Restricting sports activity in reducing the rate of varicocele and related infertility parameters in athletes

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Abstract

Introduction: The aim of this study is to test the hypothesis that the cessation of sports training in young athletes reduces the prevalence of varicocele.

Material and methods: 1,013 young males were divided into three age-matched groups based on their sport activity. The first group consisted of 305 athletically active boys in basketball, volleyball, handball, or football; the second of 44 active water-polo players, and the third of 664 sport-inactive controls. All participants had been initially examined for the presence of varicocele, and positive ones were submitted to orchidometry and seminal fluid analysis. Those with varicocele were then asked to cease all sport activity for the following six months, and the reassessing was performed.

Results: The results showed a significantly higher percentage of varicocele present in the first group than in the control group ($p < 0.49$), while the percentage of young males diagnosed with varicocele in the second proved to be even lower than that of the control group (9.09% vs. 12.35%). After the 6-month period of cessation and abstention from all sporting activity, every parameter of the seminal fluid analysis improved in the first group, wherein statistical significance for both sperm concentration ($p < 0.001$) and sperm motility ($p < 0.023$) was found. The testicular volume was found not to have increased significantly in either group ($p > 0.05$).

Conclusions: The study shows that sport-associated varicocele has a positive prognosis when diagnosed early and upon the cessation of sports training.

Key words: varicocele, infertility, seminal fluid analysis, orchidometry, sport, basketball, handball, football, volleyball, water polo.

Introduction

In recent decades, there has been growing interest in the prevention, diagnosis, and treatment of male infertility. Apart from genital infections, varicocele, i.e. the enlargement of the veins of the testicles, is a major cause of male infertility [1]. Also of late, the idea of adhering to a healthy lifestyle has come more and more to include active participation in sports, and has been actively encouraged amongst pre-pubescent and pubescent males in their primary and secondary education; this encouragement has been further re-enforced by the influence of celebrity sports idols and celebrity sports role models. Within this particular age group, there has also been an associated increase in the occurrence of

varicocele, the main pathophysiological circumstances of which are valvular vein insufficiency, retrograde hormonal reflux, and the impairment of spermatogenesis [2].

Many studies have shown the existence of a correlation between infertility and/or erectile dysfunction and increased activity in sports. Indeed, increased physical activity and sports training is a powerful modulator of the release of many hormones [3, 4], as prolonged physical activity greatly affects the hypothalamus-pituitary-gonadal axis and the luteinizing hormone directly associated with fertility parameters [5]. In this regard, many authors have pointed out the significance of physical activity and its effects on the seminal fluid of athletes, specifically referring to reductions in their total sperm count, reduced sperm motility, and changes in morphology [6].

While genitourinary complaints have been well studied in cyclists [7], the negative effects of the cyclist's physical position and the resultant perineal hypoperfusion should be relatively obvious. Certain studies have also reported up to 30% of athletes being diagnosed with varicocele, representing a significantly higher incidence than in the general population, and up to 60–80% of body-builders are recorded as being affected. The incidence of varicocele has been shown to increase with the number of hours spent training [8].

According to recent research undertaken by the authors of the present study, varicoceles occur more frequently amongst young males playing basketball, football, volleyball, or handball (BFVH) with an active training workload of three or more times per week, when compared to control groups. Conversely, young males participating in water polo have a lower incidence of varicocele when compared to control groups [9]. Therefore, as no previous studies have attempted to investigate the restriction of sport training on young athletes diagnosed with varicocele, the aim of the study presented here was to take this course of action with the combined aims of reducing the grade of varicocele and improving semen fertility parameters in such athletes.

Material and methods

One hundred and thirteen young males of 14–18 years of age were examined in this study. They were divided into three age-matched groups. The first, named BFVH, consisted of 305 young males considered to be active athletes in either basketball, volleyball, handball, or football (i.e., association football, soccer) with a mean age of 16.5 ±0.55. The second group, named W, consisted of 44 water polo players, with a mean age of 15.9 ±0.78. This group was observed separately according to different result expectations. The third group was the control group and consisted of 664 non-sport active young males, with a mean age of 16.1 ±0.24. The criteria for defining active athletes were set as consistent sport training that had been undertaken at least three times a week for the last 3 years, but not longer than 5 years in duration. Non-sport active young males were defined as those who did sport activity occasionally; i.e., once per week or less. Forty subjects who tested negatively for varicocele were randomly sampled from the control group of 664 subjects. Their sperm values were then compared to those who did have varicocele.

At the start of the study, all subjects were tested for the presence of varicocele, after which a seminal fluid analysis and orchidometry were performed on those testing positive. Athletes from the BFVH and W groups who were diagnosed for varicocele were also consequently asked to abstain from sporting activity for the next 6 months, after which testing of varicocele presence and grade, seminal fluid analysis, and orchidometry were to be performed again. In order for these abstention periods from regular sports training to coincide with minimum sport team or club commitments, the period for the BFVH group was assigned to be from June to December, while that for the water polo players was from October to March. The compliance rate was 96% in the BFVH and 100% in the W group, respectively.

