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Association of left varicocoele with height, body mass index and sperm counts in infertile men

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SUMMARY

The aim of this study was to evaluate interrelation of left varicocoele with height, body mass index (BMI) and sperm counts. We retrospectively evaluated the data of all patients who consulted for infertility at a tertiary academic referral centre from 2000 to 2010. Patient's height, weight, BMI, semen analysis, presence or absence of varicocoele and varicocoele side and grade were evaluated. In statistical evaluations chi-square, student's *t*, Mann–Whitney *U*, ANOVA and logistic regression analyses were performed. In ANOVA analyses, Bonferroni post hoc test was performed when needed. The data of 1842 among 2780 men, presenting for infertility, were included in the study. There were 587 men (31.9%) with left varicocoele and 1255 (68.1%) men without varicocoele. Two hundred and seventy-two men (14.8%) had grade I or II, and 315 men (17.1%) had grade III varicocoeles. Mean height was 174.3 ± 6.7 and 172.5 ± 7.0 cm in men with and without varicocoele respectively ($p < 0.001$). The mean BMI of cases without varicocoeles (25.8 kg/m^2) was greater than varicocoele group (24.9 kg/m^2) ($p < 0.001$). Percentage of varicocoele was the highest in moderately oligozoospermic males and significantly higher than the men with normal sperm count. As the height increased, the probability of having varicocoele increased, and the inverse is true for BMI. If varicocoeles are a progressive lesion, perhaps taller men with varicocoeles should be followed more closely to evaluate their fertility and androgenic status.

INTRODUCTION

Varicocoele is the most common surgically correctible cause of male infertility. The prevalence of varicocoele in the general population is 15–20%, but it is notably higher (25–40%) in infertile men (WHO,1992; Agarwal *et al.*, 2009). The aetiology of varicocoele has not yet been fully understood. However, the predominance of left-side varicocoele and the unique anatomy of the left testicular vein are the basis for several theories explaining the aetiology of varicocoele (Paduch & Skoog, 2001). In all the theories, varicocoele is thought to be related to various factors resulting in an increased pressure in the veins of the pampiniform plexus and its venous drainage. In addition, the genetic susceptibility is also important (Gokce *et al.*, 2010). Although there are conflicting data in the literature regarding the relationship between varicocoele and somatometric parameters, some studies have reported an inverse relationship between body mass index (BMI) and the presence of a varicocoele. Thus, to find out some changes of height, body mass index and sperm counts in men with and without varicocoele we reviewed the data of our infertile patients.

MATERIALS AND METHODS

In this retrospective-comparative study the records of 2780 men presenting for infertility from 2000 to 2010 were evaluated. Following strict exclusion criteria, the data of 1842 men and some subgroups among them were taken into consideration. The exclusion criteria were as follows:

- less than 18 years and more than 50 years of age
- to have right or bilateral varicocoele
- presence of or any kind of treatment of cryptorchidism
- prior varicocoele and/or inguinal hernia surgery
- presence of significant hydrocele, spermatocele or prior surgery for them
- absence of any testicle for any reason
- presence or suspicion of any obstruction of the lower urogenital tract
- seminal volume less than 1.5 mL
- prior chemo or radiotherapy for any reason
- any musculoskeletal disease or deformity
- prior or active genitourinary infection.

Height and weight measurements were made routinely in the laboratory prior to semen analyses. Body mass index was calculated as the ratio of weight in kilograms to the square of height in metres (kg/m^2). Manual semen analysis was performed according to World Health Organization guidelines (WHO, 1999) to determine sperm concentration and motility. Sperm count per millilitre, total sperm counts and total motile sperm counts were used for comparisons. The patients were examined in a warm room. The volume, position and consistency of the testes and epididymides were checked, and each spermatic cord was palpated in the supine and standing position, both with and without the Valsalva manoeuver. Testicular volume was determined using Prader orchidometer. More than 80% of the men were examined by one observer (Ekmekcioglu). The severity of the varicocoeles was classified according to the standard grading system (Dubin & Amelar, 1970). Grade I varicocoeles were small and palpated only using the Valsalva manoeuver. Grade II varicocoeles were medium and palpable only in the standing position, and grade III varicocoeles were large and easily visualized through the scrotal skin without the Valsalva manoeuver. Varicocoeles were diagnosed by physical examination alone. The patients with bilateral or right varicocoeles were excluded to determine the impact of BMI and the height variations on varicocoele as objectively as possible. Subclinical varicocoeles, if determined during ultrasonographic examination were not taken into consideration.

