Is There Any Relationship Between Sleeping Position and Varicocele?

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Purpose: Varicocele is the abnormal dilatation of the veins of the pampiniform plexus, which is considered one of the most common factors related to infertility in men. The aim of the present study was to investigate whether a relationship exists between sleeping position and the presence of varicocele.

Materials and Methods: In this case-control study, 231 adult infertile men who were referred to the Kowsar Infertility Center, Yasuj, Iran, were divided into two groups: a control group including 113 infertile patients without varicocele, and a case group of 118 infertile patients with varicocele. After the first visit by the urologist and determining the presence or absence of varicocele, as well as the clinical grading of the varicocele, the patients completed demographic, clinical, and sleep position questionnaires.

Results: The findings of the current study indicated a significant relationship between the presence of varicocele and the faller-down (lying on the abdomen) sleeping position. There was also a significant positive correlation between this position and the degree of varicocele (p =0.003).

Conclusion: The faller-down or prone position during sleep has a meaningful relationship with varicocele, which may be due to increased intra-abdominal pressure. More studies are needed to confirm this hypothesis.

Keywords: prone position; varicocele; intra-abdominal pressure; male infertility

INTRODUCTION

Varicocele, characterized by the abnormal dilatation and enlargement of the pampiniform venous plexus within the testicle, is the most important cause of male infertility. Approximately 15% to 20% of men within reproductive age have varicocele[(1)]. Despite the fact that numerous men with varicocele retain normal fertility levels, its occurrence in men facing infertility issues is notably higher, reaching proportions of 30% to 40%[(2)].

The etiology of varicocele is complex and attributed to a variety of mechanisms. Factors such as elevated scrotal temperature, increased pressure within the testes, reflux of toxic metabolites, hypoxia, an abundance of reactive oxygen species, and hormonal influences are among the proposed contributors[(2)]. A prominent hypothesis explaining the pathogenesis of varicocele is focused on the testicular thermal regulation theory. Scrotal warming occurs due to the inflow of heated blood from the abdominal region, potentially stemming from dysfunctional or absent valves in the internal and external spermatic veins[(3)]. Consequently, there is a rise in the venous pressure within the spermatic plexus, leading to elevated hydrostatic pressures. These observations suggest an impairment in the venous system's ability to properly regulate blood flow[(4)]. Such impairment could result from persistent narrowing of the spermatic vessels, which may be triggered by an accumulation of toxic substances secreted by the adrenal glands. The role of oxidative stress, driven by an imbalance between reactive oxygen species (ROS) and antioxidant defenses, is increasingly implicated in the context of male infertility. Varicocele is linked with both heightened ROS levels and a reduction in anti-oxidative capacity. Yet, given that similar ROS levels are found in both fertile and infertile men, it remains ambiguous whether ROS plays a causative role or is a secondary effect. Additionally, oxidative stress has been correlated with an increase in DNA fragmentation seen in varicocele patients[(5)].

If clinical signs such as a detectable varicocele, an abnormal spermogram test, and a partner with normal fertility are present, varicocelectomy may be considered as an initial treatment option. This approach is supported by guidelines suggesting that treatment should be considered when a palpable varicocele is accompanied by abnormal semen parameters and the couple is attempting to conceive[(6)]. However, the role of surgical intervention for varicocele in enhancing fertility and the criteria for its implementation remain subjects of debate.

Previous research has demonstrated that testicular temperature can rise during sleep due to restrictive clothing and reduced movement, which impedes cooling. Furthermore, observations indicate that individuals with azoospermia or oligozoospermia who experienced lower testicular temperatures overnight in a controlled lab setting exhibited marked enhancements in sperm quality within a three-month period[(7-9)]. These findings suggest that the sleeping posture of an individual may contribute to the development or mitigation of varicocele by influencing testicular temperature and blood flow. Therefore, the aim of the present study was to investigate whether a relationship exists between sleeping position and the presence of varicocele. If a relationship between any specific sleeping position and varicocele is proven, necessary recommendations should be made to prevent the adoption of that position during sleep.

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Table 1. Comparison of demographic characteristics in the control and varicocele groups.

