Polycystic Ovary Syndrome in Premenopausal Women with Type 2 Diabetes Mellitus: Prevalence, Characters and Related Morbidity

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Abstract

Background: Polycystic ovary syndrome (PCOS) is a heterogeneous condition characterized by anovulation, hyperandrogenism, and metabolic derangements including insulin resistance and dyslipidaemia. Both PCOS and type 2 DM are linked through insulin resistance. Women with PCOS are, therefore at higher risk of type 2 DM.

Aim of the Work: The present study was conducted to investigate the prevalence of PCOS in premenopausal women with type 2 diabetes mellitus.

Setting: Diabetes clinic in Kasr Al Aini teaching hospital. Gynaecological assessment was conducted in the gynaecology clinic of Kasr al Aini teaching hospital, Cairo university.

Patients and Methods: This is a cross-sectional study. Type 2 diabetic women of reproductive age who were either on oral hypoglycemic drugs or diet control were included in the study. Baseline demographic characteristics were obtained and body mass index, waist/hip ratio and F/G scores were determined. PCOS was initially diagnosed using the criteria proposed by the Androgen Excess and PCOS Society (AEPS). Laboratory investigations included hormonal and lipid profiles. The main outcome measure was prevalence of PCOS calculated according to AEPS criteria. Reanalysis of data and recalculation of the prevalence rate according to the Rotterdam and NIH criteria was also done.

Results: Seventy one diabetic women enrolled in the study. Nine (12.68%) had clinical symptoms of PCOS according to the AEPS criteria. The prevalence rate of PCOS in women with type 2 DM according to the Rotterdam criteria was also 12.68%. According to the NIH criteria the observed prevalence rate was 9.86%. The mean age of subjects with PCOS at diagnosis of DM was significantly lower than that of non-PCOS diabetics (33.89 ± 3.55 Vs 39.84 ± 2.68 years, \( p < 0.0001 \)). Diabetics with PCOS had significantly higher BMI and WHR than diabetics without PCOS (32.73 ± 2.67 versus 30.48 ± 1.92, \( p=0.017 \) and 0.895 ± 0.036 versus 0.865 ± 0.031, \( p=0.015 \), respectively). The incidence of gestational diabetes and stillbirths was not significantly different between the two groups. Both PCOS- and non-PCOS diabetics reported a high incidence of family history of DM, however there was no significant difference between the two groups. No difference in lipid profile, was observed between the two groups.

Conclusion: The prevalence of PCOS in diabetic women is not higher than the general population. Hyperandrogenic women with PCOS show the highest risk of developing DM. Patients with PCOS are at risk of developing type 2 DM at a younger age than non PCOS diabetics. Obesity, especially abdominal obesity, is an important risk factor for developing DM in women with PCOS.

Key Words: Polycystic ovary syndrome – Type 2 diabetes mellitus – Prevalence.

Introduction

POLYCYSTIC ovary syndrome (PCOS) is a heterogeneous condition, both clinically and biochemically. It comprises a group of signs and symptoms with affected women presenting in clinical practice with menstrual disturbances (oligomenorrhoea and amenorrhoea), infertility, hirsutism or acne [1]. Several attempts have been made to reach consensus on its definition. The latest definition comes from a new group, the Androgen Excess and PCOS Society (AEPS), who concluded that the diagnosis cannot be established without hyperandrogenism [2].

