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Literature Review

THREE-DIMENSIONAL ULTRASONOGRAPHY PARAMETERS FOR THE DIAGNOSIS OF POLYCYSTIC OVARY SYNDROME: A SYSTEMATIC REVIEW

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Abstract

Polycystic ovary syndrome (PCOS) is a universally prevailing abnormal endocrinological disorder of reproductive-age women leading to subsequent anovulatory infertility. Initially, the Rotterdam criteria of laboratory reports, clinical presentation, and images support the diagnosis of polycystic ovary syndrome, although the ultrasound assessment was significantly limited. The approach of three-dimensional ultrasound proposes exact diagnoses and exceptional perception of PCOS pathophysiology. Meanwhile, Three-dimensional (3D) ultrasound improved the image and quality valuation of the volume of the ovarian, stromal, count of follicles, and blood flow inside the ovary. A systematic review performed under published literature concerning PCOS diagnosis determine by the gaudiness of three-D ultrasonography. Searching eligible English written literature with keywords of different terms of PCOS using 3-dimensional ultrasound. We review a total of eleven studies with 397 PCOS patients determined by 3-dimensional ultrasound that may reliable assessment report for a favor to PCOS. The standardized criteria method is preferred for each study's quality assessment. The value of statistics determines by the report of compliance between three reviewers. However, regarding 3-dimensional ultrasound method is extensive for the advantage of practice, accuracy, predictability, and potentially promoted standard diagnosis of POCS along with Rotterdam criteria.

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Introduction

A polycystic ovarian syndrome is a variable characteristic of complex endocrine heterogeneous disorder of reproductive-age women that subsequently affected approximately 10 % around the world.[1] Initially, PCOS diagnoses depend on the prevalence of three clinical features according to the international first conference on PCOS included chronic anovulation, hyperandrogenism, and as well as no other disorder related to endocrinology .[2,3] Conversely, in 2003 the Rotterdam performed Consensus Workshop on PCOS and established added criteria of ultrasound features like mean follicle number per ovary (FNPO) of both ovaries e"12 or ovarian volume >10 mL to hyperandrogenism and oligo-ovulation.[4] At least two criteria out of three are essential for establishing PCOS 4. Besides, previously reported to difficult of a definite diagnosis of PCOS by ultrasound.[5,6] Several studies review PCOS by comparison of controls with the method of 3-D ultrasound associated with 3-D power Doppler (PD),[7] the stromal volume and vascularity are shown to be greater in PCOS, particularly those who

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have a history of normal body weight and presence of hirsute .[8] Although, the distribution and expression of stroma for a single diagnosis of PCOS in revised Rotterdam criteria were not implicated by the original ultrasound study. The fundamental parameter of ovarian and stromal volume associated with clinical features are sufficient to establish the diagnosis of PCOS that may subsequently determine its exact management of it. Unfortunately, studies of the ovarian and stroma over ultrasound assessment were missing in the novel ultrasonographic guideline for PCOS diagnosis.[9] Some studies focus on this point and enhance the accurate diagnosis of PCOS by using 3-D ultrasound.[9] As well using 3-D ultrasound contribute to the assessments of the ovary and stromal volume and at a time performs a higher objective tool to determine the echogenicity of stromal by an estimate of ovarian mean greyness.[9] However, 3D ultrasound is considered to recognize diagnostic and accuracy thresholds for PCOS. Therefore, presents a systematic review designed to evaluate, the values and outcomes of PCOS that are compared with control by using 3-D ultrasound on basis of published literature.

Material and Methods

Search Strategy with inclusion and exclusion criteria: This systematic review is based on relevant publications on polycystic ovarian syndrome (PCOS) diagnosis by three D (3D) ultrasound (US)which were searched from English databases like PubMed, Scopus, EMBASE, Elsevier, web of science, and Cochrane Library from January 2010 to 2022. We searched with the title “role of 3D US on PCOS”, “diagnosis of PCOS by 3D US”, “3D finding of PCOS”, “US outline the feature of PCOS”, and “finding the criteria of PCOS by 3D US”. The present study purposefully to be acceptable for inclusion if it fulfilled all of the following criteria: prolonged menstrual irregular or dysfunction, may evocate of ovulatory dysfunction which is chronic in nature, (b) feature of hyperandrogenism including hirsutism, acne, or alopecia, and as well as (c) polycystic ovarian study the morphology of polycystic ovary on classic or 3D ultrasonography. Meanwhile, short notes, mini-reviews, systematic reviews, and letters to the editor were excluded from our study. The endorsed elements for systematic review protocols (PRISMA) were applied for the approach of the planned, rationale, and hypothesis, of the review.

