Frequency of rate of body temperature chart at mid cycle in pregnant women and the subsequent effect on pregnancy

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Summary

Purpose of investigation: To determine if changes in basal body temperature (BBT) during the ovuratory phase are related to subsequent effects on pregnancy. *Methods:* BBT records from 216 pregnant women in a spontaneous cycle or a clomiphene citrate cycle during a recent 6-year period were studied. The last day of low phase (LDLP) and the number of days until high phase (NDHP) were determined for all subjects. *Results:* In the spontaneous cycle group, medium-cycle cases were most frequent and long-cycle cases were most frequent in the clomiphene cycle group. The NDHP ranged between one and three days in 82.8% of the subjects in the spontaneous cycle group and in 86.1% of the subjects in the clomiphene cycle group. Conclusions: Our findings demonstrate the importance of properly evaluating an NDPH of two or even three days in a BBT-based assessment of ovarian function in the ovulatory phase.

Key words: Basal body temperature; Clomiphene citrate; Ovulatory phase.

Introduction

Basal body temperature (BBT) elevation brings about the action of progesterone [1]. BBT can also be affected by sleep duration and sleep environmental factors, such as noise and climate [2], by living environment variables such as daytime work and physical exercise, and by seasonal changes in ambient temperature. Changes in ambient temperature are also subject to geography. Finally, the dramatic changes in lifestyle and living environment that have occurred during the past quarter of a century cannot be disregarded.

The measurement of BBT is not required in current clinical practice, but is nevertheless utilized by almost all gynecological patients with infertility in the early course of ambulatory care at hospitals in Japan, because it is reasonably accurate in predicting ovulation [1, 3, 4], and is inexpensive and minimally invasive [5-7]. However, there are concerns that it is too inaccurate to be used for predicting ovulation [6, 8-10]. Although there have been attempts to evaluate the BBT records of pregnant women in whom ovulation and ovarian function were easy to investigate [11, 12], these reports were published more than 20 years ago and may not reflect our present-day living environment. Medical techniques have also immensely improved, resulting in improvements in examinations and treatment. In the present study, we investigated shifts of BBT during the ovulatory phase and the subsequent effect on pregnancy and, compared our findings to those of studies published 20 years earlier [11].

Materials and Methods

The BBT records of 216 pregnant women that were followed at our hospital or affiliated hospitals during the 6-year period from January 1999 to December 2004 were studied. Patients who conceived during a spontaneous cycle or clomiphene citrate cycle were included; those who became pregnant after hMG-hCG or Gn-RHa therapy or by means of in vitro fertilization-embryo transfer (IVF-ET) were excluded from the study. All women who had received progesterone supplementation in the luteal phase were also excluded. The last day of low phase (LDLP) and the number of days until high phase (NDHP) were determined in all BBT records by two gynecologists, each with over ten years of experience. In the event of a disagreement, the mean of the two estimates was used. All assessments were based on their professional judgment.

Results

Gestation was spontaneous in 133 women (spontaneous cycle pregnancy group) and clomiphene citrate-induced in 76 women (clomiphene cycle pregnancy group). The BBT pattern was classified as biphasic in all these cases. The opinions of the two gynecologists differed for 18 patients who conceived after spontaneous ovarian cycles (13.0%) and 12 who conceived after clomiphene citrate cycles (15.4%). The rate of agreement was thus approximately 86% (186/216). The difference between the two opinions was one day in nearly all inconsistent cases.

The duration of the follicular phase was determined in the two groups and classified as a short, medium, or long cycle [13]. In patients with ongoing pregnancies in the spontaneous cycle pregnancy group, medium-cycle cases were most frequent (42.0%), followed by long-cycle cases (36.1%). Long-cycle cases were most frequent (40.6%) in the clomiphene-cycle pregnancy group, fol-

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lowed by medium-cycle cases (39.1%) (Table 1). In the patients who miscarried the frequencies of long-cycle cases and medium-cycle cases resembled those of the spontaneous group. Short cycle cases comprised only 3.4% of spontaneous cycle pregnancies and 3.1% of clomiphene citrate cycle pregnancies. No short cycle pregnancy ended in miscarriage.

