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RESEARCH ARTICLE

Exploring the Role of Ultrasound for Diagnosing Polycystic Ovary Syndrome in Women in Najran, Saudi Arabia

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ABSTRACT

This study set out to explore the role of ultrasound for diagnosing polycystic ovary syndrome (PCOS) in patients attending the Maternal and Child Hospital in Najran, Saudi Arabia. One hundred women were recruited into the study. Among the data collected were details about the participant's age, BMI, hormone status, marital status and menstrual cycle. Ultrasound scans were undertaken to identify ovarian abnormalities. Most of the participants were aged between 15 and 25-years-old. The majority had a healthy BMI and they were married women. Having an irregular menstrual cycle was a common experience, affecting many of the participants. However, analyses of FSH, LH, progesterone and testosterone levels revealed that these were typically normal. The symptoms most often recounted by the women were abdominal pain, difficulty in conceiving, hirsutism and irregular menstrual cycles. Performing transvaginal ultrasound revealed that many of the participants had enlarged ovaries containing numerous small follicles. The findings of this study indicate that ultrasound is a useful tool for diagnosing PCOS. Furthermore, it provides information about the prevalence and characteristics of PCOS in this particular Saudi Arabian population.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a hormone disorder that typically affects women of childbearing age. Common features of PCOS are irregular menstruation, hirsutism and difficulties in getting pregnant. (1) Whilst the aetiology of PCOS has yet to be established, a surfeit of insulin is considered to be a contributing factor. Cells that are resistant to insulin are unable to take up sugar from the blood, causing elevated blood sugar. To try to compensate for the increased blood sugar, the body synthesises more insulin; however, when the levels of insulin become too much, they stimulate an excessive production of androgens, which in turn prevents ovulation.(2) Genetic factors might predispose some women to developing PCOS. Also, stress could contribute to developing PCOS as well as potentially being a symptom of the condition. (3)

The ovaries are the egg-producing component of female's reproductive system. They play a key role menstruation and conception. (1) One measure of a woman's health and that of her ovaries is regular menstruation. Females with PCOS often experience oligomenorrhoea or amenorrhoea, difficulties

getting pregnant, alopecia, excessive facial or body hair, weight gain and obesity, insulin resistance, pelvic pain, acne and depression. The latter is exacerbated by the discomfort and stress caused by the condition. All these symptoms may be under diagnosis called polycystic ovary syndrome (PCOS) [4]

Ultrasound is a non-invasive imaging technique that uses high-frequency sound waves to generate images of internal tissues. Ultrasound is useful to visualise the state of the ovaries. In PCOS, the ovaries become enlarged and they contain numerous small follicles. The diagnosis of PCOS is typically based upon the Rotterdam criteria, which details three factors 1) anovulation or oligo-ovulation, 2) biochemical or clinical detectable hyperandrogenism and 3) presence of polycystic ovaries on ultrasound. Any two of these three criteria are considered positive for PCOS. [5]

There are a number of benefits of using ultrasound to diagnose PCOS. A key benefit is that it is a non-ionising radiation imaging modality, meaning it is presumed safe for repeated use; this feature is especially important for women of childbearing age, who might need to be examined repeatedly over time. Also, it is (relatively) cheap and accessible, widely available in outpatient settings, including gynaecologists and general practitioners. Furthermore, the images captured by the scanner are in real time, meaning it is possible to view ongoing changes taking place in the ovaries and developing follicles over time.[6]

Although polycystic ovaries are central to PCOS, there are other conditions, such as adrenal disorders and ovarian tumours, which can present with polycystic ovaries. Thus, polycystic ovaries in themselves are not unique to PCOS. Consequently, it is essential to make a differential diagnosis, and ultrasound is a useful tool for ensuring that a diagnosis of PCOS is reliable. [7]

In spite of the above, ultrasound's effectiveness is limited by the absence of standardised criteria for polycystic ovaries. Another limitation is that the modality cannot directly assess ovulatory function and hyperandrogenism. Also, an ultrasound diagnosis for PCOS cannot be assumed where there is disagreement between the clinical presentation and the ultrasound scan's findings [6,7]

In recent years, the use of ultrasound to diagnose PCOS in Saudi Arabia has developed. Initially, the modality was used simply to evaluate the morphology of the ovaries. However, advancements have been made in ultrasound to include 3D and Doppler technologies. These developments have progressed ultrasound's ability to diagnose PCOS. Studies undertaken in Saudi Arabia have shown that the care of PCOS patients and management of their condition, have benefited from the reliability and effectiveness of ultrasound in diagnosing PCOS. [8–11]

This study assesses the role of ultrasound has in diagnosing PCOS.