Group Variable		Control (n=118)	Varicocele (n=113)	*P* value
Age(year)*		33.3 ± 5.79	33.86 ± 5.58	0.38
Occupation**	Unemployed	19 (16.1)	11 (9.73)	0.008
	Self-employed	65 (55.09)	59 (52.21)	
	Government employed	34 (28.81)	43 (38.05)	
	Long standing	10 (8.47)	33 (29.2)	
	Long sitting	10 (8.47)	10 (8.84)	
Education#	Elementary and middle school	7 (5.94)	5 (4.42)	0.83
	High school	51 (43.22)	52 (46.01)	
	University	60 (50.84)	56 (49.55)	
BMI *		26.01 ± 4.38	26.92 ± 3.61	0.51
Regular smoking during the day **		38 (32.2)	41 (36.21)	0.11
Regular alcohol consumption **		7 (5.94)	11 (9.73)	0.53

*mean ± SD (independent *t*-test)
**n(%) X2
#n(%) (Mann-Whitney test)

MATERIALS AND METHODS

Design and data collection

This was a case-control study of men who attended the Kowsar Infertility Clinic, Yasuj, Iran, from January to September 2023. This clinic is the only referral center for infertility in the province. Considering the lack of a similar study and the prevalence of varicocele during the last year in our clinic, the sample size of the current study is 231 people (118 men with infertility in the control group and 113 men with infertility in the varicocele group). After explaining the aim of the study, written informed consent was obtained from each participant who volunteered to participate, and the questionnaires were distributed and completed. It was approved by the Ethics Committee of Yasuj University of Medical Sciences, Iran (IR.YUMS.REC.1401.093).

Inclusion criteria included infertile Iranian men aged 20 to 40 years who were willing to participate in the study. Exclusion criteria included the presence of underlying diseases (such as diabetes, hypertension, drug addiction, and obstructive diseases of the genital tract), cryptorchidism, endocrine hypogonadism, vasectomy, hydrocele, genital tract obstructions, karyotype anomalies (microdeletion of the Y chromosome), and a history of radiotherapy or chemotherapy, determined by patient interview and medical record review, as well as an unwillingness to participate during sampling.

Description of study

All of the participants with abnormal semen parameters based on the results of the spermogram and the 6th edition of the WHO manual, published in 202[10] ("Semen volume less than 1.5 ml, total sperm count less than 39 million, sperm concentration less than 15 million/ml, progressive motility less than 32%, normal morphology less than 4%"), underwent examination by a single experienced urologist to confirm the diagnosis of varicocele. After explaining the study objectives to appropriate participants who met the inclusion criteria and obtaining written consent from each participant, the study included 231 infertile men, with 113 in the varicocele group and 118 in the control group. This sample size was considered sufficient to detect a moderate effect size (Cohen's d ≈ 0.5) between groups with 80% power at a 5% significance level. Although no directly comparable studies were available for a formal sample size calculation, this number of participants allows preliminary comparisons and provides meaningful estimates of associations.

The severity of varicocele was stratified based on the Amelar-Dubin system as follows[9]: mild (grade 1): palpable only during the Valsalva maneuver; moderate (grade 2): easily palpable without the need for the Valsalva maneuver; severe (grade 3): large and visible without the need to touch.

Measures

Participants were requested to complete the study measures in the clinic. The following measures were evaluated in each group:

1. Demographic and reproductive information including age, occupation, and BMI were collected.
2. Body mass index (BMI): calculated as weight divided by height squared (kg/m^2) for all men.
3. Socio-demographic status: The study used years of formal education as a measure of socioeconomic status, categorized into five levels: no education, first level (1 to 5 years), second level (6 to 9 years), third level (10 to 12 years), and fourth level (more than 12 years). Donyavi et al. (2011) showed that education is a good proxy measure for socioeconomic status for Iranians.
4. Sleep position: Each sleep position was analyzed along four dimensions: the position of the head, trunk, legs, and arms. Based on the study by Li et al.[11], 10 sleep positions were proposed to the patients, and they selected their typical sleep position (**Figure 1**).

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. The study was approved by the Ethics Committee of Yasuj University of Medical Sciences, Iran (IR.YUMS.REC.1401.093).

Statistical analysis

Demographic data of the groups were expressed as mean ± SD or number (percentage), and a comparison of these data was performed using chi-square, Fisher's exact, Mann-Whitney U, and independent t-tests. The association between variables was assessed using the chi-square test or Fisher's exact test, depending on the sample size and expected cell frequencies. We assessed the homogeneity of variance using Levene's test, which evaluates whether the variances between groups are equal—a key assumption for the independent t-test. The results of Levene's test confirmed that the assumption of equal variances was met ($p > 0.05$). The Kolmog-

Table 2. Comparison of sleeping posture in the control and varicocele groups.

