Establishing the Hormonal Relationship between Polycystic Ovary Syndrome and Hypothyroidism: A Literature Review

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Objective**:** *The aim of this literature review is to evaluate the hormonal relationship between polycystic ovary syndrome and hypothyroidism.*

Methods**:** *Electronic databases such as Ebscohost and PubMed were searched, using words and phrases specific to the topic. Journal articles were filtered for publications from no earlier than 2008 to ensure accuracy and relevance.*

Results**:** *Anti-thyroid peroxidase antibodies and thyroid-stimulating hormone were significantly higher in polycystic ovary syndrome patients compared to controls (P<0.05). Polycystic ovary syndrome patients also had a statistically significant higher prevalence of autoimmune thyroiditis (P=0.035) and subclinical hypothyroidism (P=0.0133) compared to controls. In polycystic ovarian syndrome patients with thyroid-stimulating hormone levels ≥2.5 mIU/L, a significantly increased insulin resistance (P=0.007) and a significantly decreased insulin sensitivity (P=0.003) were observed compared to same patients with thyroid-stimulating hormone levels <2.5 mIU/L. Serum triglycerides were significantly higher in polycystic ovary syndrome patients with subclinical hypothyroidism compared to same patients with normal thyroid function (P=0.013). A significant positive correlation was present between luteinizing hormone and thyroid volume (P=0.007) and between anti-thyroid peroxidase antibodies and thyroid volume (P<0.0001). With thyroid hormone replacement, there was a significant increase in insulin sensitivity and free T_3/T_4 levels, with a corresponding decrease in serum thyroid-stimulating hormone, prolactin, estradiol, insulin resistance, and free testosterone in polycystic ovary syndrome patients with untreated hypothyroidism. The polycystic-appearing ovaries and ovarian volumes in these patients also significantly regressed (P<0.05).*

Conclusion**:** *Polycystic ovary syndrome is associated with hypothyroidism. Hence, achieving euthyroidism may improve the clinical and morphologic characteristics of polycystic ovary syndrome.*

Keywords: *PCOS, hypothyroidism, levothyroxine, polycystic ovary, hormone, thyroid, autoimmune, insulin resistance*

BACKGROUND

Polycystic ovary syndrome (PCOS) is the most common female endocrinal abnormality in women of reproductive age,[1] affecting approximately 5 million women of childbearing age in the United States of America.[2] The condition is diagnosed using the Rotterdam criteria, which require that a patient present with at least two of the following: oligoovulation/anovulation resulting in menstrual disturbances, hyperandrogenism (biochemical or clinical presentation), and a polycystic ovarian morphology.[3]

Many patients with PCOS also suffer from metabolic derangements, including obesity, dyslipidemia, insulin resistance, and type 2 diabetes mellitus.[4] The dyslipidemia in PCOS patients is mostly characterized by increased triglycerides and decreased high-density lipoprotein (HDL).[5] This finding is thought to be due to the insulin resistance seen in many PCOS patients, as insulin increases HDL synthesis as well as triglyceride storage.[5]

Several studies have attempted to elucidate the link between PCOS and hypothyroidism. Previous studies have suggested an autoimmune relationship between these two diseases[6]; others have cited insulin resistance (thyroid hormone is involved in glucose metabolism) and thyroid-stimulating hormone (TSH) as the connection.[1] Moreover, patients with PCOS and patients with hypothyroidism share many clinical and endocrine features, including oligomenorrhea, infertility, hyperandrogenism and weight gain, elevated free testosterone, prolactin, and luteinizing hormone (LH) levels.[7] Importantly, ovaries with bilateral multicystic appearance are also often found in patients with hypothyroidism.[7] Therefore, if a hormonal relationship exists between the two disorders, as hypothyroidism is easily

treated, it is possible that achieving euthyroidism through thyroid hormone replacement therapy may improve the clinical and morphologic characteristics of PCOS including the polycystic ovaries, hyperandrogenism, and menstrual irregularities.

