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Case Report

Heart Rate Variability Biofeedback and Psychotherapy in Polycystic Ovary Syndrome: Description of a Case Report to Shed Light on this Understudied Condition

Carlo Pruneti[1], Sara Guidotti[1,2]* and Chiara Cosentino[2]

[1]Clinical Psychology, Clinical Psychophysiology and Clinical Neuropsychology Labs, University of Parma, Italy

[2]Department of Medicine and Surgery, University of Parma, Italy

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Abstract

Background: Although there is minimal information on the role of stress in PCOS, it is well-known that it may trigger the exacerbation and maintenance of the disease. Despite there being only a few studies in the literature, many researchers highlighted situations of autonomic hyperactivation characterizing PCOS. In light of these assumptions, the purpose of this study is to report on a patient who underwent psychological intervention to enhance stress management skills.

Case: A 30-year-old woman was referred by the endocrinologist. From a clinical-psychological point of view, the condition of the patient was characterized by a modest psychophysiological activation. Interpersonal difficulties did not allow the patient to benefit from the social support of her loved ones, further favoring the maintenance of the excessive arousal generated by stressful life events. The patient was treated with HRV-Biofeedback integrated within cognitive-behavioral psychotherapy.

Discussion: The multidimensional intervention brought benefits to the patient, teaching her better stress management strategies (i.e., reduction of psychological symptoms and improvement of hormonal tests). Keeping in mind the interplay between physiological, psychological, and interpersonal factors is fundamental in all psycho-somatic and somato-psychic disorders and is crucial to enhance the use of specific treatments to restore psychophysical well-being.

Introduction

Polycystic Ovary Syndrome (PCOS) is a heterogeneous endocrine disease affecting many women of reproductive age worldwide. About one in 10 women is estimated to experience PCOS before menopause and battle its complications [1]. PCOS gets its name from the many fluid-filled sacs (cysts) that often form in the ovaries causing them to enlarge. In girls with PCOS, menstruation does not usually start at puberty, and the ovaries do not release eggs or release them irregularly. Women or girls who have already had menarche may have irregular vaginal bleeding or menstrual periods may stop. Additionally, they may develop symptoms related to high levels of male hormones, a process called masculinization or virilization. Common symptoms include acne and an increase

in body hair (hirsutism). Recent scientific studies argue that the associated clinical manifestations (i.e., hirsutism, menstrual irregularity, and acne) compromise the Quality of Life (QOL) in these women [2].

Elevated Luteinizing Hormone (LH) to Follicle-Stimulating Hormone (FSH) ratio and increased frequency of Gonadotropin-Releasing Hormone (GnRH) are known as the underlying causes of PCOS. Despite our knowledge, the precise origin of the illness remains elusive [3]. There is scientific evidence supporting the role of several external and internal factors, including Insulin Resistance (IR), Hyperandrogenism (HA), and environmental, genetic, and epigenetic factors [1].

Although there is minimal information on the role of stress in PCOS, it is known that the mechanism lies in the fact

that it triggers the Hypothalamic-Pituitary-Adrenal (HPA) axis to release cortisol which, via IR, stimulates visceral fat accumulation, gluconeogenesis, and lipolysis [4]. Additionally, since cortisol stimulates the production of glucose in the liver, it is involved in the increase of insulin levels and in causing hypertrophy and hyperplasia of adipocytes. Lastly, stress is responsible for creating an inflammatory condition leading to high levels of inflammatory cytokines such as IL-6 and TNF-α, as well as disrupting the oxidant-oxidant balance [5]. Moreover, PCOS can itself represent a stressful factor by increasing rates of depression and anxiety [6]. More specifically, women with PCOS have a four-fold increased risk of developing depressive symptoms and a six-fold increased risk of developing anxiety symptoms compared to those without PCOS [7]. Furthermore, other secondary factors significantly interfere with the mood of these women. For instance, infertility and worries about conception can accentuate distress as acne and unwanted body hair can create feelings of sadness, irritability, and anxiety [8], impacting health-related quality of life [9]. Thus, individuals with PCOS may experience increased levels of depression and anxiety as a result of complex interactions between biological, psychological, and social factors. Stressful situations can overload the autonomic state by increasing sympathetic activity (i.e., augmenting Heart Rate (HR), respiratory frequency, sweating or skin conductance, and reduction of peripheral temperature) [10]. Recent studies highlighted that specific parameters connected to cardiac function are particularly sensitive in signaling conditions of sympathetic hyperactivation in patients with PCOS. More specifically, Ji, et al. [11] and Tiwari, et al. [12] found that Heart Rate Variability (HRV) is compromised and useful in signaling increased sympathetic modulation of the autonomic system.

