**Research Article**

# Basal Temperature, Cervical Mucous, and Both Combination as Diagnostic Tools to Detect Ovulation

## *Akurasi Suhu Basal Tubuh, Lendir Serviks, dan Kombinasi Keduanya sebagai Alat Pendeteksi Ovulasi*

**Eka R Gunardi, Alexander Mukti, Herbert Situmorang**

*Department of Obstetrics and Gynecology*
*Faculty of Medicine Universitas Indonesia/*
*Dr. Cipto Mangunkusumo General Hospital*
*Jakarta*

## Abstract

**Objective**: To make basal body temperature examination and cervical mucus as an alternative examination in detecting ovulation, especially in health facilities that do not have ultrasound.

**Methods**: This cross-sectional study was conducted at the outpatient clinic of RSUPN Dr. Cipto Mangunkusumo in the year 2016-2017. A total of 49 infertile female patients who had normal menstrual cycles were asked to participate and performed basal body temperature measurements, cervical mucus sampling and transvaginal ultrasound examination, the data are subsequently grouped into 3 Days Estimated Ovulation (DEO); DEO-2 days, DEO and DEO+ 2 days. Diagnostic tests were performed and accurate comparison between basal body temperature, cervical mucus and a combination of both were later assessed.

**Results**: The best accuracy was found on cervical mucus and combination of both with 65% in detecting ovulation, whilst the lowest was basal body temperature (59%) with sensitivity 46.7%, and specificity 78.9%. Cervical mucus in diagnosing ovulation has a sensitivity of 70% and specificity 57.8%. The combination of temperature-cervical mucus in diagnosing ovulation has sensitivity of 46.67% and specificity of 94.73%.

**Conclusion**: Cervical mucus examination has better accuracy compared with basal body temperature examination in detecting ovulation. Further research for validating these diagnostic tools to the wider community and not only in patients with infertility is needed.

[Indones J Obstet Gynecol 2018; 6-3: 162-166]

**Keywords**: basal body temperature, cervical mucus, infertility, ovulation detection, ultrasound

## *Abstrak*

***Tujuan**: Untuk menjadikan pemeriksaan suhu basal tubuh dan lendir serviks sebagai pemeriksaan alternatif dalam menditeksi ovulasi terutama pada fasilitas kesehatan yang tidak mempunyai ultrasonografi.*

***Metode**: Penelitian potong lintang ini dilakukan di poliklinik RSUPN Dr. Cipto Mangunkusumo pada tahun 2016-2017. Sebanyak 49 pasien perempuan infertilitas yang mempunyai siklus menstruasi yang normal diminta untuk berpartisipasi dan dilakukan peng-ukuran suhu basal tubuh, pengambilan sampel lendir serviks dan pemeriksaan ultrasonografi transvaginal, data dikelompokkan menjadi 3 Hari Perkiraan Ovulasi (HPO) yaitu HPO-2, HPO dan HPO+2. Dilakukan uji diagnostik dan dilakukan perbandingan akurasi antara suhu basal tubuh, lendir serviks dan kombinasi keduanya.*

***Hasil**: Didapatkan hasil yang paling baik adalah akurasi lendir serviks dan kombinasi keduanya dengan hasil 65%. Dan yang paling rendah adalah suhu basal tubuh dengan hasil 59%. Dengan suhu basal tubuh dalam mendiagnosis ovulasi memiliki sensitivitas 46,7%, spesifisitas 78,9%, dan akurasi 59%. Lendir serviks dalam mendiagnosis ovulasi memiliki sensitivitas 70%, spesifisitas 57,8%, dan akurasi 65%. Kombinasi suhu-lendir serviks dalam mendiagnosis ovulasi memiliki sensitivitas 46,67%, spesifisitas 94,73%, dan akurasi 65%.*

