ORIGINAL RESEARCH

Analysis of Seminal Patterns and Factors Contributing to Male Infertility: A Retrospective Study

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ABSTRACT

Background: Infertility is a global concern affecting around 17.5% of adults. Semen analysis is crucial in assessing male infertility, providing insights into potential causes and guiding therapeutic interventions. This study aimed to analyze seminal patterns in males within infertile couples and identify factors contributing to infertility. **Methods:** This retrospective study analyzed the medical records of men attending the infertility clinic. Semen analysis parameters, including semen volume, pH, viscosity, sperm concentration, motility, morphology, and white blood cell counts, were recorded. WHO reference thresholds were considered for analysis. **Results:** The study included medical records of 187 patients with a mean age of 33.12 years. The majority of the patients (68.86%) were over 30 years old. The mean duration of infertility was 4.10 years, with 63.64% reporting <5 years of infertility. Primary infertility was observed in 93.01%, and secondary infertility in 6.99%. Varicocele was observed in 30 patients, while erectile dysfunction was observed in 8 patients. Abnormalities in sperm count, motility, and morphology were prevalent. Primary infertility was observed in a significantly greater number of patients with abnormal total sperm counts as compared to those with normal total sperm counts (p=0.031). A significantly greater number of patients who consumed alcohol reported an abnormal total sperm count than those with normal sperm count (p=0.035). Normozoospermia was present in 29.95% of patients, asthenozoospermia in 18.18%, and oligoasthenozoospermia in 13.37%. **Conclusion:** Semen analysis plays a pivotal role in diagnosing male infertility. Abnormal sperm parameters were common in infertile males, with primary infertility and alcohol consumption linked to abnormal sperm count.

Keywords: infertility, semen analysis, sperm parameters, male infertility, abnormal sperm count

INTRODUCTION

Fertility pertains to the capability of achieving a clinical pregnancy. Globally, infertility constitutes a significant health concern, with approximately 17.5% of adults, or roughly one in every six individuals, experiencing infertility. [1]Medical professionals describe infertility as a condition of the reproductive system where women are unable to attain pregnancy even after engaging in consistent unprotected sexual activity for a period of twelve months or more, according to the World Health Organization (WHO) and the International Committee for Monitoring Assisted Reproductive Technology (ICMART). [2]Infertility is categorized as either primary, where a couple has never had a child, or secondary, which refers to the inability to conceive after a previous pregnancy.

Male infertility can result from various factors, including obstructions in the reproductive tract, hormonal imbalances affecting sperm production, testicular failure, abnormal sperm function and quality, as well as lifestyle factors like smoking, stress, excessive alcohol intake, obesity, and exposure to environmental pollutants, all of which can detrimentally impact sperm health and fertility. [2,3] Male factor infertility accounts for approximately 50% of totalinfertility cases. [4]It is typically caused by changes in sperm concentration, motility, and/or morphology observed in at least one of two sperm analyses conducted with a gap of 1 to 4 weeks. [5]Hence, semen analysis becomes the cornerstone in assessing male infertility, offering insights into potential causes of infertility, aiding in their identification, and facilitating the implementation of

appropriate therapies. Therefore, the objective of our study was to analyze seminal patterns in males within infertile couples and to uncover potential factors contributing to the overall issue of infertility.

MATERIALS AND METHODS

Study design and setting

This retrospective study was conducted at infertilityclinic. The medical case records of men attending the infertility clinic and those who underwent semen analysis were analyzed.This study was conducted in accordance with ethical principles that are consistent with the Declaration of Helsinki. The study protocol was approved by the Institutional Review Board/Ethics Committee.

Study investigation

Semen analysis holds a fundamental role in evaluating the male member of a couple experiencing infertility. Semen analysis records including the quantity of seminal fluid, pH and viscosity of the seminal fluid, total sperm concentration and total sperm count, progressive and non-progressive motility, total motility, sperm morphology, number of total motile sperm, presence of white blood cells (WBC, pus/epithelial cells) were recorded.

The WHO [6] has established the following lower reference thresholds for semen analysis: volume should be at least 1.5 mL; sperm concentration should reach a minimum of 15 million spermatozoa per mL; the total number of sperm in an ejaculation should be at least 39 million; morphologically normal forms should comprise at least 4%; progressive motility should be no less than 32%, and the overall motility (combining progressive and non-progressive) should be at least 40%.

