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ULTRASOUND-DETECTED TESTICULAR MICROLITHIASIS AND ITS ASSOCIATION WITH SEMEN QUALITY IN INFERTILE MEN FROM THE PESHAWAR REGION

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Abstract

Background: *Testicular microlithiasis (TM) is an ultrasonographic finding characterized by multiple tiny echogenic foci within the testicular parenchyma. It is frequently incidental, but its clinical significance in male infertility remains uncertain because published findings on semen quality are inconsistent and regional data from Pakistan are limited.*

Objective: *To determine the prevalence of ultrasound-detected TM and evaluate its association with semen quality among infertile men from the Peshawar region.*

Methods: *A descriptive cross-sectional study was conducted at Northwest General Hospital & Research Center, Peshawar. The study included 92 infertile men with documented scrotal ultrasonography and complete semen analysis records. Demographic, clinical, lifestyle, ultrasound, and semen data were collected using a structured form. Descriptive statistics and Spearman's rank correlation were used, and $p < 0.05$ was considered statistically significant.*

Results: *The mean age was 36.07 ± 5.77 years (range, 23-49 years). TM was present in 75 of 92 participants (81.5%) and absent in 17 (18.5%). Heat exposure was reported by 60 (65.2%), smoking by 43 (46.7%), previous infertility treatment by 69 (75.0%), and current medication use by 75 (81.5%). TM showed statistically significant positive correlations with sperm count category ($\rho = 0.382$, $p = 0.024$), motility category ($\rho = 0.447$, $p = 0.008$), and morphology category ($\rho = 0.371$, $p = 0.031$). The strongest observed association was with sperm motility.*

Conclusion: *TM was common in this cohort of infertile men and was significantly associated with the recorded semen-quality categories. The associations were mild to moderate and should be interpreted in the context of the cross-sectional design, the absence of a fertile control group, and the clinical characteristics of the study population. TM should therefore be assessed*

together with semen analysis, clinical history, and other infertility findings rather than used as an independent indicator of reproductive function.

INTRODUCTION

Testicular microlithiasis (TM), also termed testicular microlithiasis on sonography, is characterized by multiple tiny echogenic foci distributed within the testicular parenchyma. The finding is usually incidental during scrotal ultrasound and is commonly asymptomatic. Reported detection rates vary considerably, ranging approximately from 0.6% to 9% depending on the population examined and the reason for imaging. TM has been reported with cryptorchidism, testicular torsion, Klinefelter syndrome, hypogonadism, varicocele, hypospadias, testicular malignancy, and male infertility. These associations have sustained debate over whether TM is simply a benign sonographic variant or a marker of disturbed testicular structure and function [1,2].Sonographically, TM has been described according to the number of microcalcifications visible in an image. Classic TM generally refers to five or more microcalcifications per image, whereas limited TM contains fewer than five. This distinction has encouraged comparisons between men with and without TM and between different microlith burdens. Studies have examined semen concentration, motility, morphology, testicular volume, and hormonal profiles to determine whether the presence or severity of TM corresponds to functional impairment. However, the number of microliths has not consistently paralleled the degree of semen abnormality, and the clinical value of severity classification remains uncertain [1,3].The proposed relationship between TM and male infertility is biologically and clinically complex. Some studies describe lower sperm concentration, impaired motility, smaller testicular volume, and evidence of compromised spermatogenesis in men with TM, particularly in bilateral or classic disease [1,4,5]. Other studies have found limited, inconsistent, or clinically negligible effects. In a large general-population sample, TM was associated with only small changes in testicular volume and semen variables, while a systematic review concluded that the available observational literature did not provide consistent high-quality evidence that TM independently decreases semen parameters [3,6]. These differences may reflect heterogeneity in patient selection, TM definitions, infertility severity, imaging protocols, and outcome measurement.Semen analysis remains central to the evaluation of male fertility because it directly describes sperm count, motility, morphology, and volume. Scrotal ultrasound provides complementary information about the testes and can identify TM and other structural abnormalities relevant to infertility. The combined interpretation of imaging and semen findings is therefore more informative than treating TM as an isolated diagnosis. In men with unexplained infertility, the question is especially important: TM may indicate a testicular process related to impaired spermatogenesis, or it may simply coexist with infertility without being its cause [4,7].The clinical discussion is further complicated by the reported association between TM and testicular germ cell tumors. Evidence from infertile populations has shown an association between TM and testicular malignancy, although cross-sectional data cannot determine whether TM causes malignancy or marks an underlying testicular vulnerability [8]. Reviews addressing both pediatric and adult populations have emphasized that the prognostic value of an incidental finding remains uncertain and that risk assessment should consider additional clinical factors [9]. Consequently, overly aggressive investigation of isolated TM may expose patients to unnecessary anxiety and procedures, whereas an exclusively dismissive approach may overlook clinically important accompanying risk factors.Infertility itself carries substantial emotional, social, and clinical burden. Its evaluation is often complex because male and female factors may coexist and because clinical pathways are not always applied consistently [7]. Regional evidence is particularly important when environmental exposures, healthcare access,

