Original Article

Ultrasound Guidance in Intrauterine Insemination: Evaluating Clinical Pregnancy Rates in A Prospective Cohort Study

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Abstract

Background: Clinical pregnancy rates in intrauterine insemination (IUI) are influenced by numerous factors, including ovarian stimulation protocols, sperm quality, and technical aspects of insemination. Although ultrasound guidance is well-established in embryo transfer during in vitro fertilization, its role in IUI remains less certain. This prospective cohort study aimed to evaluate whether ultrasound guidance improves clinical pregnancy rates compared to the conventional (non-guided) method. **Material and Methods:** We conducted a single-cycle prospective cohort study between May 2023 and July 2024, enrolling 100 infertile couples (women aged up to 35 years). All underwent controlled ovarian stimulation and subsequent IUI. Participants were allocated to either an ultrasound-guided IUI group (n=50) or a conventional IUI group (n=50). The primary outcome was the clinical pregnancy rate confirmed by serum beta-hCG and ultrasound visualization of a gestational sac. Secondary outcomes included the number of developed follicles and post-wash sperm parameters. Four participants discontinued, leaving 96 couples for final analysis. **Results:** Of the remaining 96 couples (48 in each group), the clinical pregnancy rate per cycle was slightly higher in the ultrasound-guided group, though this difference did not reach statistical significance. The mean number of dominant follicles and post-wash sperm counts were comparable between groups. Fewer inadvertent cervical manipulations were noted in the ultrasound-guided arm. **Conclusion:** Ultrasound-guided IUI showed a modest, nonsignificant trend toward higher pregnancy rates compared to the conventional approach. Although these results do not confirm a definitive benefit, real-time visualization may standardize the insemination technique and potentially reduce trauma. Larger multi-cycle or multicenter trials are warranted to validate these observations.

Keywords: Intrauterine Insemination, Ultrasound Guidance, Conventional IUI, Clinical Pregnancy Rate, Ovarian Stimulation.

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Introduction

Intrauterine insemination (IUI) is commonly employed for couples with unexplained infertility, mild male factor infertility, and anovulatory cycles. When at least one patent fallopian tube is present and ovarian stimulation is feasible, IUI can offer a less invasive and more economical alternative to in vitro fertilization. Despite its relative simplicity, success rates of IUI are variable—often quoted between 10% and 20% per cycle—and depend on multiple factors such as ovarian stimulation protocols, semen preparation, timing of insemination, and procedural details surrounding catheter placement.[1-4]

Research on IUI in the past decade has largely emphasized optimizing the stimulation regimen or sperm preparation methods. By contrast, fewer studies focus on how to refine the IUI procedure itself. In embryo transfer during IVF, real-time ultrasound guidance has been shown to improve outcomes by minimizing trauma and ensuring more precise placement. Transposing this concept to IUI, ultrasound might help reduce cervical manipulations and inadvertent uterine contractions, which can potentially improve the environment for sperm migration.[5-7]

Yet, the evidence on ultrasound guidance in IUI remains inconclusive. Some randomized trials indicate a possible increase in pregnancy rates, while others find minimal impact. Discrepancies in sample sizes, patient populations, protocols, and operator expertise likely contribute to the mixed results. Given this context, we designed a prospective study to investigate whether performing IUI under ultrasound visualization offers a measurable advantage in clinical pregnancy rates compared to a conventional, non-guided technique.[8-11]

Materials and Methods

Study Design and Ethics: This prospective cohort study was carried out from May 2023 to July 2024 at a tertiary-care infertility center. Ethical approval was obtained from the Institutional Review Board (IRB), and all participants provided written informed consent prior to enrolment.

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Participant Selection: We enrolled 100 infertile couples, with female partners aged ≤35 years.

