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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026

https://eurekaoa.com/index.php/5

TESTICULAR ELASTOGRAPHY IN PATIENTS WITH VARICOCELE AND INFERTILITY

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026

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Abstract

Objectives

We wish to evaluate the performance of Real-time Elastography (RTE) in assessing the effect of varicocele on testicular interstitial elasticity as well as in forecasting the effect of varicocele on sperm motility.

Materials and methods B-mode greyscale, colour Doppler and elastography ultrasound were performed in 50 varicocele patients and 25 healthy volunteers as controls. The photos of testicular elasticity were colour-coded according to the strain distribution with gentle compression [1] (Itoh, Radiology 2006). The results of the ill patient were compared with the normal volunteer, and the RTE findings were evaluated.

The Result A favourable correlation between varicocele grade and elasto ratio was found. Most varicocele testicles showed a greater elastography ratio compared to the same side in normal volunteers. I found a negative correlation between the elasto ratio and the percentage of active motile sperms.

Conclusion RTE is a useful non-invasive tool to forecast the active motile sperm status and to evaluate the changes occurring in the interstitium of the testicles affected by varicocele. It can be done at the bedside. This information is relevant for the anticipatory treatment in several therapeutic circumstances, depending on the elasto ratio. The ratio should be less than 4.5 kPa.

Important Stuff Elastography is playing an increasingly important role in monitoring interstitial changes in the testis. Elastography is a potential sign of fertility. Elastography follow-up can prevent end-stage damage that surgery could have corrected.

Keywords: Elastography, Sono- elastography, Ultrasound, Scrotum, Testis

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Introduction

Infertility is the inability of a couple who are not using contraception to conceive naturally after 12 months. One in six couples trying to have a baby will experience infertility. Male factors account for 50% of infertility cases, with 15% unexplained.[1] In addition to physical examination and semen analysis, scrotal ultrasonography (US) can be useful to confirm obstruction or testicular dysgenesis.[2] Ultrasound (US) is the first-line imaging modality used to evaluate the male genital tract because of its noninvasiveness, safety, and absence of radiation exposure [2]. [3] Elastography is very promising for examining testicular function, although standard ultrasonography has its limits. Recent advances in technology, in the application of AI and post-processing, have expanded our insight into structural and functional assessment of testicular tissue.[4] Elastography is the first imaging of tissue stiffness and is less subjective and provides more spatial localization information than the older methods of palpation. There are two kinds of elastography in use. There are two types of elastography: strain elastography (SE) and real-time elastography (RTE).[5] This modality can be employed to quantify and visualize tissue strain by measuring the movement of tissues in response to gentle pressure. SE uses sonography data recorded during externally applied compression-decompression cycles to determine in real time the strain response of tissues [6].The SE method is a semiquantitative elastography technique that assesses the elasticity and stiffness of the target tissues in relation to the surrounding normal tissues [7]. SE as a color map overlay on top of the grayscale picture displays the US's underlying assumption that soft tissues may be more flexible than stiff ones [8]. The ratio of stiffness of the target and normal tissues is expressed by the strain ratio (SR). Some studies have demonstrated that objective tissue stiffness evaluated by SE may be useful in clinical practice as a diagnostic marker to distinguish benign and malignant tissues in various organs [9-12]. The use of SE to examine testicular tissues is a new application.

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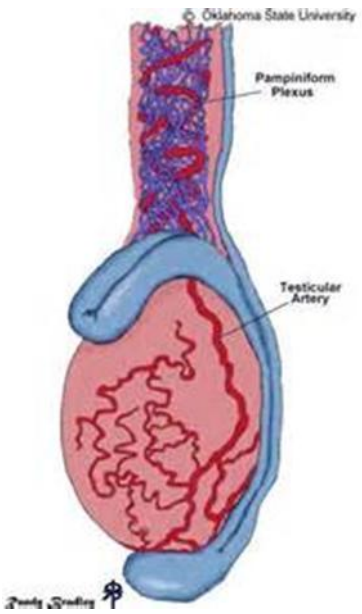

Aigner et al. found that elastography shows good sensitivity to differentiate between benign and malignant testicular tumors. This pilot study aims to investigate the reliability of RTE for assessing the effect of varicocele on testicular solidity and for employing elasto ratio as a predictive marker of the percentage of active motile sperm as described by Schurich et al. [4][13]. Infertile patients' hormone profile, morphology, motility, concentration, smoking, alcohol usage, lifestyle, and work environment are also not taken into consideration.