In the field of psychophysiology of stress, situations of autonomic hyperactivation are treated with intervention programs that are demonstrated to be useful in the management of stress-related disorders (i.e., anxiety, depression, and somatic symptoms) [13]. For instance, Jacobson's Progressive Muscular Relaxation (PMR) [14] and Biofeedback Training (BFB) highlighted promising results in reducing anxiety, depression, sleep disturbances, and chronic pain [15]. On the other hand, important findings emerged from the field of clinical psychophysiology that uses BFB to improve autonomic imbalance due to stress. More specifically, researchers are focusing their attention on the BFB based on HRV. HRV is the variation in time between consecutive heartbeats (RR intervals) and serves as a quantitative marker of autonomic balance and physiological stress. It consists of coupling and synchronizing the cardiac rhythm with the phases of respiration. Deep and regular breathing was found to increase HR fluctuation and respiratory sinus arrhythmia, and it appears capable of optimizing the balance between sympathetic (SANS) and parasympathetic (PANS) systems [16]. The two components of the autonomic nervous system (SANS and PANS) are also known as the fight-or-flight mechanism (or stress response) and the relaxation response,

respectively [17]. Despite these strengths, there are only a few studies investigating the role of specific psychological aspects that can facilitate or limit the benefits of stress reduction programs including PMR and BFB [15] on organic syndromes such as PCOS.

In the gynecological field, biofeedback has been applied to a limited extent for the rehabilitation of the pelvic floor for urinary incontinence problems or vulvodynia. In this case, the general objective is to train the muscles for better contraction (in the case of incontinence) or better relaxation (in the case of syndromes such as vulvodynia) through contraction and relaxation exercises and monitoring of the muscle tension parameter (this technique is called surface electromyography-Biofeedback) [18]. To our knowledge, there are no studies that applied biofeedback to improve stress management and, consequently, improve the organic symptoms of PCOS. Regardless of this, effective self-care for women requires tailored interventions for behavior change (such as diet and exercise), social support, and medical treatment for clinical symptoms [6]. In this article, the objective is to present the case report of a young woman diagnosed with PCOS and subjected to a multidimensional assessment. The psychological and psychophysiological aspects are detailed below. The woman underwent psychological treatment (psychotherapy and HRV-Biofeedback) to reduce the weight of stress in the genesis and maintenance of PCOS.

Case study

Participant

SL, aged 30, came to the visit accompanied by her husband for an evaluation of her general mental state. She was referred to the endocrinologist who found amenorrhea due to PCOS. The organic diagnosis was made at the age of 13 in the same period in which her mother was diagnosed with breast cancer (positively treated with surgery). In the anamnesis, the father's death at the age of 7 emerged as a significant life event. A family history of mental disorders (sister diagnosed with anorexia and bulimia) was also present. The lady requested a consultation for an in-depth analysis of the psychophysical condition because his mental suffering had reached such high levels that it was hurting his work performance. She describes herself as a shy and very discreet girl who finds it hard to talk about herself and her emotions to others. Furthermore, she reported that she has difficulty describing and sharing her internal states and needs ("I don't cry with others because I don't want them to worry", "I usually do what others tell me to do, perhaps because I am a little insecure"). Additionally, traits of constitutional anxiety seem to emerge during the psychological interview ("I'm always afraid of not taking the opportunity and making a mistake... I'm anxious and I get overwhelmed easily").

Measures

To investigate the clinical-psychological aspects, the following tests were carried out.

