

# Estimation of Endometrial Thickness by Ultrasound in Infertile Women During Secretory Phase

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## ABSTRACT

**Background & Objective:** Infertility in women can be attributed to a wide variety of factors, including inherited and acquired abnormalities of the uterus. Ultrasonography is used for determining the thickness of the endometrium during various phases of the menstrual cycle. The purpose of this study is to determine the thickness of the endometrium in women who are unable to conceive using ultrasound imaging during the secretory phase.

**Materials & Methods:** A total of 134 adult females between the ages of 22 and 45 were examined by means of an endo-vaginal and transabdominal approach with EVN 4-9 MHZ and CA1-7AD probes, respectively, during the course of this research project, which took place in Imam Al-Hujjah Charitable Hospital, Karbala, Iraq, between February 2021 and April 2022.

**Results:** The findings showed that primary infertility accounted for 69.4% of cases, which was significantly higher than women with secondary infertility, which accounted for 30.6% of cases. There were 68.8% of women who presented with primary infertility who had endometrial thickness between 9-12 mm, and there were 31.1% of women who presented with secondary infertility who had this thickness. 65.8% of women who are experiencing primary infertility and 34.1% of women who are experiencing secondary infertility have an endometrial thickness of 14-18 mm. Our study showed that 40% of women who suffer from primary infertility and 60% of those who have secondary infertility have an endometrial thickness of 19-23 mm.

**Conclusion:** When it comes to diagnosing and treating infertility, ultrasound is a crucial tool for measuring the thickness of the endometrium in women.

**Keywords:** Diagnostic imaging, Infertility, Endometrium, Pregnancy



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## Introduction

The inability of a couple to conceive a child despite making unprotected attempts for at least one year is one definition of infertility (1). Around ten percent of all couples in the world struggle with infertility, which can be caused by either genetic or environmental factors (2). Infertility in women can have a variety of root causes, including those originating from the uterus, the tubes, or the ovaries (functional and organic causes) (3). One of these factors was thought to be the thickness of the endometrium. The lining of the uterus on the inside is called the endometrium. Throughout the course of reproductive life, it undergoes a continuous transformation in both its shape and its thickness in response to cyclical shifts in hormone levels. These alterations in the endometrium are a reflection of how well the hypothalamic-pituitary-ovarian axis is able to function. Information on the likelihood of becoming pregnant is provided by the endometrium's sonographic texture, which represents cyclical changes. The endometrium must be in top shape to accommodate the blastocyst for the implantation of human embryos. Endometrial receptivity is the term

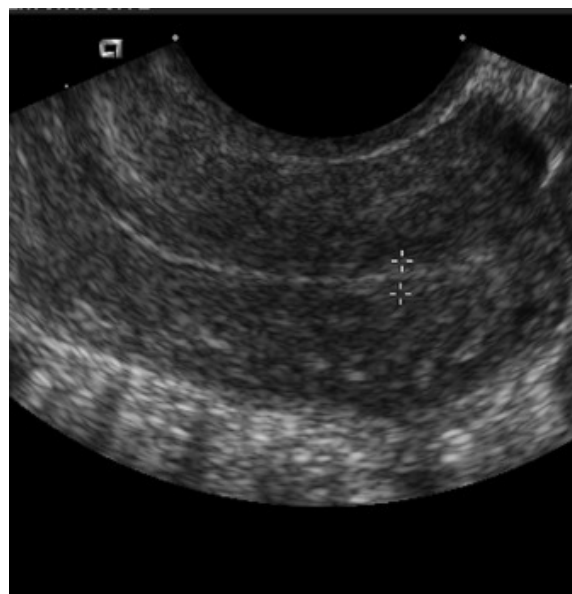
used to describe the endometrium's capacity to permit the blastocyst to adhere to it during the window of implantation. Patients undergoing in vitro fertilization have lower pregnancy rates in relation to their endometrial receptivity. On ultrasound, the endometrium has been described as having an echogenic appearance and can be seen to change appearance throughout the phases of the menstrual cycle. During the menstrual phase, the endometrium manifests itself as an echogenic thin line measuring between 1-5 mm in thickness. During the proliferative phase, there is a 6-11 mm increase in the thickness of the endometrium. During the secretory phase, the endometrial thickness can increase to a maximum of 16 mm while the echogenicity of the tissue increases (4). In women who suffer from infertility, the ultrasound is typically the second step after the clinical examination. A thicker endometrium is associated with an increased likelihood of becoming pregnant (5). During the course of an investigation into female infertility, it is necessary to evaluate the endometrium by measuring its thickness, endometrial blood flow, and endometrial

pattern (6). In many different works, the thickness of the endometrium is considered to be an accurate interpreter of pregnancy (7). According to some studies, there is no correlation between the number of pregnancies and the thickness of the endometrium (8). An ultrasound is utilized to evaluate the endometrial thickness and echogenicity, as well as to show changes that take place throughout the phases of menstruation. During the menstrual phase, it appears as a thin echogenic line. During the proliferative phase, a large amount of estradiol is produced by growing follicles, which is responsible for changes in the endometrium. After that, the corpus luteum will produce progesterone, which will cause changes in the endometrium's secretory characteristics (9, 10). Transvaginal examination provides better resolution for examining the endometrium and determining endometrial thickness throughout the different phases of the menstrual cycle, although pelvic sonography contributes significantly to the assessment of the endometrium. The purpose of this study is to determine the thickness of the endometrium in women who are unable to conceive using ultrasound imaging during the secretory phase.

