

The Relationship of Testicular Sonoelastography with Gonadotropin Hormone Levels and Sperm Parameters

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ABSTRACT

Background: Elastography is a non-invasive medical imaging technique that helps determine the stiffness of organs and other structures in our body. In this study, we investigated the effectiveness of elastography in the diagnosis of infertility. **Aim:** In this study, we aimed to examine the relationship between testicular elastography and hormonal parameters and sperm parameters. **Patients and Methods:** The study included 136 patients, 272 testicles were examined, and the mean age of the study participants was 30.1 years. Testicular tissue stiffness was measured by scrotal ultrasonographic shear wave elastography. Gonadotropin and testosterone hormones were measured from blood samples. Spermogram parameters were studied manually. **Results:** The control group included 66 patients, and the varicocele group consisted of 70 patients. Testicular stiffness degrees of the control group were measured as 4.29 kPa for the right testis and 4.23 kPa for the left testis. The varicocele group was divided into grades 1, 2, and 3 according to physical examination. In group 1 (grade 1), the right testis was 4.07 ± 1.24 kPa and the left testis was 3.77 ± 0.98 kPa. In group 2 (grade 2), the right testis was 4.31 ± 1.40 kPa and the left testis was 3.98 ± 0.93 kPa. In group 3 (grade 3), the right testis was 4.73 ± 1.50 kPa and the left testis was 3.99 ± 1.68 kPa. Hormone and sperm parameters were not statistically significant when comparing the control and varicocele groups. There was no statistical significance between the testicular tissue stiffness degrees of the control and varicocele groups. Hormone and spermogram findings were also similar in groups. **Conclusion:** It is known that varicocele leads to histological tissue changes in the testes. These changes result in tissue softness and loss while affecting sperm parameters and testosterone levels in a negative way. Before varicocele surgery, there is a need for new imaging methods with more sensitivity that can detect tissue changes in the testes.

KEYWORDS: Shear wave elastography, testis, testosterone, varicocele

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INTRODUCTION

Manual physical examination is the primary diagnostic method for intrascrotal contents. Physical examination by a careful and experienced specialist clinically distinguishes pathological conditions in the scrotum and testis and also requires imaging methods as a complementary examination method. Ultrasonography: It is one of the radiological diagnostic methods that is inexpensive and non-invasive, does not require preliminary preparation, and does not cause undesirable effects to the patient such as radioactive

rays. It is one of the gold standards used in male infertility, scrotal pain, swollen scrotum, and other rare clinical situations.^[1] Manual physical examination can sometimes remain subjective in the evaluation of anatomical pathologies in the scrotum content and


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spermatic cord. Therefore, Doppler ultrasonography to examine vascular pathologies, elastography techniques for detailed information about testicular tissue stiffness, is used as various new modalities of ultrasonographic imaging. Elastography can evaluate the tissue stiffness numerically and provide information about the tissue structure of the organ, and it has been routinely used in clinical practice, especially in breast, thyroid, and prostate diseases.^[2-4] Two different elastography techniques are used. These are strain elastography and shear elastography. In strain elastography, the radiologist makes a semiquantitative measurement by compressing and decompressing the transducer to the tissue. In shear wave elastography, however, it gives a numerical value in kilo pascal (kPa) directly about the tissue stiffness in relation to the tissue area to which it is applied.^[1] Current literature on testicular anatomy and pathologies with shear wave elastography is limited. These studies include subjects such as normal testicular tissue, varicocele, testicular tumor, and testicular torsion. However, when the articles are evaluated, it is difficult to comment on the results. The reason for this may be the anatomical and physiological characteristics of the examined organ and the effect of both testicles in cases such as varicocele. In this study, it was aimed to examine the relationship between varicocele, which is one of the most common pathologies of the testis, and normal testis, due to the presence of both hormone secretion and spermatogenesis features, with testicular tissue stiffness, gonadal hormones, total testosterone, prolactin, and sperm concentration.

