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Testicular Strain Elastography in Fertile and Infertile Men - A Comparative Cross Sectional Study

Authors
Dr Akashkumar B Y*, Dr J. Devimeenal, Dr P Chirtrarasan
Department of Radiology, Government Kilpauk Medical College and Hospital, Chennai, Tamil Nadu – 600010
*Corresponding Author
Dr Akash Kumar B Y

Abstract

Background: *Infertility affects one fifth to one sixth of couples in the reproductive age group. A condition involving the male partner contributes to approximately 50% of cases of infertility. Conventional ultrasonography has the limitation of only functional analysis of testicular tissue, whereas elastography is a promising technique in this field.*

Materials and Methods: *A total of 82 patients between 20 – 45 years of age were evaluated between February 2018 to January 2019. The patients were divided into two groups based on semen analysis as Infertile (Group 1) and Fertile (Group 2). Semen analyses, B-mode, colourdoppler and sonoelastography examinations were performed. Measurements of testicular volumes, resistive indices (RI) in intraparenchymal arteries, strain value, strain ratio (SR) and presence of varicocele were recorded.*

Results: *Mean age of the patients were (Group1, 31.68 ± 3.78 years and Group 2, 29.68 ± 3.18 years). Mean Testicular volumes between Group 1 and 2 (13.87 ± 3.50 vs. 14.99 ± 1.98) were not significantly different. Mean Strain ratios between Group 1 and 2 (0.37 ± 0.08 vs. 0.22 ± 0.09, P <0.001) were significantly different. The SRs between men with various sperm abnormalities did not show any significant difference.*

Conclusion: *Strain elastography results were found to be significantly different in patients with abnormal sperm counts. This technique therefore proves to be a useful tool for the evaluation of male infertility. But further large scale studies may be needed to clarify the value of this imaging modality in the assessment of male infertility.*

Keywords: *Testicular Strain Elastography in Fertile and Infertile Men.*

Introduction

"Infertility is defined as the inability of a non-contracepting sexually active couple, to achieve spontaneous pregnancy within one year". It affects one fifth to one sixth of couples in the reproductive age[1].

When compared to other species, human beings are inefficient in terms of reproduction. The fertility rate per cycle is thought to be around 20% and the accumulated pregnancy rate in those couples with proven fertility is approximately 90% after 12 months and 94% after 2 years[1].In approximately 20% of infertile couples, male infertility is the sole cause, and in about 30%–40% of these couples, male and female factors are the causes. Therefore, a condition involving the male partner contributes to approximately 50% of cases of infertility.

The diagnostic workup of male infertility should include a thorough medical and reproductive history, physical examination, and semen analysis, followed by imaging. Ultrasound is the first-line imaging modality which is used for the evaluation of male genital tract as it is noninvasive, safe and there is no exposure to radiation. In addition to physical examination and semen analysis, ultrasonography of scrotum may be helpful in demonstrating obstruction or testicular dysgenesis[2]. Its sensitivity and specificity increase even more by using Doppler.

Conventional ultrasonography has the limitation of only functional analysis of testicular tissue, whereas elastography is a promising technique in this field. New insights for the structural and functional evaluation of testicular tissue have been provided by the recent technical advances in ultrasound applications and post-processing developments[3].

Elastography was first described by Ophir et al. It is a new imaging technique which displays the images of tissue stiffness. These images that are created by elastography are thought to be an extension of the ancient palpation techniques. It gives better information regarding the spatial localization and is also less subjective.

Real time elastography, a method which shows stiffness of tissue under real time conditions demonstrates different values of elasticity dependent on volume and function of testis. Elastography assesses elasticity of testis. It is defined as the tendency of the tissue to resist deformation when a force is applied, or to resume its original shape after the removal of the force.

The principle of sonoelastography is to use repeated, slight pressure on the examined organ with the ultrasound transducer.

Ultrasound elastography techniques can be categorized as:

1) Strain imaging, and 2) Shear wave imaging.

Here in this study, we study only the Strain elastography and its diagnostic value in male infertility.

Strain elastography was the first technique to be introduced. There are two approaches for strain imaging : Strain elastrography (SE) and Acoustic radiation force impulse (ARFI) strain imaging.