The heterogeneity of the syndrome is partially attributed to the fact that PCOS is also associated with important metabolic derangements. The mechanisms underlying PCOS are not well understood, yet, a plethora of data point to insulin resistance (IR) and compensatory hyperinsulinaemia as the central factors [3]. Indeed, the prevalence of IR in such women is remarkable; appearing in 50-70% of the cases [4]. Furthermore, there is ongoing debate as to whether this IR is intrinsic to PCOS, related to obesity alone or related to both factors.
because patients with type 2 diabetes mellitus have both ovarian and adrenal androgen secretion and between the two disorders has been explained by compensatory hyperinsulinaemia. PCOS & type 2 DM is another common endocrine disorder characterized by insulin resistance and compensatory hyperinsulinaemia. PCOS & type 2 DM appear to be closely related. It has been reported that women with PCOS and baseline NGT have a 16% conversion rate per year to type 2 DM [9], whereas by the age of 30 yr, 30-50% of obese women with PCOS develop IGT or overt type 2 DM. This is a 3- to 7-fold greater risk than an age-comparable population [10]. The close relation between the two disorders has been explained by the fact that hyperinsulinaemia directly stimulates both ovarian and adrenal androgen secretion and suppresses SHBG synthesis, thus resulting in an increase in free biologically active androgens [11]. Androgens, on the other hand, produce mild IR by increasing the number of less insulin-sensitive type IIb skeletal muscle fibres and by inhibiting muscle glycogen synthetase activity [12]. In fact, both PCOS and type 2 DM are now considered to be two metabolically similar but phenotypically different expressions of the same syndromic continuum with IR being the common and pivotal link. The phenotypic differences may be a) due to the presence or absence of a coincidental genetic defect at the level of the ovary or the pancreas, b) the result of variations in the degree of β-cell dysfunction, or c) due to different specific molecular and tissue-specific abnormalities in insulin sensitivity [13].

Patients and Methods

This cross-sectional study was conducted on premenopausal women with type 2 diabetes mellitus in the period between March 2009 and May 2009. The patients were recruited from the diabetes clinic in Kasr Al Aini teaching hospital by convenience sampling method. Gynaecological assessment was conducted in the gynaecology clinic of Kasr al Aini teaching hospital, Cairo university. Included patients had to be either on oral hypoglycemic drugs or on diet control.

Women were excluded if they had hyperprolactinemia, and/or galactorrhea, thyroid dysfunction, severe psychiatric disease, or if they were pregnant. Women with current history of insulin treatment, oral contraceptive use during the past 6 months, and suspicion of nephropathy were also excluded from the study. Patients with a history of hysterectomy and bilateral oophorectomy, as well as menopausal women, were excluded.

History taking included the patient’s age, age at diagnosis of DM, type of medication received, or any other relevant drug intake, menstrual pattern, presence of hirsutism, fertility status, obstetric history including history of gestational diabetes, stillbirth, and family history of DM. Menstrual pattern was characterized as regular (cycles recurring every 21-35 days), oligomenorrhea (cycle length over 35 days and under six months), and amenorrhea (absence of menstruation for six months or longer).

The physical examination, apart from a general review of the systems, focused on the assessment of hirsutism, and anthropometry; body mass index (BMI), and waist to hip ratio (WHR). Weight and height were obtained and BMI [weight (kg)/height (m)^2] was calculated. Waist and hip circumferences were measured to the nearest centimeter with a soft tape at the narrowest part between the costal margin and iliac crest and at the widest part of the gluteal region respectively, and waist:hip ratio (WHR) was calculated. Hirsutism was evaluated using the modified Ferriman-Gallway (F/G) score [14]. This method to assess hirsutism requires the visual scoring of the extent of terminal hairs in nine body areas, named 1) upper lip, 2) chin, 3) chest, 4) upper abdomen, 5) lower abdomen, 6) upper back, 7) lower back, 8) thighs, and 9) upper arms. Each area was scored from 0 to 4. Hirsutism was diagnosed when a score of 7 or more was determined.

The diagnosis of PCOS was initially based on the criteria of the Androgen Excess and PCOS...
Society (2) i.e. the presence of (1) clinical and/or biochemical hyperandrogenism; (2) ovarian dysfunction, including oligo/anovulation and/or polycystic ovarian morphology and exclusion of secondary etiologies. Clinical signs of hyperandrogenism was diagnosed in presence of hirsutism (F/G score ≥7). Biochemical hyperandrogenism was defined as elevation of at least one circulating ovarian androgen. PCO was diagnosed by transvaginal ultrasonography if the volume of one or two ovaries was > 10cm³ and/or follicle count (2-9mm) was ≥12 follicles (in one or both ovaries). Secondary causes of amenorrhea and hyperandrogenism were excluded with clinical screening and hormonal profile.