Objective

The aim of this study was to assess the use of ultrasound to screen for polycystic ovary disease in women attending the Maternal and Child hospital in Najran, Saudi Arabia between January 2023 and January 2024.

METHODOLOGY

Study design

This study adopted a cross-sectional design to explore the role of ultrasound in diagnosing polycystic ovary syndrome (PCOS) in patients attending the Maternal and Child Hospital in Najran, Saudi Arabia. The aim of the study was to evaluate the prevalence of PCOS and to determine characteristic ultrasound features related to the condition.

Participants

A total of 100 women attending gynaecological consultations at the hospital were recruited into the study. Recruitment was achieved through convenience sampling. Inclusion criteria were established to be females, aged 15–55-years-old, who had either regular or irregular menstrual cycles. Participants were excluded if they had undergone gynaecological surgery or a medical history of other conditions that could affect a PCOS diagnosis.

Data collection

Data were obtained from ultrasound examinations and through a questionnaire. The purpose of the latter was to collect data about the patient's symptoms and information about their age, marital status, BMI and the regularity of their menstrual cycle. Information was also collected about the patient's symptoms, specifically whether they experienced abdominal pain, fertility problems or hirsutism.

Experienced radiologists performed the ultrasound examinations using a transabdominal or transvaginal approach, according to the patient's preference and the radiologist' professional opinion. Records were made of the scan's findings. Details noted included whether or not the following features were observed: enlarged ovaries, thickened ovarian capsule, increased ovarian stromal volume ovarian cysts and numerous small follicles.

Hormone assessment

Samples of blood were collected from each patient. Hormone assays were conducted to establish the serum levels of follicle-stimulating hormone (FSH) luteinising hormone (LH), progesterone and testosterone. Enzyme immunoassays (EIA) were performed to determine FSH and LH levels, whilst progesterone and testosterone assessed using radioimmunoassay (RIA). Levels were compared against established normal reference ranges for each hormone.

Data analysis

Statistical Package for the Social Sciences (v 23) was used to analyse the data statistically. The patients' demographic characteristics (age, BMI and marital status) were summarised using descriptive statistics. To determine the prevalence PCOS, the percentage of patients with PCOS in each ovary (left, right or bilaterally) was calculated.

For each of the features detected by ultrasound, the frequency of their occurrence was established and the prevalence was calculated as a percentage. This was achieved, by dividing the number of patients with the feature by the total number of patients who received an ultrasound scan.

Ethical considerations

Ethical approval to conduct the study was sought and obtained from the Institutional Review Board of the Mother and Child Hospital in Najran. Before collecting data, participants were required to give their informed consent to take part in the study. The participant's data was anonymised and kept confidential throughout the study.

RESULTS

One hundred female patients attending gynaecological consultations at the Mother and Child Hospital in Najran were recruited into the study. Below are the study's results.

Table 1: Demographic characteristics of the patients (n=100)

Variables	Frequency	Percent
Age		
15-25	40	40.0
26-35	39	39.0
36-45	20	20.0
46-55	1	1.0
Total	100	100.0
Marital Status		
Married	63	63
Single	37	37.0
Total	100	100.0
BMI		
Normal (18.5-24.5)	35	0.35
Obesity (25-29.9)	35	0.35
Overweight (over 30)	30	0.30
Total	100	0.100

Most of the patients (n=79) were under the age of 36 years; 40 patients were aged between 15 and 25, while 39 were aged 26–35. Twenty patients were aged between 36 and 45. Only on patient was aged between 46 and 55-years. Most of the participants (63%) were married, leaving 37% unmarried. The BMIs of the participants was fairly evenly distributed, with the 35% having a normal BMI (18.5-24.5) and an equal number falling into the obese category (25-29.9). Thirty participants were overweight, having a BMI in excess of 30.

