

ULTRASONIC VISUALIZATION OF THE ENDOMETRIAL CYCLE

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Summary: The dynamic morphological aspects of the uterine mucosa during the various phases of the endometrial cycle were examined, by using ultrasonographic methods, in 148 patients having regular menstrual cycles and a biphasic basal body temperature.

During the proliferative phase, ultrasonographic examinations permitted a visualization of the mucosa in 33%-45% of the cases, respectively in the initial and in the later part of the phase.

During the secretory phase, the endometrium was identifiable in 81.4% (initial part) to 90% of the cases (later part of phase).

During the menstrual phase, on the other hand, the median echo of the endometrial cavity could never be clearly identified.

Key words: ultrasonography, endometrium, endometrial cycle.

Ultrasonography is, at present, the only non-invasive diagnostic method that permits a study of the morphological and structural characteristics of the mucosa of the endometrium.

Bouton and coll⁽¹⁾, in a recent study, have described in a very precise and detailed way the ultrasonographic aspects of the endometrium during the physiologically normal ovarian cycle.

Thanks to the technological progress of these past few years, Sakamoto and others⁽²⁾ have subsequently been able to use the most up-to-date high-resolution ultrasonic imaging systems, and therefore define in a better way the dynamic aspects of the endometrium and uterine cavity.

MATERIAL AND METHODS

One hundred forty-eight women with regular periods underwent ultrasound examinations at the department of Obstetrics and Gynecology of the University of Naples, 2nd Faculty of Medicine.

Of these women, one hundred had previously had at least one pregnancy, while the remaining forty-eight were nulliparous. All the subjects were free from gynecologic pathology and had a biphasic basal body temperature. The age of the women ranged from eighteen to thirty-five years.

Longitudinal, transverse and oblique scanings were performed with the full bladder technique. An Aloka SSD 256 System was employed, and using a 3.5 Mhz focussed transducer, echograms of the uterus were obtained.

The ultrasonographic scanings were performed at different points in the menstrual cycle. In fact, twenty of the women were examined on the first four days of the cycle and, successively, fifteen of them from day 5 to day 7, eighteen from day 8 to day 10, twenty-two from the 11th to the 14th day, twenty-seven from the 15th to the 19th day, twenty-six from day 20 to day 24, and twenty of the last days of the menstrual cycle (tab. 1).

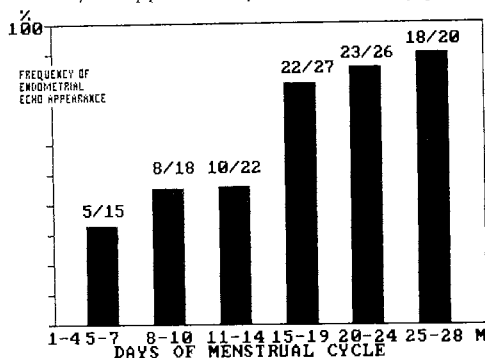
We measured the thickness of the endometrium in millimeters, using the limit between the echogenic area of the miometrium and the free edge the endometrium as a reference point.

RESULTS

The results of our studies are summarized in tab. 1, the analysis of which shows that the endometrium was never clearly visible in the echograms obtained in the first five-day period of the menstrual cycle.

In serial Ultrasonographic examinations made during the period of time going on from day 5 to day 10 of the normal menstrual cycle, the uterine cavity and endometrial mucosa were emphasized respectively in 33.3% (5/15) and 44.4% (8/18) of the cases examined.

TABLE 1. — Incidence of endometrial echo in one hundred and forty-four ultrasonographic examinations of women with a two-phasic basal body temperature and regular cycles. Sharp increase of its appearance after the ovulatory phase.



In successive scanings made at four-day intervals, the appearance rate of the endometrial mucosa increased markedly, reaching its peak incidence (90%) in the premenstrual phase (tab. 1).

Tab. 2 indicates the morphological and structural aspects of the uterine cavity and

endometrial mucosa, as visualized by ultrasonography.

On the first four ways of the normal menstrual cycle, the endometrial mucosa and cavity were not visible at all. (fig. 1).

From day 5 to day 7, the mucosa appeared to be a "linear" and thin echogenic area (fig. 2).