The Pathophysiology of PCOS

The pathophysiology of PCOS is not completely understood and still remains controversial. Normally, gonadotropin-releasing hormone (GnRH) from the hypothalamus stimulates the release of LH and follicle-stimulating hormone (FSH) from the anterior pituitary. LH then acts on the ovary to induce production of androgens by the theca cells. These androgens are converted to estrogens by the ovarian granulosa cells, under the influence of FSH.[8] There are reports that hyperinsulinemia and/or insulin resistance in PCOS leads to hypothalamic/pituitary-axis dysfunction, leading to an increased LH:FSH ratio.[2] Excess LH results in excess theca cell proliferation and increase in androgen levels. With decreased FSH stimulation of the granulosa cells, these androgens are not converted to estrogens, leading to ovarian cyst formation and anovulation.[2] In addition, as indicated by other studies, elevated androgen levels cause hirsutism in these patients, as well as a hyperestrogenic state as a result of peripheral conversion of androgens to estrone in adipose tissue.[9] This leads to a decrease in FSH by negative feedback, thus exacerbating the polycystic ovarian state.[9]

Thyroid Physiology

Thyroid hormone secretion from the thyroid gland first involves thyrotropin-releasing hormone (TRH) secretion from the hypothalamus, which stimulates TSH secretion from the anterior pituitary, which then stimulates the thyroid gland to release thyroid hormones (T_3 and T_4). Primary hypothyroidism involves thyroid gland dysfunction and is defined by TSH >5 mIU/L and T_4 levels <5 µg/dL.[10] Patients usually present with fatigue, cold intolerance, constipation, dry skin, and weight gain.[10] It is also important to distinguish between subclinical and clinical hypothyroidism. In clinical hypothyroidism, serum TSH levels are increased (>5 mIU/L), free T_4 is decreased (<5 µg/dL), and symptoms are severe; in subclinical hypothyroidism (SCH), TSH levels are increased (5–10 mIU/L) but free T_4 levels are normal (5–12 µg/dL), and symptoms are less severe or even absent.[10]

METHODS

One person conducted this review. The following electronic databases were searched with publication date limits from no earlier than 2008 to present: Ebscohost and PubMed. Search terms included *polycystic ovary syndrome* OR *polycystic ovarian syndrome* AND *hypothyroidism* AND *thyroid hormone replacement therapy* AND *levothyroxine*. PubMed generated 88 articles, which were analyzed using relevance of their headings and abstracts to the searched topic/hypothesis. Use of the search terms *levothyroxine* or *thyroid hormone replacement therapy* narrowed the list to 10 articles. These 10 articles are included in this review.

Primary studies, randomized control studies, cohort studies, cross-sectional studies, retrospective and prospective studies, and case-control studies containing current data with research conducted within or outside the United States of America were included. Nonhuman studies, systematic reviews, meta-analyses, and journal articles older than the year 2008 were excluded. The study population included young to middle-aged women/premenopausal women. Evidence tables, graphs, timelines, descriptions of what characteristics improved over time, methods, results, and discussion were used to assess the quality of a study.

In several studies included in this review, a few mathematical models were used to assess insulin resistance and insulin sensitivity. Insulin resistance was determined using the indices homeostatic model assessment of insulin resistance (HOMA-IR) and/or homeostatic model assessment of β-cell function (HOMA-B). HOMA-IR was calculated using the following formula: fasting glucose (mmol/L) × fasting insulin (µIU/mL) ÷ 22.5; HOMA-B was calculated by the following formula: 20 × fasting insulin (µIU/mL) ÷ [fasting glucose (mmol/L) – 3.5].[11] Insulin sensitivity was assessed using the quantitative insulin sensitivity check index (QUCKI) and/or the insulin sensitivity index (ISI). QUICKI was calculated using the following formula: 1 ÷ [log fasting insulin (µIU/mL) + log fasting glucose (mg/dL)]; ISI was calculated as follows: 10,000 ÷ √[fasting glucose (mg/dL) × insulin (µIU/mL)].[11]

