Original Articles/นิพนธ์ต้นฉบับ

Appropriate cut-off BMI Value for Screening Metabolic Syndrome in Polycystic Ovary Syndrome

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Abstract

Objectives: To determine the appropriate cut-off BMI value for screening the metabolic syndrome in polycystic ovary syndrome

Study design: Retrospective diagnostic test

Subjects: Women with polycystic ovary syndrome who attended the Division of Reproductive Endocrinology, Department of Obstetrics and Gynecology, Faculty of Medicine Ramathibodi Hospital, Mahidol University during Jan 2002 to Feb 2007.

Methods: Data of 190 PCOS women were analyzed. According to the protocol of the Division all women had anthropometric examined and had a 75-g oral glucose tolerance test performed. Also. Blood samples for fasting triglyceride and HDL were obtained. The metabolic syndrome (MS) was diagnosed by the AHA/NHLBI criteria.

Result: Mean age, BMI and WHR were 28.7±13.2 years, 26.3±13.2 kg/m2 and 0.84±0.07, respectively. Prevalence of MS was 28.4%. At the BMI cut-off value of 20 and 23 sensitivity and specificity was 100% both, and 26.47% and 55.15%, respectively. At the higher BMI cut-off value of 27 and 30, sensitivity and specificity of 94.44% and 83.33%, and 78.68% and 90.44%, respectively. At The BMI cut-off value of 25 has sensitivity and specificity of 98.15% and 73.53%, respectively. At this level, 101 (53.15%) women could be eliminated from the metabolic examination and only 89 out of 190 (46.84%) women would be examined. However, at this level, 1 (1.85%) women could be missed in the diagnosis of MS.

Conclusions: The appropriate body mass index cut-off value for screening metabolic syndrome in polycystic ovary syndrome is 25

Keywords: Body mass index (BMI), metabolic syndrome, polycystic ovary syndrome

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Introduction

The polycystic ovary syndrome (PCOS) is a condition characterized by hyperandrogenism and abnormal menstruation[1,2]. Prevalence of PCOS is 5-10%[3,4].The etiology of the syndrome is unknown. However, the key pathophysiology is androgen excess induced by any causes. Insulin resistance (IR) and compensatory hyperinsulinemia are the major causes of androgen excess in PCOS[5,6]. In addition, obesity, which can be found in 50% of PCOS women[7], is partially responsible for IR and is associated with hyperinsulinemia in PCOS[8,9]. Therefore, the PCOS women have a risk of the metabolic syndrome.

The metabolic syndrome (MS) was first described in 1988 by Reaven[10]. During two decades, there have been several names for this syndrome including dysmetabolic syndrome[11], syndrome X[10] and insulin resistance syndrome[12]. The main pathophysiology of MS is IR[13]. Evidence shows that MS is a risk factor of cardiovascular diseases[14,15]. The components of MS include central obesity, low HDL-C, high triglyceride, abnormal glucose tolerance and hypertension[11]. The prevalence of MS was 46% in Western PCOS women[16] and was 37% in Asian PCOS women[7]. Obesity is a risk factor for MS. However, the diagnosis of MS is made by any 3 out of 5 abnormal components[8]. It is possible that some non-obese women could have MS, and nearly a half of PCOS women may also have MS.

The aim of this study was to determine the appropriate body mass index (BMI), obesity marker, for the screening of MS

Materials and Methods

This study was approved by the Committee on Human Right Related to Researches involving Human Subjects, Faculty of Medicine, Ramathibodi Hospital, Mahidol University. The demographic and metabolic data of 190 women with PCOS who attended the Reproductive Endocrinology Clinic from January, 2002 to February 2007 were reviewed and analyzed. PCOS was diagnosed according to the Rotterdam criteria 2004[17]. All women had all 3 of the followings: 1) oligomenorrhea (cycle lasting longer than 35 days) or amenorrhea (absence of menstrual cycles in past 6 months); 2) any signs of clinical hyperandrogenism and 3) polycystic ovary (more than 12 follicles of 2-9 mm in diameter of one or both ovaries assessed by ultrasonography). The diseases which mimic PCOS including hyperprolactinemia, thyroid dysfunction, androgen secreting tumor and Cushing's syndrome were ruled out by appropriate laboratory tests. All women had not been taking oral contraceptive pills or insulin sensitizing agents for at least 3 months. According to the protocol of Division of the Reproductive Endocrinology, all women with PCOS had anthropometric measurement examined after the diagnosis of PCOS . The anthropometric measurement included blood pressure, height, waist and hip circumference. All women with PCOS had a 75-g oral glucose tolerance test (OGTT) done in the morning after an overnight fasting for at least 10 hours. Blood samples for fasting glucose (FG), triglyceride (TG), HDL-C level and 2-h post-load glucose level (2-hPG) were obtained. The metabolic syndrome was diagnosed according to the American Heart Association/ The National Heart, Lung, Blood Institute (AHA/NHLBI) criteria[18].