From day 8 to day 10, the mucosa increased in thickness up to 3 mm., but still would appear as an echogenic "line" (fig. 3).

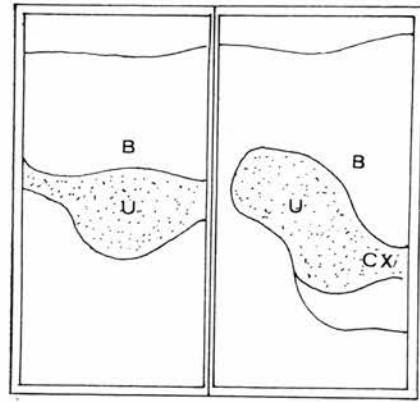
From day 11 to day 14, the endometrium would still appear as an echogenic zone, but thicker than 3 mm. (with a maximum thickness of 8 mm.), (fig. 4).

From day 15 to day 19, the mucosa was as thick as in the former interval of time and it appeared oval-shaped, surrounded by a hypoechoic "halo" (oedema of the corium), (fig. 5).

From day 20 to day 24, the cavity assumed an irregular diamond shape, having an indented and uneven contour.

TABLE 2. — Summarized scheme of the frequency, morphology, structure and dimensions of the endometrial echo in relation to the days of the menstrual cycle, in one hundred forty-four ultrasonographic examinations.

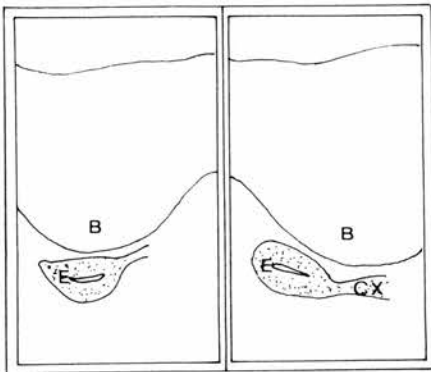
DAYS OF CYCLE	INCIDENCE OF ENDOMETRIAL ECHO	% OF ENDOMETRIAL ECHO	DIMENSIONS, MORPHOLOGY AND STRUCTURE OF ENDOMETRIAL ECHO
1-4	0/20	0	ENDOMETRIAL CAVITY NOT VISIBLE
5-7	5/15	33.3	" LINEAR " ECHOGENIC STRUCTURE
8-10	8/18	44.4	" LINEAR " ECHOGENIC MUCOSA WITH 3 MM. THICKNESS
11-14	10/22	45.4	ENDOMETRIAL THICKNESS FROM 3-8 MM. " LINEAR " ASPECT
15-19	22/27	81.4	OVAL-SHAPED ENDOMETRIUM THICK 8 MM. PERIPHERAL " HALO " (EDEMA OF THE CORIUM)
20-24	23/26	88.4	DIAMOND-SHAPED CAVITY, WITH IRREGULAR AND INDENTED CONTOUR. MUCOSA THICK 8 MM. HYPOECHOIC PERIPHERAL " HALO " AS THICK AS MUCOSA
25-28	18/20	90.0	SAME SHAPE AS FORMER PHASE. LIGHT INCREASE IN CAVITY VOLUME. NON-ECHOGENIC AREA RARELY PRESENT IN DOUGLAS POUCH



Tras. scan. Long. scan.

U: uterus
Cx: cervix
B: bladder

Fig. 1. — Echogram of endometrium during menstrual period.



Tras. scan. Long. scan.

