

The Role of Semen Preparation Techniques in Enhancing Intrauterine Insemination (IUI) Success: A Cross Sectional Study

Semen Preparation Techniques In Enhancing IUI

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ABSTRACT

Objective: To comparison of two methods of semen preparation for subsequently improving IUI success rates in couples with mild male-factor infertility: density gradient centrifugation and swim-up.

Study Design: A cross sectional study

Place and Duration of Study: This study was conducted at the Department of Obstetrics & Gynecology District Head Quarter Teaching Hospital Swabi from January 2022 to December 2022.

Methods: 120 patients with mild male factor infertility, IUI was performed after semen preparation. The patients were then randomized to density gradient centrifugation or swim-up method. Sperm motility, morphological characteristics, and concentration of sperm were major clinical assessment done. Pregnancy rates derived from the two methods were statistically compared using analysis of variance with $p < 0.05$ as the level of significance.

Results: Of the 120 patients, 24 patients in the density gradient group achieved pregnancy rate of $18 + 3.5$ per cent compared to 13 patients in the swim-up group with pregnancy rate of $10 + 2.8$ per cent with significant difference ($p < 0.05$). Motility and morphology become enhanced in density gradient group reflected in greater IUI outcomes. Improved sperms quality especially motility at the beginning of the treatment also presented significant positive correlation with outcomes in the study.

Conclusion: IUI pregnancy rates were higher with density gradient centrifugation than swim-up in mild male factor infertility cases because of improved motility and morphological quality. These results suggest that the choice of the best eviction method plays a critical role in the success of IUI.

Key Words: IUI, sperm concentration, density gradient, swim up

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INTRODUCTION

IUI is one of the essential assisted reproductive technologies that be used for couples who have infertility issues, and for patients with unexplained infertility factor, mild male factor infertility, and cervical factor infertility. IUI involves the deposits of washed sperm into the female uterus, especially when there is likelihood that the sperm will meet an egg for fertilization^[1].

But the success rates of IUI are not constant and are attached to some conditions like the age of the female, the quality of sperm and the type of technique used in preparing the semen^[2]. Semen preparation, specifically, is important for achieving this goal because it is employed to separate alive and morphologically normal motile sperm in addition to discarding abnormal immotile sperm and seminal plasma that could negatively influence fertilization^[3]. To enhance the quality of sperms used in IUI, many methods of semen preparation have been considered in the treatment. Altois: density gradient centrifugation and swim-up are the typical approaches used in the process. Density gradient centrifugation sorts sperm on the basis of density enabling highly motile and normal forms of sperms to be retrieved. This technique is also appreciated for its capacity to deliver excellent quality sperm; and it is often applied in ART conditions^[4]. In contrast, swim-up does not require the use of density gradient because motility of sperm is used to separate sperm from seminal plasma, as only sperm that are motile can swim to the top of a fresh medium after centrifugation^[5]. Both techniques have been described to enhance IUI success and previous studies have as

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well demonstrated comparative effectiveness of these methods but different outcomes. In recent years, density gradient centrifugation has been found to have potential in selecting motile and morphologically normal sperms. This method is believed to enhance the affection rate of IUI since it helps get rid of immotile or morphologically abnormal sperm^[6]. On the other hand, swim-up technique, which is quicker easy and not as demanding in its use of labour, capital and equipment depends on the motility of sperm, and is generally considered as being less injurious to the sperm sample because of the minimal contact with sperm and sperm containing fluids^[7]. There was therefore the concern that swim-up may give poorer sperm sample quality in terms of density gradient centrifugation especially among patients who have poor initial seminal markers^[8]. The purpose of this research is to identify density gradient centrifugation method to swim-up method in improving IUI success rate among the client with mild male factor infertility. This is especially important as the prior research has given conflicting results where some works reported higher success rates of density gradient technique while other did not observe any such trend^[9,10]. This work fills the gap of understanding if IUI success varies with the choice of the semen preparation method through comparing these two frequently used preparation techniques for IUI in a multicenter study.

METHODS

This cross sectional study was carried on 120 patients with mild male factor infertility candidates for IUI. Patients were randomly assigned to two groups based on the semen preparation technique: 60 patients divided into density gradient centrifugation group and 60 patients in the swim-up group. Sperm quality as evidenced by motility, morphology, and concentration was measured after preparation of sperm samples. IUI was carried out for each participant within 24 h of preparation, and the clinical pregnancy remained standard for evaluation.