Table 1. — *Duration of follicular cycle in spontaneous and clomiphene-induced pregnancies*.

	Ongoing (%)		Spontaneous abortion (%)	
Follicular phase	Spontaneous	CC	Spontaneous	CC
≤ 11	4 (3.4)	2 (3.1)	0 (0)	0 (0)
12 - 16	50 (42.0)	25 (39.1)	9 (64.3)	5 (41.7)
17 - 22	43 (36.1)	26 (40.6)	3 (21.4)	5 (41.7)
23 ≥	22 (18.5)	11 (17.2)	2 (14.3)	2 (16.7)

CC: clomiphene citrate.

In ongoing pregnancies, the number of days until high phase (NDHP) was one day in 44 women (37.9%) from the spontaneous cycle pregnancy group, and one to two days in 73 women (62.9%). In the clomiphene pregnancy group, the NDHP was one day in 36 women (45.6%), and one to two days in 58 women (73.4%). The NDHP was one to three days in 96 women (82.8%) from the spontaneous cycle pregnancy group and in 68 women (86.1%) from the clomiphene pregnancy group. In contrast, in the miscarriage group NDHP was one day in six women (40%) from the spontaneous-cycle pregnancy group, one to two in nine women (60%), and one to three days in 12 women (80%). In the clomiphene cycle group, NDHP was one day in seven women (58.3%), one to two days in nine women (75%), and one to three days in ten women (83.3%) (Table 2).

Table 2. — *NDHP in spontaneous and clomiphene-induced pregnancies*.

	Ongoing (%)		Spontaneous abortion (%)	
NDHP	Spontaneous	CC	Spontaneous	CC
1	44 (37.9)	36 (45.6)	6 (40)	7 (58.3)
1-2	73(62.9)	58 (73.4)	9 (60)	9 (75.0)
1-3	96 (82.8)	68 (86.1)	12 (80)	10 (83.3)

CC: clomiphene citrate.

Discussion

Evaluation of BBT records in daily clinical practice is based on the judgment and skill of gynecologists. Computerized evaluation of records has been attempted [14], but the results were disappointing. Human sensory judgment has proven to be a superior and substantial agreement in the evaluations of appraisers has also been documented [4]. In the present study, the rate of agreement between the two gynecologists was approximately 85%. This relatively high rate is most likely attributable to the fact that the present series of subjects were pregnant women with stable ovarian function. Cases with inconsistencies might have anomalies in BBT. Therefore, 85% agreement is probably the maximum limit for BBT records used alone.

Variations in the duration of the follicular phase were evident in women with spontaneous cycles. This phenomenon was conspicuous in the clomiphene cycle pregnancy group (Table 1). Comparing the number of cases with a follicular phase of 23 days or longer, there were very few cases with a follicular phase shorter than 11 days. Check *et al*. reported that a short follicular phase per se reduces fecundity [15]. The present study findings support this hypothesis.

Ovulation and stable ovarian function is most easily monitored in women with successful pregnancies. Indeed, existence of a pregnancy indicates that ovarian function is stable, to say nothing of the presence of ovulation. It may be said that these requirements have already been demonstrated in pregnant women. On this premise, Luciano *et al*. [8], Fedele *et al*. [9], Robert *et al*. [11], and Matthews *et al*. [12] used BBT to determine LDLP and changes in the ensuing course of BBT in pregnant women. As for the number of days until NDHP, in the present study 44 women (37.9%) in the spontaneous cycle pregnancy group and 36 women (45.6%) in the clomiphene pregnancy group were "category 1" i.e., those with the most rapid rise in BBT (Figure 1). This category corresponds to "type 1" (fairly steep) in the report by Robert *et al*., who reported that this type accounted for 74% of all cases; the percentage in the present series was considerably lower. The percentage of category 1 cases in the present series was also lower than the percentage of "quick rise pattern" cases in the study of Matthews et al., who reported this pattern in 50% of their cases.

