The Role of Ultrasound in Ovulation Detection Compared To BBT and Other Methods

Poonam[1], Suman S[2], Gupta MK[3], Rauniyar RK[3]

[1]Department of Obstetrics & Gynaecology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India, [2]Department of Radiodiagnosis, IGIMS, Patna, Bihar, India, [3]Department of Radiodiagnosis and Imaging, B.P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal.

Abstract

Background: The detection of timing of ovulation is an important step in the evaluation and management of subfertility. Ultrasonography plays a vital role in monitoring follicular growth. **Aims**: To assess the value of ultrasound scanning of the ovaries in the periovulatory period to detect ovulation and to correlate the results with basal body temperature (BBT) chart and other presumptive evidences of ovulation. **Methods:** In this prospective study, a total of 60 subfertile patients were selected from the outpatient department of obstetrics and gynaecology, BPKIHS, Dharan. BBT charting, midcycle abdominal pain record & premenstrual endometrial biopsy were performed in all patients i.e. in spontaneous ovulating and anovulating (induced later). Ultrasonographic periovulatory follicular tracking was usually started around 10th day of the cycle. The results were then correlated with BBT mainly and also with mittelschmerz and endometrial biopsy. **Results:** In this series fifty five patients, who demonstrated sixty ovulations (with failed inductions in five patients) were monitored for hundred ten cycles. The mean preovulatory follicular diameter was 20.55 mm and 21.76 mm in spontaneous and induced cycles respectively. Majority (36%) demonstrated ovulation by disappearance of follicles accompanied by increase in the amount of fluid in the pouch of Douglas (POD). In this study five cases (14.2%) out of thirty five showing biphasic BBT were anovulatoty. Whereas five cases out of twenty one showing monophasic BBT were ovulating. Amongst the inconclusive group, one (25%) patient was ovulating and the rest four (75%) were anovulatoty. Only 35% patients experienced midcycle pain. Ipsilateral pain was commoner (16.6%) than contralateral (6.6%) and central pain (11.6%). **Conclusion:** Ultrasonographic follicular tracking is a reliable method of ovulation detection. Ovulation precedes the initial rise in temperature in most women confirming the limited value of the rise in BBT as a predictor of ovulation.

Keywords: Basal body temperature, Follicular monitoring, Ovulation detection, Ultrasound.

Introduction

Ovulation detection is fundamental in the diagnostic work-up of subfertile couples, family planning programmes, and optimal artificial insemination timing. A lot of

Correspondence to: Dr. Poonam, D-6/1, Doctors' Quarter, IGIMS campus, Sheikhpura, Patna-14, Bihar, India
Email: drpoonam8@yahoo.com

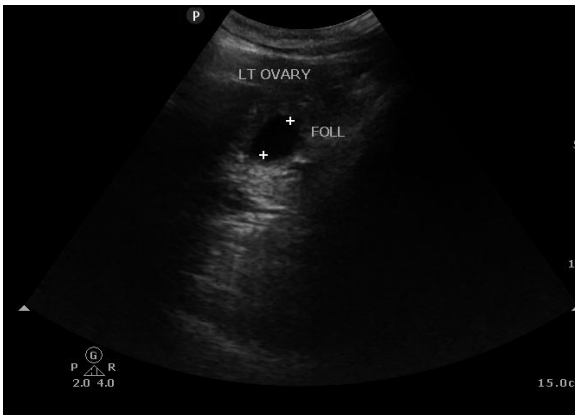

Fig.1: Ultrasound image showing dominant follicle in left ovary.

techniques exist to detect ovulation, but most of these are indirect methods. Direct methods involve seeing follicle growth and rupture by laparoscopy or high-resolution transvaginal ultrasonography[1]. But laparoscopy is technically difficult to perform and impracticable on a routine basis[2]. Although less accurate than laparoscopy, ultrasonography detection of the day of ovulation (US-Do) is a direct method. The purpose of this study was to assess the value of ultrasound scanning of the ovaries in the periovulatory period for detection of ovulation and to correlate the results with basal body temperature charts and other presumptive evidences of ovulation.

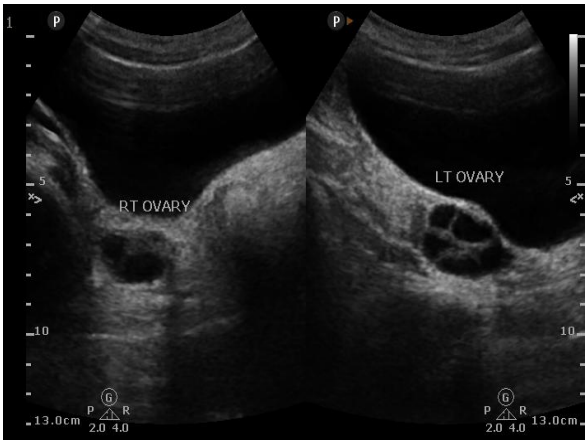

Fig.2: Ultrasound image of bilateral ovaries.

