

Contemporary and Traditional Perspectives of Polycystic Ovarian Syndrome (PCOS): A Critical Review

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Abstract: Polycystic ovarian disease is a lifestyle disorder that has no specific aetiology and manifests as a group of symptoms making its diagnosis difficult. It affects about 30-40% of young girls in their reproductive age in India.

The exact cause of PCOS is unknown however it has been linked to hormonal imbalance, insulin resistance resulting in hyperinsulinaemia as well as genetic factors though specific genes have not been identified so far. The sedentary lifestyle, dietary variations, lack of exercise and stress etc. are also the contributory factors.

Contemporary and traditional management together can improve this condition. This paper critically reviews the contemporary and ayurvedic perspectives of polycystic ovarian syndrome (PCOS) and recommends adoption of a holistic treatment, good lifestyle with appropriately balanced diet along with Yoga, Pranayam, Meditation and a stress-free living which can prove to be an effective management for PCOS.

Key words: Ayurved, Lifestyle, PCOS, Yoga

I. Introduction

The term Polycystic Ovarian Syndrome (PCOS) was first described by Irving Stein and Michael Leventhal as a Triad of 'Amenorrhoea', 'Obesity' and 'Hirsutism' in 1935 when they observed the relation between obesity and reproductive disorders.[1]. It is hence also known as the 'Stein-Leventhal Syndrome' or 'Hyperandrogenic Anovulation' (HA) and is the most common endocrine ovarian disorder affecting approximately 2-8% women of reproductive age worldwide.[2] Nowadays, it is also referred to as the 'Syndrome O' i.e. Overnourishment, Overproduction of insulin, Ovarian confusion and Ovulatory disruption. PCOS is currently considered as a lifestyle disorder affecting 2.2-26% of young girls in their reproductive age in India. A study conducted on 460 girls in the age group of 15-18 years from a residential college of Andhra Pradesh reported a prevalence of 9.13% in Indian adolescents.[3]

Though globally it has an alarming incidence, its diagnosis is difficult as it manifests as a spectrum of symptoms than a specific one. It is primarily characterized by an extremely irregular menstrual cycle in which ovulation may not occur.[4]. Normal pubertal events include Oligomenorrhoea, Hirsutism, Acne and Weight gain. However, no single criterion is sufficient for clinical diagnosis due to multiple aetiologies and presentations.[4]. Paediatric Endocrinologists nowadays tend towards an earlier work-up instead of the traditional practice of waiting for two years post-menarche.[5]

II. Diagnostic Criteria of PCOS

PCOS has undergone much iteration of diagnostic criteria.

2.1 Criteria of National Institutes of Health (NIH) 1990

- 1) Chronic Anovulation and
- 2) Clinical and Biochemical Hyperandrogenism.[6]

2.2 Rotterdam Criteria 2003

- 1) Oligo or Anovulation
- 2) Clinical or Biochemical signs of Hyperandrogenism and
- 3) Polycystic ovaries (PCO) in imaging. [7]

2.3 AES Criteria 2009

- 1) Hyperandrogenism including hirsutism and/or hyperandrogenaemia.

2)Ovulatory dysfunction including oligo/anovulation and/or PCO and

3)Exclusion of any other androgen excess or related disorders.[7]

Thus clinicians now have three sets of criteria to choose from to diagnose PCOS though the Rotterdam criteria are found to be more preferred.In view of the abovementioned criteria the current defining characteristics include Ovulation morphology on Ultrasound, Hyperandrogenism and Menstrual dysfunction with Oligo/Anovulation.

2.4Ovulation morphology on Ultrasound / Polycystic ovaries (PCO)

The inclusion of ultrasonographic evidence of PCO morphology is controversial as various criteria emphasize the condition differently. The NIH criteria do not address ovarian morphology at all while the Rotterdam criteria include it as a phenomenon different from menstrual irregularities. On the other hand the AES criteria include it under the aegis of ovarian dysfunction along with oligo/anovulation and require only one or the other as diagnostic criteria. Similarly,PCO morphology is not specific to PCOS since it is found in 20-30% of the general females in the 20-25 years age group especially so when menstrual irregularities, infertility or hirsutism are absent.[8]

2.5Hyperandrogenism (HA)

Determination of HA in females can be problematic during clinical and biochemical assessment.The diagnostic dilemma is that reporting of clinical HA is examiner-dependent i.e. subjective in nature. Though the Ferriman-Gallwey score can objectify theevaluation,it has its own limitations by having good intra-observer but poor inter-observer reliability.[8].