patterns of referral, and prior treatment differ across populations. Local data on ultrasound-detected TM and semen quality among infertile men in Pakistan, especially in the Peshawar region, remain limited.Against this background, the present study was designed to determine the prevalence of ultrasound-detected TM among infertile men from Peshawar and to examine its relationship with the recorded semen-quality parameters, specifically sperm count, motility, and morphology. By combining scrotal ultrasound findings with semen analysis in a local clinical cohort, the study sought to clarify whether TM carried measurable reproductive significance in this setting.

MATERIALS AND METHODS

Study design, setting, and period

This descriptive cross-sectional study was conducted at Northwest General Hospital & Research Center, Peshawar. The dataset comprised 92 patients recorded from January 2025 to June 2025. The sample size was reported as calculated using RaoSoft software, and participants were selected through a non-probability convenience sampling approach.

Study population and eligibility

The study population consisted of infertile men who underwent scrotal ultrasonography as part of their infertility evaluation. Eligible records contained a complete semen analysis and documented the presence or absence of TM. The stated exclusion criteria were a history of testicular surgery, trauma, or infection affecting fertility; systemic disease known to affect semen quality, including diabetes or hormonal disorders; and current fertility medication or hormonal therapy.

Data collection and study variables

Hospital or clinic records were reviewed using a structured data collection form. The recorded variables included age, marital status, duration of marriage and infertility, history of testicular disease, systemic disease, current medication, previous infertility treatment, smoking, alcohol use, and heat exposure. Scrotal ultrasound records were reviewed for the presence or absence of TM. Semen records were reviewed for sperm count, motility, morphology, and semen volume. Only variables with reported results are included in this manuscript.

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences. Continuous variables were summarized using means, standard deviations, and ranges where reported; categorical variables were summarized as frequencies and percentages. Spearman's rank correlation was used to assess associations between TM and categorized sperm count, motility, and morphology. A two-tailed p-value < 0.05 was considered statistically significant.

Ethical considerations

Data collection proceeded through the Institutional Review Board and Ethical Committee of Northwest General Hospital. Patient information was obtained from clinical records and was reported in aggregate form.

RESULTS

Participant characteristics

A total of 92 infertile men were included. Their mean age was 36.07 ± 5.77 years, with an age range of 23-49 years. Most participants were married (87/92, 94.6%). The mean duration of marriage was 7.49 ± 4.70 years and the mean duration of infertility was 2.80 ± 1.35 years. Previous testicular disease was reported by 27 (29.3%), systemic disease by 32 (34.8%), current medication by 75 (81.5%), and previous infertility treatment by 69 (75.0%). Smoking was reported by 43 (46.7%), alcohol use by 12 (13.0%), and heat exposure by 60 (65.2%) participants (Table 1).