Strain elastography is further subdivided by the method of excitation: 1) In the first method, manual compression is given by the operator on the tissue with ultrasound transducer[4]. 2) In the second excitation method, the ultrasound transducer is held steady without moving, and internal physiologic motion is seen to generate tissue displacement (E.g. cardiovascular, respiratory). Since this method is independent of superficially applied compression, it may be used commonly to assess organs located deep.

In the evaluation of infertility, a study by Schurich et al. showed that strain elastography can be used to assess the structure of testicular parenchyma and therefore it can be used as an additional modality to detect pathological alterations of testicular tissue. They also noted that testicular volume and function were significantly affecting the elasticity pattern of the testicular tissue.

However, there are not much studies showing the importance of testicular strain elastography in the evaluation of infertility.

The hypothesis of this study is that abnormal semen parameters are associated with pathological alterations in the testicular parenchyma, and depiction of which cannot be done by conventional ultrasound.

Therefore we have done this study to show the differences in testicular elasticity as measured by strain elastography in infertile men with abnormal semen analysis when compared to the fertile men, and also to see the differences in elasticity patterns in various semen abnormalities.

Materials and Methods

Patient selection:

This comparative cross sectional study was approved by our institutional review board. 82 patients attending and rology clinic were selected for the study between June 2018 to May 2019 for a period of 1 year**.** The study population were divided into infertile and fertile group having 41 each.

Inclusion criteria:

- Infertile group - Men between 20–45 years of age, clinically diagnosed with primary infertility having abnormal semen analysis and did not receive any previous fertility treatment**.**
- Fertile group – Men between 20–45 years of age with normal semen analysis.

Exclusion criteria:

- Patients who did not undergo semen analysis.
- Undescended testis.
- History of orchidectomy or previous testicular biopsy.
- Atrophy of testis, acute. trauma changes, and prior surgical interventions to testis.
- Testicular mass.
- Testicular microlithiasis, and infarct.

Data Collection

Data collection was performed in the included study group using a standard questionnaire/ proforma that includes the basic patient details such as name, age, address, occupation, dietary habits and history of smoking/ alcohol, history of previous testicular surgery/ trauma, history of previous testicular malignancy/ infarct.

Methodology

Patients were explained about the study. Informed consent was obtained.

The whole examination was performed in the supine position using GE-Logic S7 machine, supplied with SE software and using a 7-12MHz frequency transducer. Gray scale ultrasonography was done first to look for the echotexture and size of the testis. This was followed by Doppler of intraparenchymal arteries to measure the resistive index. Strain elastography (SE) of testis was performed after this. The strain ratios were calculated by putting multiple equally sized regions of interest (ROIs) on the testicular tissue (A) and scrotal subcutaneous. fatty tissue (B).Strain ratio (SR) value was automatically calculated on the sonography machine by comparing. A to B (B/A) for each patient and mean values were obtained. Mean values in infertile and fertile men were then compared.

Statistical analysis

The Data was entered in a excel worksheet and double checked. IBM SPSS version 22 software is used for statistical analysis. Data were presented as mean ± SD. Continuous variables were. evaluated by mean and SD, and compared by Student's T test. Correlation of semen parameters with SE results were tested by One way ANOVA.P value < 0.05 was considered statistically significant.

Results

Among the total 82 patients, the mean age group in the infertile group (Group 1) was 31.68 ± 3.78 and in the fertile group (Group 2) was 21.68 ±3.18 (Table 1).

The mean testicular volume in Group 1was 13.87 ± 3.50 and Group 2 was 14.99 ± 1.98 (Table 2).

The mean resistive index of the intraparenchymal artery in Group 1was 0.44 ± 0.056 and in Group 2was 0.43 ± 0.042 (Table 3).

The mean testicular strain value in Group 1 was 1.68 ± 0.37 and in Group 2was 1.38 ± 0.525 (Table 4).

The mean testicular strain ratio in Group 1 was 0.36 ± 0.07 and in Group 2 was 0.22 ± 0.09 (Table 5).

Area under the ROC curve (AUC) for testicular volume was 0.618 with a P value of 0.0709 (Figure 5).

