Evaluation of Inguinoscrotal Pathologies Among Adolescents With Special Emphasis on Association Between Varicocele and Body Mass Index

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Purpose: To investigate the prevalence of inguinoscrotal pathologies among a stable population in adolescent age and the association between varicocele and some somatometric features.

Materials and Methods: A computerized database of 12581 candidates for junior officer studentship in a military college examined from 2002 to 2009 was assessed, and prevalence of inguinoscrotal pathologies as well as relationship of varicocele with weight, height, and body mass index (BMI) were evaluated in a relatively stable group regarding the body status.

Results: Of the applicants, 1424 (11.32%) were affected by at least one inguinoscrotal pathology. Including patients surgically treated, the most common disease was varicocele (5.96%), 98% of which were left-sided, followed by inguinal hernia (3.85%), predominantly located on the right side (55.5%), and undescended testis (0.76%). Younger applicants were more prone to have lower BMI ($P = .0001$) and varicocele than the older group ($P = .036$). The presence of varicocele was significantly associated with height ($P = .0001$) and inversely correlated with BMI ($P = .0001$), but not with weight ($P = .08$). Logistic regression analysis showed that lower age and greater height were significant predictors for the occurrence of varicocele in this relatively homogenous population regarding the somatometric features.

Conclusion: Varicocele, being the most common inguinoscrotal pathology in adolescent age, was found to be highly correlated with age, height, and BMI.

Keywords: varicocele, body mass index, epidemiology, prevalence, inguinal hernia

INTRODUCTION

Male infertility is highly associated with genitourinary disorders, which is almost always thought to be congenital. In prevalence studies, patients with inguinoscrotal pathology (ISP) are rather newborn and children. However, it is true that male infertility and sexual dysfunction become problematic in young adolescent and adult people. Except varicocele, which is treated only in highly selected cases, correction of almost all inguinoscrotal abnormalities during childhood aims avoiding potential infertility or restoration and maintenance of reproductive activity.

Varicocele is abnormal dilation of the veins of plexus pampiniformis within the spermatic cord, and one of the most important causes of male infertility. Its prevalence was reported to be as high as 15% to 20% in general population.[1] The definite etiology of varicocele remains still unknown. Furthermore, there are conflicting results regarding its association with somatometric parameters, such as age, weight, height, body mass index (BMI), and secondary sex characters.[2-9]

The prevalence of ISP among adolescent individuals has not been properly documented due to the lack of proper record-keeping in Turkey. The aim of this study was to determine the spectrum and prevalence of ISP in a defined population, specifically focusing on varicocele to identify its relationship with age and BMI as a function of height and weight. In that period, our institution was a principal reference hospital undertaking health check for military high school candidates coming from all regions of our country after elimination by a matriculation. Therefore, our results would likely be a fair presentation of the genuine cross-sectional prevalence of these pathologies among adolescent population anticipated to be physically fit in our country.

MATERIALS AND METHODS

This study was conducted retrospectively using computerized database records obtained from applications for junior officer studentship at Balikesir Military Hospital from August 2002 through August 2009. Elected after a matriculation and examination composed of complete health check and fitness test, all the students were being submitted to a training procedure in a military college for two years.

The age of all the volunteer participants was recorded, and their BMI was calculated from the weight (kg)/height (m^2). After a 12-hour overnight fasting, their blood and urine samples were collected for whole blood count, urinalysis, hepatitis markers, and blood chemistry early morning. Their chest and plain abdominal radiograms were taken and checked by radiologists.

A formal medical council consisting of twelve specialists (internal medicine specialist, general surgeon, chest diseases' specialist, dermatologist, urologist, ophthalmologist, ear, nose, and throat specialist, neurologist, psychiatrist, infectious diseases' specialist, cardiologists, and orthopedist) examined all the applicants. During the procedure, special attention was paid to any inguinoscrotal disorder by both general surgeon and urologist. Examinations were performed in a well-lighted room in ambient temperature while the subject was in an upright relaxed position and subsequently performing a Valsalva maneuver. Both surgeon and urologist examined and recorded together all disorders noticed at the inguinoscrotal region, if any. In case of any suspicion or doubt on diagnosis, ultrasonography, computed tomography, or other complementary tests were referred when necessary.