Table 2: Regularity of menstrual cycle

Menstrual cycle	Frequency	Percent
Regular	38	38.0
Irregular	62	62.0
Total	100	100.0

Menstrual cycles were irregular in the majority (62%) of patients, with only 38% having regular cycles.

Table 3: Hormone status of the patients

Hormones	LH	FSH	Testosterone	Progesterone
Normal frequency	82	95	73	76
High Abnormal frequency	11	4	18	0
Low Abnormal frequency	7	1	9	24
Total	100	100	100	100

The patients' FSH, LH, progesterone and testosterone levels were tested. The levels of FSH were normal in 95% of cases, while four patients had an excess of FSH and one patient had a deficit of this hormone. Eighty-two patients had normal levels of LH; however, in 11% of patients, the levels were elevated, and they were abnormally low in 7% of patients. Progesterone levels were normal in almost three-quarters of patients (n=76), but the remaining 24% had abnormally low levels of this hormone. The number of patients with normal levels of testosterone was 73/100. It was elevated in 18% of patients and too low in the remaining 9%.

Table 4: Frequency of PCOS symptoms

Symptoms	Percentage
Sub- Infertility	31(31%)
Irregular Menstrual	64(64%)
Hirsutism	26(26%)
Abdominal pain	18(18%)
Free Fluid	1(1%)

Irregular menstrual cycle was the most commonly reported symptom, experienced by 64% of the patients. Around one-third (31%) of patients reported having difficulties conceiving and about one-quarter (26%) suffered from hirsutism. Almost one-fifth (18%) of participants experienced abdominal pain. Only one participant had evidence of free fluid, as observed during the ultrasound examination.

Table 5: Site of PCOS

In the majority of patients (49%), both ovaries were polycystic. The right ovary alone was affected in 29 patients and the left ovary was exclusively affected in 22 patients.

Site of PCOS	Frequency	Percent
Left	22	22
Right	29	29
Bilateral	49	49
Total	100	100.0

Table 6: Type of ultrasound scan used

Type of ultrasound scan	Frequency	Percentage
Transvaginal Ultrasound	85	85%
Abdominal Ultrasound	15	15%

Table 7: Transvaginal ultrasound findings (n=85)

Ultrasound finding	Frequency	Percentage
Multiple small follicles	76	(89.4%)
Enlarged ovaries	63	(74.1%)
Increased ovarian stromal volume	56	(65.8%)
Thickened ovarian capsule	48	(56.4%)
Presence of ovarian cysts	34	(40%)

For 76 of the 85 patients (89.4%) who underwent transvaginal ultrasound, numerous small follicles were detected; this was the most common diagnostic feature identified. Sixty-three (74.1%) patients had enlarged ovaries, while an increase in the ovarian stromal volume was detected in 56 patients

(65.8%). Thirty-four patients (40%) had ovarian cysts and thickened ovarian capsules were seen in 48 patients (56.4%).

Table 8: Trans-abdominal ultrasound findings (n=15)

Ultrasound finding	Frequency	Percentage
Multiple small follicles	13	(86.6%)
Enlarged ovaries	12	(80%)
Increased ovarian stromal volume	12	(80%)
Thickened ovarian capsule	8	(53.3%)
Presence of ovarian cysts	4	(26.6%)

Multiple small follicles were also the most common feature identified in transabdominal scans (n=13; 86.6%). Twelve (80%) of the patients scanned by this method had enlarged ovaries and increased ovarian stromal volume. Meanwhile, eight patients (53.3%) had thickened ovarian capsules and four patients (26.6%) had ovarian cysts.