Extraction and analysis of data

Independent of three assistants evaluated the quality of all selected full articles and two assistants teamed up with each other to data extract from each qualified article such as publication year, study type, matching exclusion and inclusion criteria, diagnostic criteria of PCOS, finding of ultrasound, measurement of follicles of PCOS by ultrasound or 3D (US). Which were transferred under the predesigned table for this systematic review. We eliminated 98 studies from our initiatory review due to duplicated downloaded. On the other hand, 28 studies were excluded due to a deficiency of inclusion criteria. Further 12 were excluded from 50 studies because there was a deficiency of data-related imaging findings for this systematic review. Hence, at the end of the evaluation, we finalized 11 relevant studies which have criteria of eligibility for the present study which is represented in table 1.

Results

Selected study:

In the present study, we retrieved a total of 148 records of study files from PubMed (n=112), Scopus (n=21), and Cochrane library (n=15) and were closely evaluated for eligibility for this systematic study. The elimination of 98 studies from the total due to duplication and unmatched criteria of our study. While the rest of the 50 studies review the abstract and assessment of the significance of ultrasound findings and images, unfortunately among 28 studies’ data of results, was not enough sufficient, and 11 studies didn’t provide ultrasound images, therefore we decided to exclude them from our study. However, at the end of the remaining 11 studies fulfilled the criteria for our study protocol. The present study is only designed for English language studies.

3-D ultrasound finding

Three-dimensional (3D) ultrasonography is a best practice for the accurate diagnosis of polycystic ovarian syndrome due to its patent to the stromal volume measurement by estimating and subtraction of the total volume of the follicle from the total volume of the ovary (fig 1,2). In the present study, we reviewed a total of eleven studies that included a total of 397 polycystic ovary syndrome women and compared with them total control of 435 women. The PCOS woman is associated with infertility and is the control without PCOS but has a history of subfertile and infertility. A total of eleven studies were diagnosed with PCOS by Rotterdam criteria and measurement of the number of follicles in each ovary, volume of ovary and stroma, and vascularization flow index (VFI), vascularization index (VI)and flow index (FI) both control and PCOS

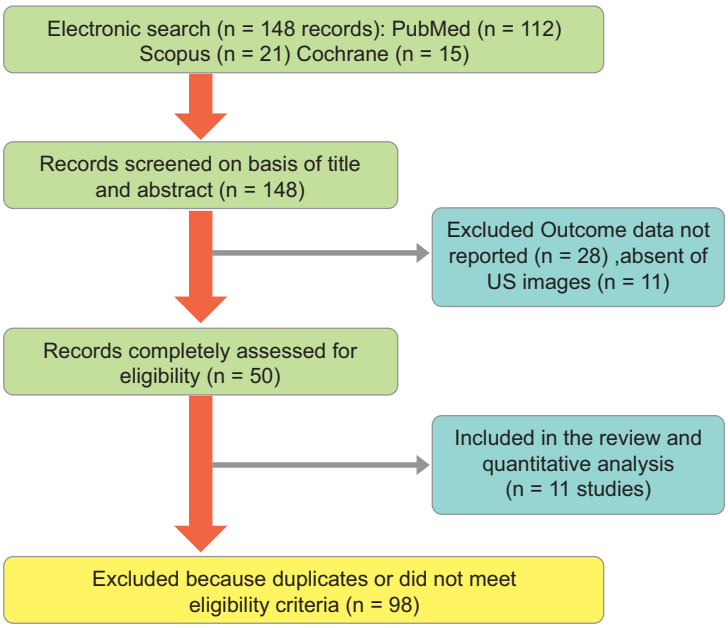

Figure 1: *The study's selection follows a chart for a systematic review of 3D ultrasound diagnosis of polycystic ovarian syndrome with a search from PubMed, Scopus, and Cochrane library.*