E: endometrium
B: bladder
Cx: cervix

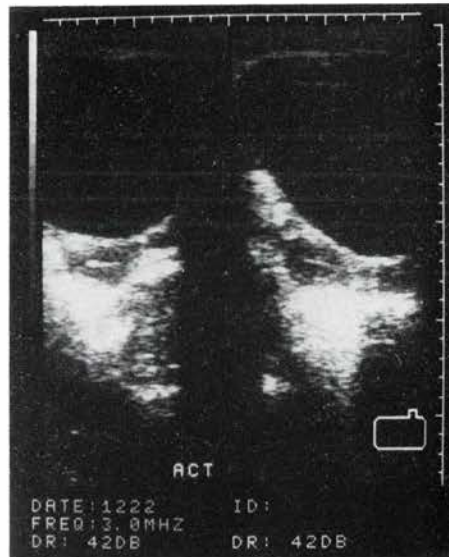
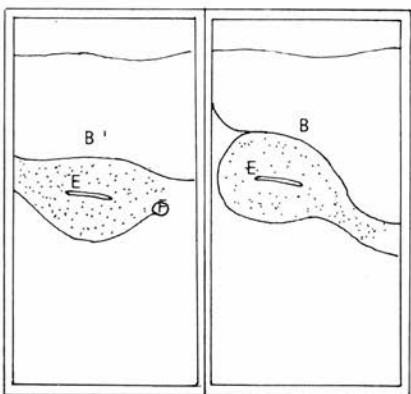
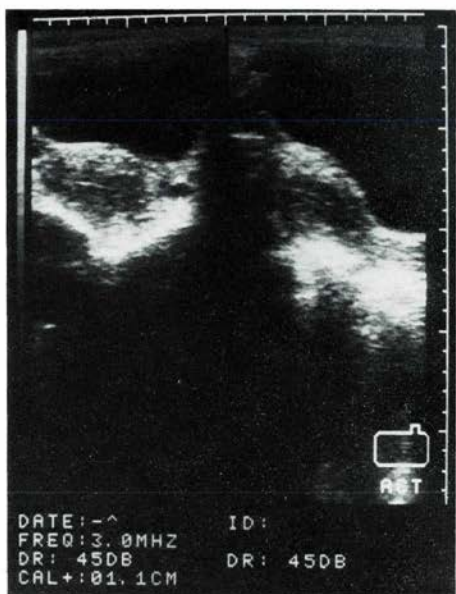


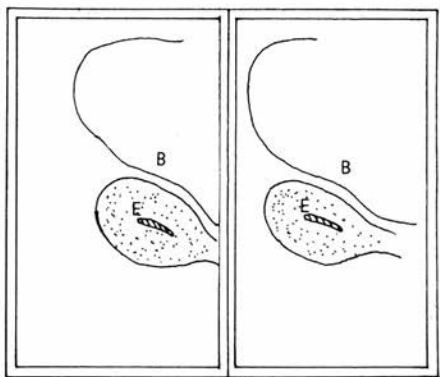
Fig. 2. — Echogram of endometrium on 7th day.



Tras. scan. Long. scan.

B: bladder
E: endometrium
F: left ovarian follicle
1,1 cm.

Fig. 3. — Echogram of endometrium on 10th day.



Long. scan.

E: endometrium
B: bladder

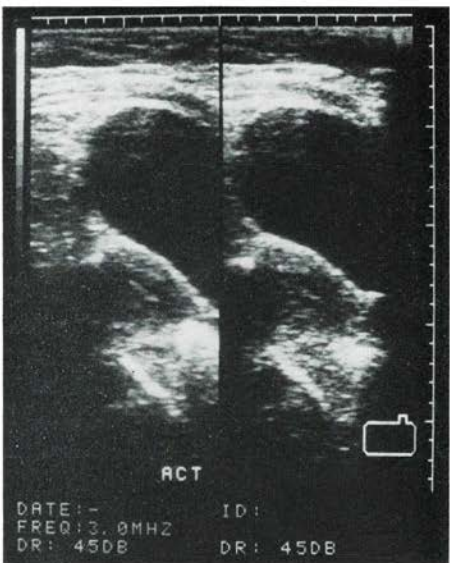


Fig. 4. — Echogram of endometrium on 12th day.

The endometrial mucosa thickness would vary from 5 to 8 mm. and a hypoechogenic peripheral "hao" was still present (fig. 6).

From day 25 to the day of menses, the sonographic appearances of the cavity and mucosa were essentially the same as those of the former interval of time, from which they differend only by a slight increase in the dimensions of the endometrial cavity.