The diagnosis is made if there are 3 of 5 of the followings:

1. Waist circumference (WC) ≥ 80 cm
2. HDL-C < 50 mg/dl
3. Triglyceride ≥ 150 mg/dl
4. FG ≥ 100 mg/dl
5. Systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg

Statistical analysis: To compare variables between groups, unpaired t-test, Mann-Whitney-U test

and X2 test were used where appropriate. Also, the sensitivity, the specificity, positive predictive value and negative predictive values were determined at the various cut-offs of BMI values. The statistical analysis was done using STATA version 10.

Results

Table 1 shows patient's characteristics with mean age of 28.7±13.2 years, BMI of 26.3±13.2 kg/m^2 and WHR of 0.84±0.07.Comparisons of anthropometric and metabolic parameters between PCOS women with MS and those without MS were also shown in Table 1. Obesity parameters, blood pressure, FG, 2hPG and TG were significantly higher, but HDL-C was significantly lower in PCOS women with MS than those without MS. There were no differences in age, testosterone level and clinical hyperandrogenism between both groups. Table 2 shows the sensitivity,

Table 1 The demographic and laboratory characteristics in PCOS womens with MS and without MS (mean±SD)

	PCOS (n=190)	PCOS with MS (n=54)	PCOS without MS (n=136)	P-value
Age (y)	28.7±5.9	29.9±6.7	28.2±5.6	NS
Waist (cm)	81.3±13.2	95.7±11.0	75.6±9.0	0.0000
BMI (kg/m^2)	26.2±6.5	33.6±5.0	23.3±4.4	0.0000
WHR	0.84±0.07	0.86±0.06	0.82±0.07	0.0001
SBP (mmHg)	117.3±16.1	129.6±15.2	112.5±13.8	0.0000
DBP (mmHg)	76.7±10.3	86.0±11.3	76.1±7.1	0.0000
FG	91.9±14.6	101.1±19.2	88.3±10.3	0.0000
2-h PG	131.7±45.6	164.9±50.2	118±36.1	0.0000
TG	112.9±73.5	165.2±72.8	92.2±63.0	0.0000
HDL	48.5±16.8	37.1±7.0	53.1±17.4	0.0000
Testosterone	68.3±37.2	73.5±43.9	66.2±33.7	NS
Menarche(y)	13.2±1.9	13.5±1.7	13.2±1.9	NS
Hyperandrogenism				
Acne	176(92.6)	51(94.4)	125(91.9)	NS
Seborrhea	168(88.4)	49(90.7)	119(87.5)	NS
Hirsutism	16(8.4)	7(13)	9(6.6)	NS

BMI = body mass index, WHR = waist-hip ratio, SBP = systolic blood pressure, DBP = diastolic blood pressure, FG = fasting blood glucose, 2-hPG = 2-hour plasma glucose, TG = total cholesterol

Table 2 Sensitivity , specificity, PPV and NPV for various cut-off BMI values for the diagnosis of MS

Cut-off BMI	Sensitivity (%)	Specificity (%)	PPV	NPV
20	100	26.47	0.60	1
23	100	55.15	0.41	1
25	98.15	73.53	0.34	0.97
27	94.44	78.68	0.32	0.90
30	83.33	90.44	0.26	0.59

PPV: positive predictive value; NPV: negative predictive value; BMI: body mass index; MS: the metabolic syndrome

specificity, positive predictive value (PPV) and negative predictive value (NPV) for prediction of MS at various BMI cut-off values. At cut-off BMI values of 20 and 23 kg/m^2, the sensitivity was both 100% and the specificity were 26.47% and 55.15%, respectively. At the higher BMI cut-off values, the decreasing sensitivity and the increasing specificity were obtained. At the BMI cut-off values of 27 and 30 kg/m^2, the sensitivity and specificity were 94.4% and 83.33%, 90.44% and 78.68%, respectively.

Discussion

The prevalence of MS in this study was 28.4% according to the AHA/NHLBI criteria. This rate was lower than that of the previous report of Thai women[7]. The possible explanation of this discrepancy is that there were more obese women in the previous study (35.3%) than in this report (28.4%). The BMI , waist and WHR in the previous study were 27.1±7 kg/m^2, 83.2±13.8 cm and 0.85±0.06, respectively, whereas they were 26.2±6.5 kg/m^2, 81.3±13.2 cm and 0.84±0.07, respectively in the present study.

The phenomena that the obesity parameters, TG, blood pressure and FG were significantly greater and HDL-C was significantly lower in the PCOS women with MS than those without MS supported the previous studies[7,19]. IR is the important pathophysiology of PCOS[5,6] as well as MS[14]. PCOS women with MS seem to have more IR compared with those without MS leading to increase in IR related parameters such as obesity, dyslipidemia and abnormal glucose metabolism.