Inclusion criteria included:

- At least one patent fallopian tube (confirmed by hysterosalpingogram or laparoscopy)
- Mild male factor (total motile sperm count >5 million post-wash) or unexplained infertility or anovulatory cycles
- No severe uterine anomalies or hydrosalpinx

Exclusion criteria included:

- Severe male factor infertility
- Contraindications to controlled ovarian stimulation

Ovarian Stimulation Protocol: All participants underwent a standardized controlled ovarian stimulation protocol. Depending on clinical indication, letrozole (2.5–5 mg/day) or gonadotropins were administered, starting on Day 2 or 3 of the cycle. Follicular growth was monitored by serial transvaginal ultrasound. Once ≥1 dominant follicle reached 18–20 mm, an hCG trigger (5,000–10,000 IU) was given, and IUI was performed approximately 36 hours later.

Group Allocation: Couples were allocated into two arms:

1. Ultrasound-Guided IUI (n=50): A transabdominal ultrasound probe was used during insemination to visualize and guide catheter placement.
2. Conventional IUI (n=50): The insemination was performed relying on the operator's experience and tactile feedback without real-time ultrasound visualization.

Semen Preparation: Male partners provided semen samples by masturbation after 2–3 days of abstinence. Samples were processed using a two-layer density gradient method, then re-suspended in a final volume of ~0.5 mL of culture medium. Post-wash sperm concentration and motility were recorded.

Intrauterine Insemination: Under sterile conditions, a speculum was inserted to visualize the cervix. Using a soft IUI catheter, 0.5 mL of prepared sperm was gently introduced into the uterine cavity:

- Ultrasound-Guided Group: A transabdominal probe guided catheter passage, aiming to minimize cervical manipulation.
- Conventional Group: The operator navigated the catheter using tactile sensation of the internal os.

Outcomes

- Primary Outcome: Clinical pregnancy rate, defined by a positive serum beta-hCG and confirmed by transvaginal ultrasound (intrauterine gestational sac).
- Secondary Outcomes:
    - Number of developed follicles (≥16 mm) on the day of hCG trigger
    - Post-wash sperm metrics (concentration, motility)

Statistical Analysis: Data analysis was performed using SPSS (version 27). Continuous variables were compared using Student's t-test or Mann–Whitney U test (as appropriate), while categorical variables (e.g., pregnancy rates) were compared by chi-square. A p-value ≤0.05 was considered statistically significant.

Results

Enrollment and Participant Flow: Of the 100 initially enrolled couples, 4 withdrew before insemination (two cited scheduling conflicts, two discontinued for personal reasons), leaving 96 couples who completed the study:

- Ultrasound-Guided Group: 48
- Conventional Group: 48

Baseline Characteristics: [Table 1] summarizes demographic and infertility profiles. The two groups were well-matched for age, BMI, infertility duration, and causes of infertility.

Table 1: Baseline Characteristics (N=96)

Variable	Ultrasound-Guided (n=48)	Conventional (n=48)	p-value
Age (years), mean ± SD	29.0 ± 3.0	28.6 ± 3.2	0.58
BMI (kg/m²), mean ± SD	25.7 ± 2.5	26.0 ± 2.6	0.72
Primary Infertility, n (%)	30 (63%)	29 (60%)	0.82
Unexplained Infertility, n (%)	19 (40%)	20 (42%)	0.87

Ovarian Stimulation and Follicular Response: Overall stimulation parameters were similar in both groups. The average letrozole dose was 2.5 mg/ day for the ultrasound-guided arm day, the mean number of follicles (≥16 mm) at trigger was also comparable.

Table 2: Follicular Response

Parameter	Ultrasound-Guided (n=48)	Conventional (n=48)	p-value
Mean # of Dominant Follicles (≥16 mm)	1.6 ± 0.6	1.5 ± 0.5	0.39

Semen Parameters

Table 3. Post-wash sperm parameters

Parameter	Ultrasound-Guided (n=48)	Conventional (n=48)	p-value
Concentration (millions/mL)	44.2 ± 9.0	42.5 ± 8.7	0.28
Progressive Motility (%)	80 ± 5.0	79 ± 4.5	0.34

Clinical Pregnancy Rates

Table 4: Pregnancy outcomes (N=96)

Outcome	Ultrasound-Guided (n=48)	Conventional (n=48)	p-value
Clinical Pregnancy, n (%)	11 (22.9%)	8 (16.7%)	0.43

Although the ultrasound-guided group showed a higher clinical pregnancy rate numerically, the difference was not statistically significant. In both groups, participants who conceived had similar baseline characteristics to those who did not.