Diagnosis of varicocele was only based on physical examination findings; however, stratification by grade was not made. An incision scar from a previous inguinoscrotal surgery in any of the applicants was accepted as the presence of this entity; however, asymptomatic and successfully treated.

Finally, all candidates and their exams were re-examined in a health council consisted of ten specialists in order to check their health conditions for the last time. Those with any physical or biochemical disorders were eliminated.

Compiled all records, total number of examined population was noted as well as total number of ISP, such as inguinal hernia, undescended testis, and varicocele. Thereafter, percentages and prevalence of detected inguinoscrotal disorders were calculated. Numeric results were expressed as mean ± standard deviation unless otherwise stated. Categorical variables were evaluated using Chi-Square test. The comparison of continuous variables, such as age, height,

weight, and BMI, was made by descriptive statistics, independent samples *t* test, and multivariate logistic regression analysis by stepwise regression, when appropriate. All analyses were performed using SPSS software (the Statistical Package for the Social Sciences, Version 14.0, SPSS Inc, Chicago, Illinois, USA). *P* values less than .05 were considered as statistically significant.

RESULTS

A total of 12684 candidates for junior officer studentship were enrolled in this study. Of those, 103 (0.8%) were excluded as they did not complete whole examination protocol. The study was conducted on the remaining 12581 candidates. Overall 7754 (61.63%) candidates were completely healthy. The remaining 4827 cases were suffering from at least one disorder, which could interfere with their application. Of those, 1424 (11.32%) have had at least one ISP.

The most common ISP was varicocele with overall 750 (5.96%) cases among which, 73 (9.7%) had previously received a varicocelectomy. Except one patient with right-sided varicocele and 14 (1.9%) with bilateral varicocele, 98.0% of varicocele were localized on the left side (735 patients). The only ISP found in 743 (5.91%) applicants was varicocele whereas varicocele was associated with left-sided atrophic testis in one patient, hypospadias in one, left-sided hydrocele in two, left-sided inguinal hernia in two, and bilateral inguinal hernia in one patient.

Of 485 (3.85%) inguinal hernias, 269 (55.46%) were right-sided, 202 left-sided (41.64%), and 14 (2.88%) bilateral. One (0.20%) left inguinal hernia was associated with ipsilateral undescended testis. Two (0.41%) other left-sided inguinal hernia and one (0.20%) bilateral inguinal hernia

Table 1. Examination results of 12581 subjects with detailed diagnoses and laterality of inguinoscrotal diseases.

Health status	**No. (%)**				
Healthy candidates	7754 (61.63)				
Patients affected with other diseases	3403 (27.05)				
Patients with inguinoscrotal diseases	**1424 (11.32 %)**	**Right-side**	**Left-side**	**Bilateral**	**Overall (%)**
- Varicocele	743 (5.91)	1	729	13	750 (5.96)*
+ atrophic testis	1 (0.01)	-	1	-	-
+ hypospadias	1 (0.01)	-	1	-	-
+ left hydrocele	2 (0.01)		2	-	-
+ inguinal hernia	3 (0.02)	-	2	1	-
Overall number of patients with varicocele (%)	**750 (100)**	**1 (0.1)**	**735 (98)**	**14 (1.9)**	
- Inguinal hernia	481 (3.82)†	269	202	14	485(3.85)‡
+ undescended testis	1 (0.01)	-	1	-	-
- Undescended testis	95 (0.76)	40	33	22	96 (0.76)§
- Atrophic testis	34 (0.27)	14	18	2	35 (0.28)**
- Hypospadias	34 (0.27)	-	-	-	35 (0.28)††
- Hydrocele	20 (0.16)	13	9	-	22 (0.17)‡‡
- Epididymal cyst	6 (0.05)	1	5	-	6 (0.05)
- Penile curvature	1 (0.01)	-	-	-	1 (0.01)
- Mea stenosis	2 (0.01)	-	-	-	2 (0.02)

* 1 with atrophic testis, 1 with hypospadias, 2 with hydrocele, and 3 with inguinal hernia. 81 cases underwent varicocelectomy ,

† of those, 428 (88.9%) have had hernia surgery.