The *Cognitive Behavioral Assessment 2.0* [19] consists of 10 sheets and estimates different psychological dimensions related to mental suffering. In detail, the battery includes (1) Sheet 1: General data; (2) Sheet 2: the State-Trait Anxiety Inventory (X-1, state anxiety); (3) Sheet 3: the State-Trait Anxiety Inventory (X-2, trait anxiety); (4) Sheet 4: Psychological Anamnesis (it includes information such as physiological functions, sexual life, educational history, pain); (5) Sheet 5: the Eysenck Personality Questionnaire, Reduced Form (EPQ/R) that includes four sub-scales that measure Extraversion (EPQ/R-E), Emotional instability or Neuroticism (EPQ/R-N), Psychoticism or antisocial tendencies (EPQ/R-P), and simulation trends (EPQ/R-L); (6) Sheet 6: a Psychophysiological Questionnaire (QPF/R) that detects the presence of psychophysiological symptoms; (7) Sheet 7: the Fear Inventory, Reduced Form (FI/R) that measures fears and includes the following scales: FI/RF (total fear score), FI/R-PH (phobias), FI/R-1 (fear of natural disasters), FI/R-2 (fear of social judgment) , FI/R-3 (fear of animals), FI/R-4 (fear of distancing), and FI/R-5 (fear of blood/surgery); (8) Sheet 8: the D Questionnaire (DQ) that measures depressive manifestations; (9) Sheet 9: the Maudsley Obsessive Compulsive Questionnaire (MOCQ) that assesses obsessions and compulsions and is composed, in addition to a total score (MOCQ/R), of sub-scales that measure the tendency to compulsive control (MOCQ/R-1, checking), compulsive cleaning from fear of contamination (MOCQ/R-2, cleaning), and mental ruminating characteristics (MOCQ/R-3, doubting/mental rumination); (10) the Sheet 10: the State-Trait Anxiety Inventory, X-1 Form reduced (STAI X-1/R), estimates the level of state anxiety at the end of the test.

The *Minnesota Multiphasic Personality Inventory - 2* [20] is a self-report questionnaire designed to identify structural personality characteristics and the presence of psychological disorders. It consists of 567 items that involve dichotomous responses (true/false). The test has internal control mechanisms (validity scales), which allow us to detect whether the above criteria are met (Lie, Frequency, and Correction). The clinical scales are Hypochondriasis, Depression, Hysteria, Psychopathic Deviation, Masculinity-Femininity, Paranoia, Psychoasthenia, Schizophrenia, Mania, and Interpersonal Sensitivity. The score is calculated in T points (range: 0-120), clinical threshold = 65).

The *Temperament and Character Inventory* [21] is a test that originates from the unified biosocial theory of personality according to which there are four main genetically independent dimensions of personality (temperament), which, in turn, have typical interaction patterns in response to specific environmental stimuli (character). The three temperamental dimensions are (1) Novelty Seeking (NS) which refers to the tendency to be easily aroused in response to new stimuli that involve the subject in frequent exploratory activities; (2) Harm Avoidance (HA), a mode of behavior characterized by the tendency to avoid any situation eliciting punishment

or frustration; (3) Reward Dependence (RD), the tendency to respond intensely to reward cues, especially those of a social nature; (4) and Persistence (P) that highlights the presence of characteristics aimed at maintaining adaptive behaviors, up to the adoption of a persevering, stubborn and rigid attitude. The description of character aspects, linked to life experiences and educational and cultural aspects is described by (1) Self-Directedness (SD), which measures aspects linked to personal identity and life goals and purposes; (2) Cooperativeness (CO), which highlights ways of relating and interacting with others; (3) and Self-Transcendence (ST), which describes the relationship with the surrounding reality. Raw scores are converted into percentiles, normal values are between the 33rd and 66th percentiles.