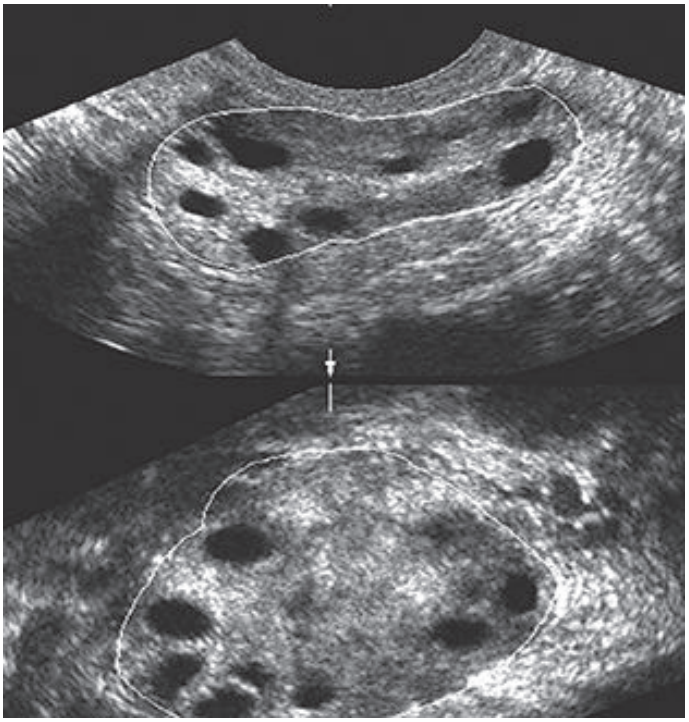

Figure 2: *A polycystic ovary syndrome views the mode of rendered inversion structure of hypoechoic as follicles.*

woman. We calculate a total of four hundred twenty-two PCO women and four hundred thirty-five as controls with compared them. A 39 PCOS woman with higher FNPO of both ovaries estimated by ultrasound and considered, P<.0001 compared to normoandrogenic women [9], while the same study evaluated the greater level of FSSP in ovaries of PCOS patients, therefore 3-D ultrasound feature provide accuracy of ovaries feature for PCOS. In the prospective observational study of 40 PCOS patients, 3-D ultrasound showed stromal volume significantly P < 0.05) and subsequently showed antral follicle count

and ovarian volume 9. In a study on 25 PCOS women who used 3D ultrasound, besides 54 infertility women ultrasound scans during the ovulation period for reveal ovarian volume higher detected in PCOS at P < 0.05) with subsequently higher V1, F1, and VFA measurements [10]. The 3-D ultrasound to find out the increased count of antral follicles as like 38.5 medium versus 12.0 and total volume of ovary significantly P < 0.001) respectively [11]. The present eleven studies included all relevant criteria representing table 1 and figure 3,4.

Table I

The relevant data from eleven studies on PCOS by features of the three-dimensional (3D) ultrasound.

Year	Author	Study type	Criteria of patients		3-D US Method	Results
			PCOS	Controls		
2002	Jarvela et al.	Method comparison study	PCOS on the US (n = 14)	Infertile women with normal ovaries (n = 28)	Vocal vascularity, 3D doppler vascular indices used for calculation of volume	Higher level of total ovarian volume (P < 0.001) but no significant differences in ovarian vascularity
2002	Pan et al.	Method comparison study	≥one clinical feature and ≥one biochemical features and PCO on US (n = 25)	Infertile women with regular cycles but no PCOS in the US (n = 54)	Volume calculation by VOCAL Vascularity by 3D Doppler vascular indices (VI, FI, and VFI)	Elevated total ovarian volume and vascularity at considered (P < 0.05).
2002	Luciano G.Nardo etal	Prospective observational study	PCOS with infertility CC-resistant woman (n=23)	-	Vocal vascularity, 3D doppler vascular indices used for calculation of volume	The volume of the ovary positively correlated with stromal volume, the total number of follicles and the total volume of follicles considered p<0.0001 respectively.
2005	Ng et al	Method comparison study	Menstrual irregularity and PCO in the US (n = 32)	Fertile women with regular cycles but no PCO in the US (n = 107)	calculation of volume by VOCAL Vascularity, 3D Doppler vascular indices (VI, FI, and VFI)	Increased antral follicle count and total ovarian volume (P < 0.001) No differences in ovarian vascularity but negatively correlated with BMI in the PCOS group (r = 0.7)
2006	Michael C et al	Retrospective cohort study	PCOS, anovulatory, and plan for IVF (n=10)	Normoandrogenic ovulatory women (n=29)	Volume calculation by VOCAL Vascularity by 3D Doppler vascular indices (VI, FI, and VFI	The mean ovarian volume for PCOS patients was 13.6 3.5 cm3 (95% CI 11.0–16.1) and 7.3 ± 2.1 cm3 (95% CI 6.5– 8.1) for normo-androgenic women (P.0001)
2007	Po M. Lam et al.	prospective observational study	Criteria of infertility with PCOS (N=40)	Without PCOS but induction of ovulation due to male factor or unexplained infertility (n=40)	Estimated Volume with 3D Doppler vascular indices (VI, FI, and VFI), VOCAL vascularity.	Increase the total ovarian volume (12.32 (8.10–16.16) mL vs. 5.64 (2.62–8.81) mL, P < 0.01) and ovarian stromal volume (9.74 (6.44–13.56) mL vs. 4.07 (1.52–6.67) mL, P < 0.01). There were no significant differences in the echogenicity of the ovaries, measured using 3D indices of ovarian vascularity and blood flow between the groups
2009	P. LAM et al	Prospective observational study	Infertility with PCOS (n=25)	Infertility without PCOS (n=25)	3D Doppler vascular indices (VI, FI, and VFI) used for the evaluation of volume	The finding volume included VI= 3.99, F1= 50.26, and VF1= 2.1 respectively.
2009	Mala YM et al	Method comparison study	Infertility with PCOS (n=25)	Infertility with PCOS (n=25)	Calculation of Volume calculation by 3D Doppler vascular indices (VI, FI, and VFI)	The finding volume included VI= 6.07, F1= 20.97, and VF1= 2.39 respectively.
2012	Battaglia et al	Prospective observational study	Infertility with PCOS (n=112)	Infertility without PCOS (n=52)	Volume calculation by 3D Doppler vascular indices (VI, FI, and VFI)	The finding was VI= 4.2, F1= 35.5, and VF1= 2.3.
2018	Kar Sujata	Method comparison study	Infertility with PCOS (n=86)	Infertility without PCOS (n=45)	Three D Doppler vascular indices (VI, FI, and VFI) for measurement of volume	The estimated finding were VI= 10.7, F1= 16.48, and VF1= 1.79.
2018	Garg etal	Method comparison study	Infertility with PCOS (n=30)	Infertility and no history of PCOS(n=30)	Determined of volume by 3D Doppler vascular indices (VI, FI, and VFI)	VI= 7.26, F1= 28.23, VF1= 2.15