Table 1. Demographic, clinical, and exposure characteristics of the study population (n = 92)

Characteristic	Result
Age, years	36.07 ± 5.77 (range 23-49)
Married	87 (94.6%)
Unmarried	5 (5.4%)
Duration of marriage, years	7.49 ± 4.70 (range 0-27)
Duration of infertility, years	2.80 ± 1.35 (range 0-13)
History of testicular disease	27 (29.3%)
Systemic disease	32 (34.8%)
Current medication	75 (81.5%)
Previous infertility treatment	69 (75.0%)
Smoking history	43 (46.7%)
Alcohol use	12 (13.0%)
Heat exposure	60 (65.2%)

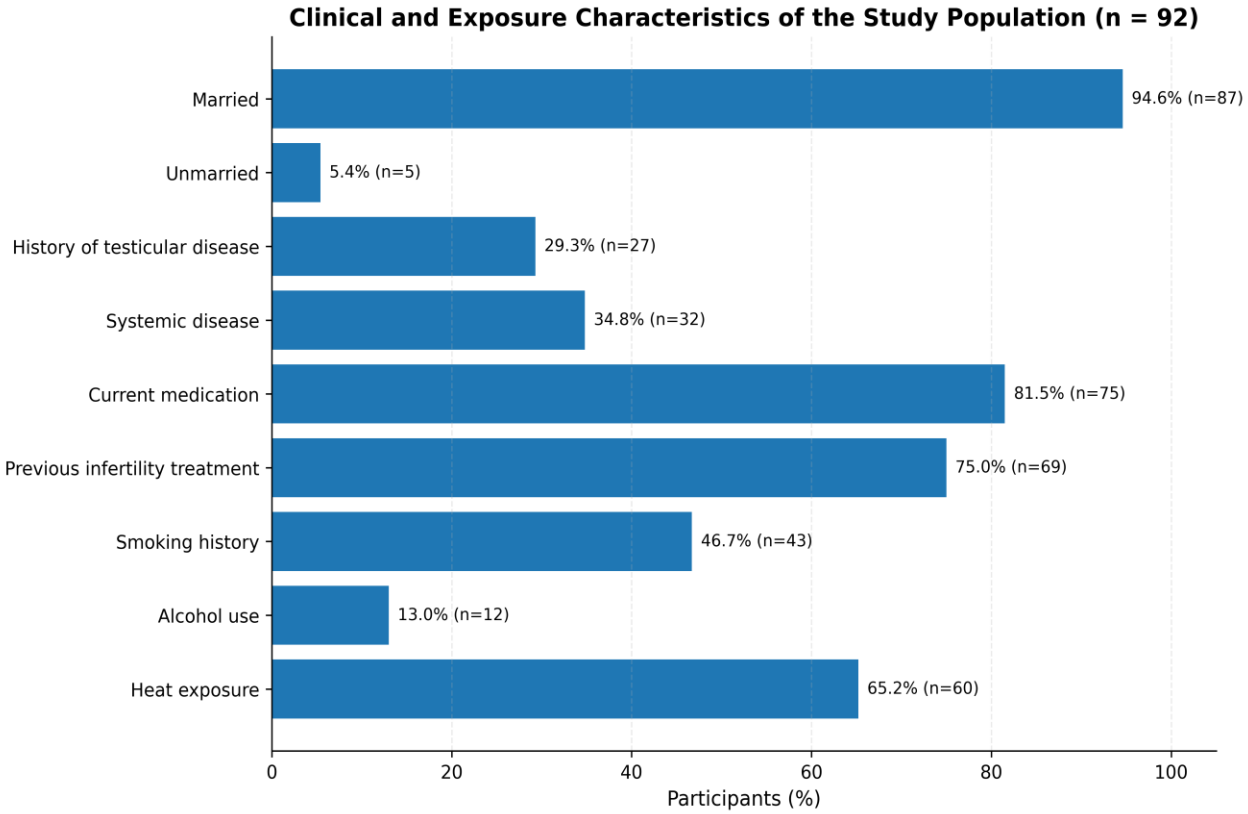

Figure 1 shows the clinical and exposure characteristics of the study population. Most participants were married (94.6%), currently using medication (81.5%), and had received previous infertility treatment (75.0%). Heat exposure was reported by 65.2%, while smoking and alcohol use were reported by 46.7% and 13.0% of participants, respectively.