The testicular artery is the only artery that is strongly connected to the pampiniform plexus, a system of anastomotic veins, and is extensively coiled [16]. The two circulating arteries are separated in certain areas by nothing more than the thickness of their respective artery walls. This vascular arrangement allows heat and small molecules, such as testosterone, to be exchanged more readily [17]. The right spermatic vein usually ends in the vena cava. There is a communication between the left renal vein and the left spermatic vein. The intraluminal pressure of the left renal vein is assumed to be higher owing to the

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compression of the left renal vein along its course from the superior mesenteric artery to the aorta. This is the so-dubbed 'nutcracker effect.' The specific mechanism by which varicoceles cause infertility is unclear. Animal studies have shown that varicoceles are associated with increased blood flow to the testis and increased interstitial fluid. It is unknown whether elevated temperature in the testes is a cause or a consequence of testicular dysfunction, but these 2 effects may decrease intratesticular concentrations of testosterone and other local factors important for spermatogenesis.

1.2. Varicocele: Definition and Classification

Varicocele is defined as ectatic and tortuous veins of the pampiniform plexus of the spermatic cord. Varicoceles affect 15% of male teenagers and can cause infertility, pain, and testicular damage.

1.2.1Clinical Classification of Varicoceles

Varicoceles: A Clinical Classification 1.2.1 Subclinical: Positive scrotal thermography or Doppler reflux detection but no palpable indication of varicocele on examination.

Level I: Cannot see, can only feel with the Valsalva technique.

Level II: Not seen or felt unless a Valsalva technique is performed.

Level III: palpable on vaginal examination only

1.4. Testicular Pathology due to varicocele.

Gross Pathology :A

The testicles eventually atrophy as varicoceles grow in severity.

Microscopic Pathology:B

shows a decreased spermatogenesis. Development stopped. Sometimes a syndrome defined only by Sertoli cells [24] develops.

Leydig cell problems [22]

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An enlargement of the tubules [25]
Interstitial fibrosis: a condition known as [25]

1.6. Diagnosis of a Varicocele

1.Scrotal Ultrasound with color Doppler Examination [26]

Spider veins increased on the spermatic cord. A diameter of a vein more than 2 mm is deemed abnormal.
Blood coming out when doing the Valsalva technique.
Size of the testicles: a difference of at least 2 milliliters, or 20%
Varicocele recurrence
Uterine and retroperitoneal ultrasound: Tumor valve diameter as a rating criterion
Varicocele 0: less than 2.5
Less severe varicocele: 2.5-2.9
Varicocele (moderate): 3–3.9; varicocele (large): 4

2.Elastography

The term "elastography" was first coined by Ophir et al. [5] to describe an ultrasound-based imaging technique that predicts local axial stresses from the gradient of axial variations of echo arrival times along the path of the ultrasound beam following quasi-static tissue deformation.
One very recent approach exploits the fact that pathological processes change the elastic properties of the damaged tissue: elastography. Such change in elasticity can be detected and visualized by elastography [5-7]. It might also be used to check the solidity of thyroid nodules, breast nodules, LNS, liver masses, prostate nodules, etc.

3.Angiography

Endovascular venography is the only imaging technique that can demonstrate dilated testicular veins, retrograde contrast flow into the scrotum, and a dilated

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pampiniform plexus; however, the testes must be protected from the x-ray beam to prevent directly imaging these abnormalities.

Materials and methods

The Baghdad Teaching Hospital said it had received 50 infertility complaints from patients between 2016 and 2017. The ages of the patients ranged from 20 to 40 years, with a mean of 28. The inpatient ultrasonography unit of the department of urosurgery of GAZI AL HARIRI Hospital for Surgical Specialities for scrotal abnormalities (varicocele). In addition, a control group of 25 healthy volunteers who had no previous history of testicular illness or infertility was included. Greyscale, colour Doppler (CD) with the Valsalva technique and elastography studies of testicular interstitium are attempts to find the influence of varicocele. Testicular varicocele is the sole pathology addressed, and hence it does not include the more common acute inflammatory disease of the testis, hydrocele or any other probable causes. A history of smoking and alcohol usage is not part of the study but is noted. The primary or secondary nature of the infertility problem in the patient. Marital status, family size Before the ultrasound examination, patients were informed about the colour Doppler examination and the advantages and disadvantages of elastography and gave their verbal consent for the examination. They were also provided their phone number so they could be contacted following the surgery. Medical history of recurrent UTIs, diabetes, and surgical treatments such as heriorrhaphy and orchidopexy .Procedures were performed under the direction of consultant radiologists with >20 years' experience in ultrasonography. Time taken for the RTE assessment ranged from 5 to 10 minutes, averaging 7 minutes.