Variable *	Varicocele N=113			Control N=118	*P* value
	Mild N=36	Moderate N=25	Severe N=52		
Fetal Left	3 (8.33)	1 (4)	3 (5.76)	18 (15.25)	0.62
Proportion differences (vs Control)	-6.92	-11.25	-9.49		
Odds ratios (95% CI)	0.51 (0.14-1.82)	0.23 (0.03-1.82)	0.34 (0.10-1.21)		
Fetal Right	12 (33.33)	5 (20)	10 (19.23)	27 (22.68)	0.18
Proportion differences (vs Control)	10.65	2.68	3.45		
Odds ratios (95% CI)	1.69 (0.75-3.81)	0.84 (0.29-2.46)	0.80 (0.36-1.81)		
Log Left	0	1 (4)	1 (1.92)	2 (1.68)	0.61
Proportion differences (vs Control)	1.68	2.32	0.24		
Odds ratios (95% CI)	0.00 (0.00-3.61)	2.44 (0.21-28.70)	1.15 (0.14-9.26)		
Log Right	0	1 (4)	2 (3.84)	3 (2.52)	0.47
Proportion differences (vs Control)	2.52	1.48	1.32		
Odds ratios (95% CI)	0.00 (0.00-3.08)	1.62 (0.25-10.47)	1.54 (0.35-6.76)		
Yearner Left	3 (8.33)	3 (12)	6 (11.53)	15 (12.6)	0.76
Proportion differences (vs Control)	4.27	0.60	1.07		
Odds ratios (95% CI)	0.64 (0.18-2.29)	0.94 (0.27-3.22)	0.90 (0.37-2.19)		
Yearner Right	8 (22.22)	7 (28)	10 (19.23)	26 (21.8)	0.59
Proportion differences (vs Control)	0.42	6.20	2.57		
Odds ratios (95% CI)	1.02 (0.43-2.41)	1.39 (0.54-3.61)	0.85 (0.38-1.89)		
Soldier Up	3 (8.33)	3 (12)	5 (9.61)	8 (6.72)	0.92
Proportion differences (vs Control)	1.61	5.28	2.89		
Odds ratios (95% CI)	1.27 (0.32-4.96)	1.88 (0.46-7.73)	1.46 (0.49-4.32)		
Faller Up	6 (16.66)	1 (4)	3 (5.76)	6 (5.04)	0.16
Proportion differences (vs Control)	11.62	1.04	0.72		
Odds ratios (95% CI)	3.73 (1.12-12.41)	0.78 (0.09-6.71)	1.15 (0.30-4.46)		
Soldier Down	0	0	4 (7.69)	7 (5.88)	0.14
Proportion differences (vs Control)	5.88	5.88	1.81		
Odds ratios (95% CI)	0.00 (0.00-2.61)	0.00 (0.00-3.21)	1.33 (0.39-4.59)		
Faller Down	1 (2.77)	3 (12)	8 (15.38)	6 (5.04)	0.01
Proportion differences (vs Control)	2.27	6.96	10.34		
Odds ratios (95% CI)	0.53 (0.06-4.48)	2.58 (0.77-8.69)	3.39 (1.11-10.34)		

*n(%) X^2

orov-Smirnov test yielded a p-value greater than 0.05, confirming a normal data distribution and thereby justifying the use of the independent *t*-test.

Results from the final model are presented as an odds ratio with a 95% confidence interval. *P* values less than 0.05 were considered significant for all analyses. All data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 21; SPSS, Chicago, IL).

RESULTS

The study sample

Over a period of one year, 231 patients were recruited to the study. The socioeconomic and clinical characteristics of the patients are presented in (**Table 1**). There were no statistically significant differences between the two groups according to age, BMI, and gravida. The occupational analysis revealed that individuals with long-standing job roles had a significantly higher likelihood of varicocele (OR = 4.44, 95% CI: 2.08-9.47, $p = 0.008$), indicating a clinically important occupational risk factor.

Comparing the frequency of sleeping positions in the studied groups showed that, based on chi-square analysis, the prevalence of fetal (left and right), log (left and right), yearner (left and right), faller up, soldier up, and soldier down positions between the studied groups had no statistically significant differences. However, the faller-down position demonstrated a clinically significant increase in the severe varicocele group, supported by an odds ratio of 3.39 (95% CI: 1.11-10.34, $p = 0.01$), indicating that patients with severe varicocele were over three times more likely to exhibit this condition compared to controls (**Table 2**). The chi-square analysis confirmed a significant difference in the faller-down position between the groups ($p = 0.01$). Further pairwise comparisons demonstrated statistically significant differences in the faller-down position between the control group and those with varicocele of mild to moderate ($p = 0.008$), moderate to severe ($p = 0.003$), and severe ($p = 0.02$) grades.