‡ 3 with varicocele, and 1 with undescended testis

§ 1 with inguinal hernia

** 1 with varicocele

†† 1 with varicocele

‡‡ 2 with varicocele

were with left varicocele. Of these patients, 428 (88.25%) had undergone previous hernia surgery. Other ISPs are shown in Table 1.

Their average BMI was 21.43 ± 1.77 kg/m^2 (range, 15.25 to 28.73 kg/m^2). Including all the participants, mean BMI of people aged between 16 and 18 years was significantly lower than older applicants between 19 and 23 years old (P = .0001).

Patients were divided into two groups according to their age. About 1019 (11.61%) patients aged from 16 to 18 years have had ISP. On the other hand, among patients between 19 and 23 years old, 405 (10.64%) have had ISP. This difference was not statistically significant. However, the number of patients with varicocele in younger group (548; 6.60%) was statistically significantly higher than that in older patients (202; 5.61%) (P = .041). Concomitantly, comparing the patients with remaining cohort (whether they had another ISP or not) in regard to their age group, the incidence of varicocele was more predominant in younger group than older subjects (P = .036; Table 2).

Their mean age was 18.17 ± 0.95 years (range, 16 to 23 years), mean height was 174.74 ± 4.60 cm (range, 161 to 197 cm), and mean weight was 65.21 ± 4.95 kg (range, 56 to 96 kg). Categorizing the patients according to the presence of any ISP, mean age of the patients with and without any ISP was 18.13 ± 0.98 and 18.18 ± 0.95 years, respectively. Age was not a significant predictor factor for the occurrence of ISP (P = .118). However, patients with ISP were statistically taller than counterparts without any ISP (P = .004). On the other hand, weight was not a significant predictor factor with regard to the presence of ISP (P = .22). Interestingly, mean BMI of the patients with any ISP (21.29 ± 1.77 kg/m^2) was significantly lower than those without ISP (21.45 ± 1.76 kg/m^2) (P = .001).

In passing, mean age (18.10 ± 0.99 years) and BMI (21.13 ± 1.74 kg/m^2) of patients with varicocele (n = 750) was sig-

Table 2. Comparison of BMI, ISP, and varicocele by age category.*

Characteristics	Patients aged 16 to 18 years (n = 8775)	Patients aged 19 to 23 years (n = 3806)	*p*
BMI, kg/m^2	21.35 ± 1.72	21.62 ± 1.85	t = 7.97 .0001
Patients with ISP, n (%)	1019 (11.61)	405 (10.64)	x^2 = 2.49 .114
Patients without ISP	7756	3401	
Varicocele, n (%)	548 (6.60)	202 (5.61)	x^2 = 4.19 .041
Subjects without ISP	7756	3401	
Varicocele, n (%)	548 (6.25)	202 (5.31)	x^2 = 4.39 .036
All other subjects	8227	3604	

*BMI indicates body mass index; and ISP, inguinoscrotal pathology.

Table 3. Comparison of subjects' physical characteristics by presence of ISP and varicocele.*

Patients' characteristics	Age, y	Height, cm	Weight, kg	BMI, kg/m^2
Overall (n = 12581)	18.17 ± 0.95	174.74 ± 4.60	65.21 ± 4.95	21.43 ± 1.77
ISP (+) (n = 1424)	18.13 ± 0.98	175.34 ± 4.77	65.49 ± 6.31	21.29 ± 1.77
ISP (-) (n = 11157)	18.18 ± 0.95	174.95 ± 4.82	65.71 ± 6.38	21.45 ± 1.76
	t = 1.565; P = .118	t = 2.852; P = .004	t = 1.229; P = .22	t = 3.314; P = .001
Varicocele (+) (n = 750)	18.10 ± 0.99	175.77 ± 4.86	65.29 ± 6.24	21.13 ± 1.74
Varicocele (-) (n = 11831)	18.17 ± 0.95	174.95 ± 4.82	65.71 ± 6.38	21.46 ± 1.77
	t = 2.028; P = .04	t = 4.504; P = .0001	t = 1.752; P = .08	t = 5.014; P = .0001

*BMI indicates body mass index; and ISP, inguinoscrotal pathology.

nificantly lower, but their height (175.77 ± 4.86 cm) was significantly greater than that of the remaining cohort (n = 11831) (18.17 ± 0.95 years, 174.95 ± 4.82 cm, and 21.46 ± 1.77 kg/m^2, respectively) whether they had any ISP other than varicocele or not (P = .05 for age; P = .0001 for height, and P = .0001 for BMI). Conversely, this significance was not reached for the applicants' weight. Although mean weight of patients with varicocele was lower than those without varicocele, their difference was not statistically significant (P = .08; Table 3).