Prevalence of testicular microlithiasis

TM was detected on scrotal ultrasound in 75 of 92 participants (81.5%); it was absent in 17 (18.5%) (Table 2). Thus, more than four-fifths of this clinic-based cohort had ultrasound-detected TM.

Table 2. Ultrasound-detected testicular microlithiasis (n = 92)

TM status	Frequency	Percentage
Present	75	81.5
Absent	17	18.5
Total	92	100.0

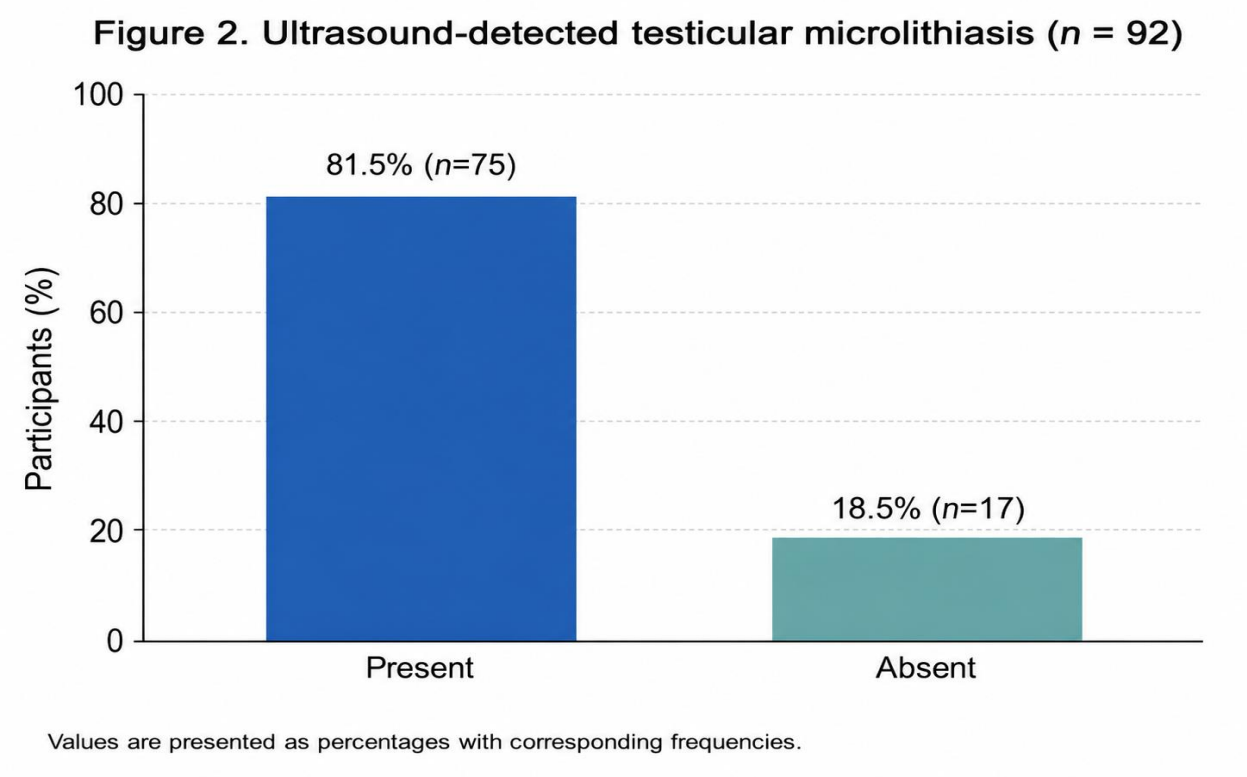

Figure 2 shows the frequency of ultrasound-detected testicular microlithiasis in the study population. Testicular microlithiasis was present in **75 participants (81.5%)** and absent in **17 participants (18.5%)**, indicating that the majority of subjects had ultrasound evidence of testicular microlithiasis.