Methods

A total of 60 infertile cases were prospectively studied in the Obstetrics & Gynaecology department of BPKIHS, Dharan, after a detailed history, clinical examination, routine and specialized investigations.

The basal body temperature was taken orally each morning at the same time while in bed before any physical activity for three consecutive cycles prior to follicular monitoring and also in all the cycles monitored by ultrasonography. Biphasic changes were taken as indications of ovulation.

Each day's BBT was plotted on a graph. Ovulation was taken as a momentary event between the last low temperature and the first point on the upsurge of the thermal shift. Endometrial Biopsy: EB was performed on D25 of the cycle with the plastic endometrial suction curette (Karman's cannula).

Follicular monitoring: It usually started on around day 10 of the cycle. Thirty six patients were presumed to have spontaneous ovular menstruation as inferred by their:

i. Biphasic BBT chart and a thermal shift of at least 0.4 to 0.6 degrees lasting for at least 11 days.
ii. History of previous regular menstrual cycles with a cycle length between 26 and 32 days.
iii. Reports of premenstrual endometrial biopsy showing a secretory endometrium
iv. Occurrence of mittelschmerz in a few of these patients.
v. Increased cervical mucorrhea experienced at mid- cycle by a few of these patients.

Table 1: Distribution of cases according to age and type of infertility.

Age (Year)	Type of infertility	
	Primary (%)	Secondary (%)
18-20	1 (2.2)	0
21-25	10 (22.2)	4 (26.6)
26-30	18 (40.0)	6 (40.0)
31-35	12 (26.6)	3 (20.0)
36-40	4 (8.8)	2 (13.3)
Total	**45**	**15**

Patients from anovular group and those from spontaneous group who either did not ovulate or showed insufficient ovulation (luteal phase defect) in their first monitored cycle, received a course of either 50, 100 or 150 mg clomiphene citrate as required, in their successive cycles from day five to day nine of their LMP. In addition 10,000 IU of HCG was given to all the patients on ovulation induction drugs, when the maximum follicular diameter reached 18-20 mm.

Table 2: Showing the type of cycles monitored.

Type of cycle	No. of pt.	Ovulating (%)	Non ovulating (%)
Spontaneous Regular cycles	36	34 (94.4)	2 (5.5)
Anovulatory cycles	24	0	24 (100.0)
Induced cycles	28 (24+4)	23 (82.1)	5 (17.8)

Note: Four patients from spontaneous regular cycles were also induced because 2 had luteal phase defect and other 2 were not ovulating.

Serial follicular monitoring usually started around day 10 of the cycle. The day of ovulation was defined as the day of maximum follicular diameter followed the next day by either disappearance of follicle, decrease in mean diameter by greater than 5mm with or without change in shape, increase in echogenic properties, change in shape only or fluid in the POD.

Each patient was asked about mid cycle abdominal discomfort or pain and mid cycle increased clear watery discharge from the cervix (>1ml).

The ultrasonographic findings of follicular monitoring done in the periovulatory period were then correlated with BBT chart mainly and other presumptive evidences of ovulation like the occurrence of mittel-schmerz.

Table 3: Showing maximum follicular size.

Dominant follicle (mm)	Normal cycle (n=34)	Induced cycle (n=23)
16-17	2	0
18-19	10	1
20-21	16	10
22-23	7	12
24-25	0	2
26-27	0	0
Total	35	25
Mean diameter (mm)	20.2	21.7

Results

Among the total cases studied forty five patients (75%) had primary and fifteen (25%) had secondary subfertility (Table 1). With regards to secondary subfertility, five patients out of fifteen were para one and 4 patients had only abortions (ranging 1-3 abortions) without any live issue. Only one patient was para 3 but her desire for male

child was unfulfilled which made her seek medical advice for subfertility.

Table 4: Showing the sonographic findings of ovulation.

Sonographic findings of ovulation	No. of patients(%)
Change in shape	8 (13.3)
Decrease in mean diameter >5mm	11 (18.3)
Increase in echogenic properties	10 (16.6)
Disappearance of follicles	12 (20.0)
Fluid in the pouch of Douglas	21 (35.0)