LDLP is generally regarded as the day of LH surge [16-18]. Ovulation occurs within 36 hours of the LH surge [9]. The day after the last day of low phase does not necessarily correspond with the beginning of the high phase because the progesterone level is reportedly 4 to 5 ng/ml during the high phase of BBT [8, 19, 20], and also because the period during which the LH surge occurs varies. Instead, it is likely to be an intermediate day, neither low phase nor of a high phase. Therefore, it is highly probable that BBT progresses to the high phase over a period of two days. If so, it may be acceptable to categorize the NDHP "category 2" cases in the present

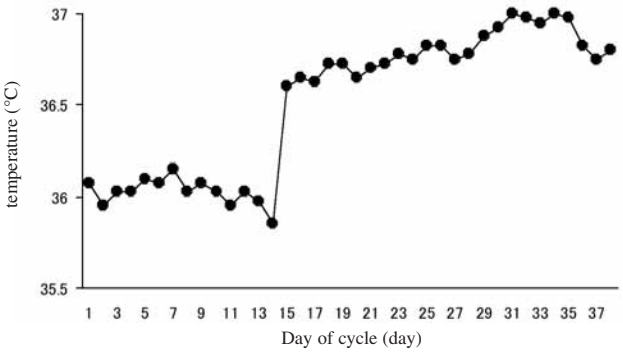

Figure 1. — BBT records of a representative NDHP category 1 case.

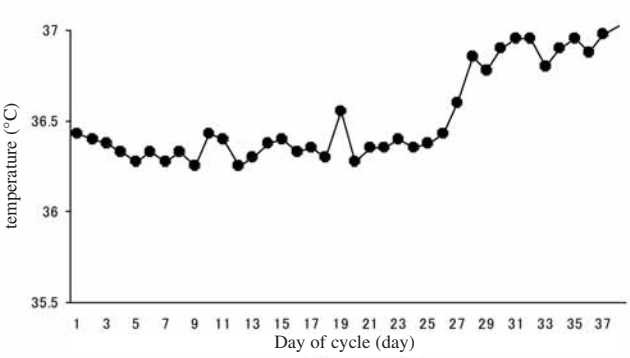

Figure 2. — BBT records of a representative NDHP category 2 case.

study as patients with a rapid rise in BBT (Figure 2). The presence of an intermediate day(s) (NDHP) has been characterized as a gradual stepwise rise (type 2) or more than one temperature nadir (type 3) by Robert *et al*. [11], and as a slow pattern by Matthews *et al*. [12]. In the present study, NDHP category "1" and "2" cases comprised 73 women (62.9%) in the spontaneous cycle pregnancy group and 58 women (73.4%) in the clomiphene pregnancy group. These percentages are still lower than the percentage of type 1 cases in Robert et al. In the present series the number of cases in NDHP categories "1" to "3" was 96 (82.8%) in the spontaneous cycle pregnancy group and 68 (86.1%) in the clomiphene pregnancy group. Guida *et al*. reported that BBT-determined ovulation days were scattered between day -1 to day +3 of actual ovulation [1]. Moreover, they found no difference between women with ongoing pregnancies and those who miscarried.

Temperature-controlled environments are much more common than they were two decades ago. The view of life and the lifestyle itself of present-day women have become more positive and active, thereby making their daily living more complicated. A rapid elevation in BBT during the gestational cycle should occur in most women, but BBT may not be as accurate in assessing ovarian function in present-day women living in cities. The accuracy of BBT records for ovulation stage is eventually reduced because the starting points of BBT elevation are to be read. BBT however, has the great advantage of being minimally invasive and allows continuous assessment of ovarian function, thus it can hardly be abandoned as the majority of patients use it to keep records. Although definitive results cannot be expected from the application of BBT for future treatment or in the early stage of treatment with low-dose clomiphene citrate, further analysis and use of the BBT records will continue in the foreseeable future.

Conclusion

Our findings demonstrate the importance of properly evaluating a NDHP of two or three days in a BBT-based assessment of ovarian function in the ovulatory phase.

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