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Testicular Volume and Testicular Atrophy Index as Predictors of Functionality of Unilaterally Cryptorchid Testis

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ABSTRACT

Goal: The goal of this study was to determine relationship between the sensitivity and specificity of testicular volume (TV) and testicular atrophy index (TAI) in the indirect assessment of functional ability of cryptorchid testicles. **Material and Methods:** The study included sixty children with unilateral cryptorchidism who were treated surgically at the Clinic of Pediatric Surgery, Clinical Center University of Sarajevo. We evaluated the correlation of the size of cryptorchid testicles with its locations in various age groups. **Results:** The results showed a significant decrease in TV and TAI in the all cryptorchid groups after the sixth month of age compared with the same parameters in control group ($p<0.001$). It is also determined a strong correlation between the TV and TAI of cryptorchid testicles with its locations in various age groups. **Conclusion:** Our results showed that the average volume of cryptorchid testicles decreased after the sixth month as well as that the reduction of testicular size correlated with increasing distance of cryptorchid testicles from the scrotum.
Key words: unilateral cryptorchidism, testicular volume, testicular atrophy index.

1. INTRODUCTION

The accurate measurement of testicular size and determination of TV has a great importance in assessing the testicular functional status both in adults and in children. As the seminiferous tubules comprise 80-90% of the testicular mass, TV is largely a reflection of spermatogenesis (1,2,3). Currently, several measurement methods are used for the assessment of testicular volume, including orchidometry, rulers, calipers, and ultrasonography (USG) (4,5). Some authors argue that USG estimates of TV are the most accurate (6), while others suggest importance of possible influence of the radiologists experience and subjectivity on the results of the measurements as well as the impact of the formula used to calculate the volume of the testicles (7). Recently, the empirical formula of Lambert provides a superior estimate of testicular volume (8).

In this study, we prospectively measured TV of unilateral cryptorchid testicles and determined TAI to evaluate the effect of the location of testicles or the age of patients on volumes of cryptorchid testicles.

2. PATIENTS AND METHODS

In accordance with the Helsinki declaration, the Institutional Review Board (IRB), and the Independent Ethics Committee of Clinical Center University of Sarajevo (CCUS) approved all aspects of this study. The study included 60 randomly selected boys with a mean age of 5.4 years (range 0.5-12 years) with unilateral cryptorchidism who were surgically treated at the CCUS from 2004 to 2006. A total of 60 healthy boys with the mean age of 6.1 years (range 0.5-12 years) comprised the control group. Patients with bilateral cryptorchidism, patients with intraabdominal form of cryptorchidism or patients with cryptorchidism who previously underwent urological or abdominal surgery were excluded from the study. Testicular volume was measured by USG, preoperatively and by caliper, intraoperatively. USG was performed by experienced radiologist using Toshiba unit with linear array 7.5 and 10 MHz transducers. All measured dimension of 120 testicles were used for calculation of the testicular volume using the empirical formula of Lambert ($L \times W \times H \times 0.71$) (8). The testicular atrophy index of the affected testis was calculated as: TAI = (contralateral testis volume – affected testis volume)/contralateral testis volume x 100 and expressed as a percentage (9).

3. STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS 16.0 (SPSS Inc, Chicago, IL, USA). Simple frequencies were determined for the age, while descriptive statistics were used for the testicular volume measurements. Paired *t* test was used to determine whether USG and caliper measurements had significant mutual discrepancies in the results. Differences in TAI values between the groups

were tested with the non-parametric Mann–Whitney U test. Mean differences between pre- and postoperative TAI measurements were evaluated by paired Student's *t*-test. Statistical level of 95% (p<0.05) was considered as significant for all performed tests.

4. RESULTS

Sixty children with unilateral cryptorchidism and sixty children from control group with descended testicles were evaluated in the form of determining of TV and TAI. The mean age of children of control group was 6.1 years (range 6 months to 12 years) which was not significantly different compared with the mean age of children with cryptorchidism (p=0.76). Statistical correlation of measured results between measured volume by the caliper and USG showed significant correlation (*P*<0.01).