2.6Menstrual dysfunction with Oligo/Anovulation

The absence of menstruation for a period of 45 days or more and/or 8 or less menstrual cycles per year are also important diagnostic signs.[9].The cycle maybe either oligo-ovulatory or anovulatory.[8].Oligomenorrhoea is considered a highly predictive surrogate marker of PCOS and also an independent predictor of Type II Diabetes.[10].Additional features may include Excessive hair growth, Abnormal bleeding, Obesity, Hair loss, Acne and Infertility.[4].The exclusion of other endocrine abnormalities like Cushing's syndrome, Thyroid abnormality, Hyperprolactinaemiaetc.is necessary. It is this heterogenous nature of symptoms that vary over time which makes the disorder more difficult to diagnose.[8].Hence, the PCOS Foundation has named it as 'The Silent Killer' that usually remains undiagnosed due to the lack of a single diagnostic test.[6].

2.7Recent diagnostic parameters

Recently, the Anti Müllerian Hormone (AMH) levels that correlate independently with both polycystic ovarian morphology and androgenic profile has been proposed as a parameter to replace ultrasonographic assessment. It has a specificity and sensitivity of 97.1% and 94.6% when using the Rotterdam criteria or 97.2% and 95.5% using NIH criteria.[9]

Another diagnostic parameter proposed as an adjunct to the PCO morphology is an assessment of the Ovarian Stromal Volume, measured as a ratio of the stromal area to the total area of the ovary(S/A ratio). This ratio can properly discriminate the women with or without PCOS and correlate with the androgen levels too but has not been adopted so far on a regular basis. [8].

In case of PCO, number of cysts ≥ 10 , of diameter ranging from 2-8 mm and an increased ovarian volume of > 10 cm³ in 3 cysts is currently considered a requisite diagnostic parameter. Similarly, the presence of an echo-dense stroma in the pelvic ultrasound scan is another necessary observation to confirm the diagnosis. The Ultrasound in fact, largely contributes to the diagnosis, monitoring and management of the condition.[4]

III. Aetiology of PCOS

The exact cause of PCOS is unknown or heterogeneous in nature.[6].However it has certainly been linked to a variety of aetiological factors.

3.1 Insulin resistance

PCOS is not just a reproductive disorder but a multifaceted metabolic disorder that shows a high association with insulin resistance [11] leading to hyperinsulinaemia, wherein 10% show Type II Diabetes.Besides, 30%-35% have Impaired Glucose Tolerance (IGT).[12],[13].Such a condition results in the increased production of testosterone thus leading to abnormal or non-existent ovulation.Scientists at the Medical College of Georgia at Georgia Regents University reported that high activity levels of a micro RNA named miR-93 in fat cells hinders the use of glucose by insulin contributing to PCOS and also to insulin resistance.[14].

3.2 Hormonal imbalance [15]

The imbalance of certain hormones is common in women suffering from PCOS.

- i) High testosterone levels leading to signs of hyperandrogenism.
- ii) High Luteinizing hormone (LH) whose excessively increased levels disrupt proper ovarian functions.
- iii) Low Sex Hormone Binding Globulin (SHBG) hormone that allows the expression of hyperandrogenism.
- iv) High Prolactin levels which stimulates the production of milk in pregnancy and is found to be raised in comparatively few patients.

The exact reason of these hormonal imbalances is unknown but researchers are trying to establish their link with the ovary itself, the part of the brain that governs the hormonal secretions or the other endocrine glands. The possibility whether insulin resistance triggers such changes too needs to be assessed.