RESULTS

Thyroid Dysfunction in PCOS

Several studies have suggested the relationship between hypothyroidism and PCOS. A cross-sectional study by Sinha et al[1] identified an increasing prevalence of various thyroid disorders in patients with PCOS. The study recruited 106 patients identified as having

excessive hair growth and menstrual abnormalities. Using the Rotterdam's criteria, the researchers were able to diagnose 80 of the patients as having PCOS, out of which 62 presented with oligomenorrhea and 12 presented with amenorrhea. These 80 patients were then compared with age-matched controls without the disease. Initially, many clinical and laboratory parameters were compared between the two groups, including serum levels of LH, FSH, TSH, free testosterone, antithyroid peroxidase antibodies (anti-TPO Ab), and clinical hirsutism (measured by Ferriman–Gallwey score). Elevated anti-TPO Ab and TSH were observed in the PCOS patients, with a statistically significant difference in all parameters measured ($P<0.05$).

To determine the difference in the prevalence of thyroid disorders between the groups, serum TSH, free triiodothyronine (free T_3), free thyroxine (free T_4), anti-TPO Ab levels, as well as an ultrasound of the thyroid gland were used. Thyroid disorders studied included goiter, SCH, clinical hypothyroidism, autoimmune thyroiditis (AIT), Graves' disease, and multinodular goiter. A goiter was present in 27.5% of PCOS patients and in 7.5% of controls ($P<0.05$). As measured by serum TSH levels in PCOS patients and controls (4.547±2.66 and 2.67±3.11, respectively; $P<0.05$), SCH was present in 22.5% of PCOS patients and in 8.75% of controls. AIT was also found in 22.5% of PCOS patients and 1.25% of controls as evidenced by serum anti-TPO Ab levels in PCOS patients compared with controls (28.037±9.138 and 25.72±8.27, respectively; $P=0.035$). Clinical hypothyroidism was also found in 2.5% of PCOS patients and 1.25% of controls.

Similarly, AIT in patients with PCOS was also studied by Novais et al[12] In the study, 65 young women (aged 18–40 years old) with PCOS were compared to 65 young women without the disease. The researchers in the study looked at serum levels of TSH, free thyroxine, free triiodothyronine, anti-TPO Ab, anti-thyroglobulin antibodies (anti-TG), and thyroid ultrasound findings in both groups. AIT was found in 43.1% of the PCOS patients and 26.2% of the control group. A significant association between AIT and PCOS was not present when the results were adjusted for weight and insulin resistance (odds ratio [OR] 0.78, confidence interval [CI] 0.28–2.16). A statistically significant difference in the prevalence of SCH was found between the two groups, with mean TSH values of 2.9±1.8 mIU/L in the PCOS group and 2.2±1.2 mIU/L in the group without PCOS ($P=0.0133$). SCH was observed in 16.9% of PCOS patients and 6.2% of the controls (OR 3.10, CI 0.93–10.31).