Liquefaction time should be ≤30 minutes, the viscosity of the semen should be <2mL, WBC (pus cells/epithelial cells)should be ≥6 million, total motile sperm should be ≥20 million, non-progressive motility should ≥40%.

Data collection and statistical analysis

The patient's social history, demographic details, clinical findings and semen analysis reports were recorded. Collected data was analyzed using a statistical package in social sciences version 23.Descriptive statistics summarized categorical variables using frequency and percentages, while continuous variables were presented as mean and standard deviation (SD) as well as median and range. Further, associations were studied among the normal and abnormal total sperm count with age, duration of infertility, type of infertility, smoking or tobacco use, alcohol consumption and presence of erectile dysfunction using a chi-square test. A $p<0.05$ was considered for the level of significance.

RESULTS

A total of 187 medical records were assessed during the study, with a mean age of 33.12 years. Among these patients, the majority(n=115, 68.86%) were over 30 years old.The mean duration of infertility among the patients was 4.10 years, with 119 patients(63.64%) reporting an infertility duration of <5 years. Most of the patients (98.93%) collected semen samples through masturbation.Primary infertility was predominant, affecting 93.01% of patients, whereas secondary infertility was observed in 6.99% of patients [Table 1].

Table 1: Demographic characteristics

Parameter	Number of patients (N=187)
Age (years), mean (SD), (n=167)	33.12 (7.18)
Age groups (years), (n=167)	
≤30	52 (31.14)
>30	115 (68.86)
Duration of infertility (years), mean (SD)	4.10 (1.86)
Duration of infertility (years)	
<5	119 (63.64)
≥5	68 (36.36)
Mode of collection	
Masturbation	185 (98.93)
Coitus interrupts	2 (1.07)
Infertility, (n=186)	
Primary	173 (93.01)
Secondary	13 (6.99)
Anatomical abnormality	2 (1.07)
Smoking/tobacco consumption	48 (25.67)
Alcohol consumption	11 (5.88)
Erectile dysfunction	8 (4.28)
Varicocele	30 (16.04)
Mumps orchitis	1 (0.53)

Data presented as (%), unless otherwise specified.
SD, standard deviation.

Their female partners also influenced infertility in 10 patients, and the mean number of abstinence days was 3.39. Only 2 patients (1.07%) had anatomical abnormalities. Only 25.67% of patients reported smoking or tobacco use and 5.88% admitted to alcohol consumption. Varicocele was observed in 30 patients, while erectile dysfunction was observed in 8 patients and mumps orchitis in only 1 patient.

The whole semen sample collection was observed in 182 (97.33%) patients. The mean duration between semen collection and testing was 39.43 minutes. Only 10.16% patients experienced an abnormal duration between sample collection and testing exceeding 30 minutes. The mean pH of the semen sample was 7.95. Abnormal viscosity of the semen was observed in 5.91% of patients only. The median total sperm count was 35 million andthe median total sperm concentration was 20 million/mL.A total of 51.34% of patients had an abnormal count and total sperm concentration revealed that 45.45% had an abnormal concentration [Table 2].

Table 2: Patterns of semen analysis among the study subjects

Parameter	Number of patients (N=187)
Semen sample collected	
Whole	182 (97.33)
Partial	5 (2.67)
Duration between collection and testing (minutes), mean (SD)	39.43 (15.02)
Liquefaction time (minutes)	
Normal	168 (89.84)
Abnormal	19 (10.16)
Seminal fluid (mL), mean (SD)	2.34 (1.21)
Seminal fluid	
Normal	157 (83.96)
Abnormal	30 (16.04)
pH, mean (SD)	7.95 (0.29)
Viscosity, (n=186)	
Normal (<2 mL)	175 (94.09)
Abnormal (>2 mL)	11 (5.91)
Total sperm count (million/ejaculate), median (range)	35 (0-1085.60)
Total sperm count	
Normal	91 (48.66)
Abnormal	96 (51.34)
Total sperm concentration (million/mL), median (range)	20 (0-271.40)
Total sperm concentration	
Normal	102 (54.55)
Abnormal	85 (45.45)
WBC (pus/epithelial cells)	
Normal	166 (88.77)
Abnormal	21 (11.23)

Data presented as (%), unless otherwise specified.
pH,potential for hydrogen SD; standard deviation; WBC, white blood cell.

