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REVIEW ARTICLE **OPEN ACCESS**

Polycystic Ovarian Syndrome: Prevention and Management

D. Vasumathi*[1], R. Arulkumar[2], V. Loganayagi, R. M. Mohankumar[2], R. Manikandan[2], R. Arulselvam[2]
[1] Department of pharmaceutics, KMCH College of pharmacy, Coimbatore.
[2] Department of pharmaceutics, Sri Shanmugha College of pharmacy, Salem.
Corresponding author: R. Arulkumar*
Email id: arulkumar1998r@gmail.com

ABSTRACT
Polycystic ovarian syndrome is a hormonal condition that affects women of reproductive age. It is distinguished by a number of symptoms, including irregular or nonexistent menstrual periods, elevated androgen (male hormone) levels, and the appearance of numerous cysts on the ovaries. PCOS can cause infertility, insulin resistance, obesity, and cardiovascular problems. PCOS is typically managed with a combination of lifestyle changes, such as maintaining a healthy weight through diet and exercise, and drugs focused at addressing specific symptoms and underlying hormonal imbalances. The drugs administered may differ depending on the individual's symptoms and goals. This Primer summarizes the present level of knowledge on the prevention, management, and future research directions of polycystic ovarian syndrome.
Keywords: PCOS, hormonal disorder, Environmental Factors

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INTRODUCTION

Polycystic ovary syndrome (PCOS) is a common hormonal disorder that affects women of reproductive age. It is estimated to affect approximately 5-10% of women of childbearing age worldwide (1). PCOS is characterized by a collection of symptoms that include irregular menstrual cycles, infertility, weight gain, and excessive hair growth (2). Women with PCOS also have an increased risk of developing type 2 diabetes, cardiovascular disease, and endometrial cancer (3). The exact cause of PCOS is not fully understood, but it is believed to be related to a combination of genetic and environmental factors (4). Women with PCOS have high levels of androgens, which are male hormones that women also produce in small amounts. These high levels of androgens can interfere with the normal function of the ovaries, leading to the formation of cysts. Diagnosis of PCOS is typically based on a combination of symptoms, physical examination, and laboratory tests. Treatment options for PCOS include lifestyle changes, such as exercise and weight loss, as well as medication to regulate menstrual cycles and lower androgen levels (5). PCOS can have a significant impact on a woman's quality of life, including her reproductive health, physical health, and emotional well-being. Therefore, early diagnosis and treatment of PCOS are essential. In this article, we will discuss the causes, symptoms, diagnosis, and treatment of PCOS, as well as the potential long-term health risks associated with this condition. The exact cause of polycystic ovary syndrome (PCOS) is not fully understood, but it is believed to be related to a combination of genetic and environmental factors. Here are some of the possible causes of PCOS that have been proposed:

Insulin Resistance: Insulin resistance, a condition where the body's cells do not respond normally to insulin, is common in women with PCOS. High levels of insulin in the body can cause the ovaries to produce more androgens, which can lead to PCOS symptoms (6). Insulin Resistance: Insulin resistance is a common feature in women with PCOS. It occurs when the body's cells become resistant to the action of insulin, leading to high levels of insulin in the bloodstream. Insulin resistance can cause the ovaries to produce more androgens, which can lead to the development of PCOS (7). Insulin resistance is a common feature of Polycystic Ovary Syndrome (PCOS), a hormonal disorder affecting reproductive-aged women. PCOS is characterized by hyperandrogenism, anovulation, and polycystic ovaries. Insulin resistance is observed in up to 80% of women with PCOS and is believed to play a key role in the pathogenesis of the disorder. Insulin resistance occurs when the body's cells become less responsive to insulin, a hormone produced by the pancreas that regulates glucose uptake from the bloodstream into cells. This leads to increased insulin production by the pancreas, which can eventually result in hyperinsulinemia, a state of abnormally high