INSULIN AND LIPID DERANGEMENTS

Dittrich et al[11] also found a relationship between hypothyroidism and PCOS. TSH levels ≥2.5 mIU/L and < 2.5 mIU/L were determined in 103 women defined as having PCOS by the Rotterdam criteria. An oral glucose tolerance test was administered to patients, and glucose and insulin concentrations were determined at 0, 60, and 120 min. In patients with TSH levels ≥2.5 mIU/L, a significantly increased HOMA-IR (3.40±2.99; $P=0.007$) was observed. In addition, in these patients, a significant positive correlation ($P<0.05$) between TSH levels and insulin resistance (HOMA-IR) ($r=0.387$), and between TSH and fasting insulin concentrations ($r=0.368$), was present compared with PCOS women with TSH levels <2.5 mIU/L. A significantly decreased QUICKI (0.34±2.99; $P=0.003$) and ISI (5.57±4.31; $P=0.005$) were also observed in patients with TSH levels ≥2.5 mIU/L. A significant negative correlation ($P<0.05$) between TSH levels and insulin sensitivity (QUICKI) ($r=-0.358$) and ISI ($r=-0.407$) was present in patients with TSH levels ≥2.5 mIU/L compared to patients with TSH levels < 2.5 mIU/L. In PCOS patients with TSH levels < 2.5 mIU/L, HOMA-IR was less (2.04±1.68), and QUICKI and ISI were higher (0.36±0.04 and 8.45±6.83, respectively) than patients with TSH levels ≥2.5 mIU/L; however, no statistically significant correlation was observed between TSH levels and HOMA-IR ($r=0.049$), QUCKI ($r=-0.0.032$), and ISI ($R=-0.054$).

A separate study by Celik et al[13] analyzed PCOS patients with SCH in relation to insulin resistance and lipid parameters. The study involved three groups: group 1 consisted of 20 women with PCOS and SCH, group 2 consisted of 39 women with PCOS with normal thyroid function, and group 3 consisted of 53 women without PCOS with normal thyroid function. A 75-g, 2-h oral glucose tolerance test was carried out in all participants following 3 days on a carbohydrate-rich diet, and insulin resistance was measured with HOMA-IR. In addition, glucose, total cholesterol, HDL, low-density lipoprotein (LDL), and triglyceride levels were also measured by standard enzymatic techniques. Serum triglycerides levels were 143.26±99.86 mg/dL in group 1, 88.56±37.56 mg/dL in group 2, and 83.71±31.94 mg/dL in group 3 – with statistically significant differences observed between groups 1 and group 2 ($P=0.013$) and between groups 1 and group 3 ($P=0.013$). There was no statistically significant difference in glucose, total cholesterol, HDL, and LDL between the groups. Fasting insulin levels were 12.45±8.62 µU/mL in group 1, 8.60±5.35 µU/mL in group 2, and 7.04±3.55 µU/mL in group 3. HOMA-IR was

2.92±2.34 in group 1, 1.95±1.52 in group 2, and 1.60±0.86 in group 3. A statistically significant difference in fasting insulin and HOMA-IR levels was observed between groups 1 and 3 (P=0.011 and P=0.017, respectively). No significant difference was observed in fasting insulin and HOMA-IR levels between groups 1 and 2 (P=0.072 and P=0.077, respectively).

Thyroid Volume in PCOS

A study by Cakir et al[14] evaluated thyroid volume (TV) in 47 patients with PCOS and 30 age- and body mass index (BMI)-matched controls along with various hormonal and biochemical parameters. Serum LH and anti-TPO Ab levels were determined by specific electrochemiluminescence immunoassays, and TV was evaluated using a high-resolution ultrasound machine. The mean TV was 10.13±3.98 mL in PCOS patients and 10.46±4.36 mL in healthy controls (P=0.734). Anti-TPO Ab-positive women were also found to be similar between the two groups (P=0.456). However, a significant positive correlation was present between TV and LH (r=0.316; P=0.007) and TV and anti-TPO Ab (r=0.602; P<0.0001).

In the same study, using a multiple linear regression model, TV was also observed to be significantly associated with serum LH levels (P<0.001) and anti-TPO Ab levels (P<0.001). The authors also determined the insulin resistance using the HOMA-IR index, and participants were divided into two groups according to HOMA-IR levels. Although mean TV was higher in the group with higher HOMA-IR levels (>2.7), the difference was not found to be statistically significant.

