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Systematic Review

The role of transvaginal ultrasound in assessing ovarian function and guiding treatment in infertility management

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ABSTRACT

This study investigates the role of transvaginal sonography (TVS) in diagnosing and managing female infertility. It highlights TVS's effectiveness in detecting ovulatory disorders, structural abnormalities and age-related fertility issues. Results revealed 85% accuracy in diagnosing polycystic ovary syndrome (PCOS) and a 92% accuracy in identifying uterine anomalies, significantly aiding treatment planning. TVS also contributed to the evaluation of endometrial issues and ovarian reserve in women over 35, revealing diminished reserves in 68% of cases. Compared to hysterosalpingography (HSG) and laparoscopy, TVS offered a non-invasive, cost-effective and comfortable alternative for structural evaluations. The findings underscore the value of TVS in personalizing fertility treatments, particularly in assisted reproductive technologies (ART).

Keywords: Assisted reproductive technology, Endometrial assessment, Female infertility, Ovarian reserve, Polycystic ovary syndrome, Structural abnormalities, Transvaginal sonography

INTRODUCTION

Infertility is a significant concern that affects a substantial portion of the global population, with an estimated 10-15% of couples experiencing difficulty in conceiving.[1] One of the critical steps in addressing infertility involves accurately diagnosing the underlying causes, which range from ovulatory dysfunction and structural abnormalities to age-related reproductive decline.[2]

Advances in medical imaging technologies have vastly improved the ability to diagnose and manage infertility, with transvaginal ultrasound (TVS) emerging as a cornerstone in this diagnostic process.[3] Transvaginal ultrasound as a form of imaging is especially valuable in the assessment of details in the female reproductive system especially the ovaries, the uterus and the endometrial lining.[4,5] The usefulness of ultrasonic imaging in infertility extends beyond just the diagnostic area, it has a great function in monitoring ART such as IVF.[6] Influenced by the high-resolution images that the TVS provides, physicians are able to assess ovarian function TVS, through measurement of the size and maturation of ovarian follicles and assessment of the uterine environment, assists in the correct timing of ovulation induction as well as egg retrieval and embryo transfer.[7]

The use of TVS in infertility treatment has created a considerable improvement in the decisions in treatment avenues, making it much more effective for patients. The primary objective of this study is to evaluate the role of transvaginal ultrasound (TVS) in assessing ovarian function and its effectiveness in guiding treatment decisions in the management of infertility. Specifically, the study aims to examine the diagnostic accuracy of TVS in identifying ovulatory disorders, structural abnormalities and age-related infertility factors, while also evaluating its

impact on treatment outcomes, particularly in ART procedures.

METHODS

Study design

This study adopts a qualitative analysis of secondary literature to assess the role and advantages of transvaginal sonography (TVS) in evaluating ovarian function and guiding infertility treatment. The literature reviewed spans various clinical studies focusing on the diagnostic accuracy and therapeutic implications of TVS in different infertility conditions, such as ovulatory disorders, structural abnormalities and age-related infertility factors. Comparisons with other diagnostic methods, such as hysterosalpingography (HSG), laparoscopy and blood tests, were also explored to understand the strengths and limitations of TVS in infertility management.

Data collection

Secondary research information was gathered from peer-reviewed journals, clinical trials and reviews indexed in medical databases and carried out between 2015 to 2023.

Sources of data for this study were PubMed, Scopus, Embase and Web of Science, where search terms used include transvaginal ultrasound OR infertility, ovarian reserve AND transvaginal sonography, diagnostic performance OF TVS compared TO hysterosalpingography and endometrial assessment in infertility management. The articles that formed the focus of the study were subjected to a strict analysis and both qualitative and quantitative data were obtained. Some of the diagnostic and treatment indicators used were: ovarian reserve assessed using antral follicle count, ovarian volume and Endometrial thickness, structural abnormalities of the uterus or tubes, hormonal reported from blood tests- FSH and AMH.

Inclusion criteria

Studies assessing the role of transvaginal sonography (TVS) in diagnosing and treating female infertility. Studies with clear documentation of the diagnostic parameters used (e.g., follicle count, endometrial thickness). Comparative studies involving TVS and other diagnostic tools such as HSG, laparoscopy or blood tests.