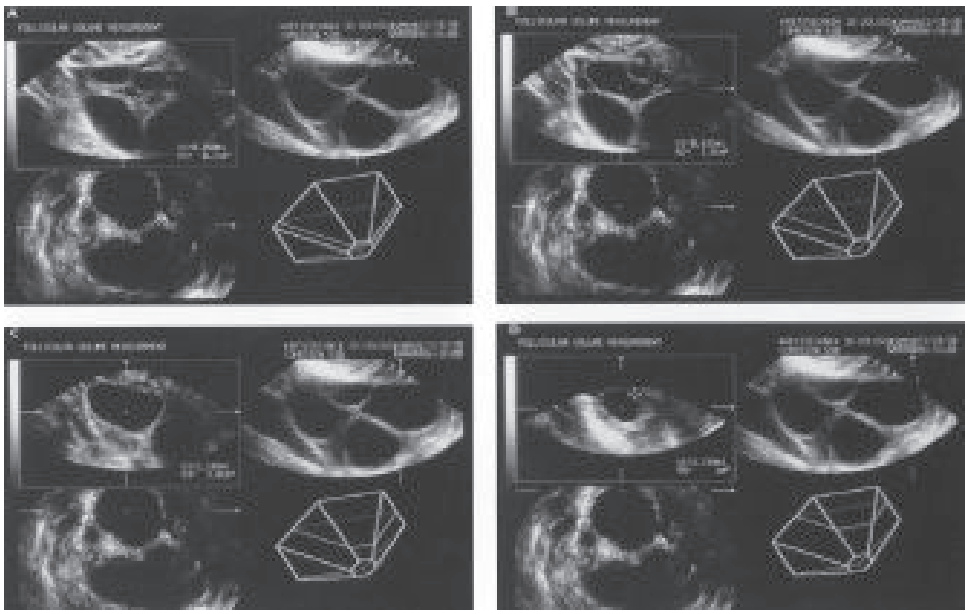

Figure 3. *Calculation of follicular volume. 3D US detected serial modifying the shape of follicular diameter which is highlighted outline.*

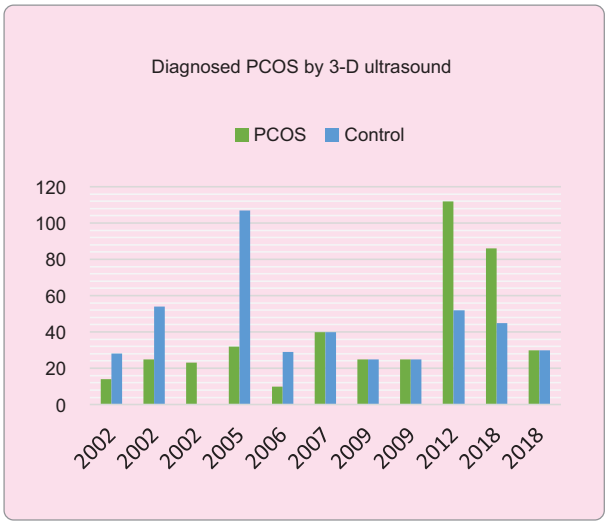

Figure 4: *The eligible participants of PCOS patients versus control among eleven studies by 3-D ultrasound.*