Thyroid Hormone Replacement in PCOS

In the study by Trummer et al,[4] endocrine and metabolic parameters were studied in 583 women with PCOS, with or without elevated serum TSH levels. Women with and without hypothyroidism were compared, with 109 women on thyroid replacement therapy and 16 women having SCH. PCOS women with elevated TSH had significantly increased fasting insulin and HOMA-IR index levels, with lower insulin sensitivity (QUCKI) and HDL. A significant positive correlation was also present between fasting insulin and TSH levels (r=0.093, P=0.030). Insulin levels, HOMA-IR, and QUICKI were observed to be similar between PCOS women on thyroid hormone replacement therapy and euthyroid women without thyroid hormone replacement therapy. However, significant differences were present in BMI and HDL between the two groups; BMI was higher (34.3 kg/m^2 with thyroid hormone replacement, 28.4 kg/m^2 without thyroid hormone replacement), and HDL was lower (72 mg/dL with thyroid hormone replacement, 78 mg/dL without thyroid hormone replacement) in PCOS women on thyroid hormone replacement therapy. In addition, serum TSH levels in PCOS women on thyroid hormone replacement therapy were greater than euthyroid PCOS women not on thyroid hormone replacement therapy.

Muderris et al[15] found that thyroid hormone replacement therapy could be helpful in patients with PCOS and hypothyroidism. Muderris et al[15] studied 26 patients with untreated hypothyroidism: 10 had PCOS, while 16 did not have. The 26 patients with untreated hypothyroidism were compared with 20 euthyroid participants without polycystic ovaries. Blood sample was taken before and after thyroid hormone replacement therapy, and serum levels of testosterone, androstenedione, dehydroepiandrosterone-sulfate (DHEAS), prolactin, estradiol, LH, FSH, free triiodothyronine, free thyroxine, and TSH were determined by radioimmunoassay; ovarian volumes were also examined. Levothyroxine was administered only to the 26 patients with hypothyroidism, and the size and appearance of the ovaries were observed 3 months after euthyroidism was achieved. Prior to the treatment with levothyroxine, serum prolactin (21.3 mIU/L in PCOS patients and 18.4 mIU/L in patients without PCOS), DHEAS (3.4 mg/mL in PCOS patients and 1.9 mg/mL in patients without PCOS), and free testosterone levels (2.5 pg/mL in PCOS patients and 1.6 pg/mL in patients without PCOS) were significantly higher in the hypothyroid patients with PCOS than in the hypothyroid patients without PCOS. In addition, a significant difference (P<0.05) was observed in pre-treatment serum free triiodothyronine, free thyroxine, TSH, prolactin, and testosterone concentrations in hypothyroid patients compared with euthyroidic controls. Upon administration of thyroid hormone replacement therapy, there was a significant increase in serum free thyroxine (6.9 to 11.3 pg/mL), with a significant decrease in serum TSH (39.8 to 2.9 µIU/L), prolactin (21.3 to 13.1 mIU/L), estradiol (97.2 to 64.9 pg/mL), and free testosterone levels (2.5 to 1.3 pg/mL) in patients with hypothyroidism and concurrent PCOS.

Compared to controls, serum DHEAS remained high in patients with PCOS and concurrent hypothyroidism, while 17-hydroxyprogesterone, 11-deoxycorticosterone, and serum cortisol levels remained unchanged after euthyroidism was achieved. Prior to initiation of thyroid hormone replacement therapy, hypothyroid

patients with PCOS had complaints of oligomenorrhea. Five hypothyroid women with PCOS and 13 hypothyroid women with normal-appearing ovaries reported an improvement in their menstrual cycle following euthyroidism. Basal ovarian volumes were significantly greater in hypothyroid patients with or without PCOS ($P<0.05$). Left ovarian volumes were also observed to be significantly larger than right ovarian volumes in hypothyroid patients with PCOS compared with hypothyroid patients without PCOS (left ovary: 11.1 cm^3, right ovary: 8.5 cm^3; left ovary: 6.9 cm^3, right ovary: 6.3 cm^3, respectively; $P<0.05$). When euthyroidism was achieved, ovarian volumes in hypothyroid patients with and without PCOS decreased significantly ($P<0.05$).