insulin levels in the bloodstream. Hyperinsulinemia has been implicated in the development of many of the metabolic and reproductive abnormalities observed in PCOS, such as obesity, type 2 diabetes, dyslipidemia, and infertility. Several mechanisms have been proposed to explain the link between insulin resistance and PCOS. One proposed mechanism is that insulin resistance leads to hyperandrogenism by stimulating the production of androgens in the ovaries and adrenal glands. Insulin resistance also leads to a decrease in sex hormone-binding globulin (SHBG), which increases the levels of free androgens in the bloodstream. In addition to hyperandrogenism, insulin resistance in PCOS is associated with other metabolic abnormalities, such as dyslipidemia and impaired glucose tolerance. These abnormalities increase the risk of developing type 2 diabetes and cardiovascular disease, which are already more prevalent in women with PCOS compared to the general population. Management of insulin resistance in PCOS involves lifestyle interventions such as weight loss, exercise, and a healthy diet. Pharmacological interventions, such as metformin, have also been shown to improve insulin sensitivity and menstrual regularity in women with PCOS. Insulin resistance is a common feature of PCOS and plays a key role in its pathogenesis. Insulin resistance in PCOS is associated with metabolic and reproductive abnormalities that increase the risk of developing type 2 diabetes and cardiovascular disease. Management of insulin resistance in PCOS is essential to improve metabolic and reproductive outcomes in affected women (8), (9), (10).

Hormonal Imbalances: Women with PCOS have higher levels of androgens, which are male hormones that women also produce in small amounts. High levels of androgens can interfere with the normal function of the ovaries, leading to the formation of cysts. Women with PCOS also tend to have low levels of follicle-stimulating hormone (FSH) and high levels of luteinizing hormone (LH), which can contribute to irregular menstrual cycles and other symptoms (11). Women with PCOS often have higher levels of androgens, which are male hormones that women also produce in small amounts. These high levels of androgens can interfere with the normal function of the ovaries, leading to the formation of cysts. Additionally, women with PCOS may have lower levels of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which are hormones that regulate the menstrual cycle (12).

Genetic Factors: PCOS tends to run in families, suggesting that there may be a genetic component to the disorder. Several genes have been linked to PCOS, but more research is needed to understand their exact role (13). There is evidence to suggest that PCOS may have a genetic component. Women with a family history of PCOS are more likely to develop the condition themselves (3). Several genes have been linked to the development of PCOS, including those involved in insulin signaling and androgen production (14). Inflammation: Chronic inflammation may play a role in the development of PCOS. Women with PCOS have been found to have higher levels of inflammatory markers in their blood compared to women without the condition

Environmental Factors: Some environmental factors, such as exposure to endocrine-disrupting chemicals, may contribute to the development of PCOS. However, more research is needed to understand the link between environmental factors and PCOS (17). It is important to note that not all women with PCOS have the same underlying causes, and that the disorder can manifest differently in different individuals. Exposure to environmental toxins, such as bisphenol A (BPA) and phthalates, may increase the risk of developing PCOS (18). Polycystic ovary syndrome (PCOS) is a hormonal disorder that affects up to 10% of women of reproductive age (19). It is characterized by a hormonal imbalance involving insulin resistance, excess androgen production, and the overproduction of luteinizing hormone (LH) by the pituitary gland (20). Insulin resistance is a common feature of PCOS, and it can cause the ovaries to produce more androgens than they normally would. These excess androgens can disrupt the normal ovulation process, leading to irregular periods, and can also cause other symptoms such as hirsutism (excessive hair growth) and acne (21). In addition, LH levels are often elevated in women with PCOS. LH stimulates the production of androgens by the ovaries, so high levels of LH can contribute to the hormonal imbalance seen in PCOS (20). The symptoms of PCOS can vary from woman to woman, but common signs include irregular periods, hirsutism, acne, weight gain, and infertility (3). In some cases, PCOS can also lead to more serious health problems such as type 2 diabetes, high blood pressure, and heart disease (22). Treatment for PCOS typically involves managing the symptoms of the condition through lifestyle changes, such as a healthy diet and regular exercise, and medications that help regulate menstrual cycles and reduce androgen levels. For example, a woman with PCOS may be prescribed birth control pills to help regulate her periods and reduce androgen levels, or a medication called metformin to help improve insulin sensitivity (20). Polycystic ovary syndrome (PCOS) is a common endocrine disorder affecting approximately 10% of reproductive-aged women worldwide. It is characterized by hyperandrogenism, menstrual irregularities, and polycystic ovaries on ultrasound. The etiology of PCOS is not fully understood but is believed to be multifactorial, with both genetic and environmental factors playing a role. Several studies have reported an increased familial risk of PCOS, suggesting a genetic component. The heritability of PCOS has been estimated to be around 70%, indicating that genetic factors are likely to play a significant role in the development of the disorder