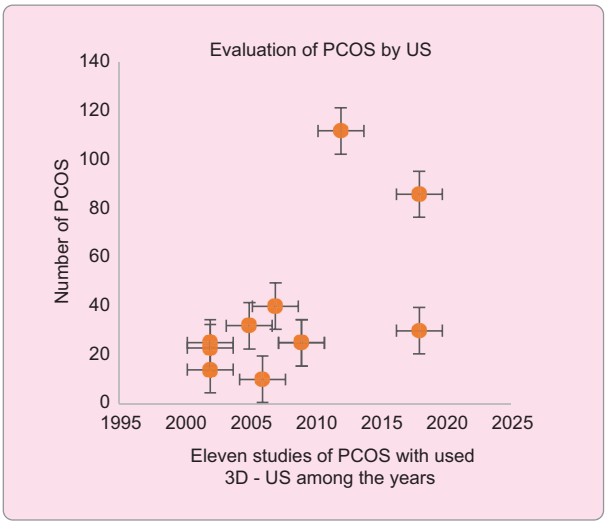

Figure 5: *PCOS patients among studies with selected years performed by 3D-US.*

Discussion

To our knowledge, this is the first systematic review of features of polycystic ovarian syndrome detected at 3-dimensional ultrasonography. The prevalence of PCOS greatly affects approximately 1 out of 10 women around the world [12]. PCOS is a highly complicated endocrine disorder and the Rotterdam in the years 2003 to estimate the important step to display the diagnostic criteria of PCOS associated with some specific ultrasound features. The morphology features of PCOS were determined by ultrasonography and correlated with hormonal studies

and clinical features. There is no single gold standard method to diagnose PCOS. Besides, an ultrasonography study is considered an essential method for evaluation and as well establishing the confirmed diagnosis of PCOS [12,13]. while 3-D ultrasound has a better option compared to other ultrasounds such as B-mode ultrasound and 2-D ultrasound. Conversely, some studies demonstrated PCOS by 3D-US and found an increase in the antral follicles and an enormous volume of the ovary. While the PCOS criteria by Rotterdam with the number of follicles and ovarian volume as 12 or more and >10 cm3 detected by 2D US [8]. 3D ultrasound permitted the calculation of the stomal volume both manually and automatically by inversion mode and thresholding. Previously reported that stromal volume was significantly higher in women with PCOS and PCO than in controls (16.7 and 15.0 ml versus 9.6 ml, all P, 0.05) [14] by performed of 3D-US. Though, the echogenicity of stromal is purposely comparatively analyzed in PCOS. 3D-US has capable of More accurate or perfect measurements of ovarian volume and subsequently measurement of stromal volume with calculations that subtract by the total volume of follicles and ovarian respectively. The present systematic review included a total of eligible 11 studies performed of 3D-US and accurate measurement of volume which are represented table1. A total of 247 PCOS patients participated in the eleven studies of our included systematic review, and accurate finding of PCOS ultrasound features that positively favor the diagnosis of PCOS. In the case of PCOS patients, there was a frequent blood flow increase detected by 2D-US, while 3D-US was applied for examining the ovarian blood flow [7]. In the present review, Pan et al., using a 3D-US method, find the volume of ovary and vascularity high in Chinese women (n=25) with PCOS versus subfertile women(n=54) along normal cycles of menstrual and ovarian morphology. Comparatively three-D ultrasound new modality for imaging that permits progressive improvement of volume estimation and assessment of quality properly. Therefore, the present study focuses that if formal use of 3D-US on a regular basis and clinically provides accurate ultrasonic features for the diagnosis of PCOS associated with the Rotterdam criteria.

Conclusion

The present systematic review highlights the potential importance of the diagnosis of PCOS with the detection of stromal echogenicity, and the volume of the ovary, stromal, and ovarian vascularity by performing 3D ultrasound. This systematic review recommended that proper use of 3D-US subsequently may potentially be useful for the method of diagnosis along with Rotterdam guidelines of PCOS that may ensure clinical standards and lead to definite treatment and good outcomes.

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