## Methods

This is a descriptive study, involving 134 females with the age range of 22 to 45 years old from the ultrasound clinic in Imam Al-Hujjah Charitable Hospital, Karbala, Iraq. Inclusion criteria were to have female patients of fertile age coming for infertility ultrasound examination. Patients with primary and secondary infertility in their secretory phase of menstrual cycle were considered for measuring endometrial thickness. Exclusion criteria were focused on fertile patients with pelvic abnormalities and female patients who had reached menopause.

This study was carried out from February 2021 to April 2022. Examination performed via an ultrasound device (HS50, Samsung, KOREA), using endo-vaginal and transabdominal approach with EVN 4-9 MHZ and CA1-7AD probes, respectively. Examination of the uterus and adnexa in secretory phase was carried out for the purpose of estimating the appearance of the endometrium and assessing its thickness. After getting a complete history from the patient, an ultrasound device was used to perform a scan of the uterus in the longitudinal plane in order to get the clearest possible image of the endometrium. The endometrium can be assessed using ultrasound as a primary imaging test. The total thickness of the two layers that make up the typical endometrium varies depending on where in the menstrual cycle a woman is. It was necessary to take a measurement of the part of the endometrium that was the thickest. Sonography was performed on each individual patient just once. The caliper of the ultrasound equipment was placed on the two margins of the endometrium in order to obtain this measurement, as illustrated in [Figure 1](#).



**Figure 1.** A 34-year-old woman with normal endometrium. Endometrium appears as a 3 mm-long thin echogenic line on ultrasound (normal 1-4 mm; calipers).

The assessment of endometrial thickness does not take into account the fluid that is contained within the endometrial cavity. SPSS software, version 24 (IBM SPSS, Armonk, NY, USA) was used to conduct the analysis on the data that was collected from the females. Tables were used to depict the qualitative factors such as age, day of menstruation, and type of infertility in the form of frequencies and percentages respectively. Regarding the quantitative variables, we looked at the mean, the minimum, the maximum, and the standard deviation.

## Results

The mean age of the participants in this study was  $31.08 \pm 6.12$  years, with primary infertility outnumbering secondary infertility by 69.4% to 30.6%. In relation to the day of menstruation at which changes in endometrial thickness were observed, the majority of cases were observed on day 17 (35 cases), followed by cases on day 16 (32 cases), and then day 18 (25 cases) respectively. The age range of the 134 women who participated in the study was 22 to 45 years old, and their mean age was 31.08 years old, with a standard deviation of 6.12 years. [Table 1](#) displays the distribution of female infertility. As a consequence of this, more cases were observed to have primary infertility than secondary infertility; specifically, 93 cases (69.4%) presented with primary infertility, whereas 41 cases (30.6%) presented with secondary infertility.

**Table 1. Distribution of female infertility.**

		Frequency	Percent
Valid	Primary	93	69.4
	Secondary	41	30.6
	Total	134	100.0

[Table 2](#) display changes in endometrial thickness that seen in both infertility types. The results obtained display that there were 31 (68.8%) women in primary infertility with endometrial thickness of 9-13 mm and 14 (31.1%) in secondary infertility. There were 52 women (65.8%) in primary infertility with endometrial thickness of 14-18 mm and 27 (34.1%) in secondary infertility. There were 4 women (40%) in primary infertility with endometrial thickness 19-23 mm and 6 (60%) in secondary infertility.

**Table 2. Changes of endometrial thickness and type of infertility.**

Endometrial thickness [mm]		Type of infertility		
		Primary	Secondary	Total
9 - 13	Count	31	14	45
	Percent	68.8	31.1	
14-18	Count	52	27	79
	Percent	65.8	34.1	
19-23	Count	4	6	10
	percent	40	60	

[Table 3](#) displays mensuration day and changes seen in endometrial thickness.

