**"Rebalancing Hormones: Understanding PCOS and Paths to Recovery"**

**INTRODUCTION**

Polycystic ovary syndrome is most common endocrine disorders in young women. This problem caused by an imbalance of female hormones. Most of the women with PCOS develop numerous small cysts on their ovaries, which is why it is called PCOS. Cysts are usually harmless but can be confusing for women. It is a range of different signs and symptoms, some mild, that come together to form a range of diseases, some of which have developmental, endocrine and metabolic effects. There is no universal recognition of PCOS. There is no consensus definition of PCOS.



**Fig 1:appereance of ovaries in PCOS**

**CLINICAL FEATURES**

It is a complex clinical presentation that was previously thought to be a triad of oligomenorrhoea, hirsutism and obesity but is now recognised as a heterogeneous disorder that results in androgen overproduction primarily from the ovary, and it is associated with insulin resistance. PCOS may be accompanied by amenorrhea, infertility, hyperandrogenemia(HA), and signs of metabolic disturbance such as

Insulin resistance and dyslipidemia.

**prevalence of PCOS**

The exact prevalence of PCOS is unknown because the syndrome is not precisely defined and is primarily determined by the section of diagnostic criteria. As of 2010, the WHO estimated that it is affected 11 6 million women worldwide (3.14% of woman)

 The prelevance of PCOS is remarkably similar around the world. according to the original 1990 US national Institute of health and NIH, diagnostic criteria, the prevalence of clinically evident PCOS, involvement of reproductive age in the United States, Europe, Asia and Australia, ranges between 5% and 9%. in India, the prevalence of menstrual dysfunction in women with PCOS ranges from 14.6-22.8%. The prevalence is gradually increasing in India. It has been reported that PCOS is becoming an epidemic in Bangalore due to the lifestyle that people have adopted. (2013 Indian Express ). According to the age distribution analysis, PCOS was prevalent throughout the reproductive age. Patients with PCOS were discovered after the age of 45. the highest prevalence 48% was observed in the age group of 15-25. According to the study, one in every five women in India suffers from PCOS. In east India, the figure is one in every four another recent study found that approximately 18 per cent of women in India, primarily in the east, have polycystic ovarian syndrome(PCOS).

**Pathophysiology of PCOS**

PCOS appears to have multifactorial and polygenic pathophysiology. To comprehend the pathophysiology of PCOS one must consider both the nature of ovarian dysfunction and the external influences that influence ovarian behaviour. The pathophysiology of PCOS is characterized by the dysfunction of the theca cells. dysfunction of theca cells in PCOS contributes to the disruption of normal follicular development. under normal conditions, theca cells produce androgens, which granulosa cells convert to oestrogens. access to androgens produced by the theca cells in PCOS can disrupt this process impairing follicle maturation and forming numerous small cysts within the ovaries. The exact pathophysiology is unknown, but it is thought to involve a combination of genetic, hormonal, and environmental influences. Genetic factors are important in the development of PCOS.according to research, there is a strong familial clustering of PCOS, implying a genetic predisposition. several candidate genes, including those involved in insulin signalling(INSR, IRS-1).hormone production and regulation (CYP11A, CYP17, FSHR, LHR)and ovarian function, have been linked to PCOS. (AMH, FSHR).this genetic variations may play a role in PCOS, hormonal imbalances and metabolic abnormalities.PCOS is defined by high levels of androgens (male hormones)like testosterone, and androstenedione, and dehydroepiandrosterone sulphate(DHEAS). the ovaries and adrenal glands are thought to be responsible for excessive Rogen production.it is thought to be caused by an increase in the pituitary gland luteinizing hormone (LH)secretion, which stimulates ovarian theca cells to produce androgens. Furthermore, insulin resistance(discussed further below)can boost androgen production by increasing ovarian sensitivity to LH. Insulin resistance, defined as the body’s tissue becoming less responsive to insulin, is a key feature of PCOS. insulin resistance results in compensatory hyperinsuleminia or elevated insulin levels in the blood. Through a variety of mechanisms, hyperinsulinemia contributes to the pathogenesis of PCOS.insulin can directly stimulate ovarian theca cells to produce androgens. reduced levels of sex hormone binding globulin (SHBG) insulin inhibits the production of SHBG in the liver, resulting in high ER levels of free testosterone. Insulin resistance can disrupt ovarian and follicles development and maturation, resulting in the formation of multiple small cysts. insulin resistance can also impair glucose metabolism, increasing the risk of type 2 diabetes PCOS is linked to chronic low-grade inflammation, which is characterized by elevated levels of pro-inflammatory cytokines like interleukin-6 (IL-6) and tumour necrosis factor-alpha (TNF). multiple factors, including adipose tissue dysfunction, oxidative stress, and immune dysregulation, are thought to contribute to this inflammation. inflammation can also contribute to insulin resistance and interfere with ovarian function. In PCOS, the normal process of folliculogenesis (development and maturation of ovarian follicles)is disrupted. the ovaries develop multiple small cysts as a result of stalled follicular development, giving them the distinctive appearance of polycystic ovaries.this disruption is thought to be caused by PCOS-related hormonal imbalances, insulin resistance, and chronic inflammation a mature follicle, which is also a cystic structure, develops during a normal menstrual cycle with ovulation.