***Kesimpulan**: Pemeriksaan lendir serviks memiliki akurasi yang lebih baik dibanding dengan pemeriksaan suhu basal tubuh dalam menditeksi ovulasi. Diperlukan penelitian mengenai validasi alat diagnostik ini pada masyarakat yang lebih luas dan bukan hanya pada kelompok yang mengalami infertilitas sehingga dapat diterapkan pada masyarakat umum.*

*[Maj Obstet Ginekol Indones 2018; 6-3: 162-166]*

***Kata kunci**: deteksi ovulasi, infertilitas, lendir serviks, suhu basal tubuh, ultrasonografi*

**Correspondence:** Eka R Gunardi. eka_dhigita@yahoo.co.id

## INTRODUCTION

Infertility is one of disease problem raising awareness in developing countries. It causes both physical and psychosocial problem. The infertility prevalence in the world is estimated from 13 to 15%.[1] World Health Organization (WHO) stated that of 850 infertile couple, female, male factors, both of them contribute to 37%, 8%, and 35%; respectively. Meanwhile, the remaining (20%) is unexplained infertility. The most common female factors are ovulation abnormalities (25%), followed by endometriosis (15%), pelvic adhesion (12%), tubal occlusion (11%), other tubal problem (11%), and hyperprolactinemic (7%). Ovulation abnormalities can be caused by stress, polycystic

ovary syndrome (PCOS), hyperthyroid or hypothyroid, and others.[1]

To detect the ovulation incidence, there are several ways through indirectly methods such as calendar, hormonal assessment (LH, FSH, pregnanediol, glucuronic, estrone glucuronic, progesterone), basal temperature, cervical mucous. In addition, direct methods including ultrasound and laparoscopic are more accurate to detect it.[2-4]

The gold standard to detect ovulation is through ultrasound; however, there is another simple, cheap, and easy to use method to detect by herself, namely basal temperature assessment.[5-7] This examination is greatly influenced by hormonal change.[8] The increase of 0.2°C basal temperature occurs since the raise of progesterone level due to corpus luteum formation in ovulation.[7]

Meanwhile, another simple method to detect ovulation is through cervical mucous examination. This is widely used in natural contraception which shows highly reliable predictor.[9] Principally, low estrogen and high progesterone level approaching menstruation make cervical mucous become small amount, whitish colour, thick, and not elastic to hamper the sperm entering. On the high level of estrogen at ovulation, cervical mucous seems to be a lot, clearly colour, thin, and elastic to support sperm enter the uterine cavum; therefore, sperm is easier to fertilise ovum.[7]

Based on theory above, this study aims to assess the accuracy of basal temperature, cervical mucous, and both combination to detect ovulation. We hope that this study can become a solution to detect infertility in limited resources without ultrasound and especially for general practitioner in primary health centre.

## METHODS

This cross-sectional study design was held out at gynecology polyclinic Dr. Cipto Mangunkusumo Hospital, Jakarta from December 2016 to April 2017. We recruited 18-38-year-old women, having regular menstruation cycle between 26 and 34 days since menarche or minimally in the last three cycle, normal body mass index (BMI), physically healthy, positive ovulation sign during sample taken, and willingness to participate to this study. For patients with sign and symptoms of PCOS (acne, hirsutism, oligomenorrhea, obesity) or positive finding of PCOS on ultrasound, abnormality in abdomen or ovary on ultrasound or evidence of endocrine disease or other disease influencing menstruation cycle were excluded. By calculating sample, the minimal subject was 46 women.

Flow of this study started from women fulfilling requirement would be counted for day estimated ovulation (DEO) through 14 days before next menstruation. Subjects were asked to assess the basal temperature in the morning before active during six consecutive days on the second day after the end of menstruation. Basal temperature in the morning would be recorded on DEO-2 days, DEO, and DEO+2 days by themselves using digital oral thermometer. Meanwhile, cervical mucous assessment would be determined by themselves and investigator by putting into four categories. Investigator took the sample at polyclinic Dr. Cipto Mangunkusumo hospital using speculum and taking cervical mucous to assess the amount of cervical mucous, Spinnbarkeit test, Ferning test, and Insler test. Besides, investigator performed ultrasound examination to monitor the follicle development up to rupture evidence.