DISCUSSION

PCOS is an endocrine disorder that afflicts women of reproductive age. The condition is associated with irregular menstrual cycles, insulin resistance, hyperandrogenism and numerous cysts present in the ovaries.[12] Diagnosing PCOS is mainly achieved using clinical and biochemical standards, including the Rotterdam criteria. The latter has three criteria: anovulation or oligoovulation, hyperandrogenism and polycystic ovaries. Clinical and biochemical tests and ultrasound examination need to be conducted to determine whether or not the criteria are fulfilled. The presence of at least two of the criteria is indicative of PCOS. [4]

As polycystic ovaries are not overtly visible, ultrasound imaging has become an essential method of viewing the state of the ovaries and detecting the cysts that characterise the condition. To evaluate and diagnose PCOS, this retrospective quantitative cross-sectional study, which was conducted in Najran, Saudi Arabia, analysed data collected from patients attending the Maternity and Children's Hospital. The study determined the patient-age range that was most affected, the most common symptoms experienced, the status of patients' hormones and the patients' marital status. The study also evaluated the relationships between PCOS, hormone levels, prevalence of irregular menstrual cycles, the location of the cysts in the ovaries. These findings have important implications for understanding and managing PCOS.

Table 1 shows that most of the patients (n=79) were under the age of 36 years; 40 patients were aged between 15 and 25, while 39 were aged 26–35. Twenty patients were aged between 36 and 45. Only on patient was aged between 46 and 55-years. These findings are in agreement with other studies of PCOS in Saudi Arabian women [13,14] that found the prevalence of the condition to be greater amongst young women. This observation might be due to heightened knowledge about PCOS among women of childbearing age. These women are more likely to seek medical advice, which in turn increases the potential for diagnosing PCOS. [15,16]

Table 1 also shows that most of the participants (63%) were married; only 37% were unmarried. Marriage is the social norm in Saudi Arabia; therefore, that two-thirds of the patients were married

is to be expected. [17] This finding highlights that marital status has no bearing upon the condition, and early diagnosis and treatment is desirable for all patients.

The BMIs of the participants was fairly evenly distributed, with the 35% having a normal BMI (18.5-24.5) and an equal number falling into the obese category (25-29.9). Thirty participants were overweight, having a BMI in excess of 30. Saudi Arabia suffers from a high level of obesity, so this distribution of BMIs is also following the expected pattern. There is a recognised positive association between obesity and PCOS, as being obese compounds metabolic problems and hormonal imbalances that attend PCOS. Ultrasound imaging is a valuable tool for diagnosing PCOS in obese women.

PCOS is an endocrine disorder that afflicts women of reproductive age. The condition is associated with anovluation, hyperandrogenism and polycystic ovaries. [12] Diagnosing PCOS is mainly achieved using the clinical and biochemical criteria, such as irregular menstruation, hyperandrogenism and the images produced by ultrasound scans of the ovaries. [4] Being a non-invasive imaging modality, ultrasound is useful for viewing the state of the ovaries and detecting the multiple small follicles that are characteristic of PCOS. [16] The findings of this study were that 62% of patients had irregular menstrual cycles, meaning 38% had regular cycles (Table 2). The high prevalence of irregular menstruation is in agreement with the findings of other studies covering PCOS. [18,19]

Each patients' FSH, LH, progesterone and testosterone levels were measured (Table 4). The study's results are informative about the characteristics and prevalence of PCOS in women in Najran.

Eighty-two per cent of patients had normal levels of LH; however, in 11% of patients, the levels were elevated, and they were abnormally low in 7% of patients. Based upon this finding, it can be assumed that the levels of LH are normal in the majority of PCOS patients in Saudi Arabia. Other studies have published similar findings, in which the LH levels of PCOS patients are normal or slightly increased. [20] One factor that could contribute to divergent prevalence rates is inconsistent thresholds for the level of LH that is categorised as abnormal.

