alabousi A, Almohaimede K, Abdullah P, Atri M. Evaluating the Transvaginal Ultrasound Diagnostic Criteria for Abnormal First-Trimester Pregnancy With Follow-Up Into the Third Trimester and Validation of Results. Journal of Obstetrics and Gynaecology Canada. 2021 Sep 1;43(9):1055-61.
3. Ku CW, Allen Jr JC, Lek SM, Chia ML, Tan NS, Tan TC. Serum progesterone distribution in normal pregnancies compared to pregnancies complicated by threatened miscarriage from 5 to 13 weeks gestation: a prospective cohort study. BMC pregnancy and childbirth. 2018 Sep 5;18(1):360.
4. Ghaedi B, Cheng W, Ameri S, Abdulkarim K, Costain N, Zia A, Thiruganasambandamoorthy V. Performance of single serum progesterone in the evaluation of symptomatic first-trimester pregnant patients: a systematic review and meta-analysis. Canadian Journal of Emergency Medicine. 2022 Sep;24(6):611-21.

5. Coomarasamy A, Devall AJ, Cheed V, Harb H, Middleton LJ, Gallos ID, Williams H, Eapen AK, Roberts T, Ogwulu CC, Goranitis I. A randomized trial of progesterone in women with bleeding in early pregnancy. New England Journal of Medicine. 2019 May 9;380(19):1815-24.
6. Coomarasamy A, Devall AJ, Brosens JJ, Quenby S, Stephenson MD, Sierra S, Christiansen OB, Small R, Brewin J, Roberts TE, Dhillon-Smith R. Micronized vaginal progesterone to prevent miscarriage: a critical evaluation of randomized evidence. American journal of obstetrics and gynecology. 2020 Aug 1;223(2):167-76.
7. Eshre Guideline Group on RPL, Bender Atik R, Christiansen OB, Elson J, Kolte AM, Lewis S, Middeldorp S, Mcheik S, Peramo B, Quenby S, Nielsen HS. ESHRE guideline: recurrent pregnancy loss: an update in 2022. Human reproduction open. 2023 Jan 1;2023(1):hoad002.
8. Kurihara C, Inoue K, Kai H, Suzuki K, Saeki H, Funabashi Y, Kishi N, Kuge A, Murakami T, Saito Y, Uchida E. Our "WMA Declaration of Helsinki": opinions and proposals from patient and public for research ethics. InEthical innovation for global health: Pandemic, democracy and ethics in research 2023 Nov 15 (pp. 243-269). Singapore: Springer Nature Singapore.
9. Jensen KK, Sal M, Sohaey R. Imaging of acute pelvic pain: pregnant (ectopic and first-trimester viability updated). Radiologic Clinics. 2020 Mar 1;58(2):347-61.
10. Youssef A, Vermeulen N, Lashley EL, Goddijn M, van der Hoorn ML. Comparison and appraisal of (inter) national recurrent pregnancy loss guidelines. Reproductive biomedicine online. 2019 Sep 1;39(3):497-503.
11. Lim MK, Ku CW, Tan TC, Lee YH, Allen JC, Tan NS. Characterisation of serum progesterone and progesterone-induced blocking factor (PIBF) levels across trimesters in healthy pregnant women. Scientific reports. 2020 Mar 2;10(1):3840.
12. Sedgwick PM, Hammer A, Kesmodel US, Pedersen LH. Current controversies: Null hypothesis significance testing. Acta Obstetricia et Gynecologica Scandinavica. 2022 Jun;101(6):624-7.
13. Okeke Ogwulu CB, Goranitis I, Devall AJ, Cheed V, Gallos ID, Middleton LJ, Harb HM, Williams HM, Eapen A, Daniels JP, Ahmed A. The cost-effectiveness of progesterone in preventing miscarriages in women with early pregnancy bleeding: an economic evaluation based on the PRISM trial. BJOG: An International Journal of Obstetrics & Gynaecology. 2020 May;127(6):757-67.
14. Tunde-Byass M, Varner CE. Serum progesterone levels in the emergency department should not change the care of patients with first trimester bleeding. Canadian Journal of Emergency Medicine. 2022 Sep;24(6):559-60.
15. Deng W, Sun R, Du J, Wu X, Ma L, Wang M, Lv Q. Prediction of miscarriage in first trimester by serum estradiol, progesterone and β-human chorionic gonadotropin within 9 weeks of gestation. BMC pregnancy and childbirth. 2022 Feb 10;22(1):112.
16. Cavalcante MB, Sampaio OG, Câmara FE, Barini R. ESHRE guideline update 2022: New perspectives in the management of couples with recurrent pregnancy loss. American Journal of Reproductive Immunology. 2023 Aug 1;90(2).
17. Tan TC, Ku CW, Kwek LK, Lee KW, Zhang X, Allen Jr JC, Zhang VR, Tan NS. Novel approach using serum progesterone as a triage to guide management of patients with threatened miscarriage: a prospective cohort study. Scientific Reports. 2020 Jun 4;10(1):9153.