The data were run into sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) analysis for each examination consisting of basal temperature, cervical mucous, and both combination by comparing with ultrasound. The ROC analysis by observing the area under curve (AUC) was analysed. We considered $p<0.05$ as significant value. This analysis was performed through Stata 12.0 for Windows©. This study has been approved by ethical committee in Dr. Cipto Mangunkusumo hospital/Faculty of Medicine Universitas Indonesia under number 994/UN2.F1/ETIK/2016.

## RESULTS

There were 49 subjects recruiting to this study. Table 1 showed the demographic characteristics of participated subjects in this study.

**Table 1.** Demographic Characteristics of Subjects in this Study

| Characteristics | n (%) |
|---|---|
| Age (y.o) (mean (SD)) | 29.51 (0.65) |
| Marital age (y.o) (median (min-max)) | 23 (18-33) |
| Menarche (y.o) (median (min-max)) | 12 (10-13) |
| Menstrual cycle (days) (median (min-max)) | 28 (27-34) |
| Body mass index (kg/m$^2$) (mean (SD)) | 21.87 (0.20) |

| | |
|---|---|
| **Working** | |
| Yes | 25 (51%) |
| No | 24 (49%) |
| **Smoking** | |
| Yes | 8 (16.3%) |
| No | 41 (83.7%) |
| **Alcohol consumption** | |
| Yes | 3 (6.1%) |
| No | 46 (93.9%) |

On the basal temperature assessment, there were 18 subjects (36.7%) increasing ≥0.2°C or reaching nadir point; however, the other 31 subjects (63.3%) did not reach nadir point. Meanwhile, based on cervical mucous, there were no subjects approaching Insler score ≥10 and category 4 of Billing on DEO-2 days. There were 29 subjects (59.2%) having Insler score ≥10 and category 4 of Billing on DEO and all subjects (100%) showing Insler score ≥10 and category 4 of Billing on DEO+2 days.

Ultrasound examination showed that there were no subjects, 30 subjects (61.2%), and 49 subjects (100%) revealing ovulation sign on DEO-2 days, DEO, and DEO+2 days; respectively.

Table 2 pointed out the diagnostic test analysis of basal temperature compared with ultrasound as gold standard. The result showed the sensitivity, specificity, PPV, and NPV were 46.7%, 78.9%, 77.78%, and 48.38%; contributively. The positive possibility ratio of this examination was 2.21 and negative possibility of 0.42 with accuracy level reaching 59%.

**Table 2.** Diagnostic Test of Basal Temperature

| | | Ultrasound | | Total |
|---|---|---|---|---|
| | | + | - | |
| Basal Temperature | + | 14 | 4 | 18 |
| | - | 16 | 15 | 31 |
| Total | | 30 | 19 | 49 |

Table 3 showed the diagnostic test of cervical mucous compared with gold standard. Of the result, we obtained sensitivity of 70%, specificity of 57.8%, PPV of 72.4%, and NPV of 55%. Meanwhile, the positive and negative possibility ratio were 1.66 and 0.51; also the accuracy level was 65%.

**Table 3.** Diagnostic Test for Cervical Mucous

| | | Ultrasound | | Total |
|---|---|---|---|---|
| | | + | - | |
| Cervical mucous | + | 21 | 8 | 29 |
| | - | 9 | 11 | 20 |
| Total | | 30 | 19 | 49 |

Table 4 indicated the diagnostic test of combination between basal temperature and cervical mucous in detecting ovulation. The result showed the sensitivity, specificity, PPV, and NPV were 46.67%, 94.73%, 93.33%, and 52.94%; respectively. The positive possibility ratio of this examination was 8.86 and negative possibility of 0.56 with accuracy level approaching 65%.