The men with varicocoele were subgrouped as they had clinical varicocoele (grade I + grade II + grade III) or no varicocoele (grade 0) and, grade III varicocoele. Because the intra-observer variations are known to be higher for Grade I and II varicocoeles, these men were grouped together. In addition, a substudy was included to compare Grade III varicocoeles with men without varicocoeles.

The height of patients was subgrouped as height group (HGr) I (<161 cm), HGr II (161–170 cm), HGr III (171–180 cm), and HGr IV (>180 cm). The relationship between height and varicocoele grade was evaluated. For the evaluation of BMI and varicocoele relations, BMI subgroups were as follows: BMIGr I (<20), BMIGr II (20–<25), BMIGr III (25–<30), and BMIGr IV (≥ 30). For sperm counts, the subgroups were sperm count group (SCGr) I (azoospemia), SCGr II (<5 millions/mL), SCGr III (5–<20 millions/mL), and SCGr IV (≥ 20 millions/mL).

In statistical evaluations chi-square, student's *t*, Mann–Whitney *U*, ANOVA and logistic regression analyses were performed. Probability of less than five per cent was considered significant. In ANOVA analyses, Bonferroni post-hoc test was performed when needed.

RESULTS

There were 587 men (31.9%) with left varicocoele and 1255 men (68.1%) without varicocoele. Two hundred and seventy-two men (14.8%) had grade I or II, and 315 men (17.1%) had grade III varicocoeles.

Mean height was 174.3 ± 6.7 and 172.5 ± 7.0 cm in men with and without varicocoele respectively ($p < 0.001$). The mean BMI of cases without varicocoeles (25.8 ± 3.8 kg/m^2) was greater than that of the varicocoele group (24.9 ± 3.5 kg/m^2) ($p < 0.001$).

When all men and all grades of varicocoele were taken into consideration men without varicocoele were significantly shorter and had higher BMI than men with varicocoele. Similar results were observed when men with grade III varicocoele were compared with those without varicocoele (Table 1).

Regression analyses demonstrated that, a 1 cm increase in height caused a 1.04 times increase in the probability of having a varicocoele (B = 0.038, $p < 0.001$). A one unit increase in BMI caused a 1.08 times decrease in the probability of having a varicocoele (B = 0.074, $p < 0.001$).

Table 1 The mean values of height and body mass index in men with no varicocoele and with all degrees of varicocoele and grade III varicocoele. The varicocoele ratios in height, BMI and sperm count groups

	Whole group			
Varicocoele	*n* (%)	Height (mean-cm)	BMI	
Absent	1255 (68.1)	172.5	25.8	
Gr I+II	272 (14.8)	173.5	24.9	
Gr III	315 (17.1)	175.0	24.8	
Total	1842	173.0[a]	25.5[a]	
	Height (cm) groups			
Varicocoele	I (<161) n (%)	II (161–170) n (%)	III (171–180) n (%)	IV (>180) n (%)
Absent	73 (83.9)	461 (72.7)	584 (77.2)	137 (59.3)
Present	14 (16.1)	173 (27.3)	306 (34.4)	94 (40.7)
Total[b]	87	634	890	231
Gr III[c]	5 (5.7)	80 (12.6)	172 (19.3)	58 (25.1)
	Body mass index groups			
Varicocoele	I (<20) n (%)	II (20–<25) n (%)	III (25–<30) n (%)	IV ($\geq$ 30) n (%)
Absent	51 ((56.7)	528 (64.5)	509 (71.0)	167 (77.0)
Present	39 (43.3)	290 (35.5)	208 (29.0)	50 (23.0)
Total[b]	90	818	717	217
Gr III[c]	20 (22.2)	159 (19.4)	109 (15.2)	27 (12.4)
	Sperm count (millions/mL) groups			
Varicocoele	I (0)	II (>0–<5)	III ($\geq$ 5–<20)	IV ($\geq$ 20)
Absent	290 (78.6)	188 (66.2)	235 (59.3)	542 (68.3)
Present	79 (21.4)	96 (33.8)	161 (40.7)	251 (31.7)
Total[b]	369	284	396	793
Gr III[c]	47 (12.7)	54 (19.0)	84 (21.2)	130 (16.4)

[a] $p < 0.001$ (ANOVA analysis). [b] $p < 0.001$ between men with and without varicocoele in height, BMI and sperm count groups (chi-square test). [c] $p < 0.001$ between men without and with Gr III varicocoele in height, BMI and sperm count groups (chi-square test).