The levels of FSH were normal in 95% of cases, while four patients had an excess of FSH and one patient had a deficit of this hormone. These results are consistent with the findings of other studies. Since most patients had normal levels of FSH, the implication is that assaying the levels of this hormone is not a useful metric for diagnosing PCOS in Saudi Arabian women. [20]

The percentage of patients with elevated levels of testosterone was 18%, whilst 9% of patients had a deficit. Hyperandrogenism, as presented by the raised level of testosterone, can be considered a common feature among Saudi Arabian women with PCOS. Hyperandrogenism is a criterion used to diagnose PCOS. [4] The effect of increased levels of testosterone includes irregular menstruation, acne and hirsutism. [20]

Progesterone levels were normal in almost three-quarters of patients (n=76): however, the level was abnormally low in the remaining 24%. This finding suggests that the progesterone levels of many Saudi Arabian PCOS patients could be deficient. The result is in agreement with the findings of other studies that also found the levels of progesterone to be deficient in women with PCOS. [20] Insufficient progesterone can be part of the cause of low infertility and irregular menstrual periods. [4] This study's findings emphasise the role that ultrasound can play in accurately diagnosing PCOS when it is combined with hormone assays. The knowledge provided can be used to determine the most suitable PCOS management strategies for the patient.

The data presented in Table 4 are informative about the characteristics and prevalence of PCOS in women in Najran; they also emphasise the value of ultrasound for diagnosing PCOS. Irregular menstrual cycle was the most commonly reported symptom, experienced by 64% of the patients. Other researchers point to the irregular menstruation as being a common characteristic of PCOS, [21] indicating irregular menstrual cycles can be a key indicator PCOS. Around one-third (31%) of the

patients in this study reported having difficulties conceiving. This is consistent with existing research that reports PCOS is to be a prime cause of female infertility.[22] To enhance prospects of conceiving a baby, it is essential that women with PCOS are diagnosed and treated promptly.

Twenty-six of the patients suffered from excessive facial or body hair. Other studies have reported similar findings, and it is recognised that hirsutism is prevalent among patients with PCOS. [21] The common presentation of hirsutism in this study highlights the role that ultrasound can play in diagnosing PCOS, as the modality can be used to detect ovarian cysts and other ovarian abnormalities that are characteristic of PCOS.

Table 4 shows that 18% of the patients experienced abdominal pain. However, this is considered not to be a primary symptom of PCOS; nonetheless, there is an association between PCOS and conditions that do cause abdominal pain, such as ovarian rupture or torsion. [22] Finding reports of abdominal pain in almost one-fifth of the study participants emphasises the importance of conducting thorough examinations. This should include ultrasound to eliminate other aetiologies that could be responsible for this symptom.

One participant presented with free fluid, which was detected in the ultrasound examination (Table 4). Such fluid could indicate a PCOS-associated complication, such as a ruptured ovarian cyst. That only 1% of the study cohort presented with free fluid, it suggests that ultrasound might not be of value in detecting all potential complications associated with PCOS, though the modality remains a valuable diagnostic tool.

The study found that for the majority of patients (49%), both ovaries were polycystic. The right ovary alone was affected in 29 patients and the left ovary was exclusively affected in 22 patients. It has been reported that in Najran, the prevalence of PCOS ranges from 10% to 30% [23]. This study is in agreement with earlier research that finds PCOS to be a common condition among women in Najran. Furthermore, the finding that in almost half of the patients, both ovaries were polycystic is also consistent with the findings of other studies. It is common that PCOS affects the ovaries bilaterally; this is often seen in ultrasound scans. [22] The bilateral presence of ovarian cysts in PCOS is attributed to hormone imbalance and follicular dysregulation. [24] Using ultrasound to detect bilateral PCOS can help to make a differential diagnosis of PCOS from other ovarian disorders and diseases.

The data in Table 6 shows that most of the ultrasound scans (85%) in this study used the transvaginal approach, with just 15% using the transabdominal approach.

Saudi Arabia is not unique in using transvaginal ultrasound to diagnose PCOS. Indeed, transvaginal ultrasound is regarded as the gold standard for diagnosing PCOS, so is used in other countries too. Transvaginal ultrasound is the most effective means of viewing the ovaries and detecting the characteristic numerous small follicles. Furthermore, the modality facilitates a count of the follicles and for the ovarian volume to be measured. Those data are key diagnostic criteria for PCOS. [16]