Out of the total cases studied, 36 were presumed to be ovulating (table 2) as they were menstruating spontaneously and were fulfilling the criteria for spontaneous ovulation. Regular menstrual cycles in the range 26 to 36 days are usually indicative of ovulation.[3] However, two in this group were actually not ovulating and two had suboptimal ovulations (luteal phase defect) which were later induced along with twenty four cases that were presumed to be non-ovulating. In this group, two patients belonging to secondary subfertility group had presented with recurrent abortion. They were having luteal phase defect as diagnosed from their BBT records, luteal phase length less than 11 days and their preovulatory follicular dimension (16 mm). The remaining 2 belonged to primary subfertility group. Both were diagnosed as having luteinised unruptured follicle. One patient with LUF was suffering from rheumatoid arthritis and was on regular non-steroidal anti-inflammatory drugs. These twenty four cases from the anovulating group and the remaining four from the spontaneous (regular menses) group were induced with clomiphene citrate (50 to 150 mg) from days 5 to 9 of the menstrual cycle. Amongst the twenty four anovular cycles 41.6% (10 cases) had polycystic ovaries based on the USG findings.

In the remaining fourteen anovular cases, seven (29.16%) had follicular atresia and five (20.83%) had luteinized unruptured follicle (LUF) syndrome.

In the spontaneously ovulating group, the follicular dimension ranged from 16-23mm with mean preovulatory diameter as 20.25 whereas in the induced group the range was 18-25 mm and the mean was slightly greater i.e. 21.76 (Table 3).

In the present study, amongst the spontaneous regular menstruating group, single follicle was observed in thirty cases (Table 5). Out of this, twenty eight ovulated. The remaining two which did not rupture had LUF. Two ruptured at comparatively smaller diameters (16mm) which were found to have luteal phase defect with a history of recurrent abortion.

This study shows a 52% incidence of multifollicular recruitment in clomiphene induced cycle in comparison to 20% in the spontaneous regular cycles.

35% of patients experienced midcycle pain. In both the groups ipsilateral pain (16.6%) was commoner than contralateral (6.6%) and central pain (11.6%). (Table 6)

In the present study, the result of periovulatory follicular monitoring by USG was correlated with BBT charts. The graphs were classified as biphasic (58.3%), monophasic (35%) or inconclusive (6.6%)

Table 5: Showing the number of dominant follicles and the number of follicles which ruptured.

No. of dominant follicles	Spontaneous-No. of cycles	Spontaneous-No. of follicles ruptured	Induced-no. of cycles	Induced-no of follicles ruptured
0	0	0	19	0
1	30	28	17	12
2	5	6	22	8+2
3	1	1	12	2
4	0	0	4	1
Total	36	35	74	25

Table 6: Showing the occurrence of mittelschmerz.

Side of pain	Same side as dominant follicle	Contralateral side	Central Pain	Total
No. of cases	10	4	7	21
Percentage	16.6%	6.6%	11.6%	35.0%

Five cases (14.2%) out of thirty five showing biphasic BBT were anovulatory. Whereas five cases (23.8%) out of twenty one showing monophasic BBT were ovulating. Amongst the inconclusive group, one (25%) patient was ovulating and the rest four (75%) were anovulatory. (Table 7 & 8)

Table 7: Types of BBT chart in spontaneous regular and irregular menstruating group.

Type of BBT	Regular menses (%)	Irregular menses (%)	Total (%)
Biphasic	30 (83.3)	5 (20.8)	35 (58.3)
Monophasic	5 (13.8)	16 (66.6)	21 (35.0)
Inconclusive	1 (2.7)	3 (12.5)	4 (6.6)
Total	36	24	60

The retrospective assessment of BBT charts showed the thermal nadir to occur one day prior to follicular rupture in 37.14% of spontaneous and 60% of induced cycles. Whereas, 57.14% of the spontaneous and 40% of the induced group showed the ovulation between twenty four to forty eight hours of the thermal nadir.

Three patients were anovulatory despite showing secretory endometrium and biphasic BBT. All these three were shown by USG to be luteinized unruptured follicles out of which two ovulated with clomiphene and one remained persistent LUF. And one patient showing proliferative endometrial was ovulating. However, this patient BBT was biphasic. (Table 9)

Discussion

The detection of timing of ovulation is an important step in the evaluation and management of subfertility. Sonography has a vital role in monitoring follicular growth in subfertile patients. The anatomic information obtained with ultrasonography concerning the size and development of maturing follicles and corpora lutea can be used to

Table 8: Time interval between the thermal nadir and USG Day of ovulation.

Time of ovulation after thermal nadir	Spontaneous regular cycle	Percentage	Induced cycle	Percentage
Within 24 hrs	13	37.14%	15	60%
24-48 hrs	20	57.14%	10	40%
>48 hrs	2	5-7%	0	0

Table 9: Showing relation between BBT and premenstrual endometrial biopsy.

