The Role of Sonoelastography in the Evaluation of Testes With Varicocele

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OBJECTIVE To evaluate the role of elastosonography in the evaluation of testicular elasticity as a predictive sign of testicular damage in patients with varicocele.

MATERIALS AND METHODS Between December 2010 and December 2014, we evaluated patients with varicocele by sonoelastography (SE) of the testes. We created 3 groups: group A included patients with untreated varicocele; group B, patients treated with the same technique; and group C, healthy age-matched patients without varicocele. All patients underwent SE for the evaluation of testicular stiffness and results were graded from 1 to 3 following the color scale grading.

RESULTS During the study period, 36 boys (9-16 years old) with untreated varicocele, 47 treated patients, and 24 age-matched healthy subjects underwent control visit for varicocele and SE. All right testes of all groups were scored as 1, whereas testes with varicocele were stiffer than normal; all hypotrophies were scored as 3, whereas not all testes that were scored 3 were associated with testicular hypotrophy. There was a significant and statistical recovery rate of the testicular volume and the sonoelastographic score after surgery.

CONCLUSION Testes with varicocele are significantly stiffer than normal ones. All testes with testicular hypotrophy had grade 3 sonoelastographic scores, but not all patients with a grade 3 score have testicular hypotrophy or continuous spermatic vein reflux. Our results show that sonoelasography can play a significant role in the evaluation of testicular elasticity as a predictive sign of testicular damage. UROLOGY 100: 203–206, 2017. © 2016 Elsevier Inc.

Varicocele is the first cause of male subfertility and its correlation with testicular growth arrest is well known. It is now accepted that the treatment of varicocele in children should be concomitant with the onset of ipsilateral testicular hypotrophy (or testicular growth arrest) independently by the clinical grade and when varicocele is accompanied by pain. Obviously, changes in semen quality are not considered as a parameter for surgery in pediatric patients, but remain the first indication for surgery in adult patients, or as soon as patients are old enough to perform semen analysis.[1-4]

Generally, patients with varicocele are managed with control visits, ultrasound to evaluate testicular volume, and Doppler ultrasound to evaluate spermatic vein reflux; without testicular hypotrophy, patients are advised to follow the wait-and-see approach. Many studies reported that testicular hypotrophy is associated with a high grade of spermatic vein reflux, but at present there is no available test to predict which patients will have testicular hypotrophy.[5]

Sonoelastography (SE) is an imaging technique used to determine the elasticity of tissue; results are expressed following a color scale wherein red indicates well-vascularized tissues with a good elasticity, blue indicates stiffer tissue, and green represents mixed stiffness.[6-10]

The usefulness of this technique represents the capacity of real-time ultrasound to evaluate tissue and the stiffness of tissue immediately during the examination, focusing on a specific site or area.

The aim of the present study is to evaluate the role of SE in the evaluation of testicular elasticity as a predictive sign of testicular damage.

MATERIALS AND METHODS

Between December 2010 and December 2014, patients followed at our center for varicocele were asked to participate in the study. Patients with varicocele who visited our department usually underwent objective examination, testicular ultrasound, and Doppler velocimetry every 6 months. Patients with testicular hypotrophy are treated surgically and then monitored at 3, 6 and 18 months after surgery. In the present study, we considered only patients who underwent additional SE. Varicocele was classified as follows: grade 1—palpable varicocele only with Valsalva; grade 2—palpable varicocele without valsalva; and grade

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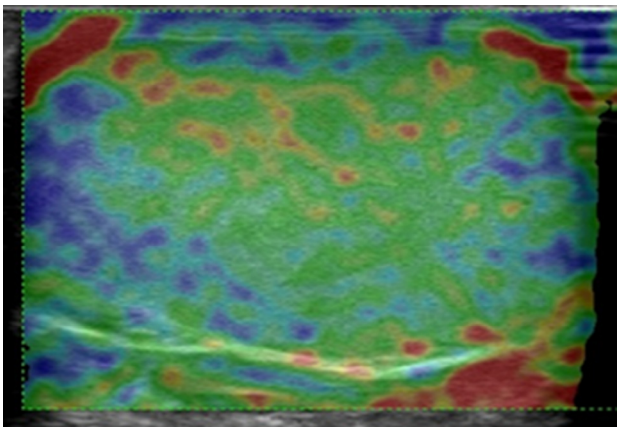

Figure 1. Normal testis (score 1): see green and red color distribution. This represents good stiffness and vascularization of a tissue. (Color version available online.)

