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Original Article

Clinical and biochemical characteristics of women with menstrual disturbance

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ABSTRACT

Objective: Menstrual irregularity is one of the major complaints in women of reproductive age. The aim of this study was to evaluate the complications in women with different menstrual disturbances.
Materials and methods: This is a retrospective study. A total of 576 women were screened first, and 470 women were included later [257 women with oligo/amenorrhea (149 hyperandrogenic and 108 non-hyperandrogenic women) and 213 normocyclic controls]. Endocrine and metabolic parameters and insulin resistance were compared among different menstrual patterns.
Results: The average duration of menstrual cycle length was positively correlated with age, levels of androgens and prolactin, lipid profiles, and the parameters of insulin resistance. Hyperandrogenic women with amenorrhea had higher levels of androgens and more lipid profiles disorders than hyperandrogenic women with oligomenorrhea. However, nonhyperandrogenic women with amenorrhea had a degree of insulin resistance and metabolic disturbance similar to that of nonhyperandrogenic women with oligomenorrhea. Interestingly, for women with normal prolactin levels, serum prolactin levels were significantly lower in amenorrhea than oligomenorrhea in both hyperandrogenic and nonhyperandrogenic groups.
Conclusion: The degree of menstrual disturbances does not correlate with the severity of insulin resistance and metabolic disturbances in women without excess levels of androgen. For women with normal prolactin levels, amenorrheic patients had significantly lower serum prolactin levels than oligomenorrheic patients.

Introduction

Hyperandrogenism and chronic anovulation are the major components associated with polycystic ovary syndrome (PCOS). The morbidity of PCOS is associated with insulin resistance, type 2 diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, and low-grade chronic inflammation [1]. A recently reviewed study found that not all women with PCOS should be considered as being similar in terms of cardiovascular risk profiles [2]. Irregular menstrual cycles are associated with insulin resistance [3] and increased risk of cardiovascular disease [4]. Ovulatory dysfunction is associated with a wide range of menstrual disturbances, including irregular cycles and clinical amenorrhea. Menstrual disorders are easy-to-use parameters in the clinical setting. Amenorrhea and oligomenorrhea represent different types of menstrual disturbances. However, the correlation between menstrual interval and biochemical parameters remains unclear in women with chronic anovulation. The association between the severity of menstrual disorders and endocrine and metabolic parameters is controversial [3–7]. We conducted this retrospective study to examine the relationship between menstrual disorders and the metabolic syndrome (MBS).

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Methods

We retrospectively reviewed the medical records of female patients who visited the Reproductive Endocrinology Clinic at the Wan Fang Medical Center at Taipei Medical University from January 1, 2009 to November 31, 2011. The chief complaints of these patients were menstrual disturbance, dysmenorrhea, infertility, and acne/hirsutism. The following patients were excluded: (1) women who had been diagnosed with congenital adrenal hyperplasia, androgen-secreting tumor, Cushing's syndrome, disorders of the uterus (e.g., myoma, adenomyosis, Asherman's syndrome, Müllerian agenesis), and chromosomal anomalies (e.g., Turner syndrome); (2) women who had had menarche less than 3 years before evaluation or who were older than 46 years; (3) women with inadequate clinical/biochemical records; and (4) women who received hormones or drugs for major medical diseases. A total of 576 women were initially screened.

Modified Ferriman–Gallwey (mF–G) scores were recorded by one investigator. Hirsutism was defined as an mF–G score $\geq$ 6. Biochemical hyperandrogenemia was defined as total serum testosterone $\geq$ 2.78 mmol/L. Hyperandrogenism was defined as hirsutism and/or biochemical hyperandrogenemia.