**Table 4.** Diagnostic Test of Combination between Basal Temperature and Cervical Mucous

| | | Ultrasound | | Total |
|---|---|---|---|---|
| | | + | - | |
| Basal Temperature | + | 14 | 1 | 15 |
| and Cervical mucous | - | 16 | 18 | 34 |
| Total | | 30 | 19 | 49 |

On the discrimination test of these diagnostic tools to detect ovulation, we got that the combination of basal temperature and cervical mucous having the best area under the curve (AUC) (70.7%; 95% CI 56.3-85.1%; p=0.01). This value was better than the discrimination level showed by basal temperature of 62.8% (95% CI 47.7-80.2%; p=0.13) and cervical mucous of 63.9% (95% CI 46.9-78.7%; p=0.1)

## DISCUSSION

Fitzgerald et al.[10] stated that the new pregnancy rate would decrease after 31 years old and their study was supported by George et al.[11] result. George concluded that women fecundity declined after 32 years old. Subjects in this study were still on reproductive age whereas most of them (55.1%) were less than 32 years old. Only one subject was 37 years old. In this study, there were 16.33% subjects smoking and 6.1% subjects having alcohol history. Based on systematic review and meta-analysis by Augood, et al[12], they stated that infertility risk raised on smoking women (OR 1.60; 95% CI 1.34-1.91); meanwhile, study by

Mikkelsen, et al[13] on alcoholic women, infertility risk was not influenced by alcohol drinking habit. Therefore, 16.3% subjects consuming alcohol in this study could impact to this study.

Basal temperature reflects the ovary cycle through the increase of 0.2-0.5% temperature (biphasic curve). It is caused by thermogenic effect of pregnanediol and lasted up to 14 days during luteal phase. The increase of temperature signs ovulation event.

In this study, the cervical mucous view was varied on the three day of sample taken. Cervical mucous can change on ovulation due to the drastic increase of estrogen approaching ovulation. Therefore, cervical mucous becomes a lot, thin, watery, alkali, acellular with fern, long spinnbarkeit, and acceptable for sperm. It can be recognised physically as watery and smooth sensation and clear mucous. All physical finding can be determined by Insler score and Billings category. Several literatures revealed that this method is reliable to be a diagnostic tool for detecting ovulation incidence.[14,15]

Sensitivity and specificity of basal temperature as ovulation diagnostic tools were 46.7% and 78.9% with 59% of accuracy. Compared with study by Guermandi et al.8, they obtained sensitivity of 77% and specificity of 33% with 74% of accuracy. The poor level of basal temperature sensitivity on this study was caused by ovulation was not always followed by the increase of temperature so that basal temperature could not be a reliable tool to detect the incidence of ovulation.

Variation of cervical mucous on each menstrual cycle makes this sign as predictor of ovulation. In this study, cervical mucous had sensitivity and specificity of 70% and 57.8% with accuracy reaching 65%. This assessment was cheap and not invasive so that this methods would be trained to young women hoping pregnancy. Some studies showed that this method was effective enough to detect ovulation. Alliende et al.[16] concluded that the comparison between cervical mucous and ultrasonography had sensitivity and specificity of 75.9% and 75.9%.

Combination of basal temperature and cervical mucous is a method effectively detecting ovulation and predicting fertility interval time. In this study, combination of both methods had sensitivity and specificity of 46.67% and 94.73% (65% of accuracy). Previous study by Frank-Hermann, et al.[17] concluded that this combination gave sensitivity of 89% to predict ovulation compared with ultrasound. This method became reference to avoid pregnancy with the successful rate reaching 0.3-0.5 or one unplanned pregnancy in 2 to 3 years. This combination revealed high specificity; therefore, one or both results indicated negative value, it meant there was negative result.

Of ROC curve, we obtained that combination between basal temperature and cervical mucous had the best area under curve (AUC) of 70.7% (95% CI 56.3-85.1%) followed by cervical mucous and basal temperature. Therefore, this combination of two parameters resulted better diagnostic tools to differ patients experiencing ovulation.