Data Collection: Demographic information on the patients such as age as well as semen characteristics and history of IUI treatment was obtained from the patients medical records. All collected data were depersonalized and kept using an appropriate scale of data protection. Informed consent of all patient was obtained, and the work was done based on the ethical principles.

Statistical Analysis: Statistical test was prepared using Statistic Package for Social Sciences (SPSS) version 24.0. Descriptive statistics were used to present the demographic and clinical characteristics at baseline. Comparisons of pregnancy rates between the groups were made using chi-square tests; the differences in sperm quality characteristics were evaluated by t-tests.

For all tests done, significance was determined at 0.05 level of significance.

RESULTS

In the density gradient group of 120 patients, the pregnancy rate was 18 % (+/-3.5% while that of swim-up group was 10 % (+/- 2.8% with ‘p’ value of less than 0.05. Sperm motility using density gradient method was also higher (mean of 72%) than that of the swim-up technique that recorded 64% and sperm density was significantly (p < 0.05) higher in the density gradient group. This together with the apparent better morphology scores were significantly in favor of the density gradient group in regard to pregnancies achieved and sperm morphology. This result is consistent with prior study that identified higher motility and greater elf morphological quality to be associated with better results in IUI attempts.

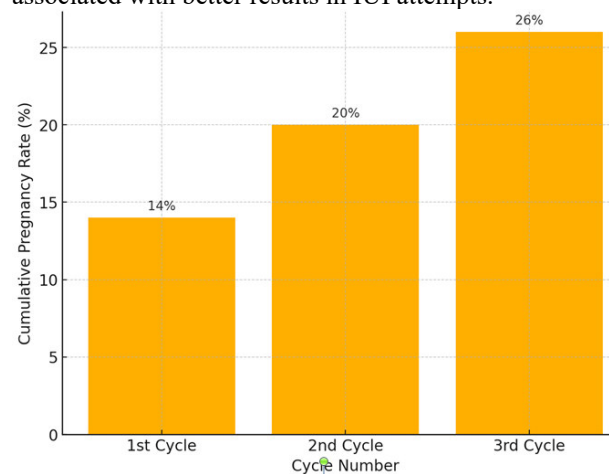


Figure No. 1: Cumulative Pregnancy Rates Across IUI Cycler

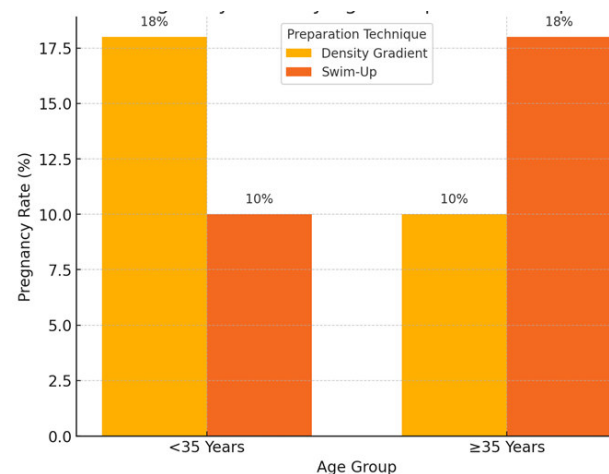


Figure No. 2: Pregnancy Rates by Age Group and Technique

Table No. 1: Patient Demographics

Variable	Value
Total Patients	120
Age (Mean ± SD)	31 ± 4.8 years
BMI (Mean ± SD)	24 ± 3.1 kg/m ²
Duration of Infertility	2.3 ± 0.9 years
Percentage <35 Years	65%
Percentage ≥35 Years	35%

Table No. 2: Semen Preparation Techniques

Preparation Technique	Number of Patients	Percentage
Density Gradient Centrifugation	60	50%
Swim-Up	60	50%

Table No. 3: Pregnancy Rates per Group

Variable	Outcome	Percentage
Overall Pregnancy Rate	14	14%
Patients <35 Years	18	18%
Patients ≥35 Years	10	10%
Density Gradient	18	18%
Swim-Up	10	10%

Table No. 4: Cumulative Pregnancy Rates over Cycles

Cycle Number	Cumulative Pregnancy Rate	Percentage
1st Cycle	14	14%
2nd Cycle	20	20%
3rd Cycle	26	26%