WBC (pus cells) showed abnormal values in 21 patients (11.23%).

The mean total motile sperm count was 7.20 million, and 119 patients (63.64%) had abnormal total motile sperm count. The mean immotile sperm count was 50.09%. The mean total motility was 35.50%, and 99 patients (52.94%) demonstrated abnormal total motility [Table 3].

Table 3: Motility and morphological characteristics

Parameter	Number of patients (N=187)
Total motile sperm (million), median (range)	7.20 (0-273.70)
Total motile sperm	
Normal	68 (36.36)
Abnormal	119 (63.64)
Immotile sperm (%), mean (SD)	50.09 (29.15)

Total motility (%), mean (SD)	35.50 (25.22)
Total motility	
Normal	88 (47.06)
Abnormal	99 (52.94)
Progressive motility	
Normal	65 (34.76)
Abnormal	122 (65.24)
Non progressive motility,(n=186)	
Normal	5 (2.69)
Abnormal	181 (97.31)
Sperm morphology	
Normal	122 (65.24)
Abnormal	65 (34.76)
Data presented as (%), unless otherwise specified. SD, standard deviation.	

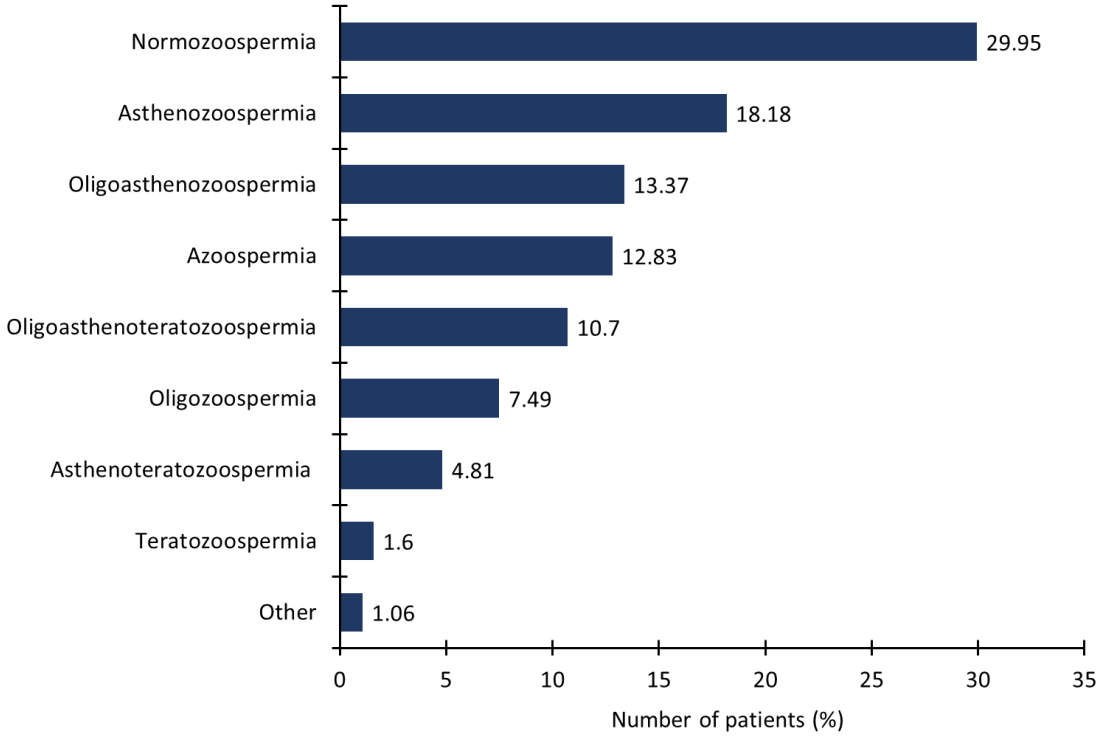
The abnormal progressive motility of spermwas seen in 65 patients (34.76%) and abnormal non-progressive motility in 181 patients (97.31%). Sperm morphology exhibited abnormal results in 65 patients (34.76%).
Primary infertility was observed in a significantly greater number of patients with abnormal total sperm count (n=93) as compared to those with normal total sperm count (n=80, p=0.031). A significantly greater number of patients who consumed alcohol reported an abnormal total sperm count than those with normal sperm counts (9.38% vs. 2.20%, p=0.035)[Table 4].