A number of factors explain the preference of using transvaginal ultrasound over abdominal ultrasound to diagnose PCOS. Image quality is the primary benefit offered by transvaginal ultrasound. Compared to abdominal ultrasound, the image quality of the ovaries is better. Furthermore, transvaginal ultrasound is less vulnerable to the effects of body habitus and gas in the bowel; this makes it a more effective imaging modality for patients with high BMI values. The adoption of transvaginal ultrasound might vary according to cultural and religious factors. For women in conservative societies, transvaginal ultrasound might consider it to be a more acceptable and modest option. [26,27,28]

Although transvaginal ultrasound is the preferred method for diagnosing PCOS, abdominal ultrasound remains an important alternative modality. In instances where a patient does not want a transvaginal scan, or where the patient has vaginal bleeding or has recently undergone pelvic

surgery, abdominal ultrasound is the preferred option. Abdominal ultrasound can also be useful in an initial screen when a patient presents with symptoms, but no diagnosis of PCOS has been made. Transvaginal ultrasound can then be used for further evaluation if PCOS is suspected. [29]

The data presented in Table 7 show that transvaginal ultrasound is highly effective in detecting the characteristic features of PCOS. The presence of multiple small follicles was observed in 89.4% of the patients, making it the most common manifestation detected by transvaginal ultrasound. This finding meets the Rotterdam criteria, which defines PCOS as each ovary having ≥ 12 12 follicles with a diameter of 2–9 mm. [4] The high prevalence of multiple small follicles detected in the patients recruited into the study reinforces the benefit of using transvaginal ultrasound to diagnose PCOS reliably in Saudi Arabian women. Enlarged ovaries were prevalent in this study, affecting 74.1% of the patients. This is consistent with findings reported in other works, in which enlarged ovaries are recognised as a characteristic feature of PCOS seen on ultrasound scans. [16,30] Ovarian stromal volume is another feature that can measured using ultrasound. Increased ovarian stromal volume, which is characteristic of PCOS, was detected in 65.8% of the patients in this study; this. Other studies have similarly reported increased stromal volume. [16,31] That a thickened ovarian capsule was identified in 56.4% of the patients in this study, lends further support to ultrasound having a role in diagnosing PCOS.

For some patients in this study both, transabdominal and transvaginal ultrasound scans were undertaken (Table 8). The findings show that transabdominal ultrasound also has role in diagnosing PCOS. The feature identified most often by transabdominal ultrasound was multiple small follicles, which were detected in 86.6% of the participants. These observations were consistent with those obtained from transvaginal ultrasound, further supporting the value of ultrasound for diagnosing PCOS.

Of those patients who underwent transabdominal scans, a high percentage was found to have enlarged ovaries and increased ovarian stromal volume. This adds further support to using transabdominal ultrasound to diagnose PCOS. However, compared to those patients who underwent transvaginal ultrasound, the detection of thickened ovarian capsule and ovarian cysts was lower in the transabdominal ultrasound patients. This is likely to reflect the limitations of transabdominal ultrasound viewing the ovaries as described earlier.

CONCLUSION

This study considers the ultrasound findings, demographic characteristics, hormone status and symptoms of PCOs patients. The study's findings indicate that PCOS is prevalent among women of reproductive age; consequently, it is essential that the condition be diagnosed promptly and managed appropriately. The study highlights the importance of assaying hormones and using ultrasound to diagnose and assess patients with PCOS. From the findings of this study, clinical practice implications are revealed, and emphasise that the condition needs to be managed using a multidisciplinary approach that considers hormone therapy, fertility treatments and lifestyle interventions.

LIMITATIONS

The findings of this study are constrained by a number of limitations. By using convenience sampling to recruit participants, the findings may not be generalisable to other populations. The study might also be vulnerable to selection bias, as it was performed in just one hospital. Furthermore, the data were vulnerable to recall bias and inter-observer variability, as they were obtained from self-reported symptoms and ultrasound findings.

RECOMMENDATION

It is essential to recognise the variability that can arise from using ultrasound to diagnose of PCOS in diverse healthcare settings and regions within Saudi Arabia. The findings of this study might not be generalisable to the whole Saudi population because they are derived from a specific sample. To investigate the factors that influence the ultrasound technique used to diagnose PCOS in different regions of Saudi Arabia requires additional study.

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