Amenorrhea was defined as no menstrual bleeding over a period of at least 3 months and oligomenorrhea was defined as fewer than nine cycles per year [8]. Normocyclic controls were defined as having regular menstrual intervals of 24–34 days. To simplify the experimental groups, 106 women were further excluded due to primary amenorrhea ($N = 9$), premature ovarian failure ($N = 10$), hyperprolactinemia (serum prolactin $>$ 26.4 μg/L or 1.15 nmol/L; $N = 59$), and irregular cycles without oligomenorrhea/amenorrhea ($N = 28$). Finally, the 470 women were classified into three subgroups, namely, normocyclic ($N = 213$) and oligomenorrhea/amenorrhea ($N = 257$; 147 women had oligomenorrhea and 110 women had amenorrhea). To further evaluate the clinical and biochemical characteristics of women with amenorrhea and oligomenorrhea, the 257 women were classified as hyperandrogenic ($N = 149$, oligomenorrhea = 83, amenorrhea = 66) and non-hyperandrogenic ($N = 108$, oligomenorrhea = 64, amenorrhea = 44).

PCOS was diagnosed according to the 1990 National Institutes of Health diagnostic criteria, which required both oligomenorrhea or amenorrhea and hyperandrogenism for a diagnosis of PCOS. Of the 470 cases, 149 women with PCOS and 321 women without PCOS were considered separately.

The number of menstrual cycles during the previous year was recorded. Menstrual cycle length was defined as the average duration/year. Body mass index was defined as body weight in kilograms divided by body height in meters squared (kg/m^2).

Medical histories included detailed menstrual and medical/surgical records as well as anthropometric measurements. The dates and assays for blood sampling have been previously described [9]. The timing of blood sampling was either in the early follicular phase (Days 1–5 for normocyclic women) or more than 35 days after the previous menstrual bleeding (for oligo/amenorrheic women). The following components were evaluated: (1) total testosterone, androstenedione, dehydroepiandrosterone sulfate, 17-α-hydroxyprogesterone, and free androgen index (FAI); FAI = T (nmol/l) × 100/sex hormone-binding globulin (SHBG) (nmol); (2) fasting insulin, fasting glucose, 2-hour oral glucose tolerance test glucose level, and the homeostasis model assessment of insulin resistance index (HOMA-IR); HOMA-IR = [fasting insulin (μU/mL) × fasting glucose (mg/dL)]/405; (3) serum thyroid-stimulating hormone (TSH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), and prolactin; (4) total cholesterol, triglycerides (TGs), high-density lipoprotein (HDL), and low-density lipoprotein (LDL); and (5) SHBG and anti-Müllerian hormone (AMH).

The MBS (2005 National Cholesterol Education Program-Adult Treatment Panel III) was defined as the presence of at least three of the following criteria: abdominal obesity (waist circumference $>$ 80 cm), serum TG $\geq$ 1.7 mmol/L, serum HDL $<$ 1.3 mmol/L, blood pressure $\geq$ 130/$\geq$ 85 mmHg, and fasting plasma glucose $\geq$ 5.6 mmol/L.

Statistical analysis

Statistical analysis was performed using SPSS 13.0 for Windows (SPSS, Inc., Chicago, IL, USA). We evaluated the correlation between menstrual cycle length and PCOS-related parameters with Pearson's correlation coefficients using the two-tailed method. Data are presented as the mean ± standard deviation. We used the Chi-square and Fisher's exact tests to compare categorical variables and analysis of variance to compare continuous variables (Tables 1 and 2). Differences between the groups were considered significant when $p < 0.05$.

Results

The average duration of menstrual cycle length was positively correlated with the following parameters: age ($r = -0.133$, $p = 0.004$), AMH ($r = 0.199$, $p < 0.001$), SHBG ($r = -0.174$, $p < 0.001$), ferritin ($r = 0.319$, $p < 0.001$), LH ($r = 0.123$, $p = 0.008$), prolactin ($r = -0.217$, $p < 0.001$), HOMA-IR ($r = 0.234$, $p < 0.001$), fasting insulin ($r = 0.220$, $p < 0.001$), total cholesterol ($r = 0.207$, $p < 0.001$), LDL ($r = 0.200$, $p < 0.001$), total testosterone ($r = 0.169$, $p < 0.001$), androstenedione ($r = 0.169$, $p < 0.001$), and FAI ($r = 0.165$, $p < 0.001$).