**Table 3. Changes seen in endometrial thickness during days of cycle.**

Day of mensuration		Endometrial Thickness			Total
		9-13 mm	14-18 mm	19-23 mm	
16	Count	23	9	0	32
	Percent	71.8%	28.1%	0.0%	
17	Count	21	14	0	35
	Percent	60%	40%	0.0%	
18	Count	11	14	0	25
	Percent	44%	56%	0.0%	
19	Count	4	6	0	10
	Percent	40%	60%	0.0%	
20	Count	0	3	0	3
	Percent	0.0%	100%	0.0%	
21	Count	0	2	0	2
	Percent	0.0%	100%	0.0%	
22	Count	0	3	0	3
	Percent	0.0%	100%	0.0%	
23	Count	0	5	0	5
	Percent	0.0%	100%	0.0%	
24	Count	4	1	0	5
	Percent	80%	20%	0.0%	
25	Count	3	3	0	6

Day of mensuration	Endometrial Thickness			Total
	9-13 mm	14-18 mm	19-23 mm	
26	Percent	50%	50%	4
	Count	0	4	
27	Percent	0.0%	100%	1
	Count	0	1	
28	Percent	0.0%	100%	1
	Count	0	1	
29	Percent	0.0%	100%	2
	Count	0	2	

## Discussion

Infertility, which is defined as the inability of a couple to conceive a child despite having frequent unprotected sexual intercourse over the course of a year, is considered to be a common issue that affects human societies (11, 12). Infertility in women can be caused by a variety of factors, including age, stress, smoking, an unhealthy diet, being overweight or underweight, sexually transmitted infections, and hormonal shifts caused by conditions such as polycystic ovary syndrome and primary ovarian insufficiency (13-15). In this study, the endometrial thickness of a group of volunteers who were unable to conceive was measured by ultrasound. One of the factors that contributes to female infertility is a thickening of the endometrium. There were a total of 134 females included in this study; 93 of them (69.4%) were diagnosed with primary infertility, and 41 of them (30.6%) were diagnosed with secondary infertility. The age of the female, her body mass index, and her estradiol level all affect the thickness of the endometrium. According to the findings of a study carried out by Gallos et al., an increase in the thickness of the endometrium makes it more likely that a woman will become pregnant. Additionally, an increase in endometrial thickness is associated with an increase in both the live birth rate and the pregnancy loss rate (16). Some cases that are associated with infertility have a problem in the proliferative phase, which can be identified clinically (17-19). This study also shows that the thickness of the endometrium was greatest in the secretory phase as opposed to the proliferative phase. Furthermore, the thickness of the endometrium continues to increase in thickness as the number of days in the cycle increases. According to Kovacs et al., findings, the endometrium undergoes cyclical changes in preparation for implantation during the proliferative and secretory phases of the menstrual cycle (20). They came to the conclusion that pregnant women had a higher quality embryo, more follicles, and a thicker endometrium than non-pregnant women who underwent assisted fertilization. This was done by comparing the embryos of pregnant women with those

of non-pregnant women. The probability of becoming pregnant increased as the thickness of the endometrium grew. Ultrasound, since it is a non-invasive method, has the ability to demonstrate endometrial thickness, sub endometrial blood flow, and endometrial peristalsis wave, making it the best method to evaluate endometrial receptivity. Endometrial receptivity refers to the ability of the endometrium to allow normal embryo implantation (21-23). Women who had thin endometrium during the proliferative phase of this study developed thicker endometrium during the secretory phase and underwent changes in their ability to conceive. At day 17 and day 18 of their secretory phase, 14 women had endometrial thickness measuring 14-18 mm. Results showed that at day 19, 6 women had endometrial thickness between 14-18 mm, whilst a study carried out by (17) showed that at day 19 of their secretory phase, 10 women had endometrial thickness ranging between 13-16 mm (17). Several studies have shown that the pattern of endometrium can be described as trilinear, and that a healthy endometrial thickness is associated with a successful pregnancy (24-28). In general, it is shown that an endometrial thickness of less than 8 mm has a significant negative predictive value (29). In this particular research, abnormalities in the thickness of the endometrium were discovered in approximately one third of the cases. Other causes of infertility, such as endometriosis, tubal obstruction, and other issues with ovulation, are estimated to account for approximately one-seventh of diagnosed cases. Cervical lesions, polycystic ovarian syndrome, and primary ovarian insufficiency each account for about three percent of diagnosed cases. There are still some cases of infertility that do not have a known cause; a study carried out by Santulli et al. and colleagues showed that 10% of cases of infertility had no known cause (30).

## Conclusion

Female patients who initially received treatment for infertility had a thinner endometrium during the

proliferative phase of their menstrual cycle. Their endometrial thickness may have increased during the early secretory phase of their menstrual cycle or on the 21st day of their cycle, but they were unable to conceive a child during the proliferative phase because their endometrium was too thin. In order for women to conceive, it is important for them to be aware of the normal endometrial thickness that occurs during the various phases of their menstrual cycle. In women who are undergoing treatment for infertility, ultrasound is an extremely important tool for determining the thickness of the endometrium.

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## Conflict of Interest

The authors declare no conflict of interest.

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