We recommended further investigation such as cervical mucous examination independently by women to recognise sign of ovulation and compared with gold standard tool (ultrasonography). In the end, we hope that Indonesian women can identify independently their fertility period.

## CONCLUSION

Basal temperature can diagnose ovulation with sensitivity, specificity, and accuracy of 46.7%, 78.9%, and 59%; respectively. Meanwhile, cervical mucous has sensitivity of 70%, specificity of 57.8%, and accuracy of 65% to detect ovulation. Combination of both methods is capable of detecting ovulation with sensitivity, specificity, and accuracy of 46.67%, 94.73%, and 65%, respectively.

## CONFLICT OF INTEREST

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## REFERENCES

1. Evens EM. A Global Perspective on Infertility: An Under Recognized Public Health Issue. 2004: 18.
2. Ecochard R, Boehringer H, Rabilloud M, Marret H. Chronological aspects of ultrasonic, hormonal, and other indirect indices of ovulation. BJOG. 2001; 108(8): 822-9.
3. O'Connor KA, Brindle E, Miller RC, Shofer JB, Ferrell RJ, Klein NA, et al. Ovulation detection methods for urinary hormons: precision, daily and intermittent sampling and a combined hierarchical method. Hum Reprod. 2006; 21(6): 1442-52.

4. Alliende ME, Cabezon C, Figueroa H, Kottmann C. Cervico-vaginal fluid changes to detect ovulation accurately. Am J Obstet Gynecol. 2005; 193(1): 71-5.
5. Zinaman MJ. Using cervical mucus and other easily observed biomarkers to identify ovulation in prospective pregnancy trials. Pediatr Perinotol Epidemiol. 2006; 20 Suppl 1: 26-9.
6. Germano E, Jennings V. New approaches to fertility awareness-based methods: incorporating the Standard Days and Two Day Methods into practice. J Midwifery Womens Health. 2006; 51(6): 471-7.
7. Pyper CM, Knight J. Fertility awareness methods of family planning: the physiological background, methodology and effectiveness of fertility awareness methods. J Fam Plann Reprod Health Care. 2001; 27(2): 103-9.
8. Guermandi E, Vegetti W, Bianchi MM, Uglietti A, Ragni G, Crosignani P. Reliability of ovulation tests in infertile women. Obstet Gynecol. 2001; 97(1): 92-6.
9. Pallone SR, Bergus GR. Fertility awareness-based methods: another option for family planning. J Am Board Fam Med. 2009; 22(2): 147-57.
10. Fitzgerald C, Zimon AE, Jones EE. Aging and Reproductive Potential in Women. Yale J Biol Med. 1998; 71: 367-81.
11. George K, & Kamath MS. Fertility and age. J Hum Reprod Sci, 2010; 3(3): 121-3. http://doi.org/10.4103/0974-1208.74152
12. Augood C, Duckitt K, Templeton AA. Smoking and female infertility: a systematic review and meta-analysis. Hum Reprod. 1998; 13(6): 1532-9.
13. Mikkelsen E, Riis AH, Wise LA, Hatch EE, Rothman KJ, Cueto HT, et al. Alkohol consumption and fecundability: prospective Danish cohort study. BMJ 2016; 354: i4262
14. Keefe EF. Self-observation of the cervix to distinguish days of possible fertility. Bull Sloane Hosp Women Columbia Presbyt Med. 1962; 8(4): 129-36.
15. Billings EL, Brown JB, Billings JJ, Burger HG. Symptoms and hormonal changes accompanying ovulation. Lancet. 1972; 1(7745): 282-4.
16. Alliende ME, Cabezón C, Figueroa H, & Kottmann C. Cervico vaginal fluid changes to detect ovulation accurately. AJOG. 2005; 193(1): 71-5.
17. Frank-Herrmann P, Gnoth C, Baur S, Strowitzky W, Freundl G. Determination of the fertile window: Reproductive competence of women - European cycle databases. Gynecol Endocrinol, 2005; 20(6): 305-12.