DISCUSSION

This study evaluated different sleeping positions in varicocele patients compared to infertile men without varicocele for the first time. In the current study, sleeping positions were classified as fetal (left and right), log (left and right), yearner (left and right), faller (up and down), and soldier (up and down) positions. The results showed that the faller-down position (prone) was significantly higher in the varicocele group than in the control group; also, this position showed a positive correlation with the degree of varicocele.

To the best of our knowledge, unfortunately, no study was found comparing different sleep positions in patients with varicocele compared to normal subjects. Therefore, the results of some related studies were used to compare with the findings of the current research.

A varicocele is generally characterized by a spermatic vein reflex that leads to dilation of the pampiniform venous plexus[12]. The relationship between the faller-down position and varicocele can be explained as follows.

On one hand, studies have shown that a small increase in intra-abdominal pressure (IAP) during inspiration can be sufficient to reverse the flow in the spermatic vein and provide the basis for varicocele formation. In one study, it was shown that in the prone position, the IAP increases from 10 ± 3 in the supine position to 13 ±

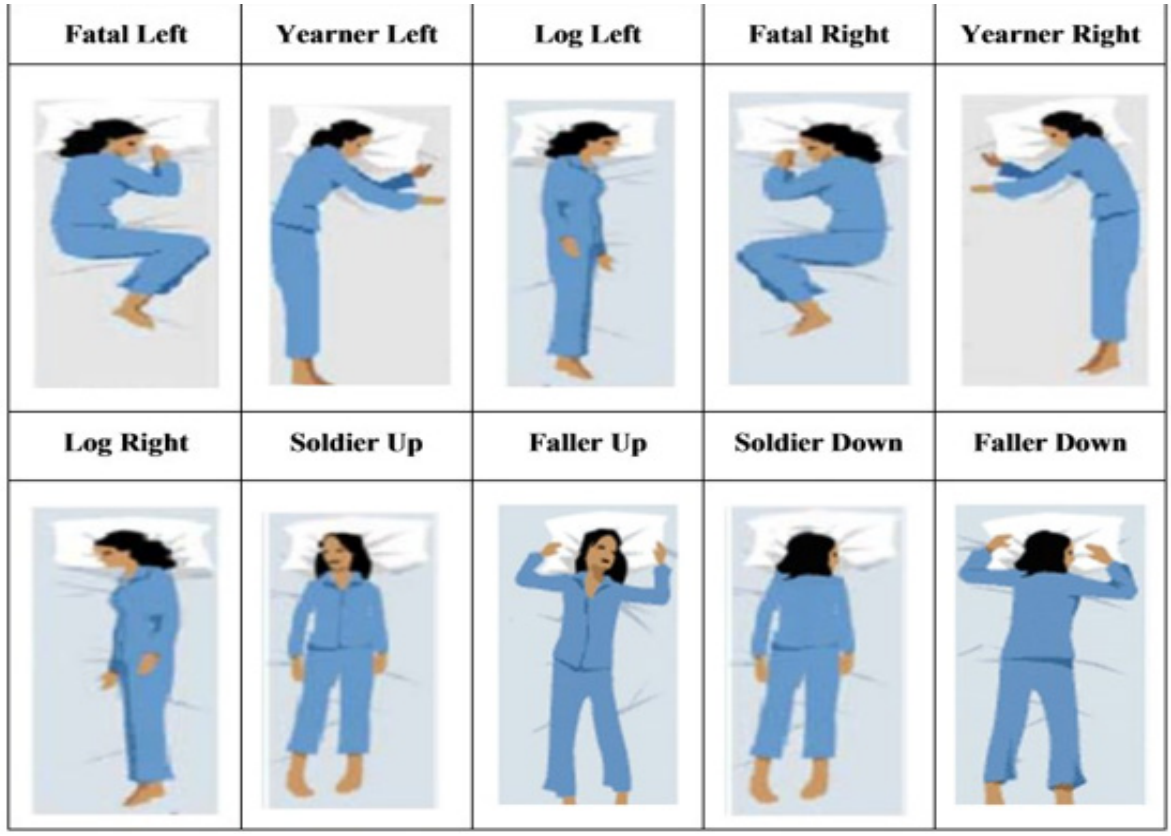

Figure 1. Diagram of sleeping positions.

4 in the prone position. In addition, an increase in IAP is associated with various physiological changes, such as an increase in central venous pressure, an increase in pulmonary capillary wedge pressure (PCWP), systemic vascular resistance, a decrease in venous return, and a decrease in visceral, kidney, and glomerular blood flow[13]. This increase in pressure may be limited, but in the long term, from adolescence to adulthood, considering that a person spends more than a third of his life asleep, it can have adverse effects on the development of varicocele. Consistent with our data, Erdogmus et al. investigated the relationship of varicocele with chronic obstructive pulmonary disease (COPD), and they suggested that people use abdominal muscles to overcome the problem of exhalation, the result of which is an increase in intra-abdominal pressure, which causes a decrease in the venous return of the scrotum. Finally, it was found that COPD is related to the occurrence of varicocele, which shows the effect of increased abdominal pressure in varicocele[14]. Also, Turgut et al. investigated the relationship between chronic constipation and varicocele, which can be effective in causing varicocele due to the effect of increased abdominal pressure caused by chronic constipation[15].