The adjusted varicocele-physical characteristics odd ratios revealed similar pattern to the crude descriptive analyses. Lower age and greater height were significant risk factors for occurrence of varicocele, whereas the effect of weight did not seem to have any association with presence of varicocele (Table 4).

DISCUSSION

Inguinoscrotal pathologies and their surgical therapies are important causes of male infertility as well as severe psychological affection. These conditions, if left untreated or not treated properly, may lead to further complications and have negative impact on physical, psychological, and socioeconomic status of the patient himself, his family, and the whole society. The true prevalence and frequencies of ISP in the adolescent and young adult age group have not been well documented in our country. Over the period of the study, between 2002 and 2009, our center was the only hospital in charge of health check in order to eliminate the applicants for military junior officer studentship. Therefore, we believed that our data could represent the results of a reference hospital for prevalence and distribution of ISP among a stable population in adolescent and young adult age group.

Table 4. Associations between varicocele and somatometric characteristics by logistic regression analysis.*

	B	p	Exp (B)	95% Confidence interval for Exp (B)
Height	0.034	.000	1.034	1.019 to 1.049
Weight	-0.011	.080	0.990	0.978 to 1.001
Age	-0.084	.040	0.919	0.848 to 0.996

*Hosmer-Lemeshow goodness-of-fit test of equations P > .05

Prevalence of varicocele was found to be about 6%, being the most common disorder among patients with ISP (52.66%). Its prevalence in population-based studies, mostly scholar and military screenings, has been estimated in a wide range from 3.2% to 20% in general population.[2,10,11] Meanwhile, almost one-third of the patients referred for evaluation of male infertility were suffering from varicocele.[2] Semen analysis was not done and the rate of infertile men was not investigated in the study as this was a cohort namely regrouped for a recruitment tool.

The exact etiology of varicocele has yet to be determined. A consequence of human being's upright position, lack or incompetent venous valves in the internal spermatic veins, longer course and perpendicular insertion of left internal spermatic vein to the left renal vein, and increased intraluminal pressure of the latter due to possible compression of left renal vein between the aorta and superior mesenteric vein, which was also named as "nutcracker phenomenon", are the popular arguments for the anatomic pathogenesis and left-side predominance of the varicocele.[12-14] "Nutcracker phenomenon" is a mechanism similar to superior mesenteric artery syndrome occurring in patients with fast weight loss characterized by upper gastrointestinal obstruction due to compression of the duodenum in regard to narrowing of the angle between the aorta and superior mesenteric artery.

Furthermore, lean body status can enhance easier detection of varicocele around the spermatic cord at physical examination, and thus, varicocele can be highly diagnosed in patients with low BMI.[2,3] In a recent paper exploring relationship between BMI and varicocele diagnosed by Doppler ultrasonography, Chen and Huang showed that there was a significant difference and an inverse correlation of BMI and cholesterol level between adult males with or without varicocele.[3] In an Austrian study, BMI was inversely correlated with the grade of varicocele, being significantly lower in grade III varicocele.[4] Unfortunately, we did not consider investigating the grading of varicocele. We could suggest that physical examination would give sufficient information, and Doppler ultrasonography has not

been used for detection of varicocele in this study.

In this study, we also found that BMI was highly associated and inversely correlated with the prevalence of varicocele as in other studies.[2,3,5,6] In whole cohort, mean BMI of patients with varicocele or any other ISP was significantly lower than other people. This significance was higher when only patients with varicocele, who were nearly half of the patients with any ISP, were compared to other remaining applicants ($P = .0001$), emphasizing the role of lower BMI in varicocele, which was tried to be explained by nutcracker phenomenon or simply theory on easier detection. Overweight individuals were uncommon in our cohort; there was not any obese patient and only a few overweight applicants, whose BMI was ranging from 25 to around 28 kg/m^2 [44 (3.1%), 143 (4.2%), and 288 (3.7%) overweight in patients with ISP, without ISP, and healthy subjects, respectively (data not shown)]. In other words, one may say that lower BMI was highly associated with the occurrence of varicocele in our cohort, vast majority of which was composed of people with normal weight.