Exclusion criteria

Studies not focused on infertility diagnosis or management. Studies that did not provide specific data on diagnostic accuracy or treatment outcomes related to TVS. Non-peer-reviewed articles, opinion pieces or case reports with limited generalizability.

Outcome measures

Diagnostic accuracy of TVS in detecting ovulatory disorders, structural abnormalities and endometrial issues. Correlation between TVS measurements and successful fertility treatments (e.g., ART outcomes, ovulation induction success). Comparative outcomes of infertility management using TVS alone versus combined with other diagnostic modalities (HSG, laparoscopy). Patient age and ovarian reserve indicators and their impact on fertility treatment success rates.

RESULTS

In this study, the role and advantages of transvaginal sonography (TVS) in diagnosing and managing female infertility were assessed. Results from transvaginal sonography evaluations revealed several key insights regarding its application in detecting ovulatory disorders, structural abnormalities and age-related infertility factors.

Hence results tabulated in Table 1 show that transvaginal sonography remains as a dependable and cheap technique, which has greatly improved the diagnostic capacity of the fertility problems in women with infertility as a result of various reproductive disorders.

This Table 2 presents the pro and con of diagnostics in females with infertility and the effectiveness of diagnostics by TVS, HSG, Laparoscopy, end Blood tests. All these techniques have individual strengths toward diagnosis and prognosis and are valuable toward managing disease management by calling for integration or utilization of all of them.

This Table 3 compares the treatments given with reference to various diagnostic measures used in infertility treatment such as transvaginal sonography, hysterosalpingography and blood test. It describes how these instruments support ART success due to information on reproductive tract morphology, tubal status and hormonal status to develop individual maps for better ART performance.

Table 1: Role of transvaginal sonography in diagnosing female infertility.

Parameter	Diagnostic role of TVS	Diagnostic accuracy/effectiveness
Ovulatory disorders	Identified polycystic ovary syndrome (PCOS) in 85% of cases with characteristic "string of pearls" appearance; measured ovarian volume and antral follicle count to diagnose hypothalamic-pituitary-ovarian axis dysfunction.	85% for PCOS diagnosis, 78% for irregular ovulation patterns.[8]

Continued.

Parameter	Diagnostic role of TVS	Diagnostic accuracy/effectiveness
Structural abnormalities	Detected uterine anomalies, such as septate or bicornuate uterus, identified fallopian tube disorders through indirect signs like blockages or scarring.	92% for uterine anomalies, 65% for fallopian tube disorders.[8]
Endometrial issues	Diagnosed endometriosis through detection of characteristic implants or adhesions, visualized intrauterine adhesions in cases of Asherman's syndrome.	72% for endometriosis; 63% for Asherman's syndrome.[8]
Age-related infertility	Evaluated ovarian reserve with antral follicle count (fewer than 5 follicles per ovary for diminished reserve), detected ovarian changes in women over 35.	68% detection rate for age-related ovarian changes.[8]
Overall findings	Demonstrated high reliability as a non-invasive diagnostic tool across ovulatory, structural, endometrial and age-related infertility conditions.	Enhanced diagnostic accuracy across multiple disorders.[9]

Table 2: Quantitative comparison of diagnostic methods in female infertility assessment.

Diagnostic method	Advantages	Disadvantages	Effectiveness (quantitative results)
Transvaginal sonography (TVS)	Non-invasive, real-time imaging, identifies uterine abnormalities (e.g., fibroids, polyps), monitors follicle size and endometrial thickness.	Cannot directly assess tubal patency, relies on indirect signs (e.g., hydrosalpinx).	85% accuracy for PCOS detection, 72% for endometriosis, 63% for intrauterine adhesions.[9]
Hysterosalpingography (HSG)	Directly assesses tubal patency, detailed imaging of uterine cavity.	Uses radiation, causes discomfort, limited in detecting non-patent-related uterine issues.	65% effectiveness in detecting fallopian tube blockages.[10]
Laparoscopy	Direct visualization of pelvic organs, detects subtle abnormalities like endometriosis.	Requires anesthesia, higher cost, longer recovery time.	Gold standard for diagnosing endometriosis and pelvic anomalies.[10]
Blood tests	Provides hormonal profiles (e.g., FSH, AMH), tracks ovarian function.	Requires multiple samples over time, lacks anatomical visualization.	Complements TVS by evaluating ovarian reserve and function.[11]

Table 3: Comparative treatment outcomes of diagnostic tools in infertility management.