The *Sixteen Personality Factors Questionnaire - 5th edition* [22] is a questionnaire that allows the detection and qualitative description of 16 personality factors with an assessment of temperamental and character traits. The 16 dimensions identified are bipolar and relatively independent: A = Warmth; B = Reasoning; C = Emotional stability; E = Dominance; F = Liveliness; G = Rule-consciousness; H = Social boldness; I = Sensitivity; L = Vigilance; M = Abstractness; N = Prudence; O = Apprehension; Q1 = Openness to change; Q2 = Self-reliance; Q3 = Perfectionism; Q4 = Tension. Scores between 4 and 7 are considered average.

The *Psychophysiological Stress Profile* [23] is a continuous recording, at rest and under induced stress, of physiological parameters closely connected with the individual's tendency to respond to stressful situations and those that require strong emotional involvement. The following parameters were recorded: Surface Electromyogram (sEMG), Skin Conductance (GSR/SCL/SCR), Peripheral Temperature (PT), Heart Rate, Interbeat Interval, Cardiac Variability (HR/IBI/HRV). Values are considered normal if they move within their respective normal ranges: 1.7 - 2.5 μV for sEMG; 2.2 - 6 μS for SCL-SCR; 60 - 80 bpm for HR; and, 31 °C - 32 °C for PT.

The *Symptom Questionnaire (a weekly version)* [24] was used to assess the pre-post intervention course of the psychopathological symptoms. The SQ is a self-assessment questionnaire composed of 92 dichotomous items that investigate the state of well-being/distress perceived by the subject during a specific period. It contains four scales based on the factorial analysis of the psychological symptoms of Anxiety (A), Depression (D), Somatization (S), and Hostility (H).

Pre-post-intervention evaluation was also measured through the *dosage of hormonal values* related to PCOS (LH, FSH, Estradiol, Progesterone). The endocrinologist who performed the medical examination prescribed blood tests.

Results of the assessment

The *Cognitive Behavioral Assessment 2.0* [19] highlighted

the presence of a condition characterized by high state anxiety (STAI X1 = 93rd percentile) in the absence of constitutionality for anxiety (trait anxiety measured with the STAI X2 = 60th percentile). Consistent with this aspect, the EPQ neuroticism scale did not show any notable scores. However, a marked tendency to give a positive self-image (EPQ/R L = 83rd percentile) and basic characteristics typical of introversion (EPQ/R E = 6th percentile) emerged. In addition, great conformity and rigidity to social norms and conventions (EPQ/RP = 3rd percentile) were found. The questionnaire detecting the presence of obsessive-compulsive manifestations highlighted obsessive thoughts about control and cleanliness (MOCQ/R1= 80th percentile; MOCQ/R2 = 85th percentile). The fear inventory highlighted significant levels of anxiety in social contexts (IP2 = 83rd percentile) while a high number of psychophysiological, probably psychosomatic symptoms (QPF/R = 76th percentile) were reported in the psychophysiological questionnaire.

The validity scales (Lie, T = 55; Frequency, T = 61; Defensiveness, T = 57) of the *Minnesota Multiphasic Personality Inventory - 2* [20] are typical of a valid profile. None of the scores on the clinical scales is significant for ongoing psychopathological processes, however, slight deviations can be detected for the following scales. First, the Depression scale (D = 58) reported a score that shows a withdrawn, desperate, and discouraged attitude as well as a lack of energy, inability to concentrate, and the presence of physical and sleep disturbances. Then, the Paranoia scale (Pa = 61) is typical of a subject who presents an angry and touchy, hostile and suspicious attitude towards others. Lastly, the Social introversion scale (Si = 71) showed a high score, usually attributable to an introverted and shy person, prone to embarrassment, with low self-confidence, and a tendency to assume a submissive attitude in social contexts. To summarize, the scores obtained on the clinical scales of the MMPI-2 described a condition characterized by a depressive-oriented mood with possible repercussions on the interpersonal level. At the relational level, introversion and social withdrawal are highlighted with a tendency to assume a submissive but, at the same time, alert and suspicious attitude toward others.