Blood samples were taken after an overnight fast for 10-12h. Samples were analysed for LH, FSH, free testosterone, DHEAS, 17OH progesterone, prolactin and TSH, besides total cholesterol, HDL, LDL and fasting triglycerides levels. Samples were taken during early follicular phase in patients with regular cycles or oligomenorrhea. In the event that the patient had severe oligomenorrhea or amenorrhea, hormonal studies were considered when serum progesterone level was <4ng/ml. Midluteal serum progesterone was also added to exclude oligoovulation in hyperandrogenic (+PCO) women with regular cycles.

The prevalence rate of PCOS was calculated according to AEPS criteria and, by reanalysis of data, recalculated according to the Rotterdam criteria and NIH criteria.

Hormones were measured by chemiluminescent immunoassay on Immulite (Abbott). Triglycerides, total, HDL-, and LDL- cholesterol were measured using spectrophotometric technique on Hitachi (Rosche).

Data were statistically described in terms of mean ± standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) when appropriate. Comparison of quantitative variables between the study groups was done using Mann Whitney U test for independent samples. For comparing categorical data, Chi square (X²) test was performed. Exact test was used instead when the expected frequency is less than 5. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel version 7 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science: SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

In this study, a total of 71 women with type 2 diabetes were included. Sixty six patients (93%) were treated with oral hypoglycemic agents and 5 patients (7%) were on diet control alone.

According to AEPS criteria, PCOS was detected in 9 (12.68%) women with type 2 diabetes. Two women were hirsute only; three women had biochemical hyperandrogenism only, and four women had both clinical and biochemical hyperandrogenism. Biochemical hyperandrogenism was in the form of elevated free testosterone only in five cases, and elevated free testosterone and DHEAS in two cases. Seven out of 9 women had oligo ovulation (and oligomenorrhea) while PCO morphology on ultrasound was demonstrated in 8 out of 9 women. The prevalence rate of PCOS recalculated according to the Rotterdam criteria was also 12.68%, and according to the NIH criteria was 9.86%.

The age of the study population ranged from 31-45 years. The mean age of PCOS subjects at time of diagnosis of DM was 33.89±3.55 as compared to 39.84±2.68 years in non-PCOS cases, and this difference was statistically significant (p<0.0001). There was no statistically significant difference between the two groups in terms of positive family history of DM (Table 1).

Diabetics with PCOS were generally obese. The mean BMI in women with PCOS was higher than that of non-PCOS women (32.73±2.67 versus 30.48±1.92, p=0.017). The waist/hip ratio of PCOS women was significantly higher than that of non-PCOS women (0.895±0.036 versus 0.865±0.031, p=0.015) (Table 1).

The lipid profile of the study group is shown in Table (3). The difference in lipid levels between diabetic women with and without PCOS was not statistically significant.
by considering two additional phenotypes of the basically expanded the original NIH 1990 criteria the presence of both hyperandrogenism and ovulation; the NIH three principal definitions of PCOS in widespread use; the NIH: 1) clinical and/or biochemical hyperandrogenism; 2) ovarian dysfunction, including ovulatory dysfunction and/or polycystic ovarian morphology. According to the AEPS task force group, PCOS was above all a disorder of androgen excess and the diagnosis of PCOS cannot be clearly established without evidence of either clinical or biochemical hyperandrogenism [2].