Area under the ROC curve (AUC) for resistive index of the intraparenchymal artery was 0.551 with a P value of 0.439 (Figure 5)..

Area under the ROC curve (AUC) for testicular strain value was 0.708 with a P value of 0.0007 (Figure 5).

Area under the ROC curve (AUC) for testicular strain ratio was 0.875 with a P value of <0.0001 (Figure 5).

On comparing the various sperm disorders, the mean testicular volume in patients with oligozoospermia, azoospermia, asthenozoospermia and in patients with both oligo and asthenozoospermia were 15.220 ± 2.299, 15.111 ± 3.529, 14.304 ± 3.096 and 11.756 ± 3.812 respectively.

The mean resistive index of intraparenchymal arteries in patients with oligozoospermia, azoospermia, asthenozoospermia and in patients with both oligo and asthenozoospermia were .40 ± .055, .43 ± .060, .44 ± .040, .47 ± .057 respectively.

The mean strain value of testis in patients with oligozoospermia, azoospermia, asthenozoospermia and in patients with both oligo and asthenozoospermia were 1.63 ± .472, 1.83 ± .360, 1.48 ± .303, 1.82 ± .351 respectively (Figure 6).

The mean strain ratio of testis in patients with oligozoospermia, azoospermia, asthenozoospermia and in patients with both oligo and asthenozoospermia were .363 ± .068, .341 ± .061, .348 ± .057, .409 ± .101 respectively (Figure 7).

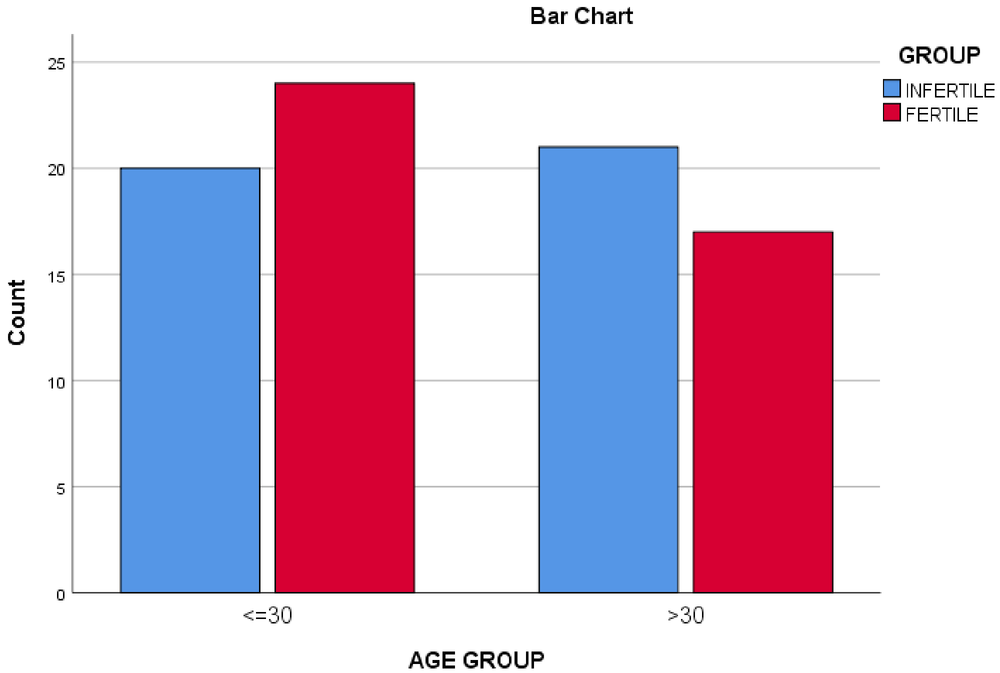


Table 1: Bar diagram showing the age wise distribution of the study population in two groups