After sonoelastography evaluation patients are asked to return to the urosurgery department for final care. The examination was performed using the ultrasonic system Voleson E9, a GE machine produced in the USA, with a linear probe of 10-12 MHz. The scrotal setting was used to perform a full B-mode evaluation,

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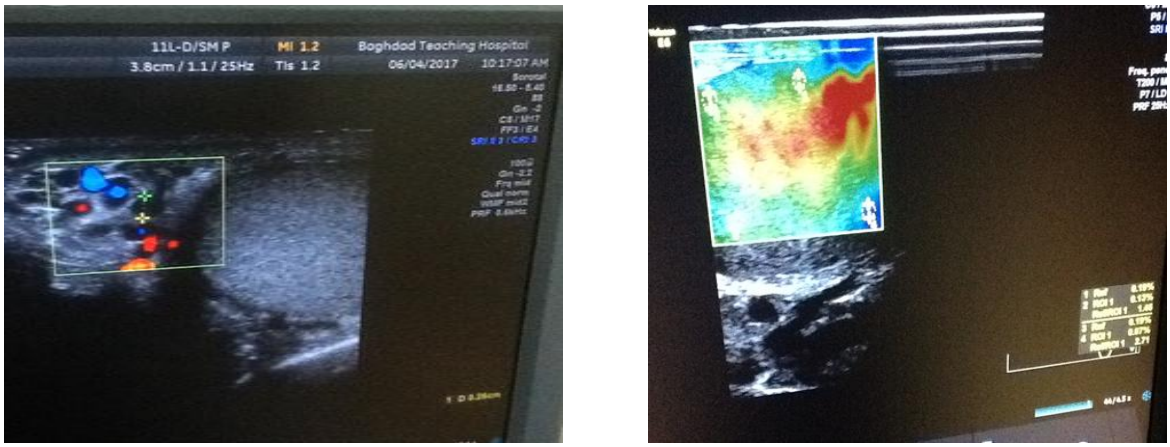
after which the exam was changed to elastography. Since the scrotal wall appears to be quite rigid, it is frequently excluded from the calculation of average strain, and a medium or large elastogram box (RTE-box) is usually employed to increase the number of samples and to avoid confusion. RTE was performed utilising the linear probe with minimum manual pressure applied on the testicle. The pressure intensity was calibrated to the scale of the quality indicator on the screen that offered real-time feedback to the user on the right stress for the scrotal application with a real-time frame rate of 13 Hz.



"Fig. 1"

Testicular elasticity was assessed by elastography with a wide RTE box. In a testis with G1 varicocele, the normal distribution of elasticity is blue (hard), green (soft), and red (extremely soft) [5]. To minimise misdiagnosis owing to the cremasteric reflex or technical problems, the elastograms are performed twice at different places of the same testis, and the average of the measurements is taken into consideration for diagnosis. The diagnostic connection was made using elasto ratio (solidity index), varicocele grade, proportion of active motile sperm, PPV and NPV.

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Results:

A total of 73 male respondents were included in the study. We included two groups in our study. A group of patients with fertility (n=50), and a normal group (n= 23).

The mean age of infertility cases was (29.2 ±6.3) and the mean age of normal cases was (29.3 ± 5.7). There was no statistical difference in age between the 2 groups (p= 0.9), figure (1).