3.3 Genetic factors

PCOS is a genetically determined ovarian disorder and the genetic links to the disease have been researched in detail. Research at the University of Oxford and the Imperial College London revealed that a gene implicated in the development of obesity is also linked to susceptibility to PCOS. [16]. A study published in 2005 also showed that excessive exposure to androgens during intra-uterine life may have a permanent effect on gene expression leading to PCOS and later to insulin resistance. [17]

The familial clustering of PCOS is common. It has been noted that the first degree relatives of patients with PCOS may be at high risk for diabetes and glucose intolerance. Similarly, a study revealed that mothers and sisters of PCOS patients showed higher androgen levels than the control subjects. (18) PCOS is a genetically determined ovarian disorder and the heterogeneity can be explained on the basis of interaction of the disorder with other genes and with the environment. [16].

3.4 Bisphenyl A (BPA)

Researchers at the University of Athens Medical School in Greece have pin-pointed Bisphenyl A (BPA), a common industrial compound used in dentistry, plastic consumer products and packaging to be a probable cause of PCOS. [16]. They found a significant positive association between male sex hormone and BPA in women with PCOS suggesting that BPA probably has a role in ovarian dysfunction. Considering this aspect, avoiding daily consumption of food or drink from plastic containers by these women can prevent any more potential risks.

3.5 Stress and other psychological factors

PCOS is often caused by psychological factors. Increased stress can upset the normal menstrual cycle and causes hormonal changes such as raised levels of cortisol and prolactin which affect menstruation that normally resumes after the stress subsides.

3.6 Miscellaneous

The sedentary lifestyle, dietary variations, lack of exercise or intensive physical exercise have also been contributory factors as also extreme weight loss, disorders of the endocrine system and various disorders of the ovaries.

IV. Risk factors of PCOS

4.1 Cardiovascular Disease

In January 1997 researchers in New Zealand reported that women with multiple cysts on their ovaries were at increased risk of heart disease. In the study 42 % of women with heart disease also had 8/> ovarian cysts compared to 22 % of women without heart disease. They should hence be regularly monitored and advised to consume less fat and cholesterol. Similarly, PCOS is characterized by endothelial dysfunction and resistance to the vasodilating action of insulin. [19] An increased risk of myocardial infarction in PCOS women than age-matched controls has also been reported. [20]

4.2 Obesity

Obesity is also a feature observed and estimated to affect 50% of PCOS women [21], classically presented in patients with upper body obesity which has been associated with menstrual disturbances [22]. It amplifies biochemical and clinical abnormalities of PCOS. [23]. Previously obesity was thought to be the cause of PCOS but now understood as a modifier of the condition.

4.3 Infertility

Another complicating feature of PCOS is the effects it has on ovulation and fertility with >75% of women with anovulation infertility [24] and treatment is based upon the patient's characteristics. Besides

follicular arrest and impaired selection of dominant follicle is possible [25] as also the risk of multiple pregnancy with treatment. [26]

V. Complications of PCOS [15]

5.1 Endometrial cancer

The long-term follow-up of 786 PCOS women found an increased risk of endometrial cancer.[27].A study revealed that in women >50 years of age with endometrial cancer 62.5% showed a greater prevalence of PCOS than 27.33% who were not suffering from the syndrome.(P=0.033)[28].

5.2 Complications in pregnancy

Women with PCOS have a greater risk of complications viz. Gestational diabetes [29], pre-eclampsia, pre-term labour, small for gestational age, [30]pregnancy induced hypertension (PIH),[31] spontaneous abortions [32]etc.

5.3 Sleep Apnoea

It has been reported that women with PCOS have increased Sleep Disordered Breathing (SDB) and daytime sleepiness.[33]

5.4 Depression

There was a higher prevalence of depression in PCOS patients associated with higher body mass index (BMI, P=0.05) and greater insulin resistance (P=0.02) [34].Besides, Impaired Glucose Tolerance[35],Dyslipidaemia,Metabolicsyndrome,Non-alcoholic steatohepatitisandhigher levels of C-reactive protein, a disease marker for cardiovascular diseasesareotherprobablerisks involved.