On the other hand, Jung et al. (2003) showed that the temperature of the scrotal sac was clearly higher in the prone position compared to the supine position. Interestingly, although this study was not conducted on people with varicocele, the study showed that in the left testicle—which is the most common side of varicocele—the temperature was significantly higher. Therefore, it is possible that high temperature is effective in the occurrence of varicocele, which needs more research[16]. Also, Lerchl and his colleagues found that the temperature of the scrotum was clearly higher during the night than during the day[17]. Therefore, one of the factors that determine the temperature of the scrotum is the position of night sleep because the sleep periods make up almost a third of the day, which is associated with an increase in the temperature of the scrotum up to 36 degrees Celsius. The scrotum can partially resist temperature changes, but during sleep and with changes in position, significant differences in the temperature of the scrotum are created[18].

In previous studies, testicular temperature in people with varicocele was clearly 0.6 to 0.8 degrees Celsius higher than in the healthy group[19]. It is known that infertile men with varicocele have a higher scrotal temperature(20). Moreover, Chen and his colleagues have shown that infertile people with varicocele have lower testicular volume, lower blood flow velocity, and higher scrotal temperature[3]. Scrotal hyperthermia is a significant risk factor for male infertility. Heat stress is considered a main factor in causing oxidative stress in the testicles of people with varicocele[18]. In 2015, Garolla and his colleagues came to the conclusion that there is a disturbance in the heat stress inhibition system in men with varicocele, especially those with changes in sperm parameters[21]. In addition, this study showed that in normozoospermic volunteers and those with oligospermia, the nighttime temperature of the scrotum was very high and reached 36 degrees, which indicates the effect of sleeping on the temperature of the testicles[21]. The result of this study is consistent with all of the above-mentioned studies regarding the increasing prevalence and grade of varicocele in the prone posi-

tion during sleep.

Transient scrotal hyperthermia in today's modern lifestyle is likely to have a negative effect on spermatogenesis, especially in men of reproductive age who desire to have children. Long hours of exposure to genital heat stress factors intensify their effects on semen quality and sperm parameters. However, simple but significant steps can be taken by individuals to help reduce the harmful effects of heat stress on male fertility. The present study suggests a change in sleep posture as a cost-effective treatment option to improve semen quality. However, the superior outcome parameter for pregnancy rates would still be semen quality. According to the above-mentioned findings, it seems that the position of a person during sleep is a cause or preventive factor for the occurrence of varicocele through its effects on testicular temperature, ventilation, and IAP. Considering the high prevalence of varicocele in infertility patients and the cost imposed on the healthcare system, if the relationship between sleeping position and varicocele is proven, it is possible to prevent such a complication to some extent.

The primary strength of our study is its novelty, being the first to investigate the relationship between sleep position and varicocele. However, there are several limitations to consider. The sample size is relatively small, with only 12 varicocele patients adopting the faller-down sleep position among 113 participants, and the ethnic composition of the groups may affect the findings. A significant potential limitation of this study design is recall bias, as participants' recollections of their habitual sleep positions may be inaccurate, especially given that individuals typically change positions approximately four times per hour during sleep. Employing objective measures, such as continuous video monitoring (e.g., closed-circuit television), could provide more reliable data. Furthermore, since the study population comprises exclusively infertile men, the findings may not be generalizable to the broader fertile male population. Although no directly comparable studies were available for sample size calculation in the present study, it seemed that our participants allowed for preliminary comparisons and provided meaningful estimates of associations. Future studies with larger samples may further validate these findings.

CONCLUSIONS

The findings of this study suggest that sleeping in a prone or faller-down position is significantly associated with varicocele. This relationship may be explained by an increase in abdominal pressure when lying down. This hypothesis is based on the observed correlation between sleep position and varicocele presence. Therefore, in a further controlled prospective study, the effect on pregnancy rates should be evaluated.

SUMMARY

This study found that men who sleep on their stomach (prone position) are more likely to have varicocele, a vein problem linked to infertility. This sleeping position may increase abdominal pressure and worsen varicocele, but more research is needed.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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DATA AVAILABILITY STATEMENT

Data will be made available upon reasonable request.

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