Diagnostic tool	Key contributions to treatment	ART success rates	Factors influencing success
Transvaginal sonography (TVS)	Provides detailed imaging of ovarian follicles, endometrial thickness and uterine abnormalities.	ART success rates: 30–50%, depending on age and infertility causes.	Accurate follicle size and endometrial thickness measurements.[12]
Hysterosalpingography (HSG)	Direct assessment of tubal patency and uterine cavity structure.	Enhances success rates by confirming open fallopian tubes.	Identification of tubal blockages or scarring.[13]
Blood tests	Measures hormonal levels (e.g., FSH, AMH) to evaluate ovarian reserve and function.	Supports ART success by identifying optimal hormone profiles.	Hormonal balance and ovarian response to stimulation.[14]

DISCUSSION

This study emphasizes the vital role of transvaginal sonography (TVS) in diagnosing and managing female infertility. The results revealed that TVS effectively detected ovulatory disorders, structural abnormalities and age-related fertility issues. Specifically, it identified polycystic ovary syndrome (PCOS) in 85% of cases by revealing multiple small follicular cysts, underscoring its reliability. Additionally, TVS demonstrated a 92% accuracy rate in detecting uterine anomalies like septate or bicornuate uterus, which is crucial for treatment planning. It also identified endometrial issues, such as endometriosis and intrauterine adhesions, in over 60% of relevant cases, enhancing clinical management. For women experiencing age-related infertility, TVS assessed ovarian reserve

through antral follicle counts and ovarian volume, revealing diminished reserves in 68% of women over 35. Compared to other diagnostic methods, such as hysterosalpingography (HSG) and laparoscopy, TVS provided non-invasive, real-time imaging and was more cost-effective and comfortable, despite being less definitive for tubal patency than HSG. Blood tests further complemented TVS by offering essential hormonal data, improving the overall accuracy of infertility assessments.

As previous studies have also established transvaginal ultrasound (TVS) as an essential diagnostic tool in assessing various parameters pertinent to infertility care.[15] For instance, research by (Lubner et al,) showed that the ability to accurately determine ovarian reserve, based upon AFC with concurrent measurement of ovarian volume via TVS offers a realistic promise of a woman's fertility potential.[16]

Besides, Aas-Eng et al, found out that assessing the size of the ovarian follicle enables a clinician to know the 'ripeness' of the follicle, so as to coordinate the right timing for the induction of ovulation and subsequent retrieval of eggs in techniques such as ART.[17] Endometrial thickness is also widely discussed according to the data presented, the best measurements are associated with enhanced implantation rates during ART cycles. Also, diagnosing conditions like PCOS through TVS can help in understanding the relationship between ovarian cysts and ovulatory disorders diagnosed in infertile women and to emphasize the importance of early screening and optimal management in the treatment of infertility. Altogether, these research outcomes support the broader strategies in which he TVS is involved in improving reproductive results.

Overall, the study confirmed that TVS is a reliable and essential tool in infertility management, helping clinicians make informed decisions regarding diagnosis and treatment. By providing detailed insights into ovarian function, endometrial health and structural abnormalities, TVS contributes significantly to improving fertility outcomes.

CONCLUSION

The findings of this study affirm that transvaginal sonography (TVS) is a critical tool in the diagnosis and management of female infertility. Its high accuracy in identifying ovulatory disorders and structural abnormalities makes it invaluable for treatment planning. Moreover, TVS effectively assesses ovarian reserve and endometrial conditions, facilitating tailored approaches to assisted reproductive technologies (ART). Given its non-invasive nature, cost-effectiveness and comfort for patients, TVS should be considered a primary diagnostic modality in fertility clinics, enhancing the overall success rates of infertility treatments.

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