Considering the main scales of the dimensions attributable to Temperament (NS, HA, RD, P) and to Character (SD, CO, ST) of the *Temperament and Character Inventory* [21], slight deviations from the typical values were observed considering the trait of Avoidance of Harm, whose global score was medium-high (77th percentile) and influenced by anticipatory worries (63rd percentile) (associated, moreover, with a tendency to prefer reflexivity) and easy perception of not having the adequate psychophysical energies in the moments in which they are required (88th percentile). However, adequate and constant maintenance of energies on work activities (the score of the Persistence dimension was medium-low, 38th percentile) was described. In line with the aspects described above, there was little openness towards new experiences

(25th percentile). Observing the dimension of the Reward Dependence (45th percentile), the dissociation between Dependence (100th percentile) and Attachment (Attachment = 0th percentile) emerged, indicating the tendency to affiliate to obtain support social and approval but without benefiting from it on an affective-emotional level. These aspects were in line with other dimensions. More specifically, the scale of Cooperativeness (80th percentile) highlighted a tendency to avoid interpersonal conflicts to maintain a constructive relationship.

The *Sixteen Personality Factors Questionnaire - 5th edition* [22], confirmed some of the aspects previously described, emphasizing some facets. Among the factors of Anxiety, Apprehension emerged (factor O=8/10), which is typical of insecure people who implement control strategies to manage the problems and the emotionality connected to them. Insecurity in one's abilities appeared to be linked to a fear of new things. A sharp conservative attitude (Openness to Change = 3/10) was confirmed as well as a tendency to inhibit spontaneity (Social Boldness = 1/10). Consistent with this aspect there is the inability to express and share one's emotions (Warmth = 2/10) and to make one's needs prevail over those of others (Dominance = 1/10). Finally, the predisposition to rumination and repression of emotion (Liveliness = 1/10) along with a tendency to be a little perseverant and self-indulgent (Perfectionism = 1/10) can be considered as perpetuating factors of mental suffering.

A *Psychophysiological Stress Profile* [23] was outlined, with continuous recording in three phases (baseline, administration of objective stress [Mental Arithmetic Task], and recovery) of the following psychophysiological parameters: surface electromyogram (sEMG), skin conductance (GSR/SCL/SCR), temperature device (PT), Heart rate, Inter-beat interval, Cardiac variability (HR/IBI/HRV). The profile was typical of a condition characterized by psychophysiological hyperactivity with high psychophysiological values in the condition of induced stress (skin conductance: SCR = 8.6 μS; heart rate: HR = 85 BPM; respiratory rate: RR = 18 cpm).

Anxious activation and alteration of depressive mood were also confirmed by the *Symptom Questionnaire (a weekly version)* [24], a questionnaire characterized by high clinical sensitivity. The mood had, also, dysphoric manifestations due to the irritability perceived by the patient. In summary, anxiety, depression, and irritability exceed the significance threshold (cut-off = 4), as follows: Anxiety = 13; Depression = 5; Hostility = 5 (Range: 0-23).

The *Hormonal Tests* conducted before the psychological treatment returned the following values: LH = 6.7 (reference values: 1.0 - 18.0); FSH = 5.1 (reference values: 4.0 - 13.0); Estradiol = 30.0* (reference values: 39 - 189), Progesterone = 0.10* (reference values: 0.38 - 0.94). The doctor did not detect the presence of insulin resistance or obesity in the patient.

To summarize, the condition of the patient was characterized by a modest psychophysiological activation probably determined by noteworthy psychological factors. In particular, relational difficulties were the cause of a rigid and repressive attitude towards emotions, both at a behavioral level and in thought processes. The interpersonal difficulties did not allow the patient to benefit from the social support of her loved ones, further favoring the maintenance of the excessive arousal probably generated by the stressful life events noted in the anamnesis. The literature reports stress as an exacerbating and chronicizing factor in PCOS, however, it is also possible that the organic condition itself, along with its secondary effects (amenorrhea, infertility, and hirsutism), has accentuated the patient's mental suffering [6].