A physical examination for the presence of varicocele in all groups was performed according to the criteria of a subclinical varicocele Doppler reflux during the Valsalva maneuver with vein dilatation for more than 3 mm. According to this procedure, the following grades were assigned: grade 1 – palpable varicocele with a Valsalva maneuver; grade 2 – palpable without a Valsalva maneuver, not visible; grade 3 – easily visible.

After 5 days of sexual abstention, a seminal fluid analysis was performed according to the volume of ejaculate as measured in graduated tubes that was primarily determined by the accessory sex gland's function. The reference limit used was $\geq$ 1.5 ml. After liquefaction, which averaged 20 min, the samples were analyzed using the Sperm Quality Analyzer SQA IIC-P (made by Medical Electronic Systems Ltd.), which determined all parameters of the seminal fluid analysis. Sperm concentration, progressive motility, and morphology (i.e. the percentage of abnormal forms) were chosen to be the only ones presented, since no other parameters showed any significant outcome. The reference values used were taken from the criteria given by the Guidelines on Male Infertility 2010, provided by the European Association of Urology [1]. The lower reference limit (in 5th centiles and their 95% confidence intervals) of progressive motility was 32% (31–34), viability at 58% (55–63),

and the minimum sperm concentration was 15 × 10^6/ml (12–16). More than 4% (3–4) of the morphologically normal forms were above the lower reference limit.

The orchidometry was performed using the Aloka 650 (5 MHz) ultrasonography tool system, which measures in three ipsilateral testicular dimensions. The volume of the testicles was calculated by multiplying the dimensions with the standard coefficient of 0.51.

The use/abuse of steroids or other substances which could otherwise adversely interfere with the outcomes of this study was given special attention and was an exclusion criterion for each subject, all of whom were required to sign their acceptance of the study protocol in which the Ethical Principles for Medical Research Involving Human Subjects (the Helsinki Declaration) were clearly stated.

Statistical analysis

Following the customary methods of statistical description, the *Z* test for proportions and the Student *t* test were applied in order to assess statistical significance. The difference of the obtained values was considered to be significant when $p < 0.05$, and highly significant when $p < 0.01$.

Results

The results of the research showed that the percentage of young males exhibiting any of the four grades of varicocele (including the subclinical form) was highest in the BFVH group, reaching a value of 17.05%. This rate is significantly higher ($Zi = 1.986$, $p < 0.049$) than that of the control group, which was 12.35%. Even though basketball players were found to score the highest (18.68%), when individual sport-based subgroups were taken into consideration, young males who play basketball, volleyball, handball, or football showed no significant differences in the percentage of being affected. The percentage of those diagnosed with varicocele within the water polo group was found to be even less than the control group at 9.09%, yet this difference was not found to be statistically significant ($p > 0.05$). However, it should be noted that two of the four participants from this group who had been diagnosed with varicocele were diagnosed with the subclinical grade while the other two were diagnosed with grade 1 varicocele, displaying the presence of lower grades among them. When comparing those who suffer from varicocele in the BFVH group and in the non-sport active group to the grades of varicocele, no significant difference in the distribution of grades was found, but the nominal difference was highest in comparing the third grades: 11.53% (the BFVH group) vs. 7.31% (non-sport active young males); $Zi = 0.83$, $p > 0.05$.

Depending on the criteria set for sexual abstinence, a seminal fluid analysis was performed within a few days for all participants with varicocele. In order to compare these seminal fluid analysis results, 40 healthy participants were selected at random from the control group, the results of which are shown in Table I. The participants who did sports were asked to take a hiatus from their regular training for 6 months. After this time, those with varicocele were then again asked to provide sperm samples. These results are also shown in Table I. All the parameters of the seminal fluid analysis measured were shown to have improved in the BFVH group, with statistical significance achieved for sperm concentration ($p < 0.001$) and progressive motility ($p < 0.023$). In the W group, the primal seminal fluid analysis values deviated slightly from the reference value, as well as those from the healthy participants randomly selected from the control group. Still, after a 6-month hiatus from water polo training, no significant differences in the sperm parameters tested were found.