What criteria to use for defining PCOS may have significant implications for patient care, clinical research and public health. Such implications have been highlighted by Broekman’s and colleagues [17] who reported that the prevalence of PCOS diagnosed according to the Rotterdam criteria appeared to be more than 1.5 times more than that diagnosed according to the NIH criteria (91 versus 55%). The Rott-PCOS group (which included women with ovarian dysfunction, but without hyperandrogenism) exhibited a lower frequency of obesity, hyperglycaemia and insulin resistance compared with the NIH-PCOS group. Also, obese women in the Rott-PCOS group without androgen excess had a different metabolic profile compared with obese women in the NIH-PCOS group, with lower rates of hyperglycaemia and hyperinsulinism, despite comparable distributions of body weight. They concluded that with the new Rotterdam consensus criteria, oligo/aneovulatory women with less severe metabolic derangements will be added to the heterogeneous group of women with PCOS. On the other hand, Moran and Teede [5] reported that non-NIH PCOS and weight-matched NIH PCOS appear to present with similar metabolic risk profiles, particularly where abdominal fat is similar between subjects. They concluded that abdominal obesity appears to be the primary determinant of metabolic abnormalities in PCOS.

In this study, the prevalence rate of PCOS in 71 premenopausal women with type 2 DM was 12.68%. Although we initially applied the AEPS criteria for diagnosing patients with PCOS, it is noteworthy that no diabetic woman with oligomenorrhoea (and PCO) was excluded from the PCOS diagnosis for absence of hyperandrogenism. The presently detected prevalence rate, therefore, did not change by recalculation according to the Rotterdam criteria; a fact which reflects the association

### Table (1): Clinical profile of diabetics with and without PCOS.

<table>
<thead>
<tr>
<th></th>
<th>Diabetics with PCOS (n=9)</th>
<th>Diabetics without PCOS (n=62)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at diagnosis of DM (years)</td>
<td>33.89±3.55</td>
<td>39.84±2.68</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Positive family history of DM</td>
<td>4 (44.4%)</td>
<td>30 (48.4%)</td>
<td>0.83</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>32.73±2.67</td>
<td>30.48±1.92</td>
<td>0.017</td>
</tr>
<tr>
<td>WHR</td>
<td>0.895±0.036</td>
<td>0.865±0.031</td>
<td>0.015</td>
</tr>
</tbody>
</table>

### Table (2): Obstetric history of diabetics with and without PCOS.

<table>
<thead>
<tr>
<th></th>
<th>Diabetics with PCOS (n=8)*</th>
<th>Diabetics without PCOS (n=59)**</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of gestational diabetes</td>
<td>3 (37.5%)</td>
<td>10 (17%)</td>
<td>0.17</td>
</tr>
<tr>
<td>History of stillbirth</td>
<td>1 (12.5%)</td>
<td>2 (3.4%)</td>
<td>0.24</td>
</tr>
</tbody>
</table>

* 1 patient with failure of conception
** 3 patients with failure of conception

### Table (3): Lipid profile of diabetics with and without PCOS.

<table>
<thead>
<tr>
<th></th>
<th>Diabetics with PCOS (n=9)</th>
<th>Diabetics without PCOS (n=62)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol (mg/dl)</td>
<td>197.17±25.0</td>
<td>202.66±22.84</td>
<td>0.51</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>40.06±4.77</td>
<td>41.40±4.42</td>
<td>0.64</td>
</tr>
<tr>
<td>LDL (mg/dl)</td>
<td>127.41±26.46</td>
<td>132.12±25.2</td>
<td>0.59</td>
</tr>
<tr>
<td>Fasting triglycerides (mg/dl)</td>
<td>185.37±33.62</td>
<td>178.10±31.94</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Discussion**