Table 1 shows the clinical and biochemical characteristics of 470 patients. The normocyclic group (A) had 213 cases and the oligo/amenorrhea group (B) had 257 cases. Compared with the controls, the women with oligo/amenorrhea had a higher prevalence of hyperandrogenism and MBS. Women with oligo/amenorrhea suffered from higher disturbances in the parameters of insulin resistance and lipid profiles than women with normal menstrual cycle.

Table 2 shows biochemical and clinical characteristics of normocyclic controls and oligo/amenorrhea in women without PCOS. The LH/FSH ratio was significantly higher in women with oligomenorrhea/amenorrhea than in women with normal cycle (Table 2); however, the LH/FSH ratio was not significantly different between women with oligomenorrhea and women with amenorrhea (Table 2). Androgens levels (total testosterone, androstenedione, and FAI), lipid profiles, and insulin resistance were similar between oligomenorrheic and amenorrheic women without PCOS (Table 2).

Table 3 shows the comparison of biochemical characteristics of PCOS women with oligomenorrhea or amenorrhea. For PCOS, amenorrheic women had significantly higher androgens, lower SHBG levels, and more lipid profile disturbances than oligomenorrheic women. In both the PCOS and non-PCOS groups, the insulin resistance and risk of MBS were not significantly different between the oligomenorrheic and amenorrheic subgroups (Tables 2 and 3). Interestingly, serum prolactin levels were significantly higher in oligomenorrheic compared with amenorrheic women for both PCOS and non-PCOS.

Discussion

Ovulatory dysfunction, defined as oligomenorrhea and amenorrhea, is a common complaint in women of reproductive age. The long-term complications of ovulatory dysfunction have not been well studied. Hyperandrogenemia is thought to increase cardiovascular and metabolic risks in women with PCOS [2,5]. Our results showed that serum androgens were correlated with the severity of menstrual disturbances. Therefore, we compared the clinical and biochemical

Table 1
Biochemical and clinical characteristics of normocyclic controls and oligo/amenorrhea.

	Total	Normocyclic control	Oligo/amenorrhea	*p*
		A	B	A vs. B
Case number	470	213	257	
Age (y)	27.7 ± 6.4	28.7 ± 6.4	27.0 ± 6.3	0.012*
BMI (kg/m^2)	25.4 ± 6.6	24.4 ± 6.0	26.2 ± 6.9	0.006*
SHBG (nmol/L)	42.8 ± 29.0	50.5 ± 32.8	36.4 ± 23.5	<0.001*
Hyperandrogenism (%)	49	38	58	<0.001*
Metabolic syndrome (%)	29	20	35	0.001*
Androgens				
Total testosterone (nmol/L)	2.17 ± 1.04	1.87 ± 1.03	2.42 ± 0.99	<0.001*
Androstenedione (nmol/L)	93.0 ± 44.2	82.6 ± 44.9	101.7 ± 41.8	<0.001*
FAI[a]	8.54 ± 8.48	6.51 ± 7.93	10.22 ± 8.56	<0.001*
Insulin sensitivity				
Fasting insulin (pmol/L)	89.6 ± 91.8	68.8 ± 66.2	106.5 ± 105.3	<0.001*
Fasting glucose (nmol/L)	5.18 ± 1.04	5.20 ± 1.28	5.15 ± 0.80	0.949
2-hour glucose (nmol/L)	6.43 ± 2.66	6.31 ± 2.91	6.52 ± 2.45	0.795
HOMA-IR	3.15 ± 3.72	2.39 ± 2.54	3.76 ± 4.36	<0.001*
Hormonal components				
TSH (mIU/L)	1.96 ± 1.17	1.82 ± 1.12	2.07 ± 1.20	0.053
FSH (IU/L)	6.30 ± 2.11	6.25 ± 2.21	6.33 ± 2.03	0.968
Prolactin (nmol/L)	0.61 ± 0.03	0.65 ± 0.01	0.58 ± 0.02	0.003*
Lipid profiles and blood pressure				
Cholesterol (mmol/L)	4.81 ± 0.90	4.60 ± 0.83	4.98 ± 0.92	<0.001*
Triglycerides (mmol/L)	1.04 ± 0.81	0.92 ± 0.69	1.14 ± 0.88	0.008*
HDL (mmol/L)	1.36 ± 0.42	1.38 ± 0.42	1.35 ± 0.42	0.772
LDL (mmol/L)	2.90 ± 0.81	2.69 ± 0.74	3.07 ± 0.82	<0.001*