Association between TM and semen-quality parameters

Spearman's analysis demonstrated statistically significant positive correlations between TM and all three reported semen-quality categories. The correlation was $\rho = 0.382$ for sperm count ($p = 0.024$), $\rho = 0.447$ for motility ($p = 0.008$), and $\rho = 0.371$ for morphology ($p = 0.031$). The largest correlation coefficient was observed for motility (Table 3).

Table 3. Spearman correlations between testicular microlithiasis and semen-quality categories (n = 92)

Semen parameter	Spearman's ρ	p-value	Interpretation
Sperm count category	0.382	0.024	Significant positive
Motility category	0.447	0.008	Significant positive
Morphology category	0.371	0.031	Significant positive

Figure 3 shows significant positive correlations between testicular microlithiasis and all semen-quality categories. The strongest correlation was observed with motility (ρ = 0.447, p = 0.008), followed by sperm count (ρ = 0.382, p = 0.024) and morphology (ρ = 0.371, p = 0.031).

DISCUSSION

This study examined ultrasound-detected TM and semen quality in 92 infertile men from the Peshawar region. Three findings are central. First, TM was recorded in 81.5% of participants, making it a common finding in this clinic-based sample. Second, the cohort had substantial frequencies of heat exposure, smoking, medication use, and previous infertility treatment, all of which are important when interpreting the observed ultrasound and semen profiles. Third, TM showed statistically significant positive correlations with sperm count, motility, and morphology categories. These coefficients were mild to moderate, with the strongest association observed for motility. The results therefore demonstrate an association within this cohort, but they do not establish TM as a cause of better or worse spermatogenesis.The prevalence of TM in this study was markedly higher than the ranges discussed in previous literature. TM detection is known to vary with the population, referral setting, ultrasound use, and diagnostic definition [1,2]. Because the present sample was drawn from men already undergoing infertility evaluation at a single center, it cannot be compared directly with a community sample. The absence of a fertile control group also prevents determination of whether the observed prevalence is specific to infertile men or reflects characteristics of men referred in the Peshawar region. Nevertheless, the result establishes that TM was frequently documented among the men included in this dataset and supports the need for region-specific evidence.The clinical profile of the cohort may