MATERIALS AND METHODS

Approval number 20.478.486/1049 was obtained from the ethics committee on 1/12/2021. Patients with infertility/varicocele complaints and normal individuals who applied to the urology outpatient clinic between 2019 and 2021 were included in the study. Inclusion criteria for the study: It was sought to be between 20 and 50 years old, diagnosed with left varicocele and having infertility between 0 and 5 years. Exclusion criteria of the study: Acute orchiepididymitis, torsion, testicular tumor, testicular surgery, testicular microlithiasis, solitary testis, and testicular pathologies were accompanied by genetic diseases. The cases were divided into four main groups and determined as group 1 (grade 1 varicocele), group 2 (grade 2 varicocele), group 3 (grade 3 varicocele), and control group. Varicocele examination: It was performed by manual examination according to the Dubin–Amelar classification.^[5] There were 66 cases in the control group: 34 cases in group 1, 29 cases in group 2, and 7 cases in group 3. The number of testicles evaluated in groups: It was 132 in

the control group, 68 in group 1, 58 in group 2, and 14 in group 3. Hormone analysis was performed with automatic measurement counters using UniCel DXI 800 Immunoassay System (Beckman Coulter, US) kits in the biochemistry laboratory of our hospital. Blood samples were obtained between 8 and 10 am. Radiological shear wave elastography measurements were obtained by an experienced radiologist in a room with suitable heat environment, with the Ablio 500 Platinum (Toshiba, Tokyo, Japan) SWE device. Bilateral testicles of each case were evaluated. Measurements were taken from the middle part of the testis with the probe (12–16 Mhz) held in a transverse plane, and the region of interest (ROI) circle was placed 1 cm deep to the testicular parenchyma. The measurement results were recorded in kilo Pascal (kPa). The semen samples obtained by masturbation were examined within 1 h, taking into account the 48–72 h sexual abstinence period of the individuals in the control and study groups. Within the framework of WHO 2010 criteria, sperm parameters were studied manually, and sperm concentrations were evaluated statistically. Statistical analysis was performed in the SPSS program, with $P < 0.01$ considered significant in the computer environment.

Statistical Analysis

Student's *t*-test and Spearman's correlation analysis tests were used to evaluate relationships between various variables. P value < 0.01 was considered significant.

RESULTS

Our study was evaluated within the inclusion criteria of 66 control and 70 varicocele cases. The varicocele group was divided into three groups according to the grading system. There were 34 cases in group 1 (grade 1 varicocele), 29 cases in group 2 (grade 2 varicocele), and seven cases in group 3 (grade 3 varicocele). The mean age of the control group and the varicocele group was statistically insignificant. The mean age of the control group was 30.3. The mean ages of group 1, group 2, and group 3 were 32.2, 29.9, and 27.8 years, respectively. In the varicocele patient group, the mean age among themselves was statistically insignificant. The number of testes evaluated by shear wave elastography was 132 in the control group and 140 in the varicocele group. The degrees of right and left testicular stiffness in the control group and groups with varicocele, along with their mean age, are given in Table 1.

For the right testis, when the degrees of hardness in the control group and between the varicocele groups were examined, no significant difference was found between the groups. For the left testis, the degree of stiffness between the control and varicocele groups was statistically insignificant. These results are summarized

Table 1: Mean age and mean testicular stiffness of the study participants

	<i>n</i>		Mean		
	Patients	Testes Evaluated	Age	Right Testicular Stiffness (kPa)	Left Testicular Stiffness (kPa)
Control	66	132	30,37	4,29	4,23
Group 1	34	68	32,26	4,07	3,77
Group 2	29	58	29,93	4,31	3,98
Group 3	7	14	27,85	4,73	3,99

Table 2: Comparison of varicocele cases of different degrees among themselves and the control group in terms of stiffness degree (right)

	Group 1 Correlation Sig. (two-tailed)	Group 2 Correlation Sig. (two-tailed)	Group 3 Correlation Sig. (two-tailed)
Control Group Correlation Sig. (two-tailed)	0,575	0,962	0,259
Group 1 Correlation Sig. (two-tailed)		0,487	0,032
Group 2 Correlation Sig. (two-tailed)			0,335