Data are either mean ± standard deviation or are percentage.
*$p < 0.05$.
BMI = body mass index; FSH = follicle-stimulating hormone; HDL = high-density lipoprotein; HOMA-IR = homeostasis model assessment of insulin resistance index; LDL = low-density lipoprotein; SHBG = sex hormone-binding globulin; TSH = thyroid stimulation hormone.
[a] FAI = Free Androgen Index, which is calculated as *T* (nmol/l) × 100/SHBG (nmol).

Table 2
Biochemical and clinical characteristics of normocyclic controls and oligo/amenorrhea in women without PCOS.

	Normocyclic control	Oligomenorrhea	Amenorrhea	A vs. B	A vs. C	B vs. C
	A	B	C			
Case number	213	64	44			
Age (y)	28.7 ± 6.4	28.5 ± 6.8	27.4 ± 5.7	0.998	0.456	0.730
Menarche (y)	12.6 ± 1.4	12.8 ± 1.7	12.6 ± 1.3	0.646	1.000	0.781
Number of cycles per year	11.7 ± 0.9	6.6 ± 1.3	2.4 ± 1.1	<0.001*	<0.001*	<0.001*
BMI (kg/m^2)	24.4 ± 6.0	24.7 ± 5.7	24.4 ± 7.4	0.981	1.000	0.995
SHBG (nmol/L)	50.5 ± 32.8	45.2 ± 24.9	41.4 ± 26.2	0.430	0.137	0.828
Metabolic syndrome (%)	20	26	33	0.742	0.327	0.868
Androgens						
Total testosterone (nmol/L)	1.9 ± 1.0	1.8 ± 0.6	1.8 ± 0.6	0.735	0.936	0.988
Androstenedione (nmol/L)	82.6 ± 44.9	85.6 ± 35.5	88.1 ± 36.9	0.925	0.762	0.977
FAI[a]	6.5 ± 7.9	5.5 ± 4.0	6.5 ± 4.5	0.446	1.000	0.556
Insulin sensitivity						
Fasting insulin (pmol/L)	68.8 ± 66.2	82.5 ± 63.6	98.7 ± 95.1	0.357	0.147	0.692
Fasting glucose (nmol/L)	5.2 ± 1.3	5.1 ± 0.7	5.2 ± 1.0	0.757	1.000	0.933
2-hour glucose (nmol/L)	6.3 ± 2.9	6.3 ± 2.4	6.6 ± 2.8	1.000	0.865	0.915
HOMA-IR	2.4 ± 2.5	2.8 ± 2.5	3.8 ± 5.6	0.546	0.286	0.618
Hormonal components						
TSH (mIU/L)	1.8 ± 1.1	2.1 ± 1.2	2.0 ± 1.2	0.333	0.586	0.999
FSH (IU/L)	6.3 ± 2.2	6.1 ± 2.4	6.6 ± 2.4	0.971	0.730	0.641
LH (IU/L)	5.1 ± 2.6	9.1 ± 7.0	9.2 ± 7.5	<0.001*	0.002*	1.000
LH/FSH	0.9 ± 0.5	1.6 ± 1.2	1.4 ± 0.9	<0.001*	0.007*	0.552
Prolactin (nmol/L)	0.65 ± 0.01	0.64 ± 0.25	0.46 ± 0.19	0.998	<0.001*	<0.001*
Lipid profiles and blood pressure						
Cholesterol (mmol/L)	4.6 ± 0.8	5.1 ± 0.8	5.4 ± 0.9	0.001*	<0.001*	0.210
Triglycerides (mmol/L)	0.9 ± 0.7	1.2 ± 1.0	1.2 ± 1.0	0.207	0.160	0.980
HDL (mmol/L)	1.4 ± 0.4	1.4 ± 0.4	1.5 ± 0.5	0.999	0.219	0.320
LDL (mmol/L)	2.7 ± 0.77	3.1 ± 0.8	3.2 ± 0.8	0.001	0.001*	0.991