(23). Genome-wide association studies (GWAS) have identified several genetic variants associated with PCOS, including those related to insulin signaling, androgen biosynthesis, and inflammation (24). Additionally, epigenetic modifications, such as DNA methylation and histone modifications, have also been implicated in the pathogenesis of PCOS (25). These modifications may alter gene expression and contribute to the development of PCOS. While genetic factors contribute to the development of PCOS, environmental factors such as obesity and insulin resistance also play a role. Obesity, in particular, is associated with increased androgen levels and insulin resistance, which can exacerbate the symptoms of PCOS (26). Polycystic ovary syndrome (PCOS) is a common hormonal disorder that affects women of reproductive age. It is characterized by a range of symptoms, including irregular periods, cysts on the ovaries, excessive hair growth, and acne. Inflammation has been identified as one of the key factors contributing to the development and progression of PCOS. Inflammation is a normal physiological response to injury or infection, but when it becomes chronic, it can lead to tissue damage and contribute to the development of various chronic diseases, including PCOS. Chronic inflammation is associated with increased production of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), which can interfere with normal ovarian function and promote insulin resistance. Insulin resistance is a hallmark feature of PCOS and is thought to be a key factor in the development of the condition. Insulin resistance occurs when cells become less responsive to the effects of insulin, leading to increased levels of insulin in the blood. Insulin resistance can lead to hyperandrogenism, a condition characterized by excessive production of androgens, such as testosterone, which can disrupt normal ovarian function and contribute to the development of PCOS. Several studies have demonstrated a link between inflammation and insulin resistance in PCOS. For example, one study found that women with PCOS had higher levels of IL-6 and TNF-α compared to healthy controls, and that these levels were positively correlated with insulin resistance (27). Another study found that treatment with anti-inflammatory drugs, such as metformin and pioglitazone, improved insulin sensitivity and reduced inflammation in women with PCOS (28). In addition to promoting insulin resistance, inflammation may also contribute to the development of other PCOS-related symptoms, such as acne and excessive hair growth. For example, one study found that women with acne had higher levels of pro-inflammatory cytokines compared to women without acne, suggesting that inflammation may play a role in the development of this symptom (29). Polycystic ovary syndrome (PCOS) is a common hormonal disorder that affects reproductive-aged women. While the exact cause of PCOS is unknown, several environmental factors have been identified as potential contributors to its development and progression. In this article, we will discuss the environmental factors that have been associated with PCOS.

Obesity: Obesity is a well-known risk factor for PCOS. The excess adipose tissue in obese individuals leads to increased levels of insulin and androgens, which are believed to contribute to the development of PCOS (30). Several studies have shown a positive correlation between body mass index (BMI) and PCOS (31, 32).

Environmental pollutants: Exposure to environmental pollutants, such as bisphenol A (BPA), phthalates, and organochlorine compounds, has been linked to an increased risk of PCOS (33, 34). These chemicals have been shown to disrupt endocrine function, leading to hormonal imbalances that can contribute to the development of PCOS.