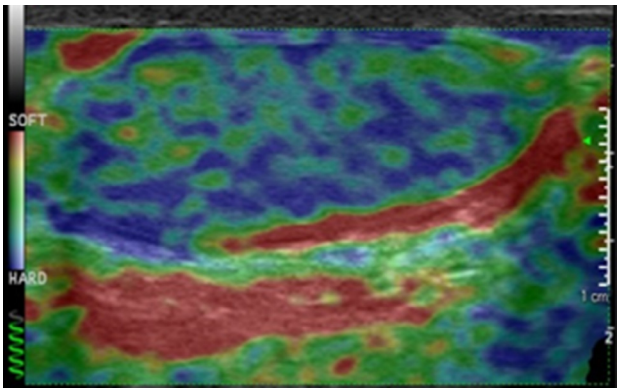

Figure 2. Testis slightly to moderately stiffer than normal (score 2): this pattern showed highly mixed colors with a peripheral low strain pattern and high central strain (green mixed with red and blue). (Color version available online.)

3—visible varicocele. Spermatic vein reflux was classified following a modified Hirsch classification.[3]

We created 3 groups of patients and the inclusion criteria for the present study were as follows: group A—age between 9 and 16 years; left varicocele; no testicular hypotrophy at ultrasound and orchidometer measurements; no previous infections of the urinary system; no previous testicular traumas nor previous inguinal and scrotal surgeries and at least 2 medical evaluations; group B—patients treated for varicocele and testicular hypotrophy who underwent SE before and after surgery; and group C—age-matched patients without varicocele and without a history of testicular trauma or inguinal surgery. All subjects were evaluated with SE.

Testicular hypotrophy was defined as a discrepancy between testes volumes of greater than 10%. The testicular elasticity was expressed as a 3-point scale (1, normal; 2, slightly to moderately stiffer than normal; 3, severely stiffer than normal) (Figs. 1-3).

Sonoelastographic Examination

SE was used to record the sonoelastographic index of elasticity of the testes with a linear probe (MyLab 60 Gold Platform; Esaote, Genoa, Italy) equipped with sonoelasto-software (ElaXto, Esaote). First, B-mode images were obtained for each testis, then SE was

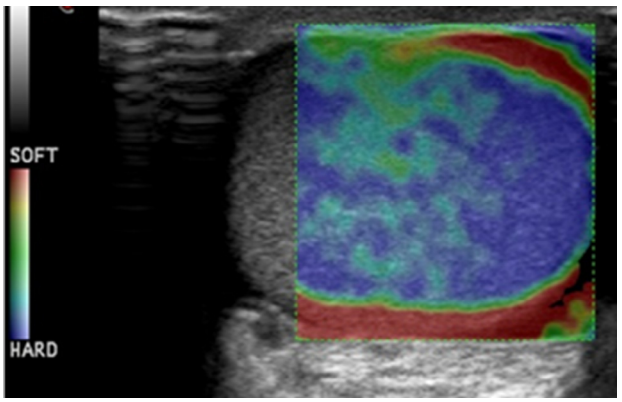

Figure 3. Testis severely stiffer than normal (score 3): there is a great blue distribution inside the testis. This represents less stiffness of the tissue. (Color version available online.)

performed by applying a light vertical pressure followed by decompression until a good-quality image was achieved. A compressive stress placed on the tissue causes a degree of deformation (strain) on the tissue itself; it was observed that the extent of deformation is inversely proportional to the stiffness of the tissue, whereas the amount of stress required to deform the tissue is directly proportional to the stiffness of the tissue. The result of the sonoelastography, based on a color scale, was displayed on the B-mode image, which ranges from green to blue. Green indicated a tissue with the greatest elastic strain, that is, the softest components, whereas blue indicated a tissue with no strain, that is, the hardest components. Elasticity was expressed using a semiquantitative 3-point scale where 1 represented the most elastic well-vascularized tissues (predominantly green and red), 3 represented the less elastic and vascularized tissues (predominantly blue), and 2 represented medium elastic tissues, where blue and green were mixed. All scans were performed by a skilled radiologist who specialized in SE of the genitourinary tract.[10]

Evaluation Criteria

After recruiting medical charts, for group B, we considered only the patients who had completed at least 2 postoperative follow-ups at 3 and 6 months after surgery and had undergone SE.