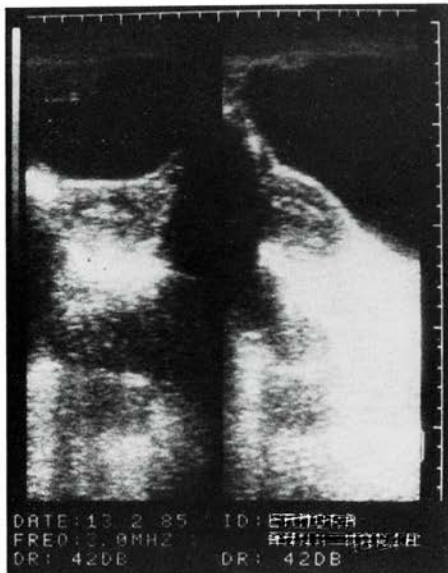
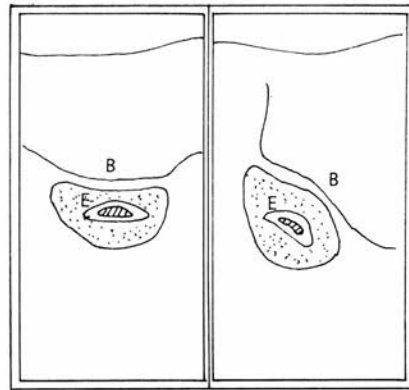


Fig. 5. — Echogram of endometrium on 17 day.



Tras. scan. Long. scan.

E: oval-shaped endometrium
and hypoechoic "halo"

B: bladder

DISCUSSION

The morphological study of the uterine cavity and endometrial mucosa, by using ultrasonographic techniques, began in 1977 with Hobbins⁽³⁾ and Kelly⁽⁴⁾ and, more recently, has continued with Bouton⁽¹⁾ and Sakamoto⁽²⁾, who have employed ecographic imaging systems of the third generation.

The latter, in one of his studies, has reported the presence of an echo along the median scanning axis of the endometrium in 88,5% of the cases examined from day 20 to day 24 of the menstrual cycle.

Fleisher⁽⁶⁾ described a "bull's-eye" endometrial configuration, characterized by an outer echogenic area (myometrium), with a more hypoechoic inner region (endometrium) surrounding a denser, central zone.

Hachelear⁽⁷⁾ noticed the presence of a non-echogenic area in the pouch of Douglas during ovulation. This zone had a spherical shape and was probably due to the local accumulation of endofollicular liquid (2-4 ml) freed at ovulation and secondary to follicular rupture.

In the initial part of the proliferative phase, we were able to demonstrate the presence of a centrally located echo within

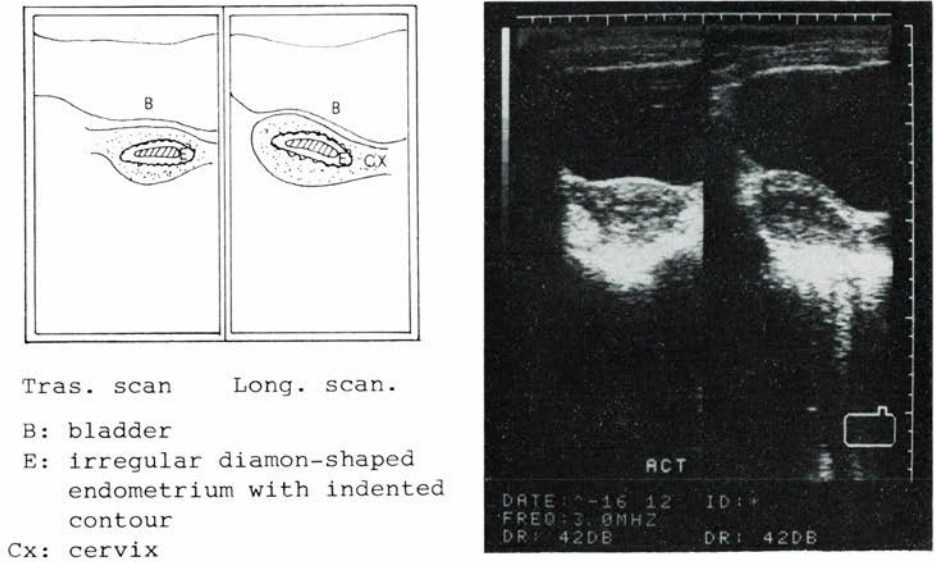


Fig. 6. — Echogram of endometrium on 23rd day.