Diet: Dietary factors have also been implicated in the development of PCOS. A diet high in refined carbohydrates and saturated fats has been associated with an increased risk of PCOS, while a diet rich in fruits, vegetables, and whole grains has been shown to reduce the risk.

Stress: Chronic stress has been shown to disrupt the hypothalamic-pituitary-adrenal (HPA) axis and increase levels of cortisol, which can lead to hormonal imbalances and contribute to the development of PCOS. Several studies have shown a positive correlation between stress and PCOS

Sleep: Sleep disturbances, such as sleep apnea and insomnia, have been associated with an increased risk of PCOS (35). Sleep disturbances can disrupt the body's circadian rhythm, leading to hormonal imbalances that can contribute to the development of PCOS. Overall, several environmental factors have been associated with the development of PCOS. These factors include obesity, exposure to environmental pollutants, diet, stress, and sleep disturbances. Identifying and addressing these environmental factors may help reduce the risk of PCOS and improve outcomes for women with the condition. Over the years, various treatment options have been used for PCOS management, including lifestyle modifications, hormonal therapy, and insulin-sensitizing agents. The choice of treatment depends on the individual's symptoms, age, and reproductive goals. In recent years, several pharmaceutical advancements have been made in the treatment of PCOS. One of the most promising treatments is the use of oral contraceptives. Oral contraceptives containing both estrogen and progestin can reduce androgen levels, regulate menstrual cycles, and prevent unwanted pregnancy. Some oral contraceptives, such as drospirenone-containing pills, have also been shown to improve insulin sensitivity in women with PCOS (36). Metformin, an insulin-sensitizing agent, has also been used in the treatment of PCOS. Metformin helps to reduce insulin resistance

and improve menstrual regularity. It can also improve ovulation rates and lower androgen levels in some women with PCOS (37). Another promising therapy is the use of anti-androgens. Spironolactone, a diuretic with anti-androgenic properties, has been shown to reduce acne and hirsutism in women with PCOS (38). Finasteride, a 5-alpha reductase inhibitor, has also been used to treat hair loss in women with PCOS (39). In addition, there is growing interest in the use of novel therapies for PCOS management. One such therapy is the use of inositols. Myo-inositol and D-chiro-inositol are naturally occurring isomers of inositol that have been shown to improve insulin resistance and ovarian function in women with PCOS (40). Overall, the treatment of PCOS is complex and requires a tailored approach for each individual. However, the pharmaceutical advancements discussed above offer promising treatment options for women with PCOS.

Metformin, an insulin-sensitizing agent, has also been used in the treatment of PCOS

Metformin is an oral medication used to treat type 2 diabetes mellitus, but it is also used as an insulin-sensitizing agent in the treatment of polycystic ovary syndrome (PCOS). PCOS is a hormonal disorder that affects women of reproductive age, and it is characterized by insulin resistance, hyperandrogenism, and ovulatory dysfunction. Metformin works by decreasing the amount of glucose produced by the liver and improving insulin sensitivity in peripheral tissues such as muscle and fat. It also has been shown to decrease androgen levels, which can help improve symptoms of hirsutism (excessive hair growth) and acne in women with PCOS. A meta-analysis of 21 randomized controlled trials with a total of 2,098 women with PCOS found that metformin was associated with significant improvements in menstrual regularity, ovulation, androgen levels, and insulin resistance compared to placebo or no treatment (41). Another systematic review and meta-analysis of 40 randomized controlled trials with a total of 3,180 women with PCOS found that metformin was associated with a significant reduction in body mass index (BMI), fasting glucose, and insulin levels compared to placebo or no treatment (42). Metformin has also been shown to be effective in improving pregnancy rates and reducing the risk of gestational diabetes in women with PCOS who are undergoing assisted reproductive technologies (ART). A randomized controlled trial with 150 women undergoing ART found that metformin plus clomiphene citrate (an ovulation-inducing medication) resulted in higher ovulation rates and pregnancy rates compared to clomiphene citrate alone (43). Another randomized controlled trial with 240 women undergoing in vitro fertilization (IVF) found that metformin plus gonadotropins (ovarian stimulating medications) resulted in higher pregnancy rates and live birth rates compared to gonadotropins alone. However, there are some side effects associated with metformin use, including gastrointestinal symptoms such as nausea, diarrhea, and abdominal discomfort, as well as vitamin B12 deficiency and lactic acidosis in rare cases. It is important to monitor patients for these side effects and adjust the dosage accordingly. Overall,metformin is an effective insulin-sensitizing agent for the treatment of PCOS, and it has been shown to improve menstrual regularity, ovulation, androgen levels, and insulin resistance. It is also effective in improving pregnancy rates and reducing the risk of gestational diabetes in women undergoing ART. However, it is important to monitor patients for side effects and adjust the dosage accordingly (43).