Intervention

Following the diagnostic evaluation conducted, the patient underwent integrated psychological treatment. Twenty-four sessions of cognitive behavioral psychotherapy were supplemented by 18 sessions of HRV-Biofeedback. CBT psychotherapy uses methods of cognitive restructuring and systematic desensitization along with written reports from the patient to teach adequate emotional processing skills and reduce the learned conditioning connected to the fear response and avoidance of threats. The eighteen sessions of HRV-Biofeedback were conducted using the emWave software provided by the HeartMath Institute in which the training for phase I of the Jacobson progressive muscle relaxation [14] was implemented. In addition, home exercises were assigned to encourage better learning of breathing and relaxation techniques. The total duration of the intervention was 11 months and was not accompanied by endocrinological treatment (no contraceptive drug was prescribed to favor the endogenous production of estrogen and progesterone).

The patient was provided with the Inner Balance, an HRV BFB device consisting of an ear clip (photoplethysmographic sensor), a signal transformer, and software for viewing HRV cardiac data on the computer in real time. HeartMath is a mHealth intervention that teaches patients to increase awareness and management of their internal states by increasing HRV through a wearable sensor. The auditory and visual feedback that is provided to the subject corresponds with the heart rhythm coherence elaborated within the Inner Balance technology of the HeartMath Institute [25]. For instance, the irregular heart-rhythm pattern (incoherence) is typical of negative emotions such as anger or frustration, while the coherent heart-rhythm pattern is typically observed when an individual is experiencing sustained, positive emotions and appreciation. "A coherent heart rhythm is defined as a relatively harmonic (sine wave-like) signal with a very narrow, high-amplitude peak in the low-frequency region (typically around 0.1 Hz) of the power spectrum with no major peaks in the other bands. Coherence is assessed by identifying the maximum peak in the 0.04 - 0.26 Hz range of the HRV power spectrum, calculating the integral in a window 0.030 Hz wide, centered on the highest peak in that region, and then calculating the total power of the entire spectrum. The coherence ratio is formulated as (Peak Power/[Total Power − Peak Power]^2)" [26].

Intervention

After the psychological intervention, improved psychological well-being was appreciated. The SQ score showing anxious activation just reached the cut-off (=4) while depression, somatization, and hostility were no longer clinically significant: Anxiety = 4; depression = 0; Hostility = 1 (range: 0 - 23).

Additionally, hormonal tests showed a significant improvement: LH = 6.3 (reference values: 1.0 - 18.0); FSH = 5.0 (reference values: 4.0 - 13.0); Estradiol = 89.0 (reference range: 39 - 189); Progesterone = 0.20 (reference values: 0.38 - 0.94).

Nevertheless, the patient subjectively reported better psychological well-being connected to a change in personality traits that favored the maintenance of suffering. «Inside myself, I feel a little different from before, I'm growing up...I'm trying to be more calm, also at work. It's still a little difficult, but I found that I'm improving, especially with my boss.» [...] «In these days, I've tried to think more for myself, to say my own opinion... It was really hard because I still feel stuck, unable. I'm afraid that what I think isn't right and this brings me, almost every time, do to what other people tell me to do. I've tried to give my impression (at work) for someone's attitude that didn't work for us.» [...] «Now I live changing, that used to scare me, more quietly because I can face life and its problems in a different way from months ago. In this period, I feel ready for a change.»

In summary, the intervention improved the patient's cognitive and behavioral symptoms as well as sympathovagal balance. By teaching the patient better stress coping strategies, it was possible to observe, consequently, a remission of the symptoms connected to PCOS (better values of LH, FSH, and, in particular, Estradiol and Progesterone). Finally, the patient became pregnant.

Discussion

The multidimensional intervention brought benefits to the patient, teaching her better stress management strategies (i.e., relaxation exercises, emotion recognition and control). The fact that BFB based on HRV has provided benefits in several clinical contexts (i.e., insomnia, fibromyalgia, chronic fatigue, inflammatory diseases, etc.) already supports the idea that this training restores ANS balance globally [27-30]. Our study, therefore, confirms and supports this evidence by demonstrating that the HRV-BFB allows balancing the ANS, generating benefits that affect the whole organism which, in turn, can restore systems impaired such as those related to the reproductive one. In addition, our results are in line with

those found by two recent reviews [31,32] which summarized the effectiveness that devices for BFB can augment the treatment's success of psychological symptoms associated with psychophysiological hyperactivation. More specifically, several studies demonstrated that HRV-BFB has positive effects in reducing symptoms including depression and anxiety [31,33-35].