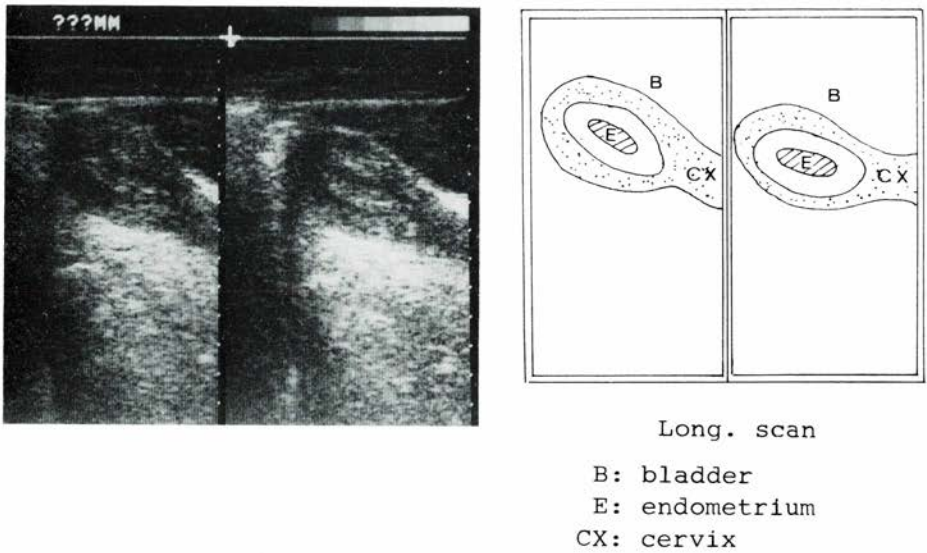


Fig. 7. — Echogram on 26th day.

the uterine cavity in 33.3% of the cases; in 44.4% during the intermediate part of the phase, and in 45.4% of the cases in the advanced proliferative phase.

In the whole proliferative phase, the endometrium reached the maximum thickness of 8 mm.

In this same phase, Bouton⁽¹⁾ has reported a maximum thickness of 3 mm, while Sakamoto⁽²⁾ has related a thickness of 10 mm.

Soon after ovulation, the endometrium slightly reduced its thickness, producing therefore a sonographic image defined by Hackeler⁽⁷⁾ as being a "ring sign" or pseudo-pregnancy pouch, that could also be caused by the decidual reaction of an ectopic pregnancy.

In the initial part of the secretory phase, the mucosa remained thick, the corium lightly oedematized and the cavity assumed an oval shape, surrounded by a hypo-echogenic peripheral "halo".

Under the influence of Progesterone, the mucosal glands and blood vessels proliferate considerably. In fact, the arteries increase their spiralization, while the veins became engorged. The consequent hyperemia determines a reduction of the echogenic capacity of the mucosa; its contour appears indented and the oedema of the corium is remarkable.

In our study, were able to clearly visualize the uterine cavity and endometrial mucosa in 81.4% of the cases examined during the initial part of the secretory phase, in 88.4% of those examined during the intermediate part of the phase, and in 90% of the cases examined during the advanced secretory phase.

CONCLUSION

On the basis of the data gathered, we can conclude, saying that the endometrium reached a high degree of thickness during the proliferative phase, but its visualization in ultrasonography was possible only in 33-45% of the cases examined.

A characteristic of this phase is the presence of a linear echo, along the median axis, with a high amplitude. This indicates that the endometrial surface during this phase is smooth, and its internal structure is homogenous with very low reflecting interfaces.

During the secretory phase, identification of the endometrial tissue on the echogram was facilitated, initially, in 81.4% of the cases examined and up to 90% of those examined in the advanced part of this phase. In fact, this tissue became dishomogeneous and, therefore, echogenic; and all these changes were associated with increased interfaces. The "linear" image of the uterine cavity disappeared and it became oval or diamond-shaped, having an irregular contour very probably due to the stromal oedema of the endometrium.

The increased endometrial interfaces are considered to be due to changes in vascular and glandular elements, and stromal oedema produced by progesterone.

In conclusion, we can say that a detailed ultrasonographic study of the endometrial cavity and mucosa can help in "dating" the endometrial cycle in many cases during the secretory phase, and in fewer cases during the proliferative phase.

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