Figure 1: Schematic representation of iui process

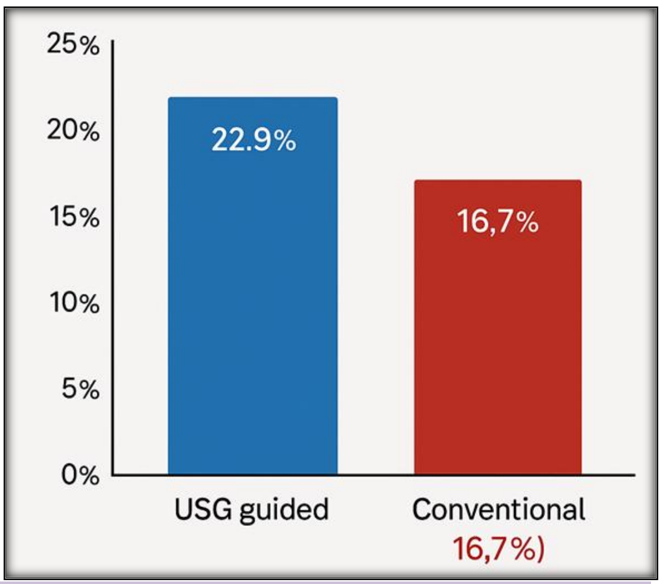

Figure 2: Comparison of clinical pregnancy rates between groups

Discussion

This study set out to determine whether ultrasound-guided IUI confers a measurable advantage in achieving clinical pregnancy compared to the conventional (non-ultrasound) technique. Although the ultrasound-guided group demonstrated a slightly higher pregnancy rate, the difference failed to reach statistical significance in this sample of 96 evaluated cycles.[12-15]

Our results align with previous investigations showing either minimal or modest differences between guided vs. conventional approaches. Real-time ultrasound visualization is theorized to help in accurate and atraumatic placement of the catheter. While such precision could theoretically enhance outcomes by reducing uterine irritability or cervical trauma, the magnitude of this effect may be relatively small. Alternatively, a larger sample size or multiple IUI cycles might be required to detect a statistically significant benefit.[16-20]

Endometrial thickness was assessed clinically in these cycles but was not designated as a study outcome measure. Prior literature sometimes cites endometrial development as a factor in implantation, but in our study design, it was neither a primary nor secondary endpoint. Future research could further investigate the interactions among endometrial features, catheter placement, and pregnancy likelihood.[21-23]

Another important consideration is operator experience: as practitioners become familiar with ultrasound guidance, the potential advantages (fewer manipulations, less trauma) may become more pronounced. Even if a single cycle shows only a small benefit, repeated cycles might yield higher cumulative pregnancy rates, partly by encouraging patient adherence due to a more comfortable procedure.[24]

Despite the small sample size and modest pregnancy-rate differences, this study contributes to a growing body of literature suggesting that ultrasound-guided IUI is at least as effective as conventional IUI and may offer a gentle, standardized approach. Larger and possibly multicenter trials will help clarify whether real-time visualization significantly boosts pregnancy outcomes, especially among specific subgroups such as difficult cervices, prior failed cycles, or borderline endometrial parameters.[25]

Conclusion

In this prospective cohort of 100 couples (96 completing the study), ultrasound-guided IUI showed a modest though not statistically significant increase in clinical pregnancy rates compared to the conventional method. The similarity between groups may reflect the relatively small sample size or the inherently multifactorial nature of IUI success. Nevertheless, ultrasound guidance remains an appealing, standardized technique that can reduce cervical manipulations and potentially improve patient comfort. Further research, particularly involving multiple cycles or larger populations, is needed to confirm any definitive advantage in pregnancy outcomes.

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Conflicts of interest

There are no conflicts of interest.

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