PCOS is one of the most common endocrinopathies in women which is diagnosable only by a collection of symptoms and signs and no single test is available for its diagnosis. There are currently three principal definitions of PCOS in widespread use: the NIH [15], the Rotterdam consensus [16], and the Androgen Excess Society and PCOS (AEPS) criteria [2]. The NIH [18] criteria require the presence of both hyperandrogenism and ovulatory dysfunction. The Rotterdam consensus [16] criteria require the presence of two out of three criteria 1) hyperandrogenism, 2) ovulatory dysfunction, 3) polycystic ovaries. This definition basically expanded the original NIH 1990 criteria by considering two additional phenotypes of the disorder, namely women who had hyperandrogenism, but normal ovulation, and women who had ovulatory dysfunction and polycystic ovarian morphology, but no evidence of hyperandrogenism. The Androgen Excess and PCOS Society arrived at a somewhat more evidence-based contemporary definition of the disorder which represented a compromise between the NIH and the Rotterdam criteria. They suggested that PCOS be defined by the presence of: 1) clinical and/or biochemical hyperandrogenism; and 2) ovarian dysfunction, including ovulatory dysfunction and/or polycystic ovarian morphology. According to the AEPS task force group, PCOS was above all a disorder of androgen excess and the diagnosis of PCOS cannot be clearly established without evidence of either clinical or biochemical hyperandrogenism [2].
of hyperandrogenism and insulin resistance. Recently, Goverde et al. [18] reported that the hyperandrogenic PCOS phenotypes are highly linked to the presence of Metabolic Syndrome and IR in Dutch PCOS women who also had a significantly higher BMI compared with women without hyperandrogenism but with PCO. This finding was also reported by Legro et al., 2004 [19]. It seems that the prevalence of IR varies between the different PCOS phenotypes, with hyperandrogenic women showing the highest risk. In the current study, seven out of nine women (77%) were also oligomenorrhoeic and eight out of nine (88%) exhibited PCO morphology on ultrasound. Azziz et al. [2] reported that the prevalence of menstrual dysfunction and PCO morphology on ultrasound in PCOS was about 75%. The fact that hyperandrogenic women with PCOS will generally show the typical PCO morphology has also been reported by Broekmans et al. [17] and is, in fact, biologically plausible as the production and release of androgens from the theca cells of the antral follicles is held responsible for the hyperandrogenism.

The prevalence rate of PCOS in our population, recalculated according to the NIH criteria was 9.86%. We did not include a control group in our study; yet, this rate is not really higher than the prevalence of PCOS previously reported in the general population (4-8%) [20]. The prevalence rate of PCOS did not seem to be affected by sampling a diabetic population. Several studies investigated the prevalence of PCOS and PCO in diabetics. Different definitions were applied to diagnose PCOS. Amin and colleagues [21] noted that the prevalence of PCOS in 157 women with type 2 DM was 8.3%. Their diagnosis was based on the NIH criteria. In a case-control study of 112 women, Klestimur and colleagues [22] found a prevalence of 4.3% among women with type 2 diabetes. Their diagnosis was again based on the NIH criteria. However, they reanalyzed their data according to the Rotterdam criteria and found a prevalence of 8.7%.

On the other hand, other authors have reported higher prevalence rates. However strict diagnostic criteria were not implied in identifying subjects with PCOS. Mizraie and Kazemi [23] reported a prevalence of 19.5% of PCOS in ninety two women with type 2 DM. However, their data was collected by questionnaire-based interviews. Peppard and colleagues [24] reported even a higher prevalence rate of 26.7% amongst diabetic women. The latter study was conducted in a university hospital clinic which was a referral centre for PCOS patients (selection bias). Besides, the number of studied patients was too small (30 cases). In a study including a group of 38 women, Conn et al. [25] found that 82% of premenopausal women with type 2 DM had polycystic ovaries on ultrasound scanning. This high prevalence might be attributed to several factors. Firstly, this study was conducted in a referral centre for PCOS (selection bias) and their study sample was small. Moreover, their findings were based on sonographic diagnosis and polycystic ovaries are demonstrated in 8-25% of normal women [26]. Finally, 45% of their study population was of Bangladeshi origin and this ethnic group has a high prevalence of type 2 diabetes [27]. Zargar et al. [28] found that 61% of women with type 2 DM had PCO and 37% had PCOS. PCO and PCOS were found in 36.7% and 25%, respectively, of their control subjects. The authors suggested that the prevalence of PCO but not PCOS was higher in type 2 DM.

