

Ovulation tracking comparison study of Mira with semi-quantitative product

Abstract

It is assessed that Mira's urinary hormones measurements show a certain correlation with serum hormones. Taking urinary Luteinizing Hormone(LH), Estrone-3-Glucuronide(E3G) which is the primary metabolic of Estradiol (E2), and Pregnenolone-3- Glucuronide(PdG) which is the major metabolic of Progesterone (P) as examples, Mira detects the concentration of urinary LH, E3G and PdG with first-morning urine, comparing with serum LH, E2, and P at the same time(within 4 hours). The R^2 of urinary LH and serum LH is 0.8857, the R^2 of urinary E3G and serum E2 is 0.6747, and the R^2 of urinary PdG and serum P is 0.6726.

Compared with serum tests, testing urinary hormones during the menstrual cycle can also show high accuracy of ovulation prediction and confirmation. When combining the LH, E3G, and PdG in one cycle, the accuracy increases to almost 100% from 86% determined by LH and E3G.

Materials and methods

A group of 14 ladies who have normal cycle length between 28-32 days was recruited to collect their first-morning urine from the period end day to the next period start day. The urine was provided to investigators daily. The investigators test the LH, E3G, and PdG levels in urine with Mira Fertility Wands and Mira Analyzer. The other urinary hormones test product-Clearblue Ovulation Test Advanced Digital-was also used to detect the fertility status by testing LH and E3G with the same urine samples. Between days 10 to 17 of the cycle, once their urinary LH>10 mIU/ml, or E3G>100ng/ml, the participants were asked to take a serum LH, E2, and P test, in a local hospital by lab equipment. About 3-5 days later, two follow-up serum E2 and P tests are requested. The urinary LH, E3G, and PdG test results are compared with serum LH, E2, and P tests which are conducted on the same day.

Results

The 14 volunteers recruited for the study about the comparison of different methods of tracking ovulation were monitored for one cycle. Their mean age was 27.5 years and their mean cycle length during the study was 29.9 days. Among the 14 women, 6 of them were married, and 5 of them had children. Among the women who have children, 3 of them have one pregnancy, 1 of them have two pregnancies, and one of them has three pregnancies. During the test cycle, all of them don't have any drugs.

The information about the recruitment participants was listed in table 1.

Tab. 1 The information of participants

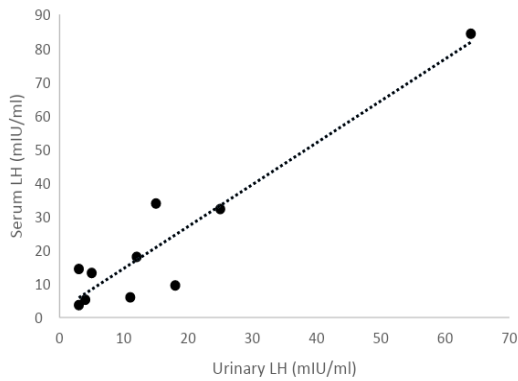
Item	Mea		
	n	Max	Min
BMI (kg/m ²)	21.6	28.2	17.5
Age	27.5	35.0	22.0
Cycle Length (day)	29.9	35.0	24.0
Period Length (day)	5.0	6.0	4.0

Luteal phase length(day)	13.4	14.0	13.0
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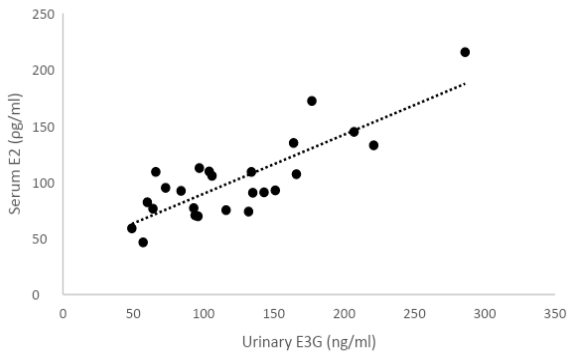
Comparison of Mira urinary test with the serum test

Urinary LH shows a high correlation with serum LH($R^2=0.8857$). The concentration of LH in urine is lower than that in serum. This may be caused by a metabolite of the hormone, or urine dilution. It can be calibrated by a standard curve. Urinary E3G shows a certain correlation with serum E2($R^2=0.6747$). Urinary PdG shows a certain correlation with serum P($R^2=0.6726$).