help explain why direct comparisons with other studies are difficult. Heat exposure was reported by 65.2%, smoking by 46.7%, systemic disease by 34.8%, current medication by 81.5%, and previous infertility treatment by 75.0%. These characteristics may represent sources of testicular stress or confounding influences on semen quality. They may also reflect the referral pattern of a population that had already sought care for infertility. Because the study did not perform adjusted multivariable analysis, the independent contribution of TM cannot be separated from these clinical and lifestyle factors.Several studies have linked TM with impaired reproductive function. D'Andrea and colleagues reported clinical and seminal differences associated with TM and its severity among men from infertile couples [1]. Rassam and colleagues found impaired spermatogenesis in patients with unexplained infertility and TM [4]. Previous literature also describes associations with smaller testicular volume, lower sperm concentration, and reduced motility, particularly in bilateral or classic TM [5]. These observations support the view that TM may be a marker of disturbed seminiferous tubular function or an underlying testicular process.Other evidence is less definitive. Anvari Aria and colleagues examined TM in a large population of young men and described associations with semen quality, but the reported clinical effect was limited [6]. Wilson and colleagues, in a systematic review, concluded that the available observational studies did not consistently show a clinically meaningful reduction in semen parameters among men with TM [3]. A large retrospective analysis of infertile men found that incidental TM was not associated with significant differences in seminal parameters or with antisperm antibody positivity [13]. Together, these findings show that the relationship between TM and semen quality is heterogeneous rather than uniform.The positive direction of the correlations in the present dataset differs from the commonly expected interpretation of TM as a negative sign. TM may sometimes be an epiphenomenon or marker of cellular turnover, inflammation, injury, or another process within the testis rather than a direct determinant of sperm production. Zhou and colleagues similarly presented TM through both imaging and physiological perspectives and emphasized that its meaning may depend on the underlying testicular state and the population being studied [10]. Under this framework, the presence of microliths alone does not define the degree of spermatogenic function. This interpretation is compatible with the mild-to-moderate coefficients observed here and with the lack of a design capable of establishing causation.Patient selection across studies is particularly important. Barda and colleagues studied azoospermic men and reported that TM identified a subgroup with lower sperm retrieval rates [11]. That population represents a severe end of male-factor infertility and differs from a general clinic sample of infertile men. A marker that has prognostic value in azoospermia or testicular sperm extraction may not show the same relationship in a broader group that includes men with varying sperm counts. The present findings therefore should not be used to contradict results from highly selected azoospermic cohorts; rather, they illustrate how the meaning of TM may change across the infertility spectrum.Geographic context is another relevant consideration. Sheyin and Chom documented TM among men with primary infertility in Nigeria, demonstrating that the finding is not limited to Western or East Asian populations [12]. The current study adds quantitative ultrasound and semen-correlation data from Peshawar. However, the high TM frequency should be interpreted cautiously until it is reproduced using standardized definitions, prospective recruitment, and a fertile comparison group. Differences in environmental exposure, occupational heat, smoking, patterns of treatment, referral pathways, and ultrasound interpretation may all contribute to regional variation.The findings have practical implications for infertility assessment. Semen analysis should remain the primary method for describing fertility-related sperm parameters, while TM should be interpreted alongside the clinical history, examination, and other ultrasound findings. The presence of TM alone should not

be treated as an independent measure of infertility severity. At the same time, TM may be clinically relevant when accompanied by testicular atrophy, cryptorchidism, a personal or family history of testicular germ cell tumor, or other recognized risk features [8,9]. This balanced approach avoids both unnecessary alarm for isolated TM and dismissal of relevant accompanying abnormalities.The study has several limitations. It was conducted at a single center with a modest sample of 92 men and did not include fertile controls. Testicular volume and hormonal measures such as follicle-stimulating hormone, luteinizing hormone, and testosterone were not recorded in the reported results. A large proportion of participants had received infertility treatment or were taking medication, but treatment details were unavailable. The cross-sectional design does not establish temporal or causal relationships, and the analysis did not adjust for smoking, heat exposure, systemic disease, treatment, or other potential confounders. The use of categorized semen variables also limits interpretation of the magnitude of change in the original continuous measurements.Despite these limitations, the study provides an initial dataset from an underrepresented region and combines scrotal ultrasound with semen-analysis findings in the same participants. Future work should use larger multicenter samples, include fertile comparison groups, record testicular volume and hormonal profiles, document occupational and environmental exposures in greater detail, and follow participants longitudinally. Standardized reporting of TM presence, laterality, burden, and semen values would make results more comparable across populations and would help clarify whether TM is a causal factor, a marker of testicular stress, or an incidental imaging finding.

CONCLUSION

Ultrasound-detected TM was present in 81.5% of the 92 infertile men included in this Peshawar cohort. TM showed statistically significant positive correlations with sperm count, motility, and morphology categories, with coefficients in the mild-to-moderate range. These findings indicate that TM was associated with semen-quality measures in this study but do not support using TM alone as a direct indicator of impaired or preserved fertility. Clinical interpretation should integrate semen analysis, patient history, relevant risk factors, and other ultrasound findings. Larger multicenter and longitudinal studies with fertile controls, hormonal assessment, testicular volume, and detailed exposure data are needed to define the reproductive significance of TM more clearly.

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ETHICS APPROVAL

Approval was obtained through the Institutional Review Board and Ethical Committee of Northwest General Hospital.

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