Data are either mean ± standard deviation or percentage.
*$p < 0.05$.
BMI = body mass index; FSH = follicle-stimulating hormone; HDL = high-density lipoprotein; HOMA-IR = homeostasis model assessment of insulin resistance index; LDL = low-density lipoprotein; LH = luteinizing hormone; PCOS = polycystic ovary syndrome; SHBG = sex hormone-binding globulin; TSH = thyroid stimulation hormone.
[a] FAI = Free Androgen Index, which is calculated as *T* (nmol/l) × 100/SHBG (nmol).

Table 3
A comparison of biochemical characteristics of oligomenorrheic or amenorrheic women with PCOS.

	Total	Oligomenorrhea	Amenorrhea	Oligo- vs. amenorrhea
Case number	149	83	66	*p*
Age (y)	26.2 ± 6.1	26.6 ± 5.9	25.7 ± 6.4	0.371
Menarche (y)	12.5 ± 1.5	12.7 ± 1.5	12.4 ± 1.4	0.171
Number of cycles per year	4.7 ± 2.4	6.5 ± 1.2	2.5 ± 1.2	<0.001*
BMI (kg/m^2)	27.4 ± 7.0	27.5 ± 7.6	27.4 ± 6.2	0.981
PCOM	69%	61%	79%	0.023*
SHBG (nmol/L)	31.2 ± 20.6	35.1 ± 23.4	26.3 ± 15.2	0.009*
Anti-Müllerian hormone (ng/mL)	8.5 ± 5.5	8.0 ± 5.3	9.2 ± 5.7	0.207
Anthropometric measurements				
Weight (kg)	70.3 ± 19.3	70.6 ± 20.9	69.9 ± 17.2	0.819
Height (cm)	159.8 ± 5.4	160.1 ± 5.7	159.3 ± 5.0	0.379
Waist (cm)	89.2 ± 17.2	88.3 ± 17.4	90.2 ± 17.0	0.493
Hip (cm)	102.9 ± 12.1	103.2 ± 12.9	102.6 ± 11.1	0.758
Waist to hip ratio	0.86 ± 0.09	0.85 ± 0.08	0.87 ± 0.09	0.098
Androgens				
Total testosterone (nmol/L)	2.9 ± 1.0	2.7 ± 1.0	3.1 ± 0.9	0.009*
Androstenedione (nmol/L)	112.6 ± 42.5	105.7 ± 39.5	121.2 ± 44.9	0.027*
FAI[a]	13.3 ± 9.5	11.8 ± 10.1	15.3 ± 8.5	0.026*
DHEA-S (nmol/L)	634.2 ± 274.2	653.2 ± 274.0	610.3 ± 274.6	0.344
17-OH PRG (nmol/L)	0.034 ± 0.019	0.034 ± 0.022	0.035 ± 0.017	0.759
Insulin sensitivity and glucose tolerance				
Fasting insulin (pmol/L)	119.1 ± 120.0	109.7 ± 112.5	130.8 ± 128.7	0.288
Fasting glucose (nmol/L)	5.2 ± 0.8	5.2 ± 0.7	5.2 ± 0.9	0.830
Two-hour glucose (nmol/L)	6.6 ± 2.4	6.5 ± 2.2	6.7 ± 2.6	0.521
HOMA-IR	4.2 ± 4.6	3.8 ± 4.1	4.6 ± 5.1	0.282
Hormonal components				
TSH (mIU/L)	2.1 ± 1.2	1.9 ± 1.1	2.3 ± 1.3	0.073
LH (IU/L)	12.2 ± 9.4	11.6 ± 7.0	12.9 ± 11.8	0.380
FSH (IU/L)	6.3 ± 1.7	6.4 ± 1.7	6.2 ± 1.8	0.421
LH/FSH	2.3 ± 3.8	2.2 ± 2.9	2.5 ± 4.7	0.675
Prolactin (nmol/L)	0.59 ± 0.20	0.62 ± 0.20	0.55 ± 0.18	0.018*
Lipid profiles and blood pressure				
Cholesterol (mmol/L)	4.8 ± 0.9	4.7 ± 0.8	5.0 ± 1.0	0.112
Triglycerides (mmol/L)	1.1 ± 0.8	1.0 ± 0.6	1.3 ± 1.0	0.023*
HDL (mmol/L)	1.3 ± 0.4	1.3 ± 0.4	1.2 ± 0.4	0.028*
LDL (mmol/L)	3.0 ± 0.8	2.9 ± 0.7	3.2 ± 0.9	0.013*
Metabolism				
Metabolic syndrome	40%	37%	45%	0.327
Hypertension	38%	35%	42%	0.415
HDL < 1.3 mmol/L	57%	51%	65%	0.076
Triglycerides ≥ 1.7 mmol/L	13%	10%	18%	0.130
Waist > 80 cm	63%	61%	65%	0.604
FPG ≥ 5.6 mmol/L	21%	22%	20%	0.768