DISCUSSION

Autoimmunity to Explain the Relationship between PCOS and Hypothyroidism

In the studies by Sinha et al[1] and Novais et al,[12] we first saw the relationship between PCOS and hypothyroidism as evident by increased serum TSH and anti-TPO Ab levels in PCOS patients. Increased anti-TPO Ab levels in PCOS patients suggest an increased frequency of autoimmune hypothyroidism in PCOS patients. This may be explained by the hyperestrogenic state in these patients. There are studies that describe hyperestrogenism as the prevailing theory for the increased prevalence of autoimmune disease in women as compared to men. So in PCOS, the increased estrogen levels may contribute to an increased risk of autoimmunity, leading to a possible autoimmune attack on the ovaries just as the thyroid gland is under attack in thyroiditis.[16] Unlike the study by Sinha et al,[1] Novais et al[12] were unable to find a significant difference in AIT in patients with and without PCOS after the results were adjusted for weight and insulin resistance, even though the prevalence of AIT was still higher in PCOS patients.

The elevated TSH found in PCOS patients in the studies can be explained by the concurrent elevation of TRH in hypothyroidism, causing increased secretion of prolactin from the anterior pituitary by direct stimulation. Increased prolactin levels may suppress GnRH, leading to an altered LH:FSH ratio seen in PCOS patients. This elevation in TSH levels cannot only explain the statistically significant increase in the prevalence of goiter and SCH in PCOS patients (seen in the study by Sinha et al[1]), elevated TSH also occurs in a thyroid gland destroyed by autoimmune antibodies owing to an attempt by the body to maintain normal thyroid hormone levels.

Insulin Resistance to Explain the Relationship between PCOS and Hypothyroidism

Dittrich et al[11] proposed that elevated serum TSH levels (≥2.5 mIU/L) in PCOS patients contribute to increased fasting insulin levels, increased insulin resistance, and decreased insulin sensitivity. Previous studies have shown that thyroid hormones may affect insulin sensitivity through the expression or the activation of uncoupling protein, β-adrenergic receptor, and peroxisome proliferator-activated receptor-γ, leading to enhanced insulin sensitivity, and reduced hyperglycemia and hyperinsulinemia.[11] Thyroid hormone's permissive effect on catecholamines also enhances lipolysis and reduces fat mass, decreasing insulin resistance.[11] Because of thyroid hormone involvement in the regulation of glucose metabolism, in patients with hypothyroidism, we see altered glucose uptake into tissues and elevated insulin levels as a result of resistance. In PCOS patients, 50–70% also present with hyperinsulinemia and insulin resistance; therefore, the metabolic picture of PCOS patients with concurrent hypothyroidism may be more severe, contributing to an even higher risk of development of diabetes.[11]

Consistent with previous studies, increased insulin resistance, fasting insulin, and fasting glucose were also observed in PCOS patients with SCH in the study by Celik et al[13] However, these parameters were similar and so not statistically significant when PCOS patients and PCOS patients with SCH were compared, possibly owing to the clinical similarity between the two disorders. In addition, as BMI and waist-to-hip ratios were not comparable between the groups, obesity as a risk factor for insulin resistance may have influenced these results.[13]

Triglycerides to Explain the Relationship between PCOS and Hypothyroidism

Celik et al[13] found a statistically significant increase in triglyceride levels in PCOS patients and in PCOS patients with SCH, while no difference was observed in total cholesterol, HDL, and LDL levels when compared to controls. The elevated triglyceride level in PCOS patients and in PCOS patients with SCH is consistent with the clinical picture of obesity in both disorders and further supports the role of the thyroid gland in modulating lipolysis and reducing fat mass.