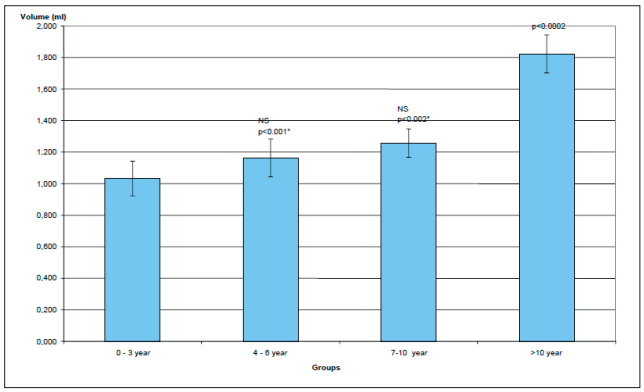

Figure 1. The mean testicular volumes of descended testicles between the different age groups. There are presented average (X±SEM) of the testicular volumes of boys aged 0-3 years (N=16); 4-6 years (N=12); 7-10 years (N=20); and boys > 10 years (N=12), p<–probability

The mean testicular volumes of descended testicles of control group are presented in Figure 1.

Results of the mean TV of the children in control groups shown no significant differences in TV between groups of the healthy boys aged 0.5-3 years (1.032±0.12), 4-6 years (1.163±0.12) and 7-10 years (1.257±0.09). Inversely, there was significant difference between TV in the each of aforementioned groups respectively to the group of the healthy children older than 10 years in whom the mean TV (±SD) was 1.82±0.15. Thus the boys aged 0.5-3 years had the mean TV decreased by 43% (*P*<0.0002), the boys aged 4-6 years decreased by 36% (*P*<0.001) and the boys aged 7-10 years by 31% (*P*<0.002) compared to the mean TV in boys older than 10 years. The mean testicular volumes of cryptorchid testicles are presented in Figure 2.

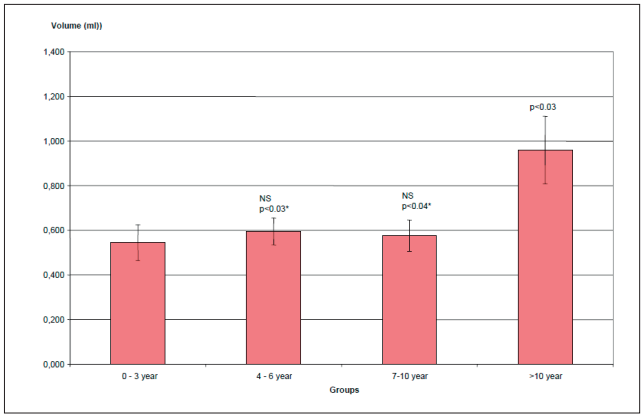

Figure 2. The mean testicular volumes of cryptorchid testicles between the different age groups. Presented are: average (X±SEM) of TV of the boys aged 0-3 years (N=16); 4-6 years (N=12), 7-10 years (N =20) and boys >10 years (N=12); p<–probability

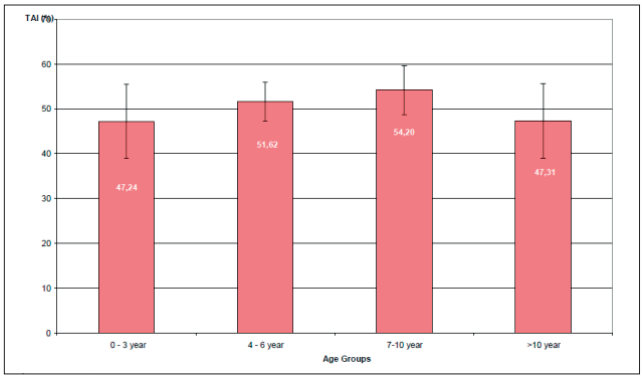

Figure 3. The mean testicular atrophy index of cryptorchid testicles between the different age groups. Presented are average (X±SEM) of TAI of testicles of cryptorchid patients aged 0-3 years (N =16); 46 years (N=12); 7-10 years (N=20); and patients > 10 years (N=12); p< probability