Correlation is significant at the <0.01 level (two-tailed) due to Spearman's correlation analysis test

Table 3: Comparison of varicocele cases of different degrees among themselves and the control group in terms of stiffness degree (left)

	Group 1 Correlation Sig. (two-tailed)	Group 2 Correlation Sig. (two-tailed)	Group 3 Correlation Sig. (two-tailed)
Control Group Correlation Sig. (two-tailed)	0,335	0,624	0,614
Group 1 Correlation Sig. (two-tailed)		0,491	<i>P</i> : 0,873
Group 2 Correlation Sig. (two-tailed)			<i>P</i> : 0,324

Correlation is significant at the <0.01 level (two-tailed) due to Spearman's correlation analysis test

Table 4: FSH, LH, total testosterone, sperm concentration, right and left testis stiffness mean values, and the control group and varicocele cases at different grades

	FSH (mIU/mL)	LH (mIU/mL)	Total Testosterone (ng/mL)	Prolactin (ng/mL)	Sperm Concentration (million/ml)	Right Testicular Stiffness (kPa)	Left Testicular Stiffness (kPa)
Control Mean	6,82	4,64	3,54	10	50	4,29	4,23
Group 1 Mean	5,76	4,1	3,74	9,26	64	4,07	3,77
Group 2 Mean	5,51	4,47	3,81	9,68	66	4,31	3,98
Group 3 Mean	4,81	4,5	4,16	8,57	96	4,73	3,99

No significant difference was found between the groups for the hormonal and sperm parameters and between right and left testicular stiffness within the group (*P*>0.01)

in Tables 2 and 3. The results of hormonal values and sperm concentrations were not statistically significant between control and varicocele groups. Control and varicocele cases of different grades: Hormone, sperm concentration, and right and left testicular stiffness degrees are summarized in Table 4.

DISCUSSION

Ultrasonic elastography has been used in recent years as a preliminary diagnosis method in the pathologies of various organs. Considering the parenchymatous structure of the testicular tissue and the ease of examination of the scrotum, there are increasing numbers of publications on the evaluation of testicular pathologies.^[6-8] When the literature is examined, the numerical data of the devices used and the pathologies examined are heterogeneous. For this reason, there is no

list of criteria that can be put forward as a result of the lack of a standard approach in the examination method. It is expected that the findings detected by manual examination of the testis should be evaluated in the light of radiological data and support each other. For example, when a patient with testicular tumor is palpated, the stiffness of the tumor tissue is different from the normal tissue. In the evaluation of this hardness by elastography, numerical data with high hardness values are available. Even in the same histological pattern, the size of the pathological tissue may reflect the stiffness score differently.^[7] In the present study, 136 cases were included in the inclusion criteria as control and varicocele groups. Varicocele pathology is the most frequently diagnosed disease in the testis.^[9] Therefore, the stiffness of 140 testicles in 70 varicocele patients and 132 testicles (right and left testicles) in control cases