Of PCOS women, who should be evaluated for MS. Although obesity is an important risk factor of MS in PCOS women[7,19], almost half of PCOS women were not obese. Furthermore, any 3 of 5 components for the diagnosis of MS could not include central obesity. Therefore, PCOS women whoever have a chance of having MS. In the present study, BMI cut-off values were used to determine MS because of their ease and convenience in clinical practice. At the BMI cut-off value of 20, sensitivity of 100%, but low specificity (26.47%) were achieved. Although this cut-off value could determine all women with MS (100%), 154 women (81.05%) needed to evaluate metabolic parameters.

Similarly, at the BMI cut-off value of 23, 100% of MS could be detected, and only 75 women (39.47%) could be eliminated from the metabolic testing. At the BMI cut-off value of 25, 101 (53.15%) women could be eliminated from the metabolic examination and only 89 out of 190 (46.84%) women would be examined. However, at this level, 1 (1.85%) women could be missed in the diagnosis of MS.

At the higher BMI cut-off value of 27 and 30, although there were higher specificity and the higher number of PCOS women could be eliminated from the examination (110 and 132 out of 190 for cut-off value of 27 and 30, respectively). The missed diagnosis of MS was also high, 3 out of 54 (5.56%) for cut-off value of 27, and 9 out of 54 (16.67%) for 30.

It seems that the appropriated BMI cut-off value should be 25 for the screening of MS in Thai women with PCOS. However, other study showed a difference of the cut-off BMI. Chen and colleagues[20] showed that BMI ≥ 23 kg/m^2 is the appropriate one for the screening MS in PCOS women in Southern China. With this BMI level, only 2.13% of MS women were missed the diagnosis.

In conclusion, the present study showed the prevalence of MS in PCOS women was 28.4%. The obesity and most metabolic parameters, were greater, but HDL-C level was lower in PCOS women with MS than those without MS. At the BMI cut-off value of 25, with sensitivity of 98.15% and specificity of 73.53% was found to be appropriate for screening of MS. Only 89 (46.84%) women need metabolic parameters examination with only one missed diagnosis of MS.

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Original Articles/นิพนธ์ต้นฉบับ

ค่าดัชนีมวลกายที่เหมาะสมเพื่อการตรวจคัดกรอง metabolic syndrome ในสตรีกลุ่มอาการที่รังไข่มีถุงน้ำหลายใบ

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ภาควิชาสูติศาสตร์-นรีเวชวิทยา คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล กรุงเทพฯ

บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาหาค่าดัชนีมวลกายที่เหมาะสมเพื่อใช้ตรวจคัดกรอง metabolic syndrome ในสตรีกลุ่มอาการที่รังไข่มีถุงน้ำหลายใบ

วิธีการศึกษาวิจัย: การศึกษาแบบย้อนหลังในสตรีกลุ่มอาการที่รังไข่มีถุงน้ำหลายใบที่มาตรวจที่หน่วยต่อมไร้ท่อการเจริญพันธุ์ ตั้งแต่ ม.ค. 2545 ถึง ก.พ. 2550 จำนวน 190 ราย สตรีเหล่านี้ได้รับการวัด anthropometric ตรวจหาระดับกลูโคสด้วยวิธี 75 กรัม Oral glucose tolerance test ตรวจหาระดับ triglyceride และ HDL-C ตามแนวทางการดูแลสตรีกลุ่มนี้

ผลการศึกษา: ค่าเฉลี่ยของอายุ ดัชนีมวลกายและอัตราระหว่างรอบเอวต่อรอบสะโพก เท่ากับ 28.7±5.9 ปี, 26.3±6.5 กก/ม^2 และ 0.84±0.07 ตามลำดับ ความชุกของ metabolic syndrome เท่ากับร้อยละ 28.4 เมื่อกำหนดค่าดัชนีมวลกายเท่ากับ 20 และ 23 ค่าความไวเท่ากับร้อยละ 100 ทั้งสองค่า และค่าความจำเพาะเท่ากับร้อยละ 26.47 และ 55.15 เมื่อกำหนดค่าดัชนีมวลกายเท่ากับ 27 และ 30 ความไวเท่ากับร้อยละ 94.44 และ 83.33 ส่วนความจำเพาะเท่ากับร้อยละ 78.68 และ 90.44 ที่ค่าดัชนีมวลกายเท่ากับ 25 มีความไวร้อยละ 98.15 และความจำเพาะร้อยละ 73.53 ณ ดัชนีมวลกายนี้ สตรีกลุ่มอาการ เพียง 89 ราย (ร้อยละ 46.84) จำเป็นต้องตรวจคัดกรองหา metabolic syndrome และไม่สามารถวินิจฉัยโรคได้ 1 ราย (ร้อยละ 1.85) เท่านั้น

สรุป: ดัชนีมวลกายที่ 25 เหมาะสมสำหรับการตรวจหา metabolic syndrome ในสตรีกลุ่มอาการที่รังไข่มีถุงน้ำหลายใบ

คำสำคัญ: ดัชนีมวลกาย, กลุ่มอาการที่รังไข่มีถุงน้ำหลายใบ, metabolic syndrome