VI. Contemporary treatment of PCOS

The contemporary treatment of PCOS can be summarized as follows-If Body Mass Index is elevated, loss of at least 5-7% body weight may restore ovulation in up to 80%obese patients possibly by reducing hyperinsulinaemia and thus hyperandrogenism.This is followed by induction of ovulation (OI) with Clomiphene citrate.However, this should be limited to three cycles.[36]Similarly, use of Insulin sensitizerasasingleagentisrecommendedas the next step.Subsequently, administrationofinsulinsensitizer with Clomiphene is advisable.Gonadotropin therapy and FSH hormone are the next option followed by Gonadotropins with insulin sensitizer. Metformin(Glucophage) is a drug of choicethatincreases ovulation andsimultaneously reduces the problems caused by insulin resistance and regulates the excessively raised levels of the androgens. In fact Clomiphene and Metformin can be administered together for a synergistic effect.[36].Anti androgenic therapytoreduce the masculine effects of testosterone like alopecia, hirsutismetc.andEflornithine as a cream to retard hirsutism though it does not remove hair. Besides, electrolysis or laser hair removal are the alternatives for permanent hair removal. [37]

Laposcopic Ovarian Drilling (LOD) is the surgical procedure recommended in patients who do not respond to Clomiphene therapy. It destroys the androgen producing tissues, thus correcting hormonal imbalance and restoring normal ovarian functioning.It ultimately results in the decrease of the elevated LH and Testosterone levels and an increase in the FSH levels.A failure of all these calls for single embryo transfer by In Vitro Fertilization (IVF) as the last resort. [38]

VII. Ayurvedic perspective of PCOS

Ayurveda describes Polycystic Ovarian Syndrome to have an equal involvement of the *Dosha, Dhātu* and *Upadhātu*. It does not correlate the condition to a single disease or syndrome but the symptoms bear a resemblance to the terminologies defined as '*Anartava*' (Amenorrhoea), '*Yonivyapad*' (anatomical and physiological disorders of the reproductive system) like – *Arajaska* (Oligomenorrhoea due to vitiation of *Vata dosha*), *Lohitakshaya* (Oligomenorrhoea due to vitiation of *Vata-Pitta doshas*), *Shushka* (dryness of vagina), *Shandhi* (reproductive disorder of genetic origin), *Vandhya* (infertile), *Pushpaghni Revati* (Idiosyncratic anovulatory menstruation), *Abeejata* (anovulation), *Rajodushti* and *Ashtartavadushti* (menstrual flow disorder due to vitiation of *Doshas*) etc.

The terms *Raja* and *Artava* have been used synonymously or otherwise in the classics. Usually *Raja* is considered as the *upadhātu* of *Raktadhātu* [39] whereas *Artava* as the *saptamdhātu* itself. [39] Similarly their *srotasa* (channels) are also two entirely different entities. In the present paper, *Raja* has been considered as the menstrual flow while *Artava* is indicative of the ovum.

VIII. Correlation of PCOS with certain Ayurvedic terminologies

8.1 Arajaska Yonivyapad : [40]

The consumption of *Pittaprapakaaaharvihar* (diet and daily regimen that aggravates *Pitta*) results in the vitiation of *Pitta* thereby affecting the *garbhashaya* leading to *shushkata* of the *Raja* (reduction of normal liquid consistency). This causes a decrease in the amount of menstrual flow. Such a pathophysiology may cause an irregularity in menstruation in two ways-

- a. an increased interval between two cycles
- b. scanty menstrual flow

The above symptoms show congruence to the contemporary symptom of menstrual irregularity but show no specifications regarding oligo/anovulation.

8.2 Lohitakshaya Yonivyapad : [41]

The nidansevan of *Vata-Pittapradhanaahar-vihar* causes a vitiation of these *doshas* resulting in *Rajaksheenata* (scanty menstruation). This may be presented in either of the previously discussed ways. Again a similarity to the contemporary symptom of menstrual irregularity is noted but it fails to clarify oligo/anovulation.