Data are either mean ± standard deviation or are percentage.
*$p < 0.05$.
17-OH PRG = 17-α-hydroxyprogesterone; BMI = body mass index; DHEA-S = dehydroepiandrosterone sulfate; FPG = fasting plasma glucose; FSH = follicle-stimulating hormone; HDL = high-density lipoprotein; HOMA-IR = homeostasis model assessment of insulin resistance index; LDL = low-density lipoprotein; LH = luteinizing hormone; PCOS = polycystic ovary syndrome; SHBG = sex hormone-binding globulin; TSH = thyroid stimulation hormone.
[a] FAI = Free Androgen Index, which is calculated as *T* (nmol/l) × 100/SHBG (nmol).

characteristics in hyperandrogenic and nonhyperandrogenic women with amenorrhea and oligomenorrhea. Hyperandrogenic women with oligo/amenorrhea met the diagnostic criteria of PCOS [10]. In the hyperandrogenic (PCOS) subgroup, women with amenorrhea had higher androgen levels and lipid profile disturbances. We found that the degree of cycle irregularity correlated with the severity of endocrine and/or metabolic disorders, and this result was consistent with previous reports [6,7]. However, in nonhyperandrogenic women, all of the parameters related to androgens, lipid profiles, insulin resistance, and metabolic complications were similar between women with amenorrhea and women with oligomenorrhea. Therefore, it appears that the degree of menstrual disturbances does not correlate with the severity of metabolic disturbances in women without excess levels of androgen.

The LH/FSH ratio was significantly higher in oligomenorrheic/amenorrheic women than in normal cyclic women as previous reports suggested [11]; however, the level of LH/FSH ratio was not significantly different between oligomenorrheic and amenorrheic women. Our study showed that LH/FSH ratio was not a predicative marker for the severity of menstrual disturbance in women with oligomenorrhea. Comparing women with PCOS, amenorrheic women had significantly higher level of androgens than oligomenorrheic women. However, for women without PCOS, the androgens levels were similar between the oligomenorrheic and amenorrheic groups. Higher androgens levels were associated with more menstrual disturbance in women with PCOS but not in women without PCOS.