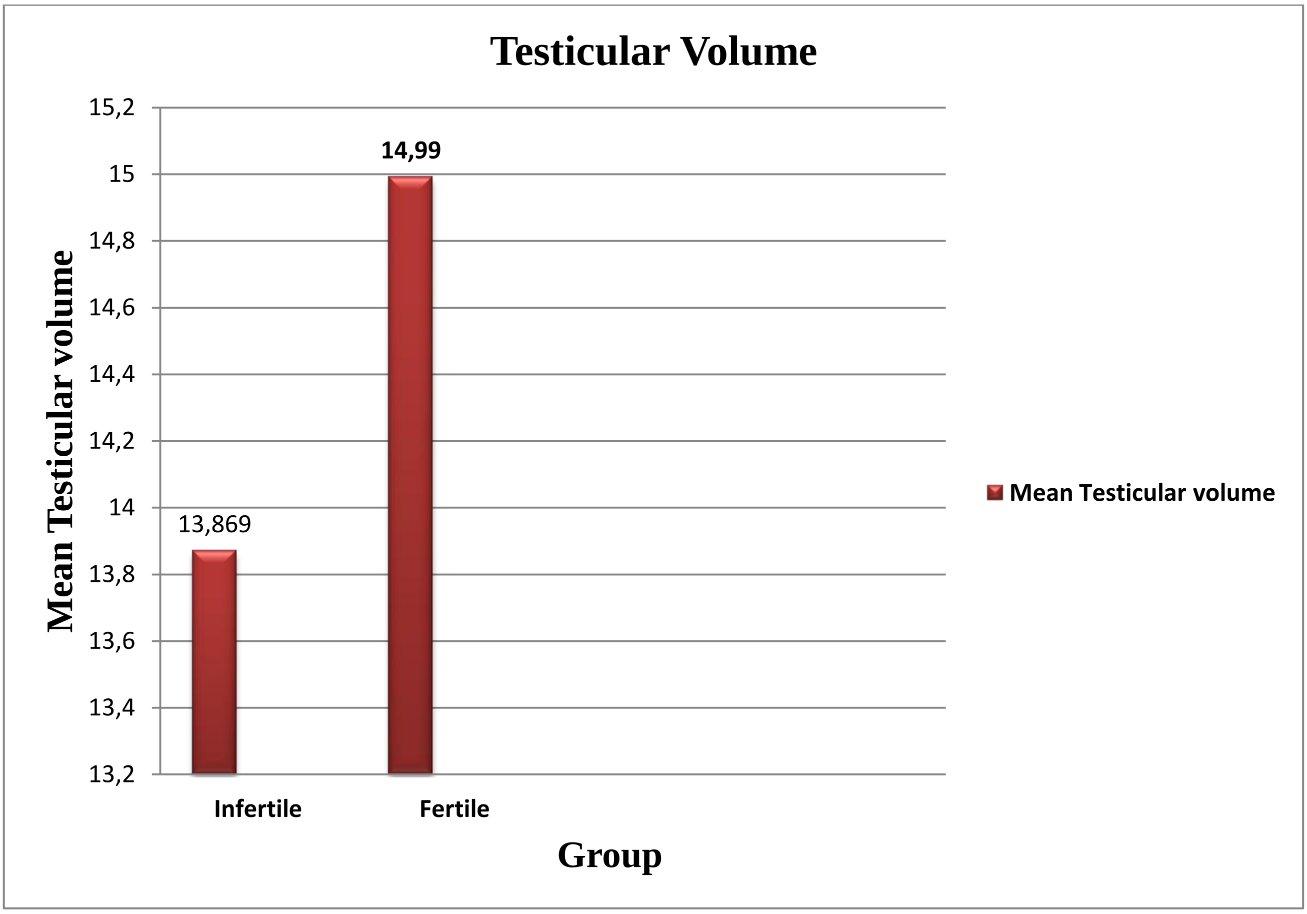


Table 2: Bar diagram showingmean Testicular volume in Infertile and Fertile population