8.3. Shushka Yonivyapad: [42]

Vataprapakakahetusevan leads to its vitiation causing *yonirukshata* (dryness of *tryavartayoni* organ genital tract) along with *mala-mootraavarodh* (constipation and urine retention) and *shool* (pain). In this context, the chief *Vataprapakakahetu* has been considered as '*Vyavayakalerundhantya*' (suppression of natural urges during coitus). Besides, this type of *yonivyapad* can be characterized as '*Shushka*' only if it is found to occur during the reproductive age so as to rule out its presence in the old age.

However the symptoms quoted here are pertaining only to the local dryness of the genital tract and do not mention any characteristics regarding menstrual flow or ovulation.

8.4 Shandhi Yonivyapada : (43)

The vitiation of *Vata* due to genetic factors causes menstrual irregularities which may or may not be associated with anovulation. This condition is said to be incurable as the uterus, ovaries or the genital system itself is undeveloped. Besides, an absence of secondary sex characteristics is also noted. The condition can be correlated to PCOS from the "menstrual irregularity" point of view but the other symptoms are incomparable.

8.5 Vandhya Yonivyapad: [44]

Sushrutacharya quotes this type of *yonivyapad* presenting as *nashtartava* (loss of menstruation). *Charakacharya* states this condition to arise due to loss of ovulation. *Harita* elaborates on six types of *Vandhyayoni*, each having specific features, management and prognosis. One of them is *Anapatya Vandhya* (infertility) wherein *dhatukshaya* is aetiological factor of *nashtartava*. Here, *artava* is considered as the *saptadhatu* or ovum and its loss results in infertility. However this type is incurable.

The above mentioned *Anapatya Vandhyayoni* can be fairly compared with PCOS due to the similar features of anovulation and absence/irregularity of menstruation thereby resulting in sterility. However, other clinical features tend to vary.

8.6 Abeejata (Anovulation)

Sushrutacharya states the aetiological factors of *Shukradushti* (vitiation of sperm) in males to be similar to those of *Rajodushti* in females leading to *Abeejata*. The same factors are also responsible for the vitiation of *doshas* in females causing the vitiation of *Raja/ Artava*. Hence, just as '*Shukramabeejata*' (azoospermia) is seen as a result of vitiation of *Shukra*, a condition of '*Artavaabeejata*' (anovulation) is noted in females due to vitiation of *Artava*. [45]

Charakacharya too quotes frequent or untimely coitus, over-exercise, unbalanced diet that includes *ruksha* (dry), *tikta* (bitter), *kashaya* (astringent), *atilavana* (excessively salty), *amla* (sour) and *ushna* (hot) *aahar*, as also *chinta/shoka* (stress-related tension), *bhaya* (fear), *krodha* (anger) and *aghatai.e* injuries due to *shastra* (weapon) or *krshara* (alkali) as the causative factors of *Shukradushti*. These can be correlated with the current lifestyle changes. [46]

8.7 Ashtartava Dushti: [47]

Vagbhatacharya states that like *Shukra*, *Artava* can too be vitiated by the *Doshas* resulting in eight types of *Artavadushti*. Such vitiation leads to *Abeejata*. Once again a similarity to PCOS is noted as anovulatory menstruation only.

8.8 Rajodushti :[48]

This terminology, put forth by *Sushrutacharya* is a result of the vitiation of *Raja* by the *Doshas*, primarily *Vata* and *Pitta* resulting in its *ksheenata* (Oligomenorrhoea). The other clinical features of PCOS are however not observed.

Considering all the above mentioned types of conditions/diseases quoted in the classics it can be noted that neither of them bears a complete resemblance to the current diagnostic criteria of PCOS. Hence, on the basis of the contemporary pathogenesis of PCOS, an Ayurvedic counterpart can be put forth. Here, the obese or lean physical feature of the patient has also been taken into consideration.

Thus it can be inferred that none of the above said terminologies can be perfectly correlated to PCOS. Each one shows congruence in only one or more criteria and hence a probable pathogenesis needs to be defined.