Spironolactone is a medication commonly used in the treatment of polycystic ovary syndrome (PCOS)

Spironolactone is a type of medication known as an aldosterone antagonist, which means it blocks the effects of aldosterone, a hormone that regulates salt and water balance in the body. In addition to its effects on aldosterone, spironolactone also blocks the action of androgens, which can help to reduce the symptoms of PCOS. Studies have shown that spironolactone can be effective in improving menstrual regularity, reducing acne and excess hair growth, and improving overall quality of life in women with PCOS. In one study, women with PCOS who were treated with spironolactone experienced significant improvements in menstrual regularity, acne, and hirsutism (excess hair growth) compared to those who received a placebo. Spironolactone is generally well-tolerated, but it can have side effects, including dizziness, headache, and breast tenderness. Rarely, it can also cause hyperkalemia (high levels of potassium in the blood), which can be dangerous. In addition to spironolactone, there are other medications that can be used to treat PCOS, including birth control pills, metformin, and clomiphene citrate. The choice of medication will depend on the specific symptoms and needs of each individual patient. Overall, spironolactone is a commonly used and effective medication in the treatment of PCOS. However, it should be used with caution and under the guidance of a healthcare provider. Patients should be monitored for side effects and regularly evaluated to ensure that the medication is providing the desired benefits (44), (45), (46).

Finasteride is a medication commonly used in the treatment of polycystic ovary syndrome (PCOS)

One of the medications used in the treatment of PCOS is finasteride, a 5-alpha-reductase inhibitor that decreases the conversion of testosterone to dihydrotestosterone (DHT), a more potent androgen. By reducing DHT levels, finasteride can improve hirsutism (excessive hair growth), acne, and androgenic alopecia (male-pattern baldness), which are common symptoms of PCOS. Several studies have investigated the efficacy of finasteride in the management of PCOS-related symptoms. In a randomized controlled trial

involving 60 women with PCOS and hirsutism, finasteride was found to be effective in reducing hair growth and improving self-esteem and quality of life (47). Another study showed that finasteride was effective in reducing acne in women with PCOS (48). In addition to its androgen-lowering effects, finasteride has also been shown to improve insulin sensitivity in women with PCOS. In a randomized controlled trial involving 24 women with PCOS, finasteride was found to improve insulin sensitivity and reduce levels of insulin and glucose in the blood (49). However, it is worth noting that finasteride is not suitable for all women with PCOS, as it may not be effective for those with normal DHT levels or those with significant hair loss due to other causes. Moreover, it can cause side effects such as decreased libido, erectile dysfunction, and breast tenderness, although these are generally mild and reversible. Overall, finasteride is a useful medication in the management of PCOS-related symptoms, particularly hirsutism, acne, and androgenic alopecia. However, it should be used judiciously, taking into account individual patient factors and potential side effects.

CONCLUSION

There is no cure records for polycystic ovarian syndrome (PCOS). However, the management of PCOS typically focuses on alleviating symptoms, improving fertility if desired, and reducing the risk of long-term complications. It's important to note that medical advancements and research continue to evolve, so there may be new developments beyond this point.

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