Table 4: Comparison of demographic characteristics between normal and abnormal sperm count

Parameter	**Total sperm count**		**P value**
	Normal (n=91)	Abnormal (n=96)	
Age groups (years)	[n=75]	[n=92]	0.093
<30	18 (24)	34 (36.96)	
>30	57 (76)	58 (63.04)	
Duration of infertility (years)			0.450
<5	57 (62.63)	62 (64.58)	
>5	34 (37.36)	34 (35.42)	
Infertility	[n=90]		0.031
Primary	80 (88.89)	93 (96.88)	
Secondary	10 (11.11)	3 (3.12)	
Smoking/tobacco consumption			0.169
Yes	20 (21.98)	28 (29.17)	
No	71 (78.02)	68 (70.83)	
Alcohol consumption			0.035
Yes	2 (2.20)	9 (9.38)	
No	89 (97.80)	87 (90.63)	
Erectile dysfunction			0.390
Yes	3 (3.30)	5 (5.21)	
No	88 (96.70)	91 (94.79)	
Data presented as n (%).			

Age groups, duration of infertility, smoking and tobacco consumption and erectile dysfunction were comparable in patients with normal and abnormal total sperm count (p>0.05).

Figure 1: Distribution of patients according to semen analysis report



Other: Hemospermia with inflammation, leukocytospermia.

Figure 1 illustrates that normozoospermia was present in 29.95% of patients, asthenozoospermia in 18.18%, oligoasthenozoospermia in 13.37%, azoospermia in 12.83%, oligoasthenoteratozoospermia in 10.70%, oligozoospermia in 7.49%, asthenoteratozoospermia in 4.81%, and teratozoospermia in 1.60%.

DISCUSSION

Male factor infertility is an important aspect often neglected in the diagnosis of infertility in couples. Semen analysis is a cornerstone of the diagnosis of male factor infertility, which helps in recognizing potential causes of infertility and in the implementation of appropriate therapies. Therefore, this study focused on studying the patterns of semen analysis and identifying potential factors contributing to infertility. The key findings of this study were: i) the mean age of the patients was 33.12 years, with majority being >30 years ii) the majority patients had primary infertility; iii) varicocele was the most prevalent, followed by erectile dysfunction and mumps orchitis; iv) mean pH of the semen was 7.95; v) abnormal liquefaction time and viscosity was observed in less number of patients; vi) abnormal total sperm count was observed in the majority of patients while total sperm concentration was observed in most of the patients; vii) abnormal number of WBC were present in a small proportion of patients; viii) an abnormal number of total motile sperms was prevalent in study patients; ix)abnormal total, progressive and non-progressive motilitywas observed in the majority ofpatients, respectively; x) abnormal sperm morphology was seen in 34.76%; xi)alcohol consumption and primary infertility were significantly associated with total sperm count xii) majority of the patients had normozoospermia, followed by asthenozoospermia, azoospermia, oligoasthenoteratozoospermia, oligozoospermia, asthenoteratozoospermia and teratozoospermia.

The mean age of the study population of the present study was 33.12 and the majority were of >30 years of age. Similarly, in a study conducted by Shagufta Khan et al. [7] most men in the age group of 30-39 years. In contrast, the majority of the patients were ≤30 years 98/159. [8]

Primary infertility was observed in 93.01% of patients in the current study. On parallel lines, other studies revealed primary infertility in 90.70% [7], 83.00% [9], and 77.00%[10] male patients. In the present study, varicocele was observed in 16.04%, erectile dysfunction in 4.28% and mumps orchitis in only 1 patient. In another study, varicocele was found in around 25% of patients [7] and in 18/447 patients [9]. In contrast to our study, another study reported erectile dysfunction was observed in 2.6% of patients. [7] Mumps orchitis was observed in 1.2% of patients in studies conducted by Shagufta Khan et al. [7] and by Rohit Kaushal et al.[9] in 1/447 patients.

Semen pH is an important factor in diagnosis of male factor infertility as the acidic pH is associated with obstruction in the ejaculatory duct. [11] The mean semen pH in this study was 7.95, which was above the lower reference limit given by WHO (7.2) [8].