IX. *Apatarpanottha Samprapti*: (Probable Pathogenesis of PCOS in lean patients)

The current unbalanced diet and lifestyle cause the vitiation of *Kaphadosha* which leads to *Jatharagnimandya*, thereby resulting in *Aamotpatti* and is responsible for an increase in the *drava* property of *Pitta* which in turn reduces the *agneya* property of *Artava*. However, the vitiated *Pitta* hampers maturation and rupture leading to anovulation or *artavakshaya*. A subsequent *Dhatvagnimandya* especially so of the *Rasadhatu*, causes the formation of a *saumyagunatmakposhakRasadhatu* having qualitative and quantitative *heensaarata*. It also results in an increase in the *malarupiKapha* and consequently in the poor formation of the subsequent *Dhatu* further causing *Dhatukshaya*. Thus, *Dhatvagnimandya* and *Dhatukshaya* together cause *Anartava* or *Rajakshaya*.

X. *Santarpanottha Samprapti*: (Probable Pathogenesis of PCOS in obese patients)

The above stated aetiological factors give rise to *Jatharagni* and *Dhatvagnimandya* along with *Aamotpatti* resulting in *Medoroga* viz. *Sthaulya* (obesity). *Aamotpatti* and *Agnimandya* cause an improper nourishment of the consecutive *dhatu*s. *Artava*, being the *saptamdhatu* thus becomes *ksheen* (under-nourished).

Sthaulya is synonymous with the vitiation of *Kapha* that causes a prolongation in the *Rutukala* (first phase) of the *Rutuchakra* (menstrual cycle). This in turn impedes the effect of *Pitta* thus hampering maturation and rupture of the follicles. The end result is once again *artavakshaya* (anovulation). The bulky appearance of the *antaphala* (ovaries) can be attributed to their vitiation by *Kapha* and *Meda* thus leading to an increase in the ovarian volume.

Thus, it can be stated that *Kapha* predominance manifests as obesity, subfertility, hirsutism, diabetic tendencies and hypothermia. *Pitta* predominance manifests as alopecia, acne, dysmenorrhoea with clots and cardiovascular disorders whereas *Vata* predominance manifests with dysmenorrhoea, oligomenorrhoea and severe menstrual irregularity.

XI. Ayurvedic management of PCOS

All the causes of the disorder mentioned in *Ayurved* include *Sanga* (obstruction) *Vatasankshobha* and *Dhatukshaya*. Hence, the main *Chikitsasiddhant* (principle of treatment) for the problem should be the drugs by which the *sangai*s are removed. Thus the drugs that are *Vatashaman*, *deepan*, *pachan* and *anulomana* must be used on a priority basis. *Vagbhatacharya* advocates *Basti* (enema), *Abhyanga* (oil massage), *Parisheka* (pouring of liquid), *Pralepa* (mask of herbal paste) and *Pichudharan* (medicated tampon) as the line of treatment. [49]

The Ayurvedic treatment protocol is thus divisible into *Antarparimarjanchikitsa* (Internal therapies) that includes *Shodhanchikitsa* (Internal cleansing therapy of *Doshas*) and *Shamanchikitsa* (Suppression therapy of *Doshas*) and *Bahirparimarjanchikitsa* (External therapies) so as to normalize the vitiated factors.

11.1 *Antarparimarjanchikitsa*

11.1.1 *Shodhanchikitsa*

This primarily includes selected *Panchkarmaupakrama* (5 major treatment modalities) especially *Anuvasan* (enema with medicated oil), *Niruha* (enema with medicated decoction) and *Uttarbasti* (enema in the genital tract) which are more beneficial in this condition. The classics too quote *Basti* to be the modality of choice in this context due to its utility in conditions of vitiated *Vata*. [50] Other *Panchkarma* modalities like *Vamana* (emesis), *Virechana* (purgation) are also prescribed for vitiated *Kapha* and *Pitta* respectively. *Snehan* (oleation) and *Swedan* (sudation) need to be given prior to any *Panchkarma*.