**Diagnosis and treatment**

In the presence of menstrual cycle abnormalities such as amenorrhea, oligomenorrhea, or long cycles, clinical and /or biochemical hyperandrogenism, and ultrasound appearance of polycystic ovaries, the Rotterdam classification should be used to define PCOS.in addition, we use ultrasound to diagnose. the ultrasound definition of PCOS specifies the following criteria, which must be included in the report: the presence of at least 12 follicles measuring 29mm in diameter in each ovary, and /or an increase in ovary size greater than 10mm PCOS is a complicated condition influenced by a combination of genetic, hormonal and environmental factors. several risk factors that may contribute to the development of PCOS have been identified. family history, insulin resistance, age, environmental factors, obesity, ethnicity, hormonal balance, and sedentary lifestyle are factors to consider.

Polycystic ovary syndrome(PCOS)treatment aims to manage symptoms and reduce long-term health risks associated with the condition.PCOS treatment consists of a combination of lifestyle changes, pharmacological interventions and targeted management of specific symptoms. Remembering PCOS treatment should be tailored to each patient's specific symptoms and needs is critical. PCOS affects between 5% and 10% of women of childbearing age (aged 15 to 44) Most women discovered they have PCOS in their 2nd and 3rd decades of life when they have difficulty getting pregnant and consult a doctor.

**PHYSIOTHERAPY ASSESSMENT**

**1. Initial Evaluation and Medical History:**

* A comprehensive discussion about the patient's medical history, including PCOS diagnosis, symptoms, and any related complications.
* Understanding the patient's current physical activity levels, exercise habits, and any limitations or barriers to physical activity.

**2. Physical Examination:**

* Assessment of body composition, including body mass index (BMI), body fat distribution, and waist-to-hip ratio.
* Skinfold measurements: Using callipers to measure the thickness of skinfolds at specific sites on the body to estimate body fat percentage.
* Bioelectrical impedance analysis (BIA): Uses electrical impedance to estimate body composition by measuring resistance to an electrical current.
* The Body Mass Index (BMI) is a widely used measure to assess a person's weight status about their height. The formula for BMI is:

$BMI=weight in kilogram÷$height in meters2​

* WHR=$\frac{waist circumference}{hip circumference}$
* Evaluation of musculoskeletal issues, such as joint pain, stiffness, or any physical limitations that might affect exercise participation.
* Postural assessment and identification of any postural abnormalities that might contribute to discomfort or pain.

**3. Functional Assessment:**

* Evaluation of functional capacity and physical fitness level, including aerobic capacity, muscular strength, flexibility, and balance.
1. Aerobic Fitness:

 VO2 max test: Measures the maximum amount of oxygen an individual can utilize during intense exercise. It's often conducted on a treadmill or stationary bike while monitoring heart rate and oxygen consumption.

1. Muscular Strength:

1-RM (One Repetition Maximum) test: Determines the maximum amount of weight an individual can lift for a specific exercise, such as bench press, squat, or deadlift, for only one repetition.

1. Muscular Endurance:

Push-up test: Measures upper body muscular endurance by counting the maximum number of push-ups performed correctly without rest.