In the current study, 10.16% of patients exhibited abnormal liquefaction time, a percentage that was relatively higher than the findings of another study where 8 out of 159 patients showed an extended

liquefaction time. [8] This study revealed that 11/187 patients had abnormal viscosity, which was also seen in a study conducted by Chitturi Ramya et al. [8] in 12/159 cases (>2 cm length). Sperm abnormalities and male infertility caused by sperm hyperviscosity are primarily attributed to several factors, including reduced sperm motility and diminished semen quality. [12]

The median total sperm count 35 million/ejaculate and the median total sperm concentration was 20 million/mL. In this study, the abnormal total sperm count was observed in 51.34 and the abnormal total sperm concentration in 45.45%. Similarly, abnormal sperm count was found in 63/159 male patients in another study conducted byChitturi Ramya [8].In a study conducted by Atul Jain et al. [13], the sperm count was <20 million/mL in the majority of the population (70%), while 20-40 million/mL in 26% of patients only.On the contrary, the results of another study revealed lower median total sperm count (22 million/ejaculate) and sperm concentration (11 million/mL) in infertile men. [7]

An abnormal count of WBC was detected in 11.23% of patients in the present study. This proportion aligned with the outcomes of a different study that indicated an elevated presence of pus cells in 18 out of 159 patients. [8] Elevated leukocyte count has been associated with abnormalities of sperm and male infertility. [12]

In this study, 63.64% had abnormal (<20 million) total motile sperms. Other studies reported 94% of patients having <50% motile sperms, out of which 46% had <25% motile sperms. [13] In another study conducted, the median total motile sperm count was significantly lesser in infertile patients as compared to fertile patients (37.5 vs. 83 million/ejaculate, p<0.001). [14]

Among the primary factors assessed in semen analysis, the correlation between motility and both pregnancy percentage and conception rate is notably more pronounced compared to the relationship between sperm concentration and these reproductive outcomes. [13] The results of the current study revealed abnormal total and progressive motility in 52.94% and 65.24% of patients, respectively.Contrary to this study, abnormal sperm motility was observed in a lower proportion of patients (24.5%) in a previous study. [8] The median total motility in the other study was 35% [7], which aligned with the mean total motility (35.50%) of the present study. In a study, significantly lower total sperm motility was observed in infertile patients than in fertile patients (55% vs. 62%, p<0.001). [14]

The results of this study revealed that abnormal sperm morphologywas observed in 34.76%; conversely, another study reported a higher number of patients with abnormal morphology (72%). [13] Also, another study reported that normal sperm morphology was significantly lower in patients with infertility than in those without (4 vs. 9, p<0.001). [14]While other study reported that only 1 patient had normal sperm morphology. [8] Therefore, these results indicate the possible variations in the presence of sperm morphologies among patients.

In this study, the greater number of patients with primary infertility (96.88 vs. 88.89%, p=0.031) consuming alcohol (9.38% vs. 2.20%, p=0.035) had abnormal sperm count as compared to normal sperm count. Similarly, a study conducted by Opoku Albert et al. the mean sperm count was significantly higher in secondary than in primary (43.31 vs. 36.44, p=0.045). [15]Likewise, alcohol addiction had a significant association with abnormal sperm count (p=0.004). [16]Another study reported a higher number of abnormal sperm count in patients consuming alcohol. [8] A review study on male infertility reports that lifestyle factors associated with male infertility include alcohol intake and smoking cigarettes. [17] This study reported a higher number of patients with smoking/tobacco consumption had abnormal sperm count than normal sperm count (28 vs. 20). However, this difference did not reach the level of significance.

The majority of the patients had normozoospermia (29.95%), followed by asthenozoospermia (18.18), oligoasthenozoospermia (13.37), azoospermia (12.83), and oligozoospermia (7.49)in this study.In previously reported studies by Chitturi Ramya et al. [8] and KalavathiBiradar et al. [16], normospermia was the most prevalent condition, accounting for 55.9% and 65.6% respectively, followed by oligoasthenozoospermia at 18.2% and oligospermia at 24.8%, while azoospermia ranged from 7.5% and 8.4%, and asthenozoospermia constituted 4.4% and 1.2% respectively.

In conclusion, this study provides a detailed overview of male infertility factors in the analyzed medical records. It highlights the prevalence of primary infertility, associations between certain factors (such as alcohol consumption) and abnormal sperm count, as well as the prevalence of abnormal sperm motility and morphology. The findings contribute to a better understanding of male infertility and could guide further research and interventions.

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