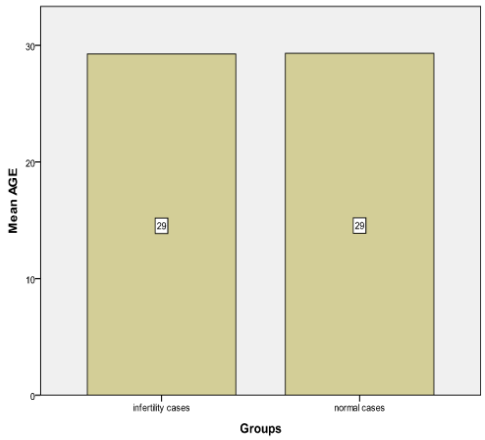

Figure (1) difference in age between infertility cases group and normal group.

We studied the correlation between Rt varicocele grade and Rt ELS. There was a strong positive correlation between theses 2 variables with R = 0.79 with significant results of p-value= 0.001 figure (2). R = 0.79, p-value= 0.001

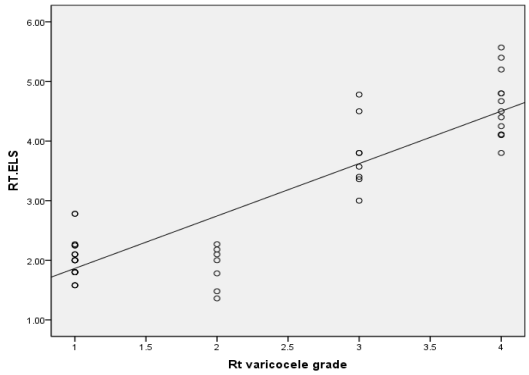

Figure (2) correlation between Rt varicocele grade and Rt ELS.

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Figure (3) shows the correlation between LT varicocele grade and LT ELS. Also, there was a strong positive correlation between theses 2 variables with R = 0.78 with significant results of p-value= 0.001 R = 0.78 , p-value = 0.001

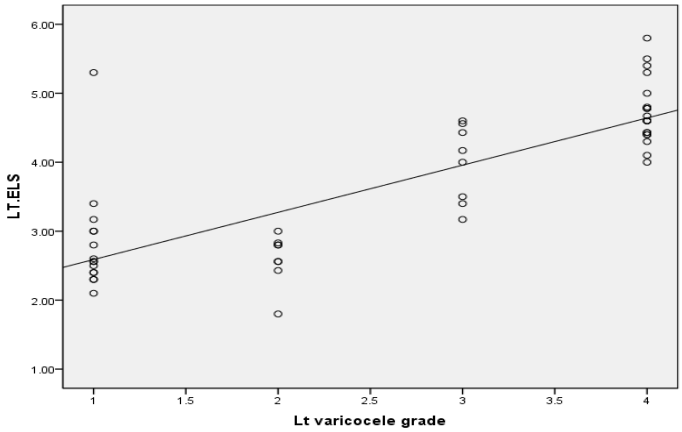
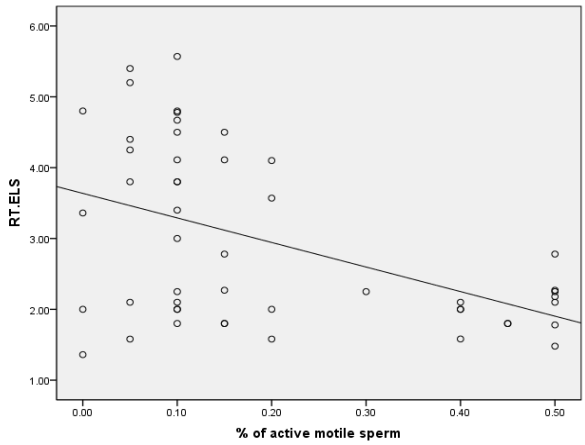


Figure (3) correlation between LT varicocele grade and LT ELS.

There was a negative correlation between % of active motile sperm and RT ELS with moderate R value (R = - 0.45) (moderate correlation) with significant results of p-value= 0.03 figure (4).



R = - 0.45 , p-value= 0.03

Figure (4) correlation between % of active motile sperm and RT ELS.