Type of BBT	Secretory Endometrium	Proliferative Endometrium	Total
Biphasic	29+(3)	1+(2)	35
Monophasic	5+(1)	0+(15)	21
Inconclusive	1+(0)	0+(3)	4
Number in brackets indicates those from anovulatory group			

distinguish physiologic from insufficient or abnormal cycles like luteal phase defect, luteinized unruptured follicles, polycystic ovaries or follicular atresia. In the present study, the result of periovulatory follicular monitoring by ultrasonography was correlated with BBT charts, mittelschmerz and endometrial biopsy.

The day of ovulation (US-DO) was defined as the 24-hour time-lag between the visualisation of a mature follicle at one scan and the appearance of a ruptured follicle or an early corpus luteum, and/or free fluid in the cul-de-sac at the next scan[4]. Precisely, ultrasound signs of luteinisation and/or follicle rupture were either a disappearance or a change in size, shape, or sonographic density.[5]

There is a relation between the thermal nadir in BBT and LH surge. The nadir is believed to represent the beginning of the LH surge. A significant increase in temperature is not noted until two days after the LH peak, coinciding with a rise in peripheral levels of progesterone to greater than 4ng/ml. Physical release of the ovum , probably occurs on the day prior to the time of the first temperature elevation.

In this study 37.14% of spontaneous and 60% of induced cases ovulated within 24 hours of nadir whereas 57.14% of spontaneous and 40% of induced patients showed ovulation between 24-48 hrs. Varmesh et al[7] reported that 20% of cases ovulated one day after the thermal nadir, 28% two days after, another 28% three days after the nadir and 14%, four days after the nadir. BBT varies considerably from cycle to cycle and from woman to woman. Moreover, 28.5% of monophasic charts were ovulatory, yet a biphasic chart did not always indicate ovulation.

So, the BBT nadir or rise did not seem satisfactorily reliable because the former often preceded while the latter often followed US-DO[6]. The findings of the present study and those attained by others indicate towards the variability of the

incidence in the relationship between thermal nadir and follicular rupture. The results demonstrated by follicular tracking (USG) detected ovulation in all cycles.

The above results of BBT confirms in that it is a relatively inaccurate method for ovulation detection. Although it documents the presence of ovulatory cycles, it is imprecise as to the exact day of ovulation. Therefore, it is difficult to time intercourse to coincide with changes in the temperature chart because they have not occurred yet. However, it is useful in documenting the presence of a luteal phase defect (luteal phase less than 11days).

Mittelschmerz is not associated with follicular rupture as once believed. Rather, this discomfort occurs with the rapid growth of the dominant follicle immediately prior to ovulation. It precedes follicular rupture as can be documented by ultrasonography. In this study only 35% of patients experienced midcycle pain.

Although timed endometrial biopsy is considered to be the gold standard for diagnosis of luteal phase defect (dysovulation), EB is not recommended for routine infertility work up (RCOG Guidelines). The drawback of EB includes expense, discomfort and subjective nature of its interpretation. Laparoscopy is the reference direct method to observe ovulation, but it is technically difficult to perform and impracticable on a routine basis.

Conclusion

Ultrasonography correlated with BBT has demonstrated that ovulation precedes the initial rise in temperature in most individuals, confirming the limited value of the rise in BBT as a predictor of ovulation. This study revealed that the ultrasonographic monitoring of follicles is a reliable, practical and the best method for ovulation detection as compared to other indirect methods.

References

1. Queenan JT, O'Brien GD, Bains LM, Simpson J, Collins WP, Campbell S. Ultrasound scanning of ovaries to detect ovulation in women. Fertil Steril 1980;34:99–105.

2. Guermandi E, Vegetti W, Bianchi MM, Uglietti A, Ragni G, Crosignani P. Reliability of ovulation tests in infertile women. Obstet Gynecol 2001;97:92–6.

3. Collins JA. Diagnostic Assessment of the Infertile Female Partner. Curr Probl Obstet Gynecol Fertil 1988;11:6–42.

4. Royston P. Identifying the fertile phase of the human menstrual cycle. Stat Med 1991;10:221–240.

5. Moghissi KS. Ovulation detection. Reprod Endocr 1992;21:39–55.

6. Ecochard R, Boehringer H, Rabilloud, M, Marret H. Chronological aspects of ultrasonic, hormonal, and other indirect indices of ovulation. BJOG 2001;108:822–829.

7. Vermesh M, Kletzky OA, Davajan V, Israel R. Monitoring techniques to predict and detect ovulation. Fertil Steril 1987;47:259–264.

8. Leader A, Wiseman D, Taylor PJ. The prediction of ovulation: a comparison of the basal body temperature graph, cervical mucus score, and real-time pelvic ultrasonography. Fertil Steril 1985;43:385–388.

9. Garcia JE, Jones GS, Wright GLJ. Prediction of the time of ovulation. Fertil Steril 1981;36:308–315.

10. Bauman JE. Basal body temperature: unreliable method of ovulation detection. Fertil Steril 1981;36:729–33.