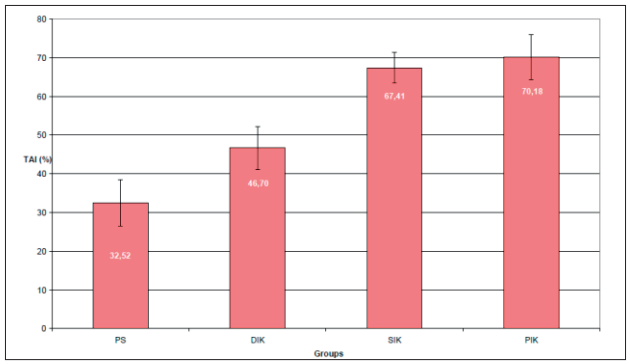

Figure 4. The effect of the localization of cryptorchid testicles on the testicular atrophy index values. Presented are average (X±SEM) of testicular atrophic index (TAI) of the cryptorchid testicles localized in prescrotal position –PS (N=13), in the distal third of the inguinal channel -DIC (N=24), the middle third of the inguinal channel –MIC ((N =16) and the proximal third of the inguinal channel-PIC (N=7); p<–probability

The results are shown no significant differences in the volumes of cryptorchid testicles between groups of patients with cryptorchidism aged 0.5-3 years (0.509±0.09), 4-6 years (0.595±0.06) and 7-10 years (0.576±0.07). However, we identified significant difference between TV of each of the aforementioned groups regarding to the group of patients with cryptorchidism older than 10 years. Group of the patients with cryptorchidism aged 0-3 years, had average of the testicles volume lower for 47% (p<0.03), group aged 4-6 years for 38% (p<0.03), and group aged 7-10 years for 40% (p<0.04) regarding to values identified within group of the patients older than 10 years.

The mean testicular atrophy index of cryptorchid testicles between the different age groups is presented in Figure 3.

Results of the mean TAI of cryptorchid testicles between the different age groups shown no significant difference of the values of TAI between compared age groups.

Results of determination of the location of cryptorchid testicles showed that 40% cryptorchid testicles were in the

distal third of the inguinal channel, 26,7% in the middle third of the inguinal channel, 21,7% in prescrotal location and in 11,7% in the proximal (lateral) third of the inguinal channel.

The effect of the localization of the cryptorchid testicles on the testicular atrophy index values is shown in Figure 4.

Results of the effect of the localization of the cryptorchid testicles on the TAI values shown no differences in TAI between testicles in prescrotal location and those positioned in the distal third of the inguinal channel. However, TAI was significantly higher in testicles located in the middle third of the inguinal channel ($p<0.01$), as well as in testicles in the proximal third of the inguinal channel ($p<0.01$), regarding to the testicles with prescrotal position. Furthermore, we determined significantly higher values of the TAI in testicles in the middle third of the inguinal channel ($p<0.04$), as well as in those in the proximal third of the inguinal channel ($p<0.02$) regarding to the testicles located in the distal third of the inguinal channel. Conversely, there was no significant difference between the TAI of testicles located in the middle and the proximal third of the inguinal channel.

5. DISCUSSION

Reliable and accurate determination of the testicular volume is of great benefit in the evaluation of patients with disorders affecting testicular growth, development and function. Tahikara, et al. determined that 80-90% of the testicular mass consists of seminiferous tubules containing germinal and Sertoly's cells (1). Numerous studies have found a correlation between testicular volume and level of the FSH, LH and testosterone in the blood serum as well as between the testicular volume and total number, volume, motility and morphology of the spermatozoids (1,2,3). There are different tools for measuring testicular volume, such as calipers, rulers, Prader's (10) and Rochester's (11) orchidometers, water displacement and USG (12).