The highest varicocoele incidence was in moderately oligozoospermic men (SCGr III) and significantly higher (40.7% vs. 31.7%, $p < 0.001$) than in men with normal sperm count (SCGr IV), and height and BMI differences were significant in general (Table 2). In azoospermic and severely oligozoospermic males, height and BMI did not differ whether they had varicocoele or not. When men with grade III varicocoele were compared with the men without varicocoele, total sperm counts were lower in the grade III varicocoele group (187.7 ± 156.1 vs. 174.7 ± 141.2 millions, $p > 0.05$). Height, BMI and sperm count per mL (59.0 ± 40.5 vs. 48.4 ± 29.5 millions, $p = 0.01$, $z = -2.57$) were significantly different. In SCGr IV males with varicocoele height, BMI, sperm count per mL, total sperm and total motile sperm counts were significantly different. When only grade III varicocoele males were compared with the men without varicocoele, total motile and total sperm counts were lower, but the differences were not statistically significant. Height, BMI and sperm count per mL were significantly different.

DISCUSSION

In this retrospective, comparative study, when all men were taken into consideration, as the height increased, the probability of having varicocoele increased, and the inverse is true for BMI. In the literature; there are 14 articles in which the relationship of

Table 2 Height, BMI, sperm count and motility comparisons inside the sperm count groups

	n (%)	Height (cm)	BMI (kg/cm^2)	Sperm count (10^6/mL)	Sperm count (total) (10^6)	Total motile (10^6)
SCGr I						
Absent	290 (78.6)	172.7 ± 7.8	25.5 ± 3.7	0		
Present	79 (21.4)	174.4 ± 6.9	25.2 ± 3.3	0		
Total	369	173.1 ± 7.6	25.5 ± 3.6	0		
P		0.062	0.307			
Gr III	47 (12.7)	174.8 ± 6.7	25.0 ± 3.5	0		
**p*		0.064	0.366			
SCGr II						
Absent	188 (66.2)	172.6 ± 7.2	26.3 ± 3.9	1.5 ± 1.4	4.8 ± 5.2	2.0 ± 2.8
Present	96 (33.8)	174.0 ± 6.9	25.6 ± 4.3	1.9 ± 1.4	6.6 ± 6.6	2.9 ± 3.7
Total	284	173.1 ± 7.1	26.1 ± 4.0	1.7 ± 1.4	5.4 ± 5.8	2.3 ± 3.2
p		0.108	0.135	**0.036**	**0.026**	**0.025**
Gr III	54 (19.0)	174.2 ± 7.3	25.3 ± 4.0	1.9 ± 1.4	6.3 ± 5.9	2.9 ± 3.7
**p*		0.150	0.090	0.079	0.097	**0.046**
SCGr III						
Absent	235 (59.3)	172.2 ± 7.2	25.8 ± 3.8	11.6 ± 4.1	39.2 ± 22.7	19.0 ± 15.0
Present	161 (40.7)	174.5 ± 6.9	25.0 ± 3.7	11.3 ± 4.1	38.6 ± 22.7	18.3 ± 13.0
Total	396	173.1 ± 7.1	25.5 ± 3.7	11.5 ± 4.1	39.0 ± 22.7	18.7 ± 14.2
p		**<0.001**	**0.038**	0.392	0.782	0.631
Gr III	84 (21.2)	175.8 ± 6.5	25.0 ± 3.8	11.2 ± 4.2	36.5 ± 20.5	17.9 ± 12.4
**p*		**<0.001**	0.113	0.436	0.316	0.503
SCGr IV						
Absent	542 (68.3)	172.4 ± 6.5	25.8 ± 3.7	59.0 ± 40.5	187.7 ± 156.1	115.2 ± 126.1
Present	251 (31.7)	174.3 ± 6.5	24.4 ± 3.2	47.2 ± 27.1	146.8 ± 96.2	86.8 ± 74.3
Total	793	173.0 ± 6.6	25.4 ± 3.6	55.3 ± 37.2	174.±141.2	106.2 ± 113.1
p		**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Gr III	130 (16.4)	174.8 ± 6.5	24.3 ± 3.2	48.4 ± 29.5	159.9 ± 114.9	97.8 ± 87.4
**p*		**<0.001**	**<0.001**	**0.005**	0.057	0.139

**p* values for the comparisons between grade III varicocoele and without varicocoele groups. SCGr, sperm count group; Gr III, grade III. Bold values means there is statistically significant difference.

varicocoele with any of somatometric parameters had been investigated. The findings on the relationship between varicocoele and any of the somatometric parameters from these studies are inconsistent for each somatometric parameter (Stavropoulos *et al.*, 2002; Delaney *et al.*, 2004; Handel *et al.*, 2006; May *et al.*, 2006; Nielsen *et al.*, 2006; Prabakaran *et al.*, 2006; Kilic *et al.*, 2007; Kumanov *et al.*, 2008; Tsao *et al.*, 2009; Al-Ali *et al.*, 2010; Chen & Huang, 2010; Baek *et al.*, 2011; Hassanzadeh *et al.*, 2011; Soylemez *et al.*, 2012). Of 14 studies, nine investigated the relationship between height and varicocoele. Three of them reported that there were no statistically significant differences between the two groups with respect to height, whereas six indicated that the patients with varicocoele were significantly taller than controls, which is similar to our study. The latter result has led to speculation that greater overall height was associated with an increased hydrostatic pressure in the spermatic vein, predominantly on the left side, which may in turn overwhelm the valve mechanisms in the veins, resulting in the development of varicocoele (Tsao *et al.*, 2009). The findings of our study support the concept of a statistically positive relationship between varicocoele and height.