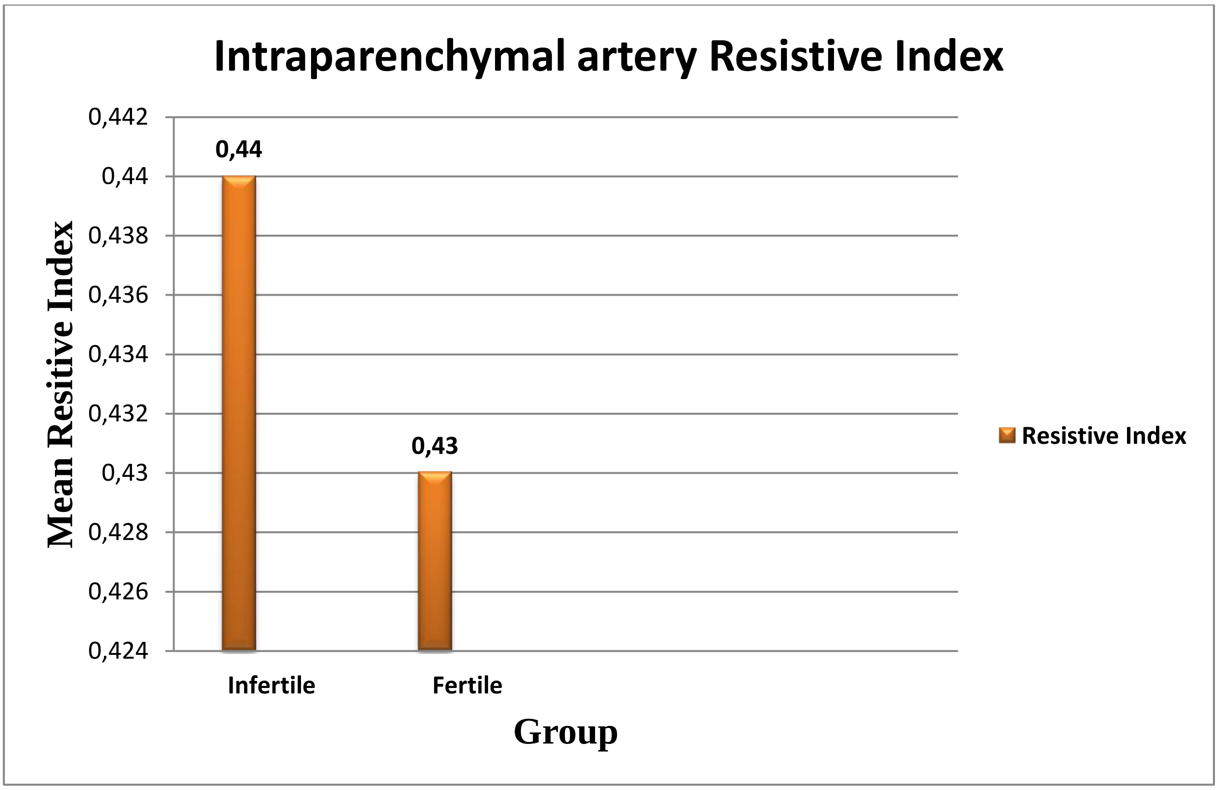


Table 3: Bar diagram showing the mean Resistive index of Intraparenchymal artery.

