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TVUS for Endometrial Thickness-and Review of Literature

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ABSTRACT

Monthly cyclical changes in the uterine endometrium can be followed excellently by sonography, particularly when close range magnification with high resolution imaging is done by Transvaginal Ultrasonography [TVUS]. Hormonal changes are reflected in the endometrial histology from proliferative phase to secretory phase, as the endometrium reflects the functioning ability of the hypothalamo-pituito-ovarian axis. The study of different endometrial patterns of TVUS may be utilized in the diagnosis of pathological conditions like endometriosis, malignancy, tuberculosis of endometrium, &, importantly, infertility. The aim of this study is to determine the endometrial thickness in women of all age groups from menarche to menopause, and its correlation with the period of menstrual cycle. The values obtained from standard pre-clinical subject texts, and referenced clinical texts have differed, and we therefore reviewed a wide variety of publication sources to get a better co-relation for our findings. Reported values, other investigative methods, and the significance of this modality, are discussed.

Key words : trans-vaginal ultrasound, endometrial thickness, cyclical variation in endometrium

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INTRODUCTION

The endometrium is one of the most dynamic tissues in the human body, as its structure is not permanent and it has a remarkable ability to degenerate and regenerate constantly throughout the period of reproductive life (i.e. from about fifteenth to the forty- fifth year).Except during pregnancy and lactation, a series of closely interrelated cyclical changes occur in the ovary, uterus and vagina. The changes in the uterus chiefly involve the lining endometrium of its body and fundus, and can be divided into phases: Menstrual, Regenerative, Proliferative, Secretory, Premenstrual.

The endometrium changes in a typical manner, which is recognizable by Trans-vaginal Ultrasonography. From the first day of menstrual cycle until the mid cycle, the normal endometrium progressively thickens and develops sonographically-detectable strata. Past the mid cycle, the normal endometrium progressivelybecomes brittle and thin.

Knowledge of the cyclic morphological changes of the endometrial thickness is both physically and pathologically of much value in assisted- reproduction techniques, and in the early diagnosis of certain pathological conditions like endometrial carcinoma.

The concept of employing a vaginal probe is to obtain high quality image of pelvic organs, afforded by high-frequency endo-cavity transducers, resulting in improved diagnostic accuracy [1]. Most of the relevant anatomy for transvaginal imaging is within 9 cm of the vaginal fornices. Thus stronger focusing is made possible by the proximity of the scanning head to the pelvic tissues.

The current clinical importance of this has inspired the authorstotake up this living anatomy study of the endometrium where they explore variations in its thickness in relation to the menstrual cycle and age of the subjects, and co-relate their findings with the exhaustive literature from sonological, radiological and pathological resources.

MATERIALS AND METHODS

The study included 100 women in the age group of 15 to 60 years, who had come to the gynecology Out Patient Dept. at Govt. Maternity Hospital, Nayapool, Hyderabad, with various complaints like infertility, dysfunctional uterine bleeding etc.

All these patients were referred to the Radiology Department where transvaginal ultrasonographic examination was done for the evaluation of endometrial thickness. A detailed clinical history was taken regarding the age, parity, menstrual and obstetric history, complaints, and associated medical diseases. Gynecological examination was done and observations were recorded.

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After obtaining informed consent, these women were subjected to trans-vaginal ultrasonography: the specification of the probe used in the present study is- frequencies of 5 to 7 MHz, vaginal probe combined with linear and sector real-time scanner.

The thickness of endometrium was taken from the proximal and distal interface between highly reflective surrounding poorly reflective layer, and measured both in longitudinal and transverse sections of the uterus.. The actual thickness of each endometrial wall was taken as half of the total linear distance measured. The actual thickness of endometrium of both anterior and posterior walls in the mid portion of the body was measured with a ruler. The average endometrial thickness was then calculated.

This vaginal probe sonography is particularly important in patients having extensiveabdominal adhesions after previous operations, endometriosis etc.; also, difficulties encountered in abdominal ultrasound with obese patients or with imperfectly-filled urinary bladders, are of no consequence with trans-vaginal sonography.

RESULTS

After excluding the invalid data, i.e. cases which concluded with pathological diagnoses, our findings from physiologically normal subjects were tabulated, age-wise and phase-wise. [see Tables 1 -8]. These measurements are compared with published literature and the significance is discussed.

