CORRELATION BETWEEN ENDOMETRIAL THICKNESS AND PLASMA PROGESTERONE LEVELS IN WOMEN WITH INFERTILITY: AN ULTRASOUND-BASED CROSS-SECTIONAL STUDY

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Abstract

Background: *Endometrial thickness and plasma progesterone levels are key indicators of endometrial receptivity and ovulation. In infertile women, insufficient endometrial development or low progesterone may impair implantation. Ultrasound assessment of endometrial thickness, combined with serum progesterone measurement, helps evaluate luteal phase adequacy and fertility potential. Understanding their correlation can aid in diagnosing and managing infertility.*

Methods: *A prospective, cross-sectional study was conducted with 40 women aged 20–40 years presenting with primary infertility. Transvaginal ultrasound was used to assess endometrial thickness, while plasma progesterone was measured via blood samples. Correlation between the two parameters was assessed using Pearson's correlation coefficient.*

Results: *The mean endometrial thickness was 6.28 mm and the mean plasma progesterone level was 5.60 ng/mL. A strong positive correlation was observed between endometrial thickness and plasma progesterone level (r = 0.848, p < 0.001). Common values observed were 5.30 mm and 5.40 mm for endometrial thickness, and 4.00 ng/mL for progesterone.*

Conclusion: *A significant positive correlation exists between endometrial thickness and plasma progesterone levels, highlighting the importance of evaluating both for optimizing fertility treatment outcomes.*

INTRODUCTION

Women's infertility is the relationship between endometrial thickness and plasma progesterone. The endometrium or uterine lining is needed for implantation and maintenance of pregnancy. A successful implantation of an embryo in artificial reproductive methods or natural conception depends on a healthy endometrial lining. Progesterone, a hormone crucial in conception, increases endometrium and prepares the formation of a secretory phase, preparing it for attachment. In the menstrual cycle, endometrial thickness is usually examined using ultrasound scanning. It is thought that for the embryo to implant successfully, the endometrium thickness needs to be at an optimal point. Recurrent miscarriage or infertility may be due to abnormal patterns of endometrial development or lack of endometrial thickness. Endometrial thickness is also generally measured using ultrasound, and a

sufficient thickness (usually 7-8 mm) is thought to be necessary for successful implantation. Following ovulation, progesterone is secreted, which stimulates the endometrium to enter a secretory phase that favors implantation.[1]

The endometrium, the inner layer of epithelial tissue lining the uterus, is a unique tissue that undergoes innumerable cycles of development, differentiation, and detachment over the course of a woman's lifetime. For assisted reproductive technology (ART) programs to be successful, the endometrium must be morphologically normal. According to available data, inadequate endometrial receptivity accounts for 50–70% of implantation failures; an endometrial thickness of 7 mm or more is optimal for embryo transfer. Endometrial thickness <7 mm or <8 mm is commonly used to describe a thin endometrium in assisted reproduction. Inadequate endometrial thickness, or thin endometrium, results in poor implantation, infertility, and ART program discontinuation. Preterm delivery, early miscarriages, and low birth weight babies are all highly likely in these situations.[2] An endometrial thickness (ET) below 5 mm is often associated with endometrial disorders, while an ET exceeding 8 mm at the phase of proliferation or 16 mm at the phase of secretory is considered abnormal. In women before menopause, ET naturally fluctuates throughout the menstrual cycle. For postmenopausal women, ET is a essential indicator for assessing the danger of endometrial cancer, with a thickness of 3–5 mm or more raising concern.[3] Progesterone, a steroid hormone, is essential for female reproduction. When estrogens are administered to menopausal women with an intact uterus, micronized progesterone (MP) can be utilized therapeutically to protect the endometrium. However, whether and at what dosage MP offers effective endometrial protection when given orally, vaginally, or transdermally is a topic of much discussion.[3]

Transvaginal ultrasound (TVS) is highly sensitive in assessing endometrial thickness in infertile women, with reported sensitivities of 88.2% for detecting endometrial polyps and 89.2% for endometrial fibroids, though its sensitivity for endometrial hyperplasia is lower at 56.2%. While TVS provides precise measurements of endometrial thickness, plasma progesterone levels must be evaluated through blood tests, typically during the mid- luteal phase. Studies have shown a strong correlation (93%) between histological endometrial dating and plasma progesterone levels in confirming ovulation, highlighting the importance of combining TVS findings with progesterone measurements for a comprehensive infertility assessment.[4] Emerging trends in infertility assessment emphasize the integration of advanced imaging techniques and non-invasive hormonal monitoring to better understand the association between thickness of endometrium & plasma progesterone levels. Recent studies have highlighted the significance of endometrial compaction defined as a reduction in thickness of endometrium from the proliferative to the secretory phase as a potential predictor of successful embryo implantation. Additionally, the development of at-home hormone-testing devices, such as Eli Health's Hormometer, enables real-time monitoring of progesterone levels using saliva samples analyzed via smartphone applications. These innovations aim to provide a more comprehensive and personalized evaluation of endometrial receptivity, potentially enhancing fertility treatment outcomes.[5]