1A



1B



1C

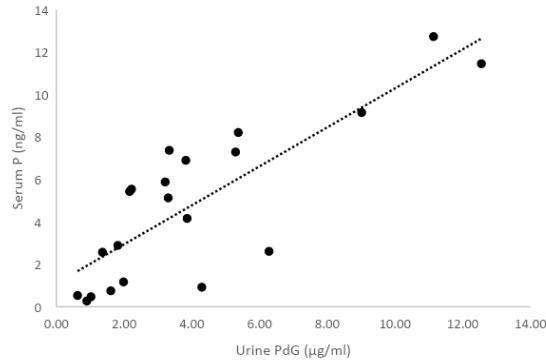


Fig 1A. The correlation of urinary LH with serum LH. 1B The correlation of urinary E3G with serum E2. 1C The correlation of urinary PdG with serum P. The X-axis indicates the urinary test results and the Y-axis indicates the serum test results.

The urinary hormones tested by Mira products show a correlation with those of serum, which means the urinary hormones test can be used to evaluate the fertility status of women. As urinary hormones can be tested at home daily with no medical assistance, it provides an easy way to track ovulation, helping to conceive.

Comparison study of Mira product with the semi-quantitative product

Three products were used to test urinary hormones and compared with the result of serum during the cycle. For the purpose of this study, one day before that when serum Progesterone is greater than 1 µg/l was defined as ovulation day. The ovulation day of the urinary test was defined as LH peak day of Mira (LH>14) and Peak Fertility of Clearblue (Smile icon) respectively.

The fertile window in this study is defined as starting from 6 days before the ovulation day tested by the serum to the ovulation date. When the E3G level greater than 100ng/ml of Mira and Clearblue display a flashing smiley, it means entering a fertile window.

Serum progesterone concentration greater than 1.52 µg/l was observed in 13/14 cycles. One cycle was tracked from day 5 to day 28 of a 28-day cycle and no higher level of progesterone and peak during the mid-luteal phase was recorded. It means that there are no ovulation occurs during this cycle.

Different profile of peak in the urinary LH concentration was observed with Mira Fertility Plus and Clearblue, which was listed in Table 2.

Tab 2. The different profiles of the peak in urinary LH

	Number		Percent	
	Mira Fertility Plus	Clearblue	Mira Fertility Plus	Clearblue
No LH peak	3	1	21.4%	7.1%
1 LH peak	11	10	78.6%	71.4%
2 LH peak	0	3	0.0%	21.4%
Warning of LH Peak within 6 days	10	5	71.4%	57.1%

Warning of LH Peak before 6 days	2	8	14.3%	35.7%
No Warning of LH Peak on ovulation day or after the ovulation	2	1	14.3%	7.1%

It is defined as True Positive (TP) when the LH peak occurs on the same day as the serum ovulation, False Positive (FP) when the LH peak occurs before or after the serum ovulation, False Negative (FN) when the LH peak doesn't occur. As the table shows, the TP rate of Mira is 78.6% and Clearblue is 71.4%, while Clearblue occurs more FP (21.4%) than Mira. Mira has higher FN (21.4%) than Clearblue (7.1%) based on the LH test.

Taking the E3G test into account, which is used as a warning for the LH peak, meaning the fertile window starts. It is defined as a True Fertile Window (TFW) when a warning of LH Peak occurs within 6 days, a False Fertile Window (FFW) when a warning of LH Peak occurs before 6 days, and a False Non-fertile Window (FNF) when no warning of LH Peak occurs on ovulation day or after the ovulation. As the table shows, the TFW rate of Mira is 71.4% and Clearblue is 57.1%.

Deviation day was calculated to assess the accuracy of each way to determine the fertility status of women, compared with serum. In this study, the deviation was obtained by calculating the date difference between the day serum progesterone greater than 1 µg/l and detected ovulation day by different urinary hormones test products. The fertility status was defined as a cycle of whether ovulation occurs.

