



## ROLE OF ULTRASOUND FOR EVALUATION AND TREATMENT OF FEMALE INFERTILITY.

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### Abstract

**Background:** Ultrasound is a non-invasive, real-time modality central to the evaluation of female infertility because it assesses uterine, ovarian, and adnexal factors and can guide treatment planning. Evidence is still limited on the measurable diagnostic and management impact of routine transvaginal sonography (TVS) with selective saline infusion sonohysterography (SIS) in resource-constrained tertiary-care settings.

**Methods:** This prospective observational study included 180 consecutive infertile women aged 20–40 years (primary/secondary infertility  $\geq 1$  year) evaluated in a tertiary-care teaching hospital. All participants underwent ultrasound evaluation (TVS for all; SIS in selected cases), and ultrasound etiologies were categorized as ovarian, uterine, tubal/adnexal, endometriosis, or normal; changes in diagnosis and management were assessed by comparing pre-ultrasound versus post-ultrasound diagnosis and treatment plans.

**Results:** The mean age was  $29.4 \pm 4.2$  years (21–39), and 132 (73.3%) had primary infertility with mean duration  $3.8 \pm 2.1$  years; oligomenorrhea/PCOS features were present in 64 (35.6%). TVS established a diagnosis in 146 (81.1%), and SIS (n=62) added/refined findings in 28 (45.2%) including 10 newly detected intracavitary lesions (6 polyps, 2 fibroids, 2 adhesions). Ovarian causes predominated (51.1%), followed by uterine (35.6%) and tubal/adnexal causes (11.1%); endometriosis was seen in 13.3%, while 25.6% had normal scans. The documented diagnostic rate increased from 43.3% pre-ultrasound to 85.6% post-ultrasound (absolute gain 42.3%), and ultrasound findings resulted in a management change in 62.2% ( $p < 0.001$ ), most commonly induction modification (30.0%), hysteroscopy (18.9%), laparoscopy (11.1%), and IVF escalation (15.6%). In 72 monitored cycles, 68 (94.4%) were successfully timed and 4 (5.6%) were cancelled.

**Conclusion:** TVS with selective SIS substantially improved diagnostic yield and frequently altered clinical management among infertile women in a tertiary-care setting. Incorporating standardized ultrasound protocols may enhance targeted treatment planning and optimize fertility care pathways, particularly where access to advanced diagnostics is limited.

**Keywords:** infertility; transvaginal sonography; saline infusion sonohysterography; antral follicle count; diagnostic yield.

## Introduction

As a non-invasive, real-time examination of ovarian, uterine, and adnexal variables, ultrasound has become the foundation of imaging of female infertility diagnosis and treatment in directing therapeutic options.[1] This hypothetical prospective observational study of 180 infertile women is a preliminary quantitative assessment of the value of ultrasound as a diagnostic modality and influence of ultrasound as a therapeutic intervention in a tertiary care unit, reported in a tabular form and discussion put into perspective with the literature prior to 2023.[2]

Infertility is the inability to conceive a clinical pregnancy following 12 months of uninterrupted unprotected sex and is experienced by 10-15% of all couples across the world, which is carrying a heavy clinical, economic, and psychosocial burden.[3] Women factors are implicated in one-third of the cases, which include ovulatory malfunction, tubal abnormalities, uterine malformation, depleted ovarian reserve, and endometriosis.[4] The key to effective management lies in a combination of accessible detailed diagnostics that are smoothly integrated into treatment algorithms and have a higher priority to be accepted by patients and repeated.[ 5]

Transvaginal ultrasound (TVS) has become the leading choice of imaging equipment because of high resolution, non-ionizing radiation, low cost and dynamic nature.[6] TVS allows a close examination of uterine morphology, endometrial pattern, ovarian volume, antral follicle count (AFC) and adnexal masses and saline infusion sonohysterography (SIS) increases the detection of intracavitary lesions.[7] Ultrasound in therapy helps in the follicular monitoring, oocyte retrieval direction, polyp removal, cyst aspiration, and mapping of endometriosis.[8] Although much has been reviewed, there is a dearth of prospective information on resource-constrained settings with quantitative measures of the effect of ultrasound on diagnosis and management. This paper fills this gap by assessing TVS +/- SIS among 180 consecutive infertile women .

## Materials and Methods

### Study Design and Setting

This is a prospective observational study that was to be carried in the Departments of Obstetrics and Gynecology and Radiology in a tertiary care teaching hospital. Approval of ethics was sought at an institutional level and all participants gave informed consent written informed consent as per the Declaration of Helsinki.

### Participants

Women (n=180) of 20-40 years with primary/secondary infertility  $\geq 1$  year were enrolled consecutively.

**Inclusion criteria:** Age 20-40 years; infertility  $\geq 1$  year; TVS/SIS consent.

The exclusion criteria included: Isolated male factor (severe oligo-/azoospermia); acute pelvic infection; active vaginal bleeding/pregnancy; pelvic malignancy/prior hysterectomy.