Materials and Methods

Design: Prospective, cross-sectional. Setting: Family Clinic Hospital, Lahore. Sample: 40 women with primary infertility. Tools: Toshiba Aplio TVS, hormone lab assays. Exclusion: Hormonal therapy, secondary infertility, endometrial pathology. Analysis: SPSS v25; Pearson correlation

Results

Table 1. Descriptive Statistics of Participants

Variable / Category	Minimum / Value	Maximum / Value	Mean / %	SD / p-value
Age (years)	20	39	30.25	5.45
Endometrial Thickness (mm)	4.20	11.00	6.28	1.41

Progesterone Level (ng/mL)	3.00	9.00	5.60	1.66
Duration of Infertility (months)	2.00	5.00	3.48	0.93
Endometrial Thickness (mm) 5.30 mm	3		7.5%	
5.40 mm	3		7.5%	
10.00 mm	3		7.5%	
Others (4.2–11 mm)	31		77.5%	
Progesterone Level (ng/mL) 4.00 ng/mL	9		22.5%	
5.00 ng/mL	8		20.0%	
7.00 ng/mL	7		17.5%	
Others (3.0–9.0)	16		40.0%	
Endometrial Thickness vs Progesterone			r = 0.848	p < 0.001

Discussion

The connection between end0metrial thickness & plasma progesterone levels is 0f critical importance when evaluating female fertility, particularly for women with infertility. Both these factors play vital roles in reproductive success, as the endometrial lining's development is directly influenced by progesterone levels, which are essential for preparing the uterus for implantation.

Information on the interaction of these two variables and their effect on fertility outcomes has been the subject of various studies. The current study showed that there was a very high positive correlation between plasma progesterone and endometrial thickness in a sample of 40 women presenting for infertility evaluation. Precisely, plasma progesterone increased in parallel to endometrial thickness, and Pearson correlation coefficient was 0.848 (p<0.01), showing a strong correlation between the two variables. This research draws attention to just how crucial endometrial thickness and progesterone are in the implantation process and success of fertility treatment. The analysis is also enhanced by the descriptive statistics, revealing a sample population of 40 women with an average age of 30.25 years (20-39 years). The age distribution yields the sample background and emphasizes that the women studied here were very young, which could have improved fertility results and maintained the correlation between plasma progesterone concentrations and endometrial thickness established in this study.

Previous work has already confirmed the roles of progesterone and endometrial thickness in determining fertility. For example, Moramezi et al. (2023) established that while endometrial thickness did not have a significant correlation with serum progesterone level, they possessed a significant negative correlation with gravidity as well as abortion rates in women who underwent IVF. Even when serum progesterone levels have an impact on pregnancy outcomes, this study showed that progesterone and endometrial thickness alone was not very significant. As our study also established\ a positive correlation between the two variables, indicating that thicker endometrial lining\ can be related to higher levels of progesterone, which can improve the chances of implantation success, this observation is partly in agreement with the observations of the current study. Their study didn't, however, find any notable correlation between endometrial thickness and progesterone levels. This variation indicates the difficulty of determining

fertility and possible differing outcomes by patient population and testing method. But according to the current research, a thicker endometrial lining can be linked to higher levels of progesterone, and this would optimize the likelihood of successful implantation, especially for females being tested for general infertility.[7]

In women with infertility that cannot be explained, Raperport et al. (2023) emphasized the role of progesterone in endometrial receptiveness, arguing that changed progesterone actions result in decreased endometrial receptiveness. According to their research, women who exhibit low levels of progesterone receptor expressionmay be less likely to become pregnant. This hypothesis is supported by the study's finding that progesterone levels and endometrial thickness positively correlate, underscoring the hormone's crucial function in making the endometrium receptive to implantation. Because endometrial receptivity may be a major factor influencing fertility outcomes, this connection is particularly pertinent for women who are experiencing infertility that cannot be explained. Although our study found a significant correlation, Raperport's study concentrated on unexplained infertility, whereas ours was done on women undergoing evaluations for general infertility. Nevertheless, both studies highlight how progesterone improves endometrial receptivity.[8]

Allah MH et al. (2023) conducted another pertinent study that emphasized the significance of uterine artery blood flow and serum progesterone levels in recurrent miscarriages. They showed that the incidence of unexplained recurrent miscarriages was significantly correlated with serum progesterone levels, indicating that progesterone is essential for maintaining pregnancy. The results of our study also suggest that higher progesterone levels, which are associated with a thicker endometrium, might improve fertility outcomes. Our results and those of Allah MH et al. further support the idea that progesterone is necessary for pregnancy maintenance, highlighting the role of progesterone in both implantation and pregnancy sustenance.[9]