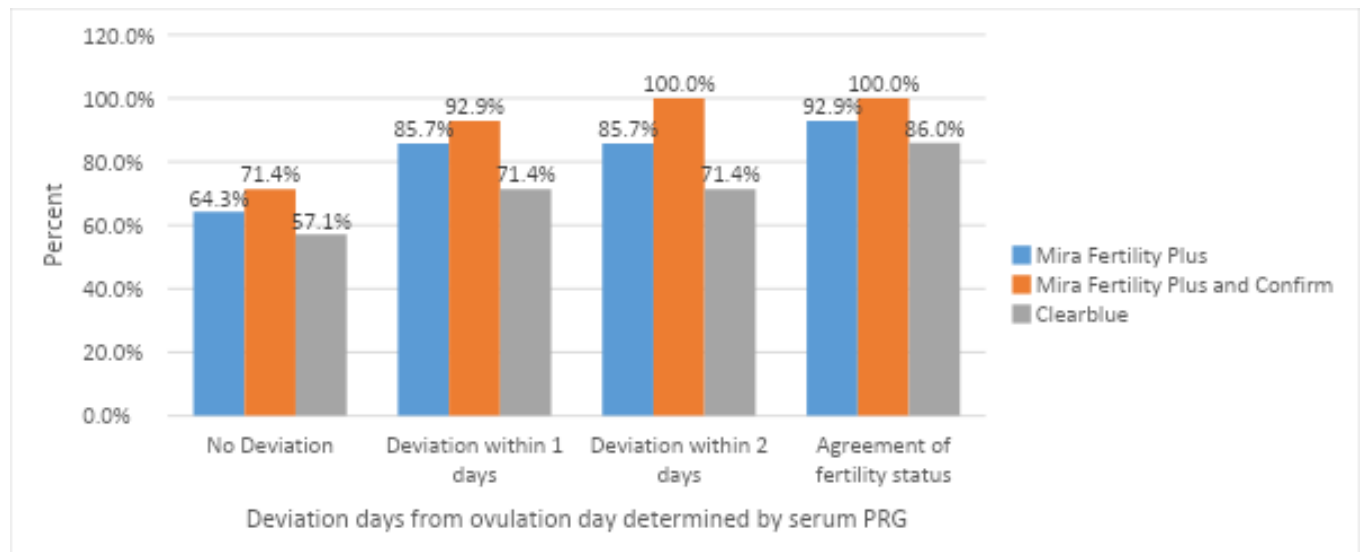


Fig. 2 The accuracy of different urinary hormones test methods.

Taking no deviation as standard, the Mira Fertility Plus combined with Mira Fertility Confirm shows the highest accuracy with 71.4%, while Mira Fertility Plus and Clearblue are 64.3% and 57.1% respectively. If the deviation within 2 days is acceptable, Mira Fertility Plus combined with Mira Fertility Confirm can be 100% agreement with serum.

Conclusion

Mira Fertility tracking products show a high correlation with the serum test, more accurate than the semi-quantitative product to track ovulation during the cycle, with 78.6% TP than 71.4% and 71.4% TFW than 57.1%.

Taking deviation within 2 days as standard, the Mira Fertility Plus combined with Mira Fertility Confirm shows the highest accuracy with almost 100%, while Mira Fertility Pus and Clearblue are 85.7% and 71.4% respectively. Mira Fertility Plus combined with Mira Fertility Confirm wand shows 28.6% higher accuracy than **Clearblue Ovulation Test Advanced Digital**. Multiple hormone tracking provides more accurate ovulation detection and more chance to conceive.

The trend of urinary LH, E3G, and PdG was drawn based on the data from volunteers. The E3G will volatility rise and peak 1-2days before the LH peak. And PdG will gradually rise after ovulation and peak 6-8 days after ovulation. It can be confirmed ovulation by PdG levels 5-6 days after ovulation.

Disclaimer

The standard to determine ovulation is by the serum hormone test LH, E2, and P, not Ultrasound.

The semi-quantitative product only tests urinary E3G and LH.

This internal pilot study includes 14 healthy women.