LH to Explain the Relationship between PCOS and Hypothyroidism

Cakir et al[14] found a positive association between LH and TV. This observation may be explained by the fact

that both LH and TSH share a similar alpha subunit. Therefore, the positive correlation of LH with TV may be due to the elevated LH levels present in PCOS patients. The LH may mimic TSH, thus stimulating thyrocytes and causing thyroid gland dysfunction.[14] In the same study, TV was increased in PCOS patients with higher insulin resistance (HOMA-IR) levels (>2.7); however, no statistically significant association between TV and insulin or insulin resistance was observed. As prior studies have shown that insulin has a 'mitogenic effect on thyrocytes', the authors of this study thought that the lack of a significant difference between insulin resistance and TV was due to a sampling and selection bias, as their study involved a small sample size of participants that were lean and young.[14] Cakir et al[14] also observed a significant positive correlation between anti-TPO Ab and TV, which supports the clinical appearance of the thyroid gland in AIT that leads to the formation of a goiter.

Thyroid Hormone Replacement to Explain the Relationship between PCOS and Hypothyroidism

In the study by Trummer et al,[4] fasting insulin levels, insulin sensitivity, and insulin resistance were observed to be improved in patients on thyroid hormone replacement therapy; however, these patients were still more obese and had higher LDL, higher systolic blood pressure, and higher TSH levels than healthy controls. The higher TSH levels may suggest that these patients may not have been on the sufficient dose of levothyroxine, and therefore it is possible that higher HDL levels and lower systolic blood pressure and BMI might be observed following treatment with the adequate dosages.[4]

Thyroid hormone replacement also led to an improvement in serum hormone levels in patients with PCOS. Previous studies have shown that hypothyroidism leads to decreased sex hormone-binding globulin levels (SHBG), increasing testosterone in the serum.[15] Thus, thyroid hormone replacement therapy may have led to decreased serum free and total testosterone by replenishment of SHBG.[15] Participants also reported improvement in their menstrual cycles and estradiol levels likely due to the effect of thyroid hormone replacement therapy causing a corresponding decrease in TRH and TSH by negative feedback, therefore decreasing prolactin levels and restoring GnRH secretion. In the same study by Muderris et al,[15] there was an observed regression in ovarian volumes upon thyroid hormone replacement therapy. Increased ovarian volumes and the polycystic appearance observed in hypothyroid patients are thought to be because of deposition of mucopolysaccharides (a characteristic of hypothyroidism) within the ovarian stroma.[15] Therefore, treatment of the hypothyroidism may have reversed this deposition, consequently decreasing ovarian volume in treated patients. The researchers could not find any explanation for higher ovarian volumes in the left compared to right ovary.[15]

LIMITATIONS

Overall, these studies helped to establish the fact that thyroid dysfunction and PCOS may be linked. However, serologies and hormone levels were utilized, and perhaps the use of confirmatory thyroid biopsies would have better elucidated this relationship. In addition, many of the studies in this review had small sample sizes. Therefore, more research with larger sample sizes is needed to not only further ascertain levothyroxine as a therapy in PCOS, but also to further determine the association between the two disorders.

CONCLUSION

In this review, we found studies connecting hypothyroidism and PCOS using various endocrine and metabolic parameters. They showed thyroid hormone derangements in patients with PCOS, a positive association between LH and TV, decreased insulin sensitivity and increased triglycerides in patients with hypothyroidism and PCOS than PCOS alone, and we found that with thyroid hormone replacement therapy, testosterone levels, ovarian volumes, and menstrual irregularities improved in patients with hypothyroidism and PCOS. Hence, achieving euthyroidism may improve the clinical and morphologic characteristics of PCOS. Therefore, it is important that regular screening of TSH should be done in patients with PCOS so that the treatment can begin at an early stage.

In summary, we know a relationship between PCOS and hypothyroidism exists; however, because the two disorders are so interconnected, this relationship is similar to the long debated chicken-egg scenario – we do not know which pathology came first.

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