The most interesting finding in our study was the correlation between serum prolactin levels and menstrual interval. Because hyperprolactinemic women had been excluded initially, the prolactin levels in our patients were all within the normal range. We found a strongly negative correlation between menstrual interval and serum prolactin levels. Prolactin was the only parameter that significantly differed between women with oligomenorrhea and amenorrhea in both the hyperandrogenic and nonhyperandrogenic subgroups. A previous study of 246 hyperprolactinemic women found that patients with amenorrhea had significantly higher serum prolactin levels than patients with oligomenorrhea [12]. We found, however, that amenorrheic women with normal prolactin levels presented with lower prolactin levels than oligomenorrheic

patients. If amenorrhea could be treated as a severe form of anovulation rather than oligomenorrhea, it might implicate a different pathological pathway of ovulatory disturbance between women with and without hyperprolactinemia. This situation has not been previously reported and warrants further study.

This is a retrospective study; data were obtained from medical records reviewed in outpatient clinics, and the patients were Asian women. The results in this study should be applied with caution due to sampling limitations.

Conclusion

The degree of menstrual disturbances did not correlate with the severity of insulin resistance and metabolic disturbances in women without androgen excess. For women with normal prolactin levels, amenorrheic patients had significantly lower serum prolactin levels than oligomenorrheic patients.

Conflicts of interest

None of the authors have any conflicts of interest.

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References

[1] Lobo RA, Carmina E. The importance of diagnosing the polycystic ovary syndrome. Ann Intern Med 2000;132:989–93.
[2] Jovanovic VP, Carmina E, Lobo RA. Not all women diagnosed with PCOS share the same cardiovascular risk profiles. Fertil Steril 2010;94:826–32.
[3] Weiss DJ, Charles MA, Dunaif A, Prior DE, Lillioja S, Knowler WC, et al. Hyperinsulinemia is associated with menstrual irregularity and altered serum androgens in Pima Indian women. Metabolism 1994;43:803–7.
[4] Solomon CG, Hu FB, Dunaif A, Rich-Edwards JE, Stampfer MJ, Willett WC, et al. Menstrual cycle irregularity and risk for future cardiovascular disease. J Clin Endocrinol Metab 2002;87:2013–7.
[5] Elting MW, Korsen TJ, Schoemaker J. Obesity, rather than menstrual cycle pattern or follicle cohort size, determines hyperinsulinaemia, dyslipidaemia and hypertension in ageing women with polycystic ovary syndrome. Clin Endocrinol (Oxf) 2001;55:767–76.
[6] Strowitzki T, Capp E, von Eye Corleta H. The degree of cycle irregularity correlates with the grade of endocrine and metabolic disorders in PCOS patients. Eur J Obstet Gynecol Reprod Biol 2010;149:178–81.
[7] Xu X, Shi Y, Cui Y, Ma J, Che L, Chen ZJ. Endocrine and metabolic characteristics of polycystic ovary syndrome in Chinese women with different phenotypes. Clin Endocrinol (Oxf) 2012;76:425–30.
[8] Practice Committee of the American Society for Reproductive Medicine. Current evaluation of amenorrhea. Fertil Steril 2006;86:S148–55.
[9] Liang SJ, Hsu CS, Tzeng CR, Chen CH, Hsu MI. Clinical and biochemical presentation of polycystic ovary syndrome in women between the ages of 20 and 40. Hum Reprod 2011;26:3443–9.
[10] Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome (PCOS). Hum Reprod 2004;19:41–7.
[11] Hsu MI, Liou TH, Liang SJ, Su HW, Wu CH, Hsu CS. Inappropriate gonadotropin secretion in polycystic ovary syndrome. Fertil Steril 2009;91:1168–74.
[12] Touraine P, Plu-Bureau G, Beji C, Mauvais-Jarvis P, Kuttenn F. Long-term follow-up of 246 hyperprolactinemic patients. Acta Obstet Gynecol Scand 2001;80:162–8.