Sit-up test: Evaluates abdominal muscle endurance by counting the number of sit-ups performed in a specific time frame.

1. Flexibility:

Sit and Reach test: Measures flexibility, particularly in the lower back and hamstrings. It involves reaching forward while seated to assess the distance reached on a measuring scale.

**4. Pain Assessment:**

* Evaluation of any chronic pain conditions, such as pelvic pain or musculoskeletal pain, which might be associated with PCOS.
1. Numeric Rating Scale (NRS):
* Patients rate their pain on a scale from 0 to 10, with 0 being no pain and 10 being the worst pain imaginable. It's simple and commonly used in various healthcare settings.



1. Visual Analog Scale (VAS):
* Patients mark their level of pain on a 10-centimeter line, with one end indicating "no pain" and the other end indicating "worst pain." The distance from the "no pain" end to the marked point is measured to determine pain intensity.

**PHYSIOTHERAPY MANAGEMENT**

**1. Exercise Prescription:**

1. **Cardiovascular Exercise**: Designing aerobic exercises such as walking, jogging, cycling, or swimming to improve cardiovascular fitness and help with weight management, insulin sensitivity, and overall health.
* 
1. **Strength Training**: Develop a program that includes resistance exercises to increase muscle strength, which can aid in metabolic regulation and weight management.
* Warm-up:

Start with 5-10 minutes of light aerobic activity like walking, cycling, or dynamic stretching to increase blood flow and prepare muscles for exercise.

* Strength Training Exercises:

Focus on compound exercises that engage multiple muscle groups simultaneously. These exercises can include:

* Squats
* Lunges
* Deadlifts
* Push-ups
* Pull-ups or lat pulldowns
* Rows
* Chest presses or bench presses
* Shoulder presses
* Repetitions and Sets:

Aim for 8-12 repetitions per set for each exercise to promote both strength and muscular endurance.

Perform 2-3 sets of each exercise, allowing for sufficient rest (about 1-2 minutes) between sets.

* Progressive Overload:

Gradually increase the weight or resistance used for exercises as strength improves. This progressive overload is essential for continued muscle adaptation and growth.

* Frequency:

Aim to perform strength training exercises 2-3 times per week, allowing at least one day of rest between sessions to allow for muscle recovery.

* Proper Form and Technique:

Emphasize correct form and technique for each exercise to prevent injuries and maximize effectiveness. Consider seeking guidance from a certified trainer initially to ensure proper execution.

* Focus on Core Strengthening:

Incorporate exercises that target core muscles, such as planks, Russian twists, or stability ball exercises, as a strong core supports overall stability and posture.

* Flexibility and Cool Down:

End the session with 5-10 minutes of stretching exercises focusing on major muscle groups to improve flexibility and reduce muscle soreness.

* Listen to the Body:

Encourage individuals to listen to their bodies and adjust the intensity or modify exercises if needed to accommodate any discomfort or physical limitations.

* Consistency and Progress Tracking:

Consistency is key. Encourage regular exercise adherence and track progress to maintain motivation and ensure the program's effectiveness.

**2. Weight Management:**

Guiding exercise routines that promote fat loss, muscle gain, and weight management, can help improve insulin sensitivity and reduce metabolic risks associated with PCOS.

**3. Lifestyle Modification:**

Offering advice on lifestyle changes including physical activity, diet, stress management, and sleep hygiene, which can positively impact hormonal balance and overall well-being.

**4. Pain Management:**

Using modalities such as heat therapy, cold therapy, or transcutaneous electrical nerve stimulation (TENS) to manage pelvic pain or musculoskeletal discomfort associated with PCOS.

**5. Stress Reduction Techniques:**

Teaching relaxation techniques, breathing exercises, and mindfulness practices to help manage stress, can influence hormonal balance and improve overall health outcomes.

**6. Posture Correction and Rehabilitation:**

Assessing and correcting posture abnormalities that may arise due to pain, weight gain, or hormonal changes associated with PCOS. This can help alleviate discomfort and improve function.

**7. Patient Education and Self-Management:**

Providing education about PCOS, its symptoms, and how lifestyle modifications, including exercise, can positively impact the condition.