were evaluated by measuring. There was no statistical significance between the right and left testicular stiffness degrees of the control cases. The right testis was 4.29 ± 2.004 kPa, and the left testis was 4.23 ± 2.57 kPa. In the study performed by Trottmann *et al.*^[10] in 2016 with testicular shear wave elastography in healthy individuals, no statistical significance was found between the measurements made in the right and left testis, as in our study. The same researchers reported that they did not obtain different values in the measurements they made from the upper, middle, and lower regions of the testis. In our study, measurements were made from the middle part of the testis. In terms of testicle content, it is composed of many seminiferous tubule segments with septum. These tubules in the middle section are larger and more suitable for imaging.^[11] The midsection of the testis may be the best place for the changes that may occur in the testis tissue. In this, the rete testis, nerve, lymphatics, vessels, and epididymis connection point is the middle part of the testis. Ultrasound data are very valuable in the measurement of testicular stiffness in the control group and testicular stiffness in the varicocele group. Because the measured value is numerical and the measured testis area was obtained from the same place for each case and by taking the average of three measurements. There are very limited values of normal testicular elastography in the literature.^[12] The data in our study include both the non-pathological group and the homogeneous young age group. Therefore, it is important in terms of measurements that can be a reference to the literature. These measured degrees of hardness are directly related to the degree of hardness of the tissue examined numerically. User-related errors are not in question in shear wave elastography.^[12] The right testis and left testis stiffness degrees in varicocele groups: It was 4.07 ± 1.24 kPa in group 1, 3.77 ± 0.98 kPa in group 2, 4.31 ± 1.40 kPa, 3.98 ± 0.93 kPa in group 3, 4.73 ± 1.50 kPa, 3.99 ± 1.68 kPa. The right and left testicular stiffness degrees of the varicocele group were compared both within itself and with the control group. Although there were numerically lower values in the left testis, the data obtained were statistically insignificant. In the varicocele group, the degrees of hardness of the left testis are given in Table 1. One of the studies in the literature that best summarizes the histopathological findings of varicocele in the testis was by Gürdal *et al.* This is the study that they did in 2008, which includes an experimental model. However, it is difficult to say that the model here exactly coincides with human varicocele. The tissue feature of varicocele in the human testis is that the testis is soft compared to the other testis. The experienced specialist realizes this in the manual examination. (Gürdal *et al.*^[13]) According

to the histopathological results in the study, the stiffness of the varicocele testis should have increased.

(Turna *et al.*^[14]) In their study, they found testicular tissue stiffness degrees in the left varicocele group to be higher than the contralateral testis and healthy control group testis. This finding is far from explaining the soft testis in manual examination. In addition, varicocele is a pathology that affects both testicles. It is noteworthy that the contralateral testis was not affected at all in Turna's study.

In our study, testes with varicocele were not measured as a harder tissue compared to the control group, and numerically lower values were obtained. Elastographic measurements confirmed the softening of the varicocele in the tissue. Varicocele does not only impair testicular functions with its histopathological tissue changes. Varicocele in male infertility: It plays an important role in pathologies such as gonadal hormone suppression, reflux of toxins, and local scrotal temperature increase.^[15] This situation causes adverse effects on the spermatogenesis of the testis, leading to worsening of sperm quality and infertility. In our study, testosterone levels and gonadotropin hormones were within normal limits in all groups. (Dede *et al.*^[16]) There was no difference in hormonal parameters between the groups in studies involving tissue stiffness in the control and varicocele groups.

We did not find any decrease in sperm concentration or motility in our study. These results are insufficient to explain the negative effects of varicocele on testis. It may be related to the duration of the histopathological worsening effect of varicocele on testicular tissue. If the relationship between varicocele and histopathological data is correct, the increase in basement membrane thickness, which causes testicular volume loss and increased testicular stiffness, and hypertrophy of interstitial cells in collagen fibers should be corrected by varicocelectomy. However, in clinical practice, the reflection of varicocele correction on sperm parameters cannot always be seen completely. Therefore, it is necessary to better elucidate the negative effects of varicocele on spermatogenesis in male infertility and to plan possible new treatment strategies.

Among the findings of our study, if the timing of correction of varicocele pathology is performed when the degree of stiffness is not different from the degree of contralateral testicular tissue stiffness, impaired testicular functions due to varicocele may increase to better levels. Although there is not enough evidence to support this in this study, this issue should be studied prospectively.

CONCLUSION

Testicular shear wave elastography is an easily applicable, inexpensive, and non-invasive technique. It can give detailed information about testicular pathologies. It is known that varicocele leads to histological tissue changes in the testis. These changes result in tissue softness and loss while affecting sperm parameters and testosterone levels in a negative way. Before varicocele surgery, there is a need for imaging methods with more sensitivity that can detect tissue changes in the testis.

Key points

The place of testicular sonoelastography in the diagnosis of infertility is a topic of discussion and needs more studies as a method of diagnosis.

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Conflicts of interest

There are no conflicts of interest.

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