As had been originally expected, the volume of the testicles in those with varicocele was smaller

Table I. Results of semen analysis for groups, with *p* values for BFVH group

Variable	*N*	Sperm count (× 10^6)	Progressive motility (%)	Morphologically normal shapes (%)	Ejaculate volume [ml]	Volume of left testicle [ml]
Boys with varicocele:						
BFVH, initially	52	29.43 ±15.5	24.6 ±12.3	62.3 ±9.6	2.4 ±0.4	13.35 ±2.9
BFVH, after 6 months, and *p* values	50	44.60 ±15.3 $p < 0.001$	33.2 ±12.0 $p < 0.023$	65.6 ±13.9 $p > 0.05$	2.5 ±0.7 $p > 0.05$	14.09 ±2.5 $p > 0.05$
W, initially	4	64.67 ±14.2	60.5 ±5.4	78.9 ±12.3	2.2 ±0.9	14.56 ±2.9
W, after 6 months	4	60.77 ±13.9	63.2 ±8.9	78.5 ±14.5	2.3 ±1.1	14.77 ±2.7
Control – no varicocele	40	57.12 ±19.8	68.5 ±14.5	74.4 ±19.3	2.5 ±0.5	15.20 ±3.7

BFVH – basketball, football, volleyball, and handball group (group I), W – water polo group (group II).

than the reference value, but the volume value in those participants who had varicocele and participated in water polo was within the normal range (i.e., in those who suffered from the initial stages of varicocele). The results are shown in Table I as well. After the 6-month hiatus, testicular volume did not increase significantly in either group.

Discussion

The effects of physical activity during adolescence in regard to varicocele progression have already been subjected to study; Zampieri and Dall'Agnola's findings were notably in accordance with the negative expectation that subclinical varicocele will progress to clinically palpable varicocele over years of forced physical activity in athletes [10]. The aim of the present study though was to investigate the incidence of varicocele in certain groups of athletes, emphasizing the possibility of healing varicocele and/or improving parameters of seminal fluid analysis after pausing a sports training workload. The participants observed had already been engaged in intense sport activities for 3.76 ±0.41 years prior to the study, which is a relatively short period compared to other sports professionals. Unfortunately, no information was available as to whether the occurrence of varicocele in these young males was directly related to their exact initiation of sports training. However, a significantly higher incidence of varicocele in the participants from the BFVH group when compared to that of the control group does seem to support the conclusion that sports training may increase the prevalence of varicocele.

The BFVH are sports that necessitate dominant body movement, both horizontally and vertically. Typical jumping against the plane forces of gravity, such as is found in basketball, may be expected to increase the presence of varicocele, given the direction of the venous blood from the testicles. In support of this hypothesis, the highest prevalence of varicocele along with the prevalence of higher grades (second and third) was found in the basketball players of this study. Conversely, the effect of increased hydrostatic pressure acting outside the body and affecting the external genital organs in water polo players is tantamount to the effect of a suspensory, as has been used in the treatment of varicocele, wherein the external pressure of the water when practicing, playing, or competing in water polo acts to enhance the blood that exits the pampiniform venous plexus and inhibits dilation of the veins. This would seem to be the main reason for the low rates of varicocele in water polo players, along with the prevalence of lower grades (subclinical and grade 1).

After halting their sport activity, the BFVH group of athletic young males showed an improvement in all parameters of seminal fluid analysis. The morphology of sperm was not as significantly improved as had been expected at first, probably owing to the short duration of the study. Sperm concentration and progressive motility are the parameters that bring the greatest short-term effects to fertility. After a 6-month hiatus, the varicoceles of 18 participants from the BFVH group were found to have been completely healed to the extent that they were impossible to detect even in their subclinical form. Of these 18 participants, 14 initially had been diagnosed as having the subclinical form, while 3 had had grade 1 varicocele, and 1 had had grade 2 varicocele. In another 31 participants from the BFVH group, the grade of varicocele was reduced by one grade for 61.3% of them, while the grade remained the same in the others. Only 1 participant experienced progression of varicocele from subclinical to grade 1. The semen parameters in 85.7% of participants from the BFVH group also improved.

These results evidently show that it is possible to improve sperm parameters by halting sport activity in young males who suffer from varicocele. Therefore, it has also been indirectly demonstrated that the sports undertaken by the young males from the first group did contribute to their increased rates of varicocele. It should be noted that these participants were engaged in sports for an average of three and a half years prior to the study; hence there still remains the question of to what extent seminal fluid quality is reversible amongst athletes who have played sports for a period greater than 5 years.

Considering the fact that there was no significant increase in testicular volume, it is obvious that a longer period of hiatus from sport activity is needed for the testicles to recover from the adverse effects of varicocele. Finally, the study results presented here contrast with those of Rigano *et al.*, who concluded that sport training does not modify the prevalence of varicocele compared to the general population, but physical activity must still be taken into consideration as an aggravating factor in the natural history of instances of varicocele [11].

In conclusion, sports-associated varicocele in pubescent males is a disease that can have a positive prognosis when diagnosed early and coupled with the limitation of sports activity. Semen parameters that play a key role in fertility are improved after taking a hiatus from sports training. Considering all the other benefits of physical activity, an active sports life in young males with varicocele should be transferred to sports which do not show an increased risk for the disease. In this regard, the study presented here has demonstrated the positive effects of water polo training;

there are surely other sports with similar positive impacts on varicocele.

Conflict of interest

The authors declare no conflict of interest.

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