Statistical analysis was performed using Student's *t*-test, chi-square test, and Fisher's exact test. Significance value was set at $P < .05$. The analysis was conducted with the Statistical Package for Social Sciences software version 15 for Windows (SPSS Inc., Chicago, IL).

RESULTS

During the study period, 36 boys (9-16 years old) with untreated varicocele, 47 treated patients, and 24 age-matched healthy subjects underwent control visit for varicocele and SE.

Group A: Four patients had grade 1 varicocele, 20 patients had grade 2 varicocele, and 12 patients had grade 3 varicocele; 6 cases had "short" spermatic vein reflux, 14 patients had "medium" spermatic vein reflux, and 16 patients had "continuous" spermatic vein reflux. There was no correlation between the clinical grade of the varicocele and the grade of the spermatic vein reflux ($P > .05$).

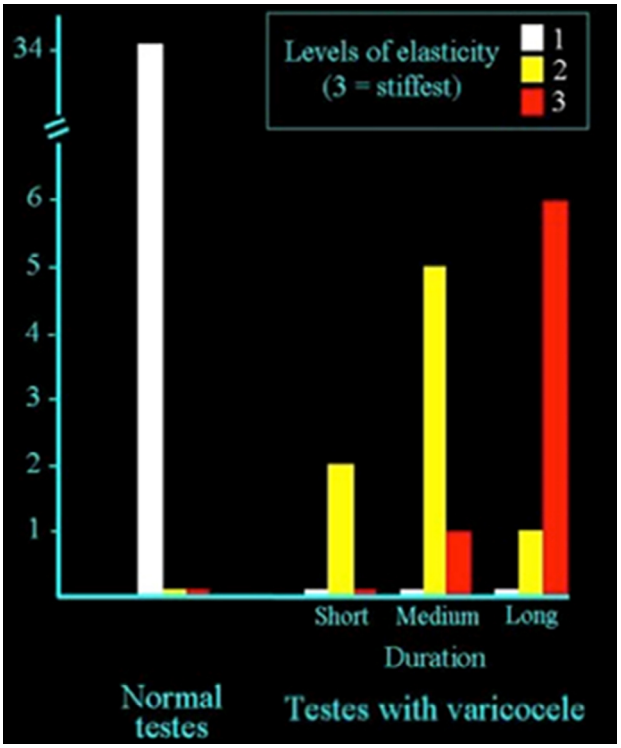

Figure 4. Cumulative score parameters. (Color version available online.)

During follow-up, 5 patients (14%) underwent surgery for testicular hypotrophy; all of these patients had continuous spermatic vein reflux. Two patients had a first medium spermatic vein reflux, whereas the other patient had a continuous spermatic vein reflux at diagnosis. There was no correlation between the clinical grade of the varicocele and testicular hypotrophy ($P > .05$).

Group B: All patients had continuous spermatic vein reflux and testicular hypotrophy. There was no correlation between the clinical grade of varicocele and testicular hypotrophy ($P > .05$).

Group C: During follow-up, none of these patients developed clinical or subclinical varicocele.

Sonoelastographic Data

The elasticity was graded 1 in all 83 right-side testes of groups A and B and in all testes of the control group (group C); in the testes with varicocele (group A), the elasticity was graded 1 in 4 patients (with grade 1 varicocele), graded 2 in 18 cases, and graded 3 in 14 cases. The differences in the degree of elasticity between normal testes and testes with varicocele and between continuous and medium/short spermatic vein reflux were highly significant ($P < .001$ in both cases). There was also a statistical difference between the sonoelastographic degrees of clinical grade 3 and grade 1 or 2 varicoceles ($P = .048$) (Fig. 4).