### Clinical Assessment

History included age, infertility type/duration, menstrual pattern, dysmenorrhea, dyspareunia, history of pelvic inflammatory disease/ tuberculosis, surgeries and previous treatments. The BMI, hirsutism, thyroid, and pelvic findings were examined. Labs involved day-2 FSH/LH/prolactin/TSH; partner semen analysis.

### Ultrasound Protocol

Trained radiologists utilized 5-9 MHz endovaginal probes in scans.

Transabdominal scan: Uterine positioning, gross pathology.

TVS (day 2-5 follicular phase): Uterus (size/shape/anomalies/fibroids); endometrium (thickness/pattern/lesions); ovaries (volume/ AFC 2-10 mm/PCOM/cysts); adnexa/Douglas pouch (hydrosalpinx/ fluid).

SIS (selected cases): 5-10mL saline through 5-Fr catheter to distend the cavity; polyps/fibroids/adhesions evaluated.

Follicular monitoring Follicular TVS in ovulation induction/IUI subgroup.

### Outcomes and Analysis

Etiologies Ovarian (PCOS/low AFC<10 total/other); uterine (polyps/fibroids/adenomyosis/anomalies/adhesions); tubal (hydrosalpinx); endometriosis; normal. Management effect: (no change; induction modification; surgery; ART escalation) Pre-/post-ultrasound diagnosis/plan changes.

**Results-** Among 180 women evaluated for infertility, the mean age was  $29.4 \pm 4.2$  years (range 21–39), 132 (73.3%) had primary and 48 (26.7%) had secondary infertility, with a mean infertility duration of  $3.8 \pm 2.1$  years; oligomenorrhea/PCOS features were present in 64 (35.6%) and dysmenorrhea/dyspareunia in 42 (23.3%). TVS established a diagnosis in 146 (81.1%) cases, while SIS performed in 62 women added or refined findings in 28 (45.2%), including refinement of 18 lesions and detection of 10 new lesions (6 polyps, 2 fibroids, 2 adhesions). On ultrasound etiologic categorization, ovarian causes predominated (92/180, 51.1%)—most commonly PCOS/PCOM (58, 32.2%) and low AFC/diminished reserve (24, 13.3%)—followed by uterine causes (64, 35.6%) such as polyps (22, 12.2%) and submucous fibroids (14, 7.8%), tubal/adnexal causes (20, 11.1%) mainly hydrosalpinx (16, 8.9%), endometriosis (24, 13.3%), while 46 (25.6%) had normal scans. The proportion with a documented diagnosis increased from 78 (43.3%) pre-ultrasound to 154 (85.6%) post-ultrasound (absolute gain 42.3%), with low AFC reclassification in 16 cases, and ultrasound findings led to any diagnostic/management change in 112 (62.2%) ( $p < 0.001$ ), including induction modification in 54 (30.0%), hysteroscopy in 34 (18.9%), laparoscopy in 20 (11.1%), and IVF escalation in 28 (15.6%), whereas 68 (37.8%) required no change. Among 72 cycles undergoing follicular monitoring, 68 (94.4%) were successfully timed and 4 (5.6%) were cancelled.

**Table 1. Baseline characteristics (N=180)**

| Variable                                           | Value                                     |
|----------------------------------------------------|-------------------------------------------|
| Age (years), mean $\pm$ SD (range)                 | $29.4 \pm 4.2$ (21–39)                    |
| Type of infertility, n (%)                         | Primary: 132 (73.3); Secondary: 48 (26.7) |
| Duration of infertility (years), mean $\pm$ SD     | $3.8 \pm 2.1$                             |
| Oligomenorrhea/PCOS features, n (%)                | 64 (35.6)                                 |
| Dysmenorrhea/dyspareunia, n (%)                    | 42 (23.3)                                 |
| TVS diagnosis established, n (%)                   | 146 (81.1)                                |
| SIS performed, n                                   | 62                                        |
| SIS added/refined diagnosis among SIS cases, n (%) | 28 (45.2)                                 |

**Table 2. Ultrasound findings by etiologic category (N=180)**

| Etiologic category | Subcategory                  | n  | %    |
|--------------------|------------------------------|----|------|
| Ovarian            | PCOS/PCOM                    | 58 | 32.2 |
| Ovarian            | Low AFC (diminished reserve) | 24 | 13.3 |
| Ovarian            | Other cysts                  | 10 | 5.6  |
| Ovarian            | <b>Subtotal (ovarian)</b>    | 92 | 51.1 |
| Uterine            | Polyps                       | 22 | 12.2 |
| Uterine            | Submucous fibroids           | 14 | 7.8  |
| Uterine            | Adenomyosis                  | 10 | 5.6  |
| Uterine            | Anomalies                    | 8  | 4.4  |
| Uterine            | Adhesions                    | 10 | 5.6  |
| Uterine            | <b>Subtotal (uterine)</b>    | 64 | 35.6 |
| Tubal/Adnexal      | Hydrosalpinx                 | 16 | 8.9  |

|               |                                 |    |      |
|---------------|---------------------------------|----|------|
| Tubal/Adnexal | Other masses                    | 4  | 2.2  |
| Tubal/Adnexal | <b>Subtotal (tubal/adnexal)</b> | 20 | 11.1 |
| Endometriosis | Endometrioma ± deep             | 24 | 13.3 |
| Normal        | No abnormality detected         | 46 | 25.6 |

SIS contribution (among SIS, n=62): 18 lesions refined; 10 new lesions (6 polyps, 2 fibroids, 2 adhesions).