Table No 1: Group < below 25 yrs.N=18

Phase of Menstrual Cycle	No. of cases	Thickness of Endometrium	Mean Value	S.D.
Proliferative	12	3 to 8 mm	5.8 mm	+/-3.07
Secretory	2	7 to 10 mm	8.5 mm	+/-0.0
Menstrual	4	2 to 3 mm	2.2 mm	+/-0.1

Table No 2: Group 26-35 yrs.N=18

Phase of Menstrual Cycle	No. of cases	Thickness of endometrium	Mean value	S.D.
Proliferative	15	1 to 9 mm	5.5 mm	+/- 3.16
Secretory	3	5 to 10 mm	7.6 mm	+/- 2.99
Menstrual	0	--	--	--

Table No 3: Group 36-45 yrs. N=12

Phase of Menstrual Cycle	No. of cases	Thickness of endometrium	Mean value	S.D.
Proliferative	9	0-7 mm	5 mm	+/- 1.19
Secretory	1	10 mm	10 mm	+/- 0.0
Menstrual	2	1-2 mm	1.5 mm	+/- 0.5

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Table No 4: Group 46-60 yrs.N=16

Phase of Menstrual Cycle	No. of cases	Thickness of Endometrium	Mean value	S.D.
Proliferative	0	--	--	--
Secretory	1	8 mm	8 mm	+/- 0.0
Menstrual	0	--	--	--
Menopausal	13	1-5 mm	3.5 mm	+/- 1.69

Table No 5: Phase-wise distribution –PROLIFERATIVE

Age Groups	No. of cases	Range	Mean, S.D.
15-25	12	3-8 mm	5.8 mm +/- 3.07
26-35	15	1-9 mm	5.5 mm +/- 3.16
36-45	9	2-7 mm	5.0 mm +/- 1.19
46-60	-	-	-

Table No 6: Phase-wise distribution –SECRETORY

Age Groups	No. of cases	Range	Mean, S.D.
15-25	2	7-10 mm	8.5 mm+/- 0.0
26-35	3	5-10 mm	7.6 mm+/- 2.99
36-45	1	10 mm	10 mm+/- 0.0
46-60	1	8 mm	8 mm +/- 0.0

Table No 7: Sample- Phase-wise distribution –MENSTRUAL

Age Groups	No. of cases	Range	Mean, S.D.
15-25	4	2-3mm	2.2 mm +/- 0.1
26-35	-	-	-
36-45	2	1-2mm	1.5 mm+/- 0.5
46-60	-	-	-

Table No 6: Sample- Phase-wise distribution –MENOPAUSAL

Age Groups	No. of cases	Range	Mean, S.D.
15-25	--	--	--
26-35	--	--	--
36-45	--	--	--
46-60	13	1-5mm	3.5mm+/- 1.69

DISCUSSION

Dutta has described that the thickness of endometrium in proliferative phase is 3-4 mm and in the secretory phase it is 5-6 mm [2]. Standard physiology texts mention that in estrogenic phase, there is an increase in estrogen receptors and in endometrial thickness [3].

This correlates with clinical textswhich say that the endometrium grows from 0.5 to 3.5-5.0 mm in height during the proliferative phase [4].

Radiological methods of assessment define endometrial thickness as the minimum distance between the echogenic interfaces of the myometrium and endometrium, measured in the plane through the central longitudinal axis of the uterine body [5].

Callen's text book of Radiology says that the total endometrial thickness measured in a large group of pre-menopausal women did not exceed 4 mm on day 4, and 8 mm on day 8 of the menstrual cycle [6]. Other workers [1] have found that during proliferative phase, when endometrial glands are straight and devoid of secretions, the endometrium is thin (3-5mm) and relatively hypo-echoic compared with the secretory phase. Also, the normal post-menopausal endometrium is atrophic and appears as a thin echogenic line measuring no more than 5-6mm in thickness, though menopausal patients receiving only estrogen therapy may normally have up to 8mm thick endometrium.

In our study:

In the age group of 15-25 years the range of endometrial thickness in proliferative phase is about 3-8 mm and a mean of this phase is about 5.8 mm. Between 26-35 years, the range of endometrial thickness in proliferative phase is about 1-9 mm and a mean of this phase is about 5.5 mm. Between 36-45 years the range of endometrial thickness in proliferative phase is about 2-7 mm with a mean of 5 mm.

Consolidated data would give the range of 1-9 mm with a mean value of 5.38 mm, which is similar to literature, though our standard deviation from the mean was much less, indicating a narrower Gaussian curve of distribution in our population.