11.1.2 *Shamanchikitsa*

In the menstrual disorders caused by *Vatadi dosha*, drugs suppressing that particular *dosha* should be used. *Kashyapacharya* quotes the use of *Rasona* [51] (*Allium cepa*), *Shatapushpa* (*Anethum graveolens*) and

Shatavari(*Asparagus racemosus*) to be beneficial in all disorders of *Artava*. He advocates the utility of *Shatapushpakalpa*(a formulation of *Shatapushpa*)[52] in the infertile woman to gain progeny.

11.2 *Bahirparimarjanchikitsa*

Besides these, external therapies like *Abhyanga*, *Parishek*, *Pralepa*, *Pichudharan*, *Pinda*(bolus)[53], *Yonidhavan*(cleansing of the vagina), *Varti*[54](medicated pessary), *Dhoopan*(medicated smoke) are also recommended for local action.[49]

XII. Lifestyle management of PCOS

In view of the current lifestyle and the aetiological factors of PCOS the following two regimens must be included as an integral part of the Ayurvedic management viz.

12.1 Diet regimen[55]

An appropriately designed diet regimen that not only aims at weight management but also prevents the long-term risk of PCOS viz. T2DM (Type II Diabetes), CVD (Cardiovascular diseases) etc. is the need of the hour. Insulin resistance and hyperinsulinaemia are the key aetiological factors of PCOS that need to be targeted by reducing the insulin levels but improving insulin sensitivity. Hence a high fibre, low saturated fat and low glycaemic index carbohydrate diet is strongly recommended.[56]

12.1.1 AVOID

High glycaemic index food-eg. white rice, potatoes, refined flour and bakery products.
Milk-as it spurs protein limits normal testosterone processing causing level to rise[55]
Soy products-as they impede ovulation[57]
Saturated fats-eg. red meat, dairy products as they increase oestrogen production
Hydrogenated and trans fats-eg. cooked oil, processed foods as they increase risk of T2DM, CVD etc.
Alcohol, Caffeine, Nicotine and other addictive agents.

12.1.2 CONSUME

Whole grain-eg. Ragi (*Eleusine coracana*), *Shashtishaali* (red rice) etc.
Green leafy vegetables-rich in minerals, vitamins and nutrients
Low glycaemic index whole fruits-eg. apples, pears, grapes, oranges, plums, prunes etc. that contain fibre, vitamins, minerals and phytonutrients.
Dry fruits- dates, figs and raisins.
Bright coloured vegetables-eg. carrots, capsicum, beet, salad etc. with anti-oxidants to reduce the oxidative stress of PCOS
Sprouts-contain phytoestrogen that reduce oestrogen levels
Organic-fed meat-reduces chances of hormonal imbalance and are pesticide free
Essential fatty acids-eg. nuts, olive oil, oily fish etc. that help weight management, hormonal balance and fertility.
Carbohydrate and protein rich diet[58]
Small, frequent and healthy meals with plenty of daily water intake.
Vit. B12-maintain sugar and fat metabolism, thyroid function and hormonal balance.

12.2 Yoga and *Pranayam* therapy

Relaxation is the key in PCOS. *Asanas* (Yoga postures), *Pranayam* (breathing exercises), along with certain soothing meditation helps to detoxify and de-stress the system. Yoga helps to open up the pelvis and promotes relaxation while *Pranayam* is a powerful technique that calms the mind. Studies conducted have revealed that a holistic yoga program showed significant results as compared to the conventional physical exercises followed by two random, controlled groups for a duration of one hour per day for 12 weeks in the following parameters.

- Improvement in glucose, lipid and insulin and insulin resistance values [59]
- Reduction in symptoms of anxiety [60]
- Reduction of Anti-Müllerian hormone (AMH), Luteinizing hormone (LH), Testosterone, modified Ferriman and Gallwey score (mFG) for hirsutism and an improvement in menstrual frequency.[61]

Weight loss is the most essential part of treatment as it rectifies hormonal imbalance, elevates the insulin and sex hormone binding globulin levels and reduces the testosterone levels. Several yoga postures aid in weight loss, relieve stress and improve the ovarian blood supply thereby assisting treatment of PCOS. Yoga postures which open and stretch the lumbar and pelvic region and arousing the thyroid, pituitary and hypothalamic glands are essential.