Our results of the determination of the mean volume of the cryptorchid testicles and the mean volume of the descended testicles showed that testicular volume of cryptorchid patients was significantly decreased when compared to the volume of descended testicles within the control group ($p<0.001$). Decrease of the volume of cryptorchid testicles was observed in all age groups, except within the group younger than 6 months. These results are in accordance with the results of the authors who determined significant decrease of TV of cryptorchid patients (13,14).

We found no significant differences in testicular volume between cryptorchid boys and healthy boys under the age of 6 months. Similar results were published by other authors (15,16). These results point toward need of earlier surgical intervention. Furthermore, we found no significant differences in testicular volume in the control group of boys younger than 10 years of age. Contrary to this, we observed a significant increase in testicular volume in boys of the control group older than 10 years. Similar results were gained through observations of the average volumes of the cryptorchid testicles in boys of different age groups. These results are in accordance with other studies that also found insignificant differences in testicular volumes in both descended and undescended testicles in boys younger than 10 years, as well as a significant increase in testicular volume in both groups of subjects after ten years of age (14). The observed increase in testicular volume after ten years of age could be induced by increase of the production of the testosterone that occurs in the period of pre-puberty. The mechanisms that induce disturbance of the growth and development of the cryptorchid testicles are not well understood. It is still not clear whether these disorders are lead by congenital or acquired pathophysiological mechanisms (17,18). Due to findings that testicular volume remains preserved in the first 6 months of age in children with cryptorchidism, it could be concluded that the decrease in testicular volume after 6 months of age occurs as a result inappropriate temperature milieu.

Various studies included TAI in the attempt of the finding a precise parameter in the assessment of optimal timing for operative treatment of patients with unilateral varicocele (19,20). Niedzielski et al. evaluated clinical usefulness of TAI as the criteria for the classification of the cryptorchid patients for surgery and as criteria for monitoring of the success of the treatment (9). Our results of the TAI values of the cryptorchid testicles in boys of different age groups showed no significant differences of TAI values among the age groups studied. The TAI values ranged between 47.3%–54.2%. The lower TAI values are marked at the youngest (0-3 years) and the oldest age group (>10 years). These results are in accordance with the results of Niedzielski, et al. (9). However, we should accent that the TAI values (47.3%) in age group of 0.5-3 years were higher compared with the values of TAI (35.4%) in the researches of Niedzielski in the same age group (9). This difference can be explained with the fact that mentioned researchers treated cryptorchid patients with the hormonal therapy (human chorionic gonadotrophin) before the determination of the TAI, with a consequent increase in the size of the treated testicles. Since there is not any data in the literature about determination of the TAI values within hormonally untreated patients, our research is the first one that analyzed the volume of the cryptorchid testicles and the TAI values of the cryptorchid testicles that were not hormonally treated preoperatively.

Numerous studies have determined the effect of the localization of cryptorchid testicles to its volume and function. Hack, et al. studied the relation between the incidence of the cryptorchid testicles and the number of conducted orchidopexy and the influence of the testicular localization to its volume (21). In this (21), as well as in the other studies (17), obtained results showed that more proximal forms of cryptorchid testicles have lesser volume, probably due to higher temperature of the milieu. Our research showed that there is obvious influence of the primary localization of the cryptorchid testicles to the TV and TAI. We found a significant correlation of the TAI values with the localization of the cryptorchid testicles and determined significantly higher values of the TAI values of testicles located in the middle third of the inguinal channel, as well as within the testicles located in the

proximal third of the inguinal channel, comparing to the testicles located in the distal third of the inguinal channel and those in pre-scrotal position. Since there are no results in the literature about the influence of localization of cryptorchid testicles in the index value, were not able to compare our results with those from other authors.

6. CONCLUSION

The results of our study showed that TV of cryptorchid testicles was reduced in all age subgroups after the sixth months of age. The duration of untreated cryptorchidism was associated with reduction in their volume and consequently reduced testicular atrophy index. There was a correlation between the location of cryptorchid testicles and values of TAI. From the viewpoint of cryptorchid TV and TAI, cryptorchid children should underwent surgery as early as possible.

CONFLICT OF INTEREST: NONE DECLARED

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