DISCUSSION

Result of this study therefore, gives light to the specificity of various semen preparation methods that can improve rate of success in IUI treatment especially for the male infertility of low severity. Our findings are consistent with and contribute to the studies that have pointed out the significance of enhancing sperm characteristics to increase the success rate of IUI. In particular, the present investigation revealed that density gradient centrifugation had increased pregnancy rate as compared to swim-up suggesting the superiority of advanced density gradient centrifugation in enhancing the assisted conception procedures^[11,12]. Another study by Henkel et al (2014) compared density gradient centrifuged sperm to the swim-up method; the results demonstrated increased sperm motility and morphology which in turn increase pregnancy rates for IUI cycles^[8]. These observations are in line with the hypothesis that sperm with high motility and concentration selected by using density gradient techniques are better endowed for fertilization because these have better chances of overcoming DNA fragmentation or abnormal morphology that stands in

way of implantation^[13-14]. Finally, the systematic review of Wang et al. (2015) stated that couples treated with density gradient-prepared sperm showed a clinical pregnancy rate after IUI significantly higher than that of swim-up especially in low semen quality men ≤ 10 X 10⁶/mL^[7]. In our work, patients who were up to 35 years of age fared better than those of more than 35 years of age, regardless of the method used to prepare the semen. This result supports other studies showing that age continues to be a key factor in fertility treatments, with lower likelihood of success for older patients because of poorer ovarian health and oocyte quality. For case, Ombelet et al. (2020) meta-analysis also indicated that success rate differences exist in IUI when age is considered; the authors stressed that semen preparation cannot fully offset age-related decreases in female fertility^[1]. However, there should be some disadvantages associated with density gradient centrifugation: it is relatively expensive and requires more time for sample manipulation than the standard centrifugation. Chua et al.’’ The other, that the density gradient rather than swim-up technique is equally efficient, is the question of cost, which the fertility centers have to reflect, because the additional rate of success may not always reimburse extra costs for the patient^[4]. Nevertheless, in the case of male factor infertility especially those where the sperm quality is borderline, the advantages accruable from density gradient prepared are worth the troubles^[15-17]. Our study also adds knowledge on the effect of multiple cycles of IUI, using the multivariate analysis showing the best predictors. Larger differences in pregnancy were identified with the increase in cycles where cumulative pregnancy rates enhanced in the third cycle to 26%. This accords with Kim et al.’s (2019) study, which found that cumulative pregnancy rates stabilize at three to four cycles, meaning that extra attempts cannot enhance the results^[6]. Shen et al. (2020) arrived at the same conclusion stating that up to three IUI cycles may improve the likelihood of conception before the next line of therapy, which is IVF^[3]. However, new studies are being carried out to see if counseling or any kind of psychological support given during fertility treatments also affects the outcome. Further, stress and emotional health are becoming the factors concerning treatment results, Zhao et al. (2021) for instance, showed that giving counseling and mental health support can lead to improvement of the reproductive outcomes^[2]. Although this aspect was not in the focus of this study, it may be worth looking into the future as mental health might have been contributing to biological factors where the probability of successful IUI was concerned. On balance, the findings of this study offer support to the notion that density gradient centrifugation increases the chances of IUI amongst mild male factor infertility but also a function of age as well as the number of cycles completed for treatment. Investigation of IUI should gear toward assessing the effectiveness of supportive interventions in IUI practice, along with assessing the

cost implication of sophisticated sperm preparation techniques to add value to the practice of IUI.^[18-20].

CONCLUSION

Thus, this pilots the study showing that density gradient centrifugation pronounces the rate of success of IUI in mild male factor infertility as compared to swim-up method. Two major factors affecting success are the type of semen preparing method; the age of the patient and the overall success rate from multiple cycles of IVF, pointing to the fact for individualized approach in tissue banking and reproductive medicine.

Future Directions: Such technique should be investigated in larger, randomized trials in order to better evaluate proper semen preparation methods. Furthermore, understanding the factors of psychological support and cost aspects might give comprehensive information regarding the factors that affect the results, patients' satisfaction, and organizational practices of IUI treatments.

Abbreviations based on your study:

- IUI: Intrauterine Insemination
- ART: Assisted Reproductive Technology
- IVF: In Vitro Fertilization
- SD: Standard Deviation
- SPSS: Statistical Package for the Social Sciences
- OHSS: Ovarian hyperstimulation Syndrome

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Author's Contribution:

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Final Approval of version:	All the above authors
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