Encouraging patients to actively participate in their treatment by adhering to exercise programs and making sustainable lifestyle changes.

**8. Fertility Support:**

Assisting in the design of exercise programs that are safe and supportive for individuals undergoing fertility treatments or aiming to improve fertility naturally.

**References**

1. Asunción M, Calvo RM, San Millán JL, Sancho J, Avila S, Escobar-Morreale HF. A prospective study of the prevalence of the polycystic ovary syndrome in unselected Caucasian women from Spain. The Journal of Clinical Endocrinology & Metabolism. 2000 Jul 1;85(7):2434-8.
2. Azziz R, Woods KS, Reyna R, Key TJ, Knochenhauer ES, Yildiz BO. The prevalence and features of the polycystic ovary syndrome in an unselected population. The Journal of Clinical Endocrinology & Metabolism. 2004 Jun 1;89(6):2745-9.
3. Diamanti-Kandarakis E, Kouli CR, Bergiele AT, Filandra FA, Tsianateli TC, Spina GG, Zapanti ED, Bartzis MI. A survey of the polycystic ovary syndrome in the Greek island of Lesbos: hormonal and metabolic profile. The journal of clinical endocrinology & metabolism. 1999 Nov 1;84(11):4006-11.
4. Stein IF, Leventhal ML. Amenorrhea associated with bilateral polycystic ovaries. American journal of obstetrics and gynecology. 1935 Jan 1;29(2):181-91.
5. Norman RJ, Dewailly D, Legro RS, Hickey TE. Polycystic ovary syndrome. The Lancet. 2007 Aug 25;370(9588):685-97.
6. Zawadzki JK. Diagnostic criteria for polycystic ovary syndrome (a rational approach). Polycystic ovary syndrome. 1992:377-84.
7. Clayton RN, Ogden V, Hodgkinson J, Worswick L, Rodin DA, Dyer S, Meade TW. How common are polycystic ovaries in normal women and what is their significance for the fertility of the population?. Clinical endocrinology. 1992 Aug;37(2):127-34.
8. Glintborg D, Henriksen JE, Andersen M, Hagen C, Hangaard J, Rasmussen PE, Schousboe K, Hermann AP. Prevalence of endocrine diseases and abnormal glucose tolerance tests in 340 Caucasian premenopausal women with hirsutism as the referral diagnosis. Fertility and sterility. 2004 Dec 1;82(6):1570-9.
9. Hahn S, Tan S, Sack S, Kimmig R, Quadbeck B, Mann K, Janssen OE. Prevalence of the metabolic syndrome in German women with polycystic ovary syndrome. Experimental and Clinical Endocrinology & Diabetes. 2007 Feb;115(02):130-5.
10. Martinez-Bermejo E, Luque-Ramirez M, Escobar-Morreale HF. Obesity and the polycystic ovary syndrome. Minerva endocrinologica. 2007 Sep 1;32(3):129-40.
11. Barber TM, Wass JA, McCarthy MI, Franks S. Metabolic characteristics of women with polycystic ovaries and oligo‐amenorrhoea but normal androgen levels: implications for the management of polycystic ovary syndrome. Clinical endocrinology. 2007 Apr;66(4):513-7.
12. Shroff R, Syrop CH, Davis W, Van Voorhis BJ, Dokras A. Risk of metabolic complications in the new PCOS phenotypes based on the Rotterdam criteria. Fertility and sterility. 2007 Nov 1;88(5):1389-95.
13. Azziz R, Carmina E, Dewailly D, Diamanti-Kandarakis E, Escobar-Morreale HF, Futterweit W, Janssen OE, Legro RS, Norman RJ, Taylor AE, Witchel SF. Criteria for defining polycystic ovary syndrome as a predominantly hyperandrogenic syndrome: an androgen excess society guideline. The Journal of Clinical Endocrinology & Metabolism. 2006 Nov 1;91(11):4237-45.
14. Azziz R, Sanchez LA, Knochenhauer ES, Moran C, Lazenby J, Stephens KC, Taylor K, Boots LR. Androgen excess in women: experience with over 1000 consecutive patients. The Journal of Clinical Endocrinology & Metabolism. 2004 Feb 1;89(2):453-62.