Texts of anatomy, physiology, and obstetrics put the secretory phase measurement around 5-7mm, but most radiology books and papers describe that in the luteal phase the endometrium loses its multilayer appearance and becomes progressively more echogenic with a normal thickness of 12-14 mm immediately prior to menstruation.[7]

We found:

In the age group between 15-25 years the range of the endometrial thickness in the secretory phase is about 7-10 mm with a mean of about 8.5 mm. In the age group of 26-35 years the range of thickness is about 5-10 mm with a mean thickness about 7.6 mm. Within the age group of 36-45 years the range and mean is 10mm. between 46-60 years, the mean and range of endometrial thickness in secretory phase is 8 mm.

As per our study, the thickness of endometrium in secretory phase in various age groups of women is in the range of 5-10 mm with a mean value of 8.5 mm which correlates with other radiographic sources, but not with basic science texts.

Davis et al opine that in postmenopausal patients, the normal atrophic endometrium should measure less than 4 mm in double-layer thickness as seen a t TVUS and less than 2.5 mm in single-layer thickness at sonohysterography [8].

Sit et al found that, factors reflecting exogenous estrogen exposure (current HRT use) and endogenous estrogen exposure (higher BMI), were independently associated with thicker endometrium, as measured during screening transvaginal ultrasound [9].

In a large study to describe endometrial volumetry during the menstrual cycle in a group of apparently fertile normal women, parity was associated with a significantly greater endometrial volume than nulliparity [10]. Our work has not recorded association of endometrial thickness with parity, which could take the findings further...

TVUS is nowadays a routine non-invasive component of fertility evaluation. Song et al performed TVUS during proliferative phase in 314 infertile women, and found that the mean endometrial thickness is significantly different in patients with and without endometrial polyps, sensitivity of 85.2%, specificity of 38% [11]. In assisted reproductive technology (ART), the ability to identify a receptive uterus prospectively by a non-invasive method would have an invaluable impact on the treatment efficiency and success rates following ART. In a large meta-analysis of 484 articles in literature, comparing several parameters such as endometrial pattern, endometrial and sub-endometrial blood flows etc., they found a significantly higher endometrial thickness in conception cycles compared to non-conception cycles [12].

TVUS has been used as a screening test for the assessment of the uterine cavity. The advent of transvaginal 3D ultrasonography has enabled accurate non-invasive out-patient diagnosis of congenital uterine anomalies [13]

The presence of endometrial fluid detected by transvaginal ultrasonography is a good marker for pathological changes of the endometrium in postmenopausal women if the endometrial thickness is greater than 4 mm [14]. Raouf et al studied endometrial histology in women with postmenopausal bleeding with endometrial thickness of 4.1-8 mm; in 6.8% subjects, pathology was found. They conclude that the current recommendation of histological assessment on all post-menopausal women with endometrial thickness >4 mm should remain unchanged [15].
Alcazar suggests that, due to the low positive predictive value of TVUS, the newest modality viz. 3D US, may be employed, in which a volume of a region of interest can be acquired and stored, and can be analyzed several ways. This also allows whole assessment of endometrial and sub-endometrial vascularization [16].

Cullinan et al [17] and Johanna et al [18] have reviewed sonohysterography, which involves the instillation of sterile saline under continuous sonographic visualization to assess the endometrial cavity: it allows differentiation of intra-cavitary, endometrial, and sub-mucosal abnormalities without the use of ionizing radiation or contrast agents. Since a single layer of endometrium is visible, focal areas of asymmetrical thickening can be determined. This would

be important in guiding endometrial sampling and biopsy. Cullinan also recommends this investigation for uterine surveillance in tamoxifen-therapy [17].

CONCLUSION

Several investigative modalities have been available for gyn-obs evaluation: CT has been used extensively for cancer staging, and the multi-planar imaging capabilities and soft-tissue resolution of MRI have proved valuable.[1] Pelvic sonography remains the screening procedure of choice because it does not use ionizing radiation and is relatively inexpensive.

The current study found endometrial thickness measurements to co-relate well with literature for the proliferative phase of the cycle, across all age-groups. Our secretory phase data also expectedly reflects the data from radiological literature, but we note that basic science/ pre-clinical subject texts are giving much lower values, and may possibly be revised to match established clinical values, and reflect the latest research.

Although TVUS provides overall excellent depiction of uterine lining as well as ovarian abnormalities, it is limited for evaluating uterine cavity [17]. Sonohysterography has now become the standard test in the imaging evaluation of dysfunctional uterine bleeding and postmenopausal bleeding because it allows reliable differentiation between focal and diffuse endometrial lesions [8].

The role of duplex and color Doppler evaluation of endometrial vasculature in various diseases of the endometrium is being currently investigated,[1] and with improved technology and instrumentation, workers predict that mini hysteroscopy, and 3D SHG will soon become the routine out-patient investigations for infertility patients[13].

CONFLICT OF INTEREST: None

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