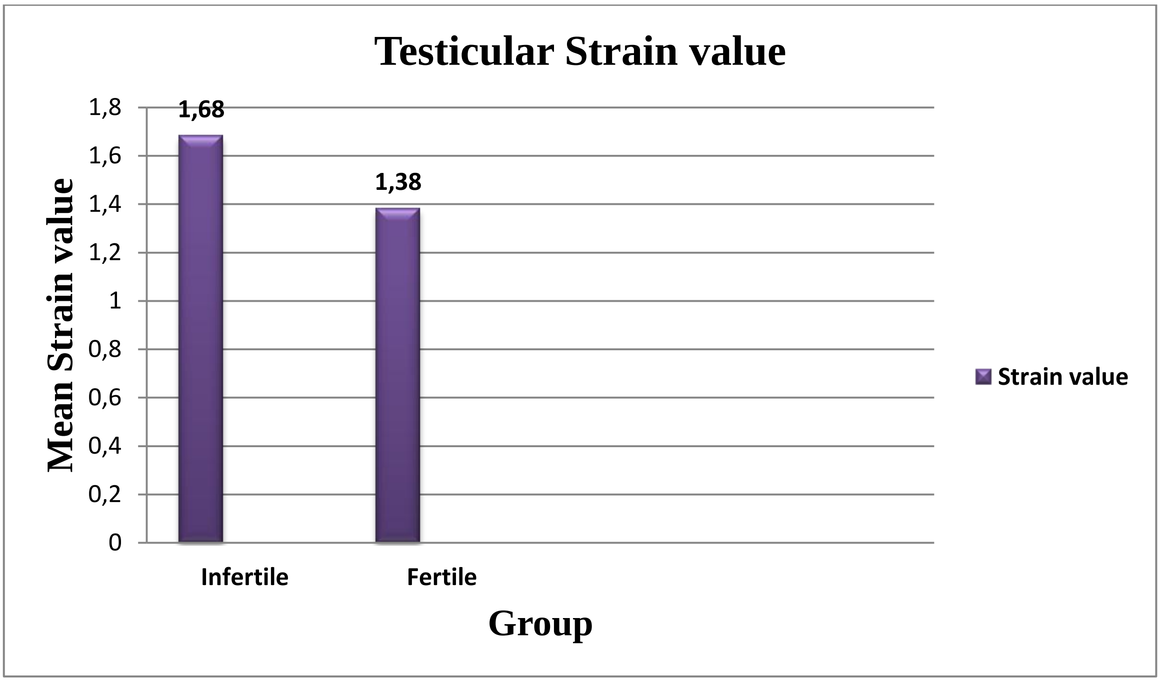


Table 4: Bar diagram showing the mean Strain value of testis in Infertile and Fertile population

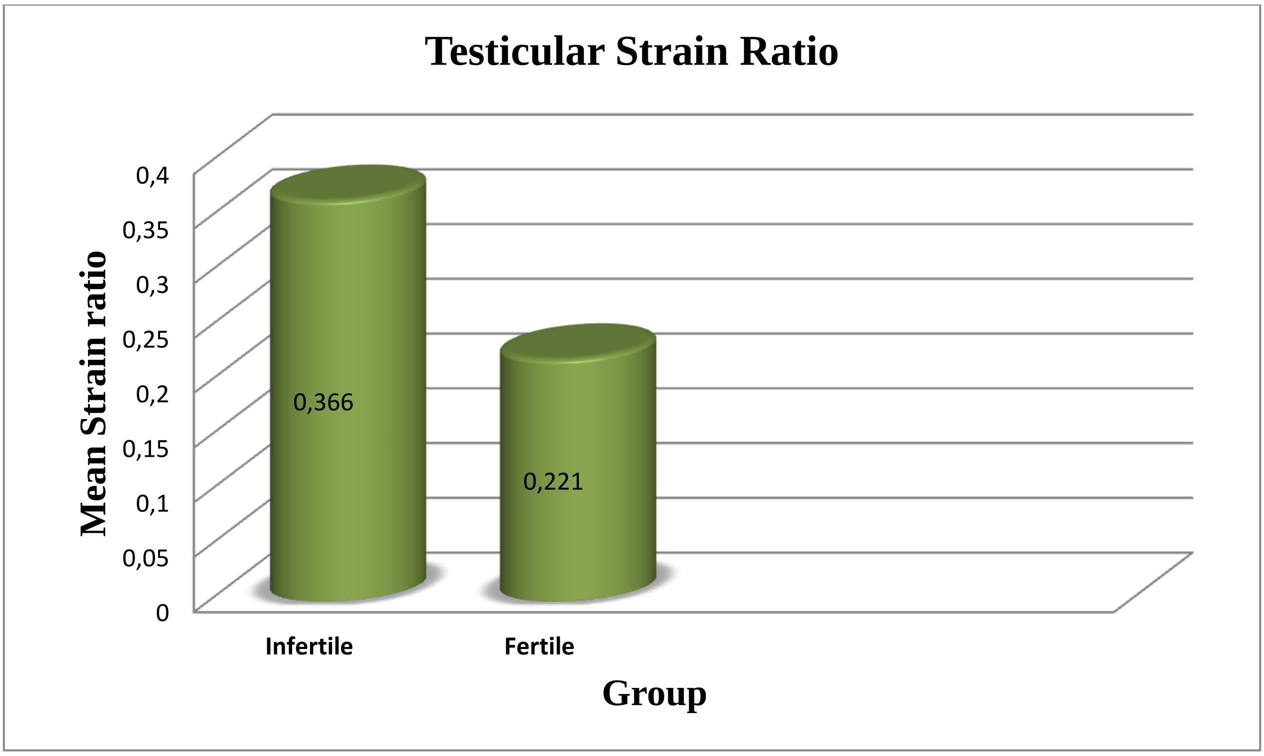


Table 5: Bar diagram showing the mean Strain ratio of testis in Infertile and Fertile population