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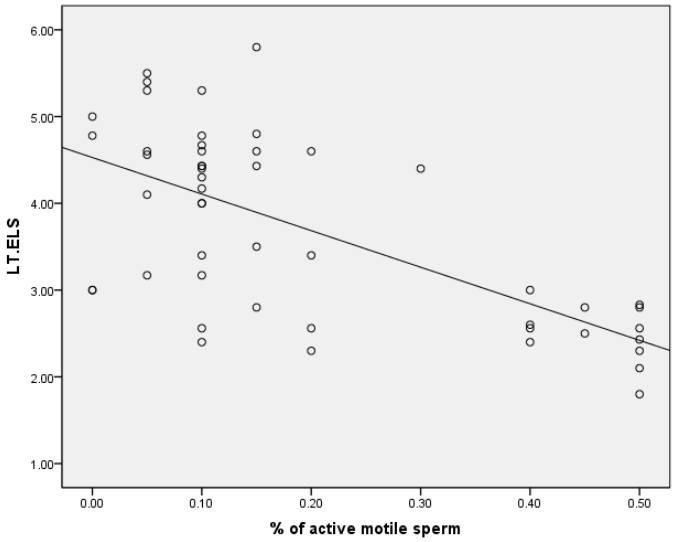
Figure (5) shows negative correlation between % of active motile sperm and LT ELS with R = - 0.66 and a s significant result of p-value= 0.001, figure (5).



R = - 0.66 , p-value 0.001

Figure (5) correlation between % of active motile sperm and LT ELS.

The distribution of fertility status according ELS was showed both for right and left testes in table (1) and figure (6). For the right testes the mean ELS value in infertility cases was (2.95±1.24) and for normal cases was (1.69±0.27) with significant difference of p-value= 0.001

For the left testes the mean ELS value in infertility cases was (3.69±1.08) and for normal cases was (1.81±0.25) with significant difference of p-value= 0.001.

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Table (1) distribution of fertility status according ELS

variables			N	Mean	Std. Deviation	p-value
ELS	RT	infertility cases	50	2.95	1.24	0.001
		normal cases	23	1.69	0.27	
	LT	infertility cases	50	3.69	1.08	0.001
		normal cases	23	1.81	0.25	

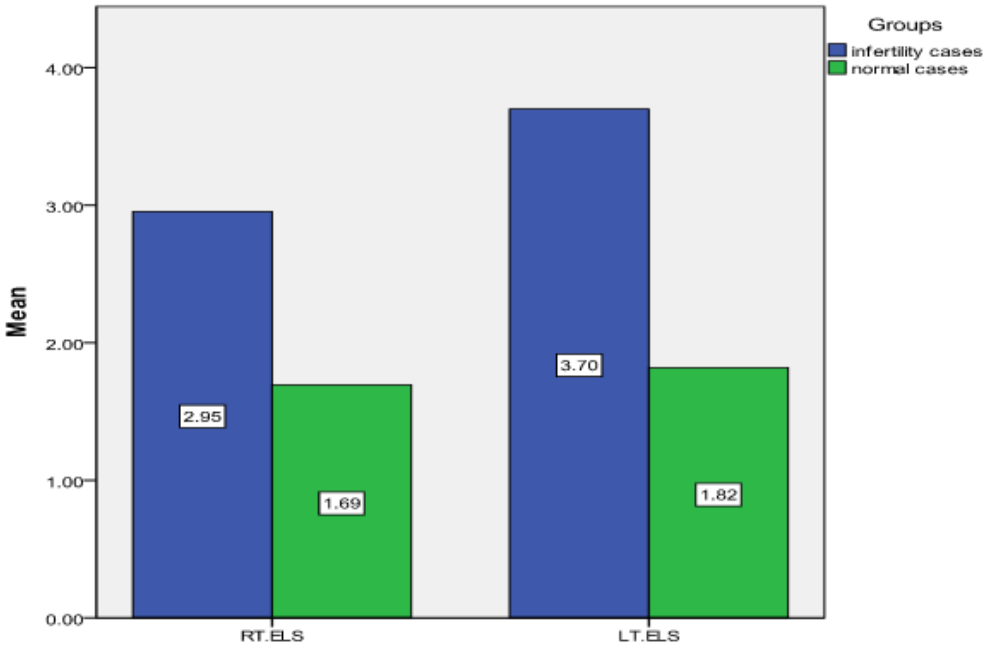

Figure (6) distribution of fertility status according ELS for both RT and LT testes

Statistical analysis:

Statistical package for social science version 20 (SPSS20) was used for both data entry and data analysis. Continuous variable presented as mean ± SD. T test for independence used to test the significance of association for continuous variable. Correlations examined using Spearman's rank correlation coefficients(R). A

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value of (R) is considered as this , (R < 0.3) as weak correlation , (R = 0.3-0.6) as a moderate correlation and (R > 0.6) as a strong correlation . P-value of < 0.05 was considered significant.