At the end of the study, 8 patients (45%) with varicocele (group A) from the grade 2 sonoelastographic group developed a grade 3 sonoelastographic score but without testicular hypotrophy. All 5 patients of this group that developed testicular hypotrophy had a grade 3 sonoelastographic score. During postoperative follow-up, at 6 months after surgery, the degree of testes stiffness improved from 3 to 2 in 4 patients ($P < .05$). Two patients who underwent surgery (patients with testicular hypotrophy) at the first reported grade 3 sonoelastographic score still had medium spermatic vein reflux detected at Doppler velocimetry.

All patients from group B had grade 3 sonoelastographic scores before surgery. Thirty-eight patients after surgery (12 months) had elasticity graded as 2 or 1 ($P < .05$). Nine patients still had an elasticity graded as 3. There was a significant improvement in elasticity after surgery ($P < .05$).

DISCUSSION

Although over the years many authors have studied varicocele to identify common elements in patients affected by this condition, it is not yet clear whether varicocele is to be treated in pediatric patients, which patients need surgery, which correlation may exist between varicocele, clinical grade, and testicular hypotrophy, and which subjects are more likely to develop testicular hypotrophy.[11-14]

Studies explaining the correlation between varicocele and testicular hypotrophy with an objective perspective and which varicocele will develop a testicular hypotrophy are not currently available in literature. Many studies reported in literature consider the efficacy of varicocele ligation about testicular volume recovery and improvement of semen quality, but there is no clear consensus on which varicocele should be treated.

Many authors have suggested a conservative treatment for testicular hypotrophy, which they reported as transitory, and others suggest treatment of each patient with continuous spermatic vein reflux (because this kind of spermatic vein reflux is associated with testicular hypotrophy). Based on these findings, it is clear that before the results of the semen analysis are obtained, some patients need treatment for impaired semen quality.[13,14]

Varicocele damages the affected testis as proven by the onset of testicular hypotrophy, which does not affect all patients but definitely affects and damages spermatogenesis, as shown by semen analysis, but, again, this is not true for all patients.

Based on the necessity to study and identify a clear cohort of patients of pediatric age who really need treatment, we decided to manage these subjects with different tests, such as color-Doppler ultrasound, Doppler velocimetry, and testicular SE.

The sonoelastographic images may demonstrate changes in the tissue that extend beyond those that can be demonstrated on B-mode ultrasound.[15,16]

Although Schurich et al as well as many other authors reported that testicular volume measured by B-mode US is correlated significantly with testicular function, these data alone are not useful to assess the real function of testes. As reported by some authors, SE may be used to assess the effect of varicocele on testes; in fact, there is a significant negative correlation between the hormonal value and

elasticity of the testes, independent of the volume, and this correlation can reflect the relative stiffness of the testis and its surrounding tissues.[16-21]

Data from our study show and confirm how the clinical grade of the varicocele, the grade of the spermatic vein reflux, and testicular volume are independent factors, but the final result (testicular hypotrophy) can be predicted using SE. Patients with grade 3 sonoelastographic score with normal testicular volume, independent of the clinical grade of the varicocele or the grade of the spermatic vein reflux at diagnosis, will have testicular hypotrophy. Our study shows that it is important to follow also patients with grade 1 varicocele because if these patients have "continuous" spermatic vein reflux, they are at risk to develop testicular hypotrophy as those patients with a higher grade of varicocele.

CONCLUSION

Testes with varicocele are significantly stiffer than normal ones, with a positive correlation with the clinical grade and significantly with the duration (grade of spermatic vein reflux following the Hirsch classification) of the spermatic vein reflux. All testes with testicular hypotrophy had a grade 3 sonoelastographic score and all hypotrophies were associated with continuous spermatic vein reflux, but not all patients with a grade 3 score have testicular hypotrophy or continuous spermatic vein reflux. These data could be used in the future as predictive factors to opt for varicocelectomy. Our results show that sonoelastography can play a significant role in the evaluation of testicular elasticity as a predictive sign of testicular damage.

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