The intricate relationship between progesterone and reproductive outcomes is further clarified by the study conducted by Fernández et al. (2022), which looked at the relationship between progesterone levels and IVF results. Fernández et al. found a weak positive correlation between progesterone levels and some IVF metrics, including harvested oocytes and ovarian follicle count, but their research did not clearly link progesterone levels to the success of pregnancy. Our research, however, showed a stronger correlation between endometrial thickness and plasma progesterone levels, which in turn affects the chance of implantation. As our research was limited to women undergoing general infertility evaluation, while IVF patients receive more intensive hormonal treatment, the difference may be explained by the different patient populations.[10]

Another valuable addition to the controversy surrounding endometrial thickness is the work of Gürsoy et al. (2023) on the use of platelet rich plasma (PRP) in thin endometria of women. They found that PRP administration improved endometrial thickness and potentially enhanced pregnancy rates. Although PRP was not a focus of the ongoing study, the bond between endometrial thickness and pro They discovered that PRP treatment increased endometrial thickness and might have increased the likelihood of getting pregnant. The relationship between endometrial thickness and progesterone levels implies that increasing endometrial thickness may raise progesterone activity, which would improve the environment for embryo implantation, even though PRP was not the study's main focus. Gestational levels indicate that increasing endometrial thickness may raise progesterone activity, which would improve the implantation environment for embryos. This lends more credence to the notion that progesterone-supported endometrial health is essential for a successful pregnancy.[11]

In conclusion, the findings from this study, alongside previous literature, indicate that both endometrial thickness and plasma progesterone levels are crucial factors in assessing fertility and implantation potential. The significant positive correlation observed in our study between these two variables highlights their intertwined role in the reproductive process. While previous studies have explored various aspects of progesterone and endometrial receptivity, the current study adds to the expanding body of observations suggesting the importance of these factors among infertility evaluation and treatment planning. The results also suggest that optimizing

both progesterone levels and endometrial thickness could potentially improve fertility outcomes, particularly in women with unexplained infertility or those undergoing assisted reproductive technologies. However, while this finding is consistent with several Prior studies, there are some gaps in the literature and limitations in the current study that could be addressed through further research to strengthen our understanding of these complex interactions and their implications for fertility.

One notable gap that could be explored in future studies is the investigation of the underlying mechanisms through which progesterone influences endometrial thickness. While this research documented a strong association between progesterone plasma levels & endometrial thickness it did not delve into the specific biological processes involved in this relationship. Understanding how progesterone affects endometrial cell proliferation, differentiation, and vascularization at a molecular level would provide a more comprehensive view of the reproductive process. To clarify how progesterone mediates the impact on endometrial development, future research could look at the production of receptors for progesterone and other biological indicators in the endometrium.

The role of progesterone in women with varying forms of infertility is another primary area that must be investigated in more studies. It would be beneficial to test whether the association between progesterone plasma level and endometrial thickness would remain valid in varying diagnoses of infertility, even though the current study targeted women undergoing evaluation for general infertility. As an example, altered hormonal profiles and individual difficulty in achieving endometrial receptivity may be seen in endometriosis, polycystic ovary syndrome (PCOS), or unexplained infertility. Future research may clarify whether the progesterone-endometrial thickness relationship is consistent in these heterogeneous populations by classifying participants according to their individual infertility diagnosis. This would increase appreciation of how progesterone may work differently based on the infertility cause.

Also, other techniques, including molecular profiling of the endometrial tissue, might provide a better picture of endometrial health even though endometrial thickness was used as a surrogate measure of endometrial receptivity in the current study. Endometrial thickness can be complemented by techniques like endometrial biopsy or assessment of some implantation-related biomarkers, which might provide more precise information about the endometrial milieu. This can perhaps be used to recognize women whose endometrial lining might seem to be of normal thickness but might still be insensitive to hormonal signals such as progesterone. Examining these otherendometrial receptivity markers can perhaps forecast fertility outcomes and adjust treatment regimes accordingly. In conclusion, although the current study presents considerable evidence of the positive relationship between endometrial thickness and plasma progesterone level, there are a number of areas where further research would assist in filling in the gaps. Investigating the underlying mechanisms, the influence of external factors, and the role of progesterone with respect to various infertility diagnoses would be a great advance. Furthermore, research into hormone supplements, reproductive technologies, and molecular receptors of endometrial receptivity would help streamline reproductive outcomes as well as streamline fertility treatment. Addressing the remaining research lacunas will provide an improved comprehensive view of the influence of progesterone as well as the effect of thickness on the endometrium that could ultimately further advance methods used in diagnosing as well as treating infertile women.

Conclusion

This study showed a strong positive correlation between plasma progesterone levels and endometrial thickness, validating the role of progesterone in endometrial development. The results supported the hypothesis that increased progesterone levels are linked to a more advanced endometrial lining, essential for successful implantation, and were in accordance with existing studies. To examine the basic underlying mechanisms of the relationship, the influence of multicultural infertility diagnosis, and the impact of extrinsic factors, more was required. Moreover, in a bid to enhance fertility treatment protocols better, it was important to study how progesterone supplementation affects endometrial receptiveness in assisted reproductive technologies.

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