DISCUSSION

Infertility may affect more than 15% of couples and may entail psychosocial problems that affect the relationship between partners. Therefore, infertility becomes a prevalent health problem. 40-50% of all infertility cases are male infertility, with varicocele being the most common treatable cause [2].

Ultrasound (US) is now considered the gold standard in the assessment of the male genital tract, and its use as a diagnostic tool for infertility is increasing. Strain elastography (SE), real-time elastography (RTE), and shear wave elastography (SWE) advancements, as well as B-mode and color Doppler ultrasonography, have been used in research on testicular tissues and spermatogenesis [4-15-16].

Strain elastography is based on the assumption that a compressed material suffers strain, which is expressed as a color map relative to the material's stiffness. By this procedure it has been possible to distinguish localized lesions of the testis, breast, prostate, pancreas, and liver. Shear wave elastography (SWE) is a relatively new method that has recently acquired popularity for revealing varied hardness levels in different parts of the body in real-time. It combines B-mode pictures and color-coded ultrasound (US) to create a quantitative image of the tissue stiffness (in kPa). The application of SWE has demonstrated that the elasticity values are defined by the testicular volume and functional characteristics [30]. Thus, SWE should be used for reliable recording of changes in tissue hardness and transformations, as its results are more reproducible than other sonoelastography techniques. However, SE [22] conducted the research since this modality was unavailable in our radiology department.

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Some recent articles in the field are looking at elastography to diagnose the reason for infertility.

The rigidity of the tissue was higher in azoospermic patients, according to the French researcher Laurence Rocher, indicating that SER may be useful for the detection of this condition [30]. In the present study it was shown that there is a negative association between the percent of active motile sperm count and the solidity of testicular tissue. It also demonstrated that the elasto ratio (SER) increases with the decrease in the percent of active motile sperm. The main effect of the varicocele surgery was an improvement in the motility; hence, we did not consider the total sperm number.

Some research indicates that SER may offer more objective data and greater diagnostic accuracy than elastography (color map). Our results demonstrated a positive correlation between SER and varicocele grade and that patients with abnormal semen parameters had significantly higher SER values. Elastography was shown to be a good tool to detect any abnormalities in the structure of testicular tissues in Egyptian researchers (Saeed Ahmed et al., 2013). They also correlated the testicular volume and function to the elasticity pattern of the testis. Consistent with this conclusion, we found that the ratio of testicular elastography was higher in the varicocele patient group compared with the healthy control group. The sperm morphology, total number of motile sperm, and volume of testicles could not be included in either group. "Compliance of patients is crucial, but we can't force the volunteers to do the semen analysis. It may also be because of the small number of patients. Dede et al. [32] reported that O's study also included varicocele and serum FSH levels and elastography scores. Serum FSH and varicocele grade revealed an inverse connection with testicular flexibility. Our study showed a negative link between varicocele and tissue elasticity, and the groups were identical in terms of the occurrence of this condition. Also, we don't mention the association between FSH levels and elastography findings among the groups since we do not have the competence. Khaled Abdel Wahab et

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al. [33] stated that seminal fluid parameters should improve to 4.5 kPa after the procedure. Due to resource limitations and the small sample size, we were unable to ascertain whether the patients had oligozoospermia, azoospermia, or teratozoospermia and to analyze the relationships between these diagnoses and the sonoelastographic data. Moreover, the subjects were not screened for cigarette smoking, alcohol intake, or any other endocrinological problems that could affect sperm characteristics.

In conclusion elastography techniques are increasingly used in the evaluation of male infertility. As indicated by us with SE, testicular flexibility was inversely connected to active sperm %. The association of SR with varicocele grade may affect sperm quality and testicular volume in patients. Additional large-scale research to investigate the link between SE values and sperm characteristics may be useful for noninvasive testing of testicular tissues in infertile men. In addition, research comparing sperm activity before and after varicocele surgery using 4.5 kpa as a cut value can provide information on this issue. Written informed permission was not obtained from the patients involved in this investigation. Only verbal consent was obtained.

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Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026

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