It is also important to underline that BFB sessions have been included within a cognitive-behavioral psychotherapy intervention aimed at exploring and modifying dysfunctional thoughts and maladaptive behaviors associated with incorrect stress management and adaptation to physical illness. A theoretical model that facilitates the understanding of variations in adaptation to disease and health outcomes is Leventhal's common sense model of self-regulation (CSM) [36] which emphasizes five key perceptions of disease: 1) identity of the disease (perceived symptoms related to the disease); 2) chronology (perceived chronicity and cyclical nature of the disease); 3) consequences (perceived impact of the disease); 4) control (perceived personal control and therapeutic control over the disease); and 5) cause (perceived cause of the disease). Adaptive disease outcomes depend on a coherent and stable self-regulatory system between disease perceptions (cognitive pathway), emotional response (emotional pathway), coping, and evaluative perceptions. The perception of the illness can alter or worsen over time depending on the acquisition of new information [37]. According to this theory, the emotional pathway is based on how individuals emotionally regulate, cope with, and appreciate health threats. In addition, it appears that a fundamental role is played by perceived control, which correlates to a variety of outcomes including psychological distress, which is, in turn, mediated by problem-focused coping and cognitive reappraisal [38]. Thus, preliminary research suggests that interventions targeting illness perception may be key to changing behavior and quality of life in women with PCOS [39].

Keeping in mind the interplay between physiological, psychological, and interpersonal factors is fundamental in all of the psycho-somatic and somato-psychic disorders, especially if the etiology is not fully understood.

Performing a multidimensional assessment seems to be a very useful methodology for patients with stress-related physical disorders [40]. Investigating explicit and implicit aspects promotes a complete understanding of the patient's suffering. In addition, the psychophysiological evaluation before treatment allows to highlight conditions characterized by autonomic hyperactivity connected to psychophysical stress. Furthermore, assessing the various psychological dimensions (emotional, cognitive, and behavioral) allows one to choose the best treatment and, possibly, select different interventions for integrated management. In our case, for instance, the initial clinical investigation made it possible to identify some components linked to personality traits that required psychotherapy and others more associated with stress management for which BFB was proposed. As already documented in a 2022 review by Wagner and colleagues, "Because biofeedback is a laborious and time-consuming approach for both therapist and patient, it is important to prescreen those patients who have a high probability of benefit from the intervention". Clinical research evidenced that some aspects such as motivation, in turn, connected to the suffering, commitment, and the level of collaboration are important requirements for therapeutic success [41,42].

Although significant progress has been made in understanding the etiology of PCOS and the prevalence of comorbid psychological distress, little research has focused on the underlying psychological mechanisms that contribute to the increased risk of distress [43]. Exploring perceptions of illness in this population should help inform future research, as well as the treatment and support women receive.

Unfortunately, nowadays, there are only a few centers specialized in multidisciplinary care due to factors related to economic expenditure and the limited availability of specialized operators. Carrying out multidimensional assessments with a careful analysis of the psychological factors connected to stress can encourage the use of specific treatments to restore psychophysical well-being.

Conclusion

The multimodal treatment strategy using biofeedback, relaxation training, stress management, cognitive behavioral techniques, psychoeducation, and medical treatments (physiotherapy, drug therapy, etc.) requires a multidisciplinary team that evaluates the whole person. Scientific literature has already demonstrated the importance of clinical-psychological evaluation in physical syndromes in which stress has a significant impact. More specifically, it was also found that HRV is altered in PCOS patients. Our results, although deriving from the study of a clinical case, are promising in indicating HRV as a useful parameter for the application of Biofeedback as a technique for enhancing stress management skills. However, further studies on large samples are necessary to support these preliminary data.

Consent

Informed consent was obtained from the patient before the publication of this article and is available for review upon request. The data were handled under the ethical standards established in the 1964 Helsinki Declaration. The subject anonymity was preserved and the data have been disguised so the patient described is not identifiable.

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