12.2.1. Asanas recommended for PCOS

Sarvangasana (Shoulder stand) [62]

It is beneficial for the reproductive system as it promotes blood circulation to the pelvic region thus increasing the efficiency of the reproductive organs. It strengthens the uterine ligaments and improves the functioning of the ovaries. It also helps to keep a balanced mood and calms the mind.

Ardhamatsyendrasana (Half Lord of the fishes pose) [63]

This pose stretches and tones the abdominal muscles and stimulates the abdominal organs and also relieves stress and irritation.

Bharadvajasana (Seated spinal twist) [64]

This posture strengthens the muscles and organs of the lumbar region.

Prasaritapadottanasana (Wide-legged forward bend) [65]

This posture flexes the lumbar and pelvic muscles and improves energy and blood circulation to the ovaries. Besides strengthening and stretching the spine it tones the abdominal muscles. It also eliminates fatigue and combats mild depression.

Baddhakonasana (Butterfly pose) [66]

This posture improves flexibility and stimulates the reproductive and digestive organs. It is a great stretch for relieving stress and tiredness. Regular practice of this posture is beneficial to the kidneys, bladder, prostate gland, and ovaries.

Suptabaddhakonasana (Reclining Butterfly pose) [67]

This pose stimulates abdominal organs like the ovaries, bladder and kidneys as well as the heart and thus improves general circulation. It relieves the symptoms of stress, mild depression, menstruation and menopause.

Ushtrasana (Camel pose) [68]

This asana stimulates the abdominal organs, is *Vata*, *Pitta* and *Kaphadoshashamak*, stimulates the thyroid gland and reduces the abdominal fat. It also improves digestion.

Padmasana (Lotus pose) [69]

This pose stimulates the spine, pelvis, abdomen and bladder and even eases menstrual discomfort. It also has a calming effect on the brain.

ArdhaBaddhaPadmaPashimottanasana (Moving the grinding wheel) [70]

The pose massages the liver, kidneys, pancreas, uterus and reproductive organs. It tones the uterine muscles and is very useful in preventing dysmenorrhoea if practiced regularly. Similarly consistent practice also helps to reduce the abdominal fat.

Suryanamaskar (Sun salutation) [71]

This pose accelerates weight loss if performed at a fast pace while a few slow rounds daily assists relaxation. It promotes sleep, calms anxiety and improves memory. It also strengthens the abdominal muscles

12.2.2 Pranayama recommended for PCOS

The following breathing exercises if performed gently, without straining the lungs are effective in the treatment of PCOS and infertility.

Kapalbhati (Cleansing breath) [72]

Kapalbatipranayama is practiced before meditation to improve concentration span while practicing meditation. It tones the abdominal muscles and reduces abdominal fat.

Ujjayi (Ocean breath) [73]

Ujjayi is an audible breath that is often compared to the sound of the ocean. It is emphasized in a *Vinyasa* style of yoga which is based on breath-synchronized poses as a way to link the breath with the movement.

Anuloma-VilomaPranayama (Alternate nostril breathing) [74]

Practice of *AnulomaVilomaPranayama* reduces mental tension and worries. It is helpful in contemplation and also gives the strength to meditate for several hours. It keeps the mind calm, peaceful and cheerful and helps in overcoming depression.

12.2.3 Meditation and Relaxation exercises for PCOS:

Nispandabhava (Unmoving observations) [75]

Shavasana (Corpse pose) [76]

Both these poses control stress related disorders and calm the mind.

XIII. Conclusion

Polycystic ovarian disease is a lifestyle disorder that has no specific aetiology and manifests as a group of symptoms making it difficult to diagnose. Contemporary and traditional management together can improve. Thus adopting a

holistic treatment, good lifestyle with appropriately balanced diet, Yoga, *Pranayam*, meditation and stress-free living can prove to be an effective management for PCOS.

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