In accordance with other studies, our data implied that taller individuals were more susceptible to varicocele perhaps because of the longer course of left spermatic vein and increased hydrostatic pressure in a greater height.[6,7] This conclusion was not reached at Kilic and colleagues' study.[8] Nielsen and associates, in a study exploring the relationship of varicocele and BMI, found that prevalence of varicocele was significantly high among infertile men with lower BMI and these men were also taller than patients with erectile dysfunction.[2] Conversely, weight was not an important risk factor for the development of varicocele, which emphasized the main role of height in BMI.

Age has been presumed to be an important risk factor for the development of varicocele. While varicocele is hardly ever detected in population before ten years old, it is showed that the incidence of varicocele increased by about 10% for each ten years of life in a study by Levinger and coworkers.[15] The higher the age, the higher the prevalence of varicocele. Local studies from our country reported similar results about the prevalence of varicocele, which was ranging from 0.15% to 3.22% among primary school and adolescent students[11,16] and as high as 10.6% in 19 to 20-year-old population.[17] Kumanov and colleagues demonstrated the close relationship of varicocele with age, and after adjusting for age, height, penile length, and circumference were negative factors whereas weight and BMI had protective effects.[6] However, a recent South Korean population-based study on middle school boys disagrees with our results. Although BMI had a significant inverse relationship with the occurrence of varicocele, its prevalence did not increase with age.[18]

Our findings were discordant with former results owing to following reasons: firstly, there was a significant difference between the BMIs of the younger and older age groups, underlining the possible protective role of overweight in varicocele pathogenesis. Secondly, this significance could be related to the fact that younger group was mostly consisted of applicants who were rather 18 years old in mid-puberty period.

Mostly seen in men, inguinal hernia is the protrusion of a soft tissue or an abdominal organ together with the peritoneum through the inguinal canal. Therefore, it is usually the result of patent processus vaginalis with an incidence ranging from 0.8% to 5% depending on the sex spectrum of the cohort with estimates of a male-to-female preponderance of 10:1.[19,20] In studies reported from our country, its prevalence was found to be 1.45% and 3.2% among schoolchildren[21,22] and 3.2% among males of 20 to 22 years of age.[23] Our results support the findings of Akin and colleagues conducted on people in military service.

Probably, greater age in our cohort was the most prominent factor as this was enhancing the parents' awareness about the inguinal hernia. Furthermore, easy access to a general surgeon at later period of adolescence rather than a pediatric surgeon or urologist who were relatively uncommon, might play a role in the development of this difference.

In our study held on adolescent population, the prevalence of undescended testis was 0.76%, almost similar to the results of Yucesan and associates obtained from children in our country.[21] Unlike the John Radcliffe Hospital,[24] right-side predominance in our cohort (41.66%) was also seen as well as in the study of Kumanov and colleagues.[25]

Our cohort represented a hypospadias prevalence of 0.28%, less than previously cited studies. It is likely that some can-

didates with hypospadias would not apply to a military recruitment service as they would anticipate that they would fail the medical examination with this anomaly.

CONCLUSION

To the best of our knowledge, this is the largest study on prevalence of adolescent ISP, especially focusing on relationship between varicocele and BMI, maintaining closer standard deviation in physical characteristics. Considering that our cohort represented all region in Turkey, this study showed that (1) about one-third of Turkish adolescent-young adult male population had a health disorder, whether compromising his life style or not, and the prevalence of ISP was 11.32%; (2) varicocele, in front of all congenital urogenital abnormalities, was the most common ISP in male adolescent group; and (3) the prevalence of varicocele was compatible with height size and inversely correlated with age, but not with weight. Further investigations are needed to detect thoroughly the relationship of varicocele with body habitus as well as morphological, biochemical, and environmental conditions.

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CONFLICT OF INTEREST

None declared.

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