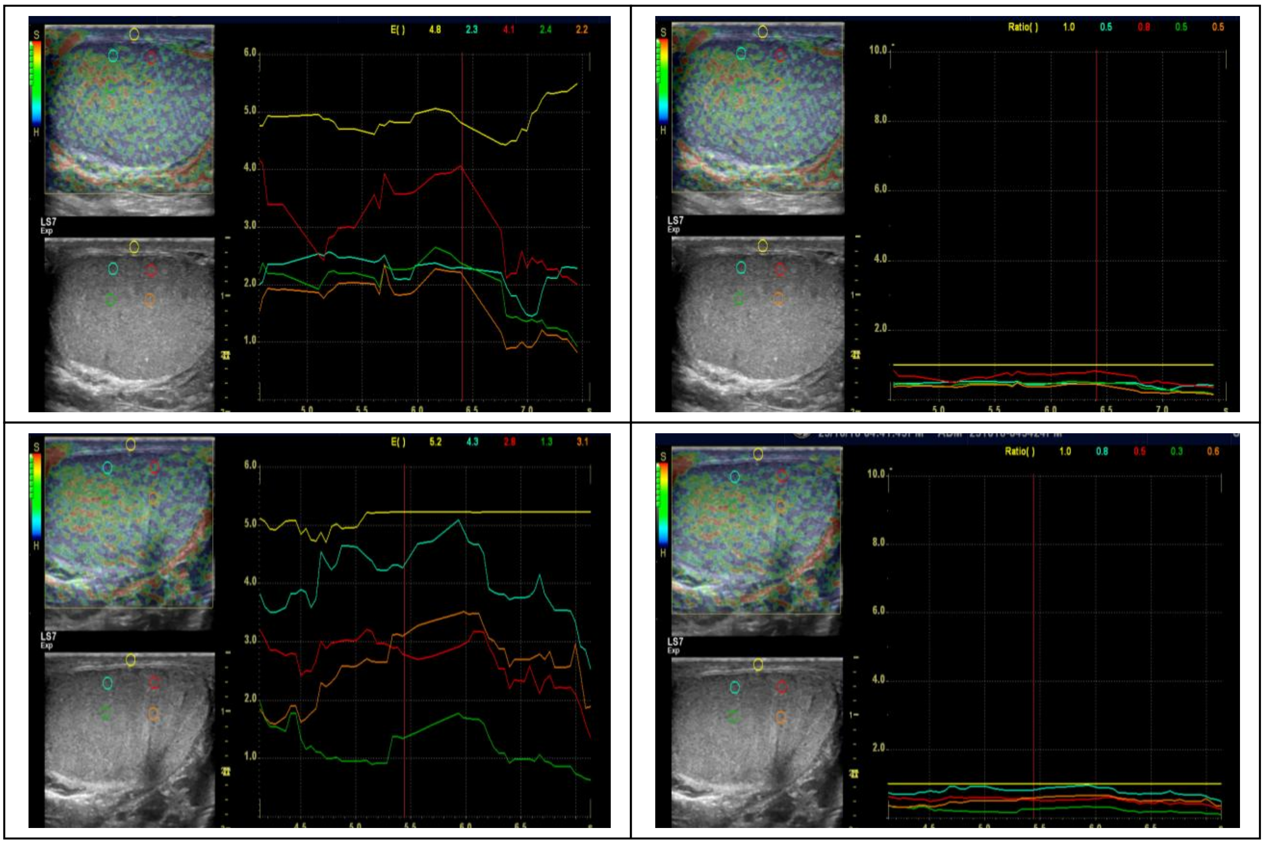


Figure 1: 30 year old male came to the andrology clinic for complaints of primary infertility since 2 years. Semen analysis showed asthenozoospermia. Testicular strain elastography demonstrating the Strain value (SV) of 2.8 and the Strain ratio (SR) of 0.56.