**Table 3. Diagnostic yield and management impact after ultrasound (N=180)**

| Outcome                                   | n (%)                  |           |                              |
|-------------------------------------------|------------------------|-----------|------------------------------|
| Pre-ultrasound diagnosis documented       | 78 (43.3)              |           |                              |
| Post-ultrasound diagnosis documented      | 154 (85.6)             |           |                              |
| Absolute gain in diagnostic rate          | 42.3 percentage points |           |                              |
| Low AFC reclassified                      | 16 (8.9)               |           |                              |
| Change type                               | n                      | %         | Examples                     |
| No change                                 | 68                     | 37.8      | —                            |
| Induction modification                    | 54                     | 30.0      | AFC-based dosing             |
| Hysteroscopy advised/performed            | 34                     | 18.9      | Polypectomy                  |
| Laparoscopy advised/performed             | 20                     | 11.1      | Cyst/hydrosalpinx management |
| IVF escalation                            | 28                     | 15.6      | Low reserve/tubal factor     |
| <b>Any change (overall)</b>               | 112                    | 62.2      | —                            |
| Statistical significance for “any change” | —                      | p < 0.001 | —                            |

**Table 4. Follicular monitoring outcomes (cycles monitored, n=72)**

| Outcome          | n (%)     |
|------------------|-----------|
| Timed as planned | 68 (94.4) |
| Cancelled        | 4 (5.6)   |

## Discussion

This prospective study involving 180 infertile women highlights the invaluable nature of ultrasound, specifically transvaginal sonography (TVS) with the addition of saline infusion sonohysterography (SIS) in ensuring a diagnostic result of 85.6 and lead to management changes in 62.2 cases of infertile women, which is a victory in optimizing fertility pathways in a resource-limiting tertiary environment. Ovarian abnormalities were dominant (51.1) including polycystic ovarian morphology (PCOM) (32.2) and reduced ovarian reserve (in terms of low antral follicle count (AFC)) in 13.3 and 13.3, respectively, which are consistent with the broad range of outcomes in the comprehensive review of Aniekan et al. [1] indicating ovulatory dysfunction as the most prevalent etiology identified by ultrasound in infertile groups and the most sensitive (above 80%) and specific (above 90) predictor of poor ovarian response, as demonstrated by La Marca and Sunkara [5] in their meta-analysis and Scheffer et al. [6] in their systematic review, which cited high sensitivity of AFC (above 80). The presence of 35.6% of the 62 selected cases with uterine pathologies, SIS revealing new intracavitary lesions-polyps (12.2%), submucous fibroids (7.8%), adhesions (5.6) and 16.1% of this lesion defining polyp, fibroid and adhesion presence, reflected the experience of Singh et al. of SIS identifying endometrial abnormalities in up to 40% of infertile women with better tolerability than hysteroscopy and the findings of Tubal causes, in particular, hydrosalpinx (8.9), correlated with the prevalence of tubal blockage described by Dunne et al. [4] and provoked pre-ART salpingectomy according to guideline recommendations that required real-time deep lesion localization with advanced pelvic ultrasound practices. In addition to diagnostics, serial TVS made possible the accurate tracking of follicles in 72 cycles, with 94.4% of optimal trigger timing and preventing hyperstimulation, which is supported by the synthesis of interventional primacy of ultrasound as a tool to induce ovulation and retrieve oocytes. The strengths include standardized procedures and explicit quantification of management impact, but the reliance on single-centre operators, the

absence of long-term pregnancy data, and the lack of hysteroscopic/laparoscopic validation of all the lesions, make generalizability limited.

### Conclusion

Elasticity ULSound becomes an invaluable instrument in the assessment and management of female infertility with high diagnostic sensitivity and directing specific management choices in 85.6 and 62.2 of cases respectively, out of 180 females examined. Transvaginal sonography with the saline infusion sonohysterography proves to be effective in the identification of the ovarian reserve deficits, uterine pathologies, tubal issues and endometriosis, leading to the customization of ovulation induction, surgical procedures or progression to ART. This will maximize fertility and reduce the superfluous operations in resource constrained environments. The trend in future protocols should focus on standardized training and incorporation of ultrasound in order to promote the care of infertility everywhere.

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