In the literature, various findings on the relationship between BMI and varicocoele have been reported. In 12 studies: first, no significant differences in BMI were detected (Delaney *et al.*, 2004; Kilic *et al.*, 2007), secondly, patients with varicocoele had a distinctly lower BMI (May *et al.*, 2006; Baek *et al.*, 2011), and thirdly, the number of the varicocoele patients decreased as the BMI increased, as found by others (Handel *et al.*, 2006; Nielsen *et al.*, 2006; Prabakaran *et al.*, 2006; Kumanov *et al.*, 2008; Tsao *et al.*, 2009; Al-Ali *et al.*, 2010; Chen & Huang, 2010; Hassanzadeh *et al.*, 2011; Soylemez *et al.*, 2012) and us. It is clear that obesity may lead to decreased detection of varicocoele, even in our study, because of difficulty in palpation on physical examination. Although the diagnostic difficulty of varicocoele is well known in obese men, the latter finding suggests that the 'nutcracker' phenomenon or other biophysical effects of increased adiposity may play a role in the pathogenesis (Handel *et al.*, 2006; Nielsen *et al.*,2006; Kumanov *et al.*, 2008; Tsao *et al.*, 2009) Nielsen *et al.*(Nielsen *et al.*, 2006) and Handel *et al.*(Handel *et al.*, 2006) have proposed a possible mechanism to explain this concept and stated that fat around the left renal vein may provide a cushion protecting against the nutcracker phenomenon in the obese men. Results of the present study, also support this provocative concept. Nevertheless, there is no direct evidence to show that the nutcracker effect correlates with the clinical presence of varicocoele and the adiposity reduces the effect of the nutcracker phenomenon.

Men with moderate oligozoospermia had the highest rate of varicocoele. This may indicate that varicocoele decreases sperm count. Another interesting finding of our study is the decreased sperm count in the group of men with normal sperm count. There was also a decrease in the motile sperm counts in this group of men. There are two studies in which infertile males have been included for BMI and/or height comparisons.(Handel *et al.*, 2006; Nielsen *et al.*, 2006) In both studies BMI was inversely correlated with varicocoele formation but infertile males had been neither subgrouped nor excluded. In our row series, when all men with or without varicocoele were analysed we found similar results in general (data not shown). However, with the intention of subgrouping, strict exclusion criteria were used. For example, men with hyper or hypogonadism and with small testicles are taller than the other men, but the ratio of varicocoele is lower. If we include them into the analyses, the results might differ.

In practice, if a man has infertility that is likely ascribable to varicocoele then our aim is to offer an operation. We do not take into consideration his height or weight. If varicocoele has detrimental effect on the testicle and its functions, who is at risk? If varicocoele is a progressive lesion, who must be screened to prevent the detrimental effects? Especially taller adolescents and young adults might be warned and this problem (if it is a problem) might be presented for public awareness. In our opinion, there is a great need for prospective controlled studies on young males. If they are followed or operated upon earlier, will the preventive operation pose greater risk or benefit for their future fertility, androgenic statusand testicular function? Might it be cheaper to operate earlier so that patients can have children without using assisted reproduction techniques?

In the present study, there are some limitations. One of the limitations of our study is that it was not performed in the general population and its control group consisted of infertile males, not men from the general population. In addition, although it is not routinely recommended (Jarow *et al.*, 2002) the lack of confirmation of varicocoele by imaging studies and also the lack of objective or direct measurement of total body fat and retroperitoneal visceral fat might be the other limitations of our study.

CONCLUSION

We found that as height increased, and/or as the BMI decreased the probability of having varicocoele increased. The lower sperm counts and motile sperm counts in men with varicocoele in normal sperm count group support the claim that varicocoele might have a detrimental effect on spermatogenesis. If varicocoeles are a progressive lesion, perhaps taller men with varicocoeles should be followed more closely to evaluate their fertility and androgenic status.

CONFLICT OF INTEREST STATEMENT

The Authors declare no conflicts of interest.

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