In our study, the mean age at diagnosis of diabetes in PCOS patients was significantly lower than that in diabetics without PCOS (33.89±3.55 versus 39.84±2.68; p<0.0001). Hence, the onset of type 2 diabetes occurs at a younger age in PCOS patients. This is in line with the findings reported by Amini and colleagues [21]. It is therefore rational to screen PCOS patients for diabetes at the time of diagnosis. Indeed, a recent position statement from the AEPS recommended that women with PCOS, regardless of weight, be screened for IGT or type 2 DM by an oral glucose tolerance test at their initial presentation and every 2 years thereafter [29].

Obesity strongly favours IR and hyperinsulinaemia [30]. IR in PCOS women with BMI over 27 is common and in women with a BMI of 30 has always been reported. Also, a waist/hip ratio (WHR) of over 85% is a recognizable risk factor for IR [31]. Serum free fatty acids (FFAs) which are elevated in abdominal obesity and type 2 DM, seem to play the role [32]. FFAs stimulate hepatic gluconeogenesis and compete with glucose for oxidation in skeletal muscle [33], thereby impairing glucose disposal, and leading to impaired insulin sensitivity as a secondary event [32]. In addition to increasing IR, increased adiposity results in increased androgen production and suppression of SHBG [34]. Furthermore, since pre-adipocytes are known to have androgen receptors which regulate adipose cell function [35], there is evidence that hyperandrogenism increases abdominal obesity, which in turn increases IR. Therefore, the android body fat distribution in PCOS women, may be both the result as well as a cause of hyperandrogenism, which precludes a vicious circle of hyperinsulinism,
hyperandrogenism and central adiposity and metabolic abnormalities [36]. In this study, we observed that diabetics with PCOS had significantly higher BMI (32.73±2.67 versus 30.78±1.92) as well as WHR (0.895±0.036 versus 0.865±0.031) than non-PCOS diabetics. Indeed, it has been previously shown that even non-obese subjects with PCOS have higher WHR values (i.e. greater abdominal obesity) and greater IR than their healthy controls [37] and consequently central or abdominal obesity might be considered the more important risk factor for type 2 DM in women with PCOS. In a series of PCOS women screened by Legro [38] the vast majority of women who had either impaired glucose tolerance or frank type 2 diabetes had a BMI >30kg/m². Our observations are also in agreement with those of Mirzaei and Kazemi [23] and Amini and colleagues [21]. Our finding that the subjects with PCOS in this study were also hyperandrogenic confirms the causal inter-relationship between androgen excess and overweight and highlights the fact that obesity influences the phenotypic presentation of PCOS [34].

PCOS patients are likely to develop gestational DM (GDM) in 20 to 40% of cases, [39] whereas approximately 40% of women with GDM are likely to have underlying PCO morphology. Besides, gestational diabetes is a risk factor for future development of type 2 DM [40]. In this study, history of GDM was more frequently reported by women with PCOS than those without PCOS (37.5% vs. 17%); however, this difference was not statistically significant. This may be due to the small number of patients included in the study. In their study on 34 women with previous GDM and 36 control women with uncomplicated pregnancy, Holte et al. [40] documented a higher frequency of sonographic and clinical evidence of PCOS. Mirzaei and Kazemi [23] reported that 33% of diabetics with PCOS suffered of GDM as compared to 23.9% of diabetics without PCOS. Conn et al. [25] found that 55% of diabetics with PCO on ultrasound had had gestational diabetes in contrast to 29% of diabetic women without PCO.

In our study, we also noted a higher incidence of stillbirth amongst diabetics with PCOS (12.5%) as compared to those without PCOS (3.4%). Yet, the difference was not statistically significant (p=0.24), probably due to the small sample size. The relatively higher incidence of stillbirth amongst PCOS diabetics may be nothing but a reflection of the higher incidence of GDM in this group. Amini and colleagues [21] have previously reported a significantly higher number of stillbirths amongst diabetics with PCOS as compared to non-PCOS diabetics.