15. Franks S. Diagnosis of polycystic ovarian syndrome: in defense of the Rotterdam criteria. The Journal of Clinical Endocrinology & Metabolism. 2006 Mar 1;91(3):786-9.
16. Kirschner MA, Samojlik E, Drejka M, Szmal E, Schneider G, Ertel N. Androgen-estrogen metabolism in women with upper body versus lower body obesity. The Journal of Clinical Endocrinology & Metabolism. 1990 Feb 1;70(2):473-9.
17. Lu Y, Wiltshire HD, Baker JS, Wang Q, Ying S. The effect of Tabata-style functional high-intensity interval training on cardiometabolic health and physical activity in female university students. Frontiers in Physiology. 2023 Feb 27;14:264.
18. Alghadeer S, Algarawi A, Abu-Rkybah F, Alshebly MM, Alruthia Y. The translation and validation of the Arabic Version of the Polycystic Ovary Syndrome Health-Related Quality of Life Questionnaire (AR-PCOSQ). BMC Women's Health. 2020 Dec;20:1-7.
19. Mirwald RL, Baxter-Jones AD, Bailey DA, Beunen GP. An assessment of maturity from anthropometric measurements. Medicine & science in sports & exercise. 2002 Apr 1;34(4):689-94.
20. Lu Y, Wiltshire HD, Baker JS, Wang Q, Ying S. The effect of Tabata-style functional high-intensity interval training on cardiometabolic health and physical activity in female university students. Frontiers in Physiology. 2023 Feb 27;14:264.
21. Ljubojević A, Gerdijan N, Pavlović R, Šebić L. Effect of Tabata training program on body fat reduction in healthy inactive women. Pedagogy of Physical Culture and Sports. 2023 May 8;27(3):198-207.
22. Handayani HY, Anwar K, Septyaningrum S. The Effect of Tabata Exercise on Fat Percentage. Halaman Olahraga Nusantara: Jurnal Ilmu Keolahragaan. 2022 Jan 25;5(1):305-14.
23. Lim LM, Abd Wahab AV, Ghani NA. THE RELIABILITY AND VALIDITY OF MALAY VERSION OF POLYCYSTIC OVARIAN SYNDROME HEALTH RELATED QUALITY OF LIFE QUESTIONNAIRE (MAL-PCOSQ). Authorea Preprints. 2022 Mar 30.
24. Pearson RC, Olenick AA, Green ES, Jenkins NT. Tabata‐style functional exercise increases resting and postprandial fat oxidation but does not reduce triglyceride concentrations. Experimental physiology. 2020 Mar;105(3):468-76.
25. Domaradzki J, Cichy I, Rokita A, Popowczak M. Effects of Tabata training during physical education classes on body composition, aerobic capacity, and anaerobic performance of under-, normal-and overweight adolescents. International Journal of Environmental Research and Public Health. 2020 Feb;17(3):876.
26. Khalafi M, Symonds ME. The impact of high‐intensity interval training on inflammatory markers in metabolic disorders: A meta‐analysis. Scandinavian journal of medicine & science in sports. 2020 Nov;30(11):2020-36.
27. Shah N, Purohit A. Effect of Tabata Training for Weight Loss in Overweight Middle Age Female of Ahmedabad City: An Experimental Study.
28. Tabata I. Tabata training: one of the most energetically effective high-intensity intermittent training methods. The Journal of Physiological Sciences. 2019 Jul 1;69(4):559-72.
29. Anjali CS, George M, Das P, Soji S. PCOD IN FEMALE REPRODUCTIVE AGE-A REVIEW.
30. Aktaş HŞ, Uzun YE, Kutlu O, Pençe HH, Özçelik F, Çil EÖ, Irak L, Altun Ö, Özcan M, Özsoy N, Aydın Yoldemir Ş. The effects of high intensity-interval training on vaspin, adiponectin and leptin levels in women with polycystic ovary syndrome. Archives of physiology and biochemistry. 2022 Jan 2;128(1):37-42.
31. Jill Mantle BA FCSP DipTPSenior Visiting Fellow, University of East London,London, England, UK ISBN 0 7506 2265 2