IR and type 2 DM have been reported more frequently in the families of women with PCOS [41]. Also, women with PCOS demonstrate insulin secretory defects that are most prominent in those with family history of DM [42]. Indeed, one link between women with PCOS and type 2 DM for which there is good evidence is through a common inherited tendency. Both, PCOS and type 2 DM, are strongly genetically determined and intriguingly, the large class III alleles of the insulin gene variable number tandem repeat which promote insulin secretion, have been implicated in both conditions. This hypothesis finds resonance in the demonstration of insulin hypersecretion in PCOS. The effect of INS might be expressed during foetal development or later in life through obesity [43]. In this study, the overall incidence of family history of DM is close to 50%. However, we found no significant difference between diabetic women with PCOS and family history of DM (44.4%) compared to diabetics without PCOS and family history of DM (48.4%); p=0.83. The high incidence of family history of DM in PCOS patients seems to reflect the high risk of DM in women with PCOS and family history of DM and therefore justifies the early screening for DM in such women [44].

IR has been defined by consensus conference as impaired metabolic response to either endogenous or exogenous insulin and it has been emphasized that IR does not have to be confined to parameters of glucose metabolism, but should apply to any of the biological actions of insulin including its effect on lipid and protein metabolism. [45]. Furthermore, women with PCOS have an atherogenic lipid profile (especially low HDL-cholesterol and elevated triglycerides) which, together with abdominal obesity and IR predisposes women with PCOS to CVDs [46]. In this study we investigated the lipid profile in cases with type 2 DM. We found no significant differences between diabetics with and without PCOS as regards total, HDL-, LDL- cholesterol and fasting triglycerides. These findings are in line with those reported by Amini and colleagues [21], Zargar et al. [28], and Conn et al. [25]. It seems that the dyslipidaemia accompanying PCOS is related to IR or obesity (especially abdominal obesity) or both rather than the syndrome itself.

Although we followed strict criteria in diagnosing PCOS, the present study design is not without limitations. The studied sample was small and lacked the inclusion of a control group. Future
case control studies with greater sample size are warranted to confirm this study results.

We conclude that, although the risk of type 2 DM among PCOS patients may be significantly higher than normal women, the prevalence of PCOS among reproductive–aged type 2 DM patients is not higher than that previously reported amongst unselected population. The former, however, has ramifications for the immediate and long term management of PCOS. Since impaired glucose tolerance is often asymptomatic, the screening of women with PCOS has been recommended [29]. However, from a clinical point of view, it may be questioned whether all women diagnosed with PCOS should be screened for metabolic abnormalities or whether screening for these abnormalities could be limited to only those women particularly at risk. Our data suggest that amongst the PCOS phenotypes, hyperandrogenic PCOS phenotypes have the highest risk of DM. Moreover, PCOS presenting with type 2 DM seemed to suffer from obesity especially abdominal obesity. Indeed, the Rotterdam consensus meeting recognized the necessity to screen obese PCOS patients for the Metabolic syndrome [16] and Goverde et al. [18] demonstrated that waist circumference represents a clinically useful parameter to select those anovulatory PCOS women who should be screened for the presence of Metabolic Syndrome or IR. In a recent report, Sattar [44] proposed that screening women with PCOS for diabetes should be restricted to those at significantly elevated risk, such as women who are obese or those who have a family history of type 2 diabetes. As regards therapeutic management, the AEPS [29] has suggested that metformin could be used to treat and to prevent progression to impaired glucose tolerance (IGT) in PCOS patients, and the American Association of Clinical Endocrinologists’ guidelines [47] has recommended metformin as an initial intervention in overweight and obese patients with PCOS. Hence, the early identification of affected patients and institution of life style changes (in the form of loss of weight) or pharmacological treatment (e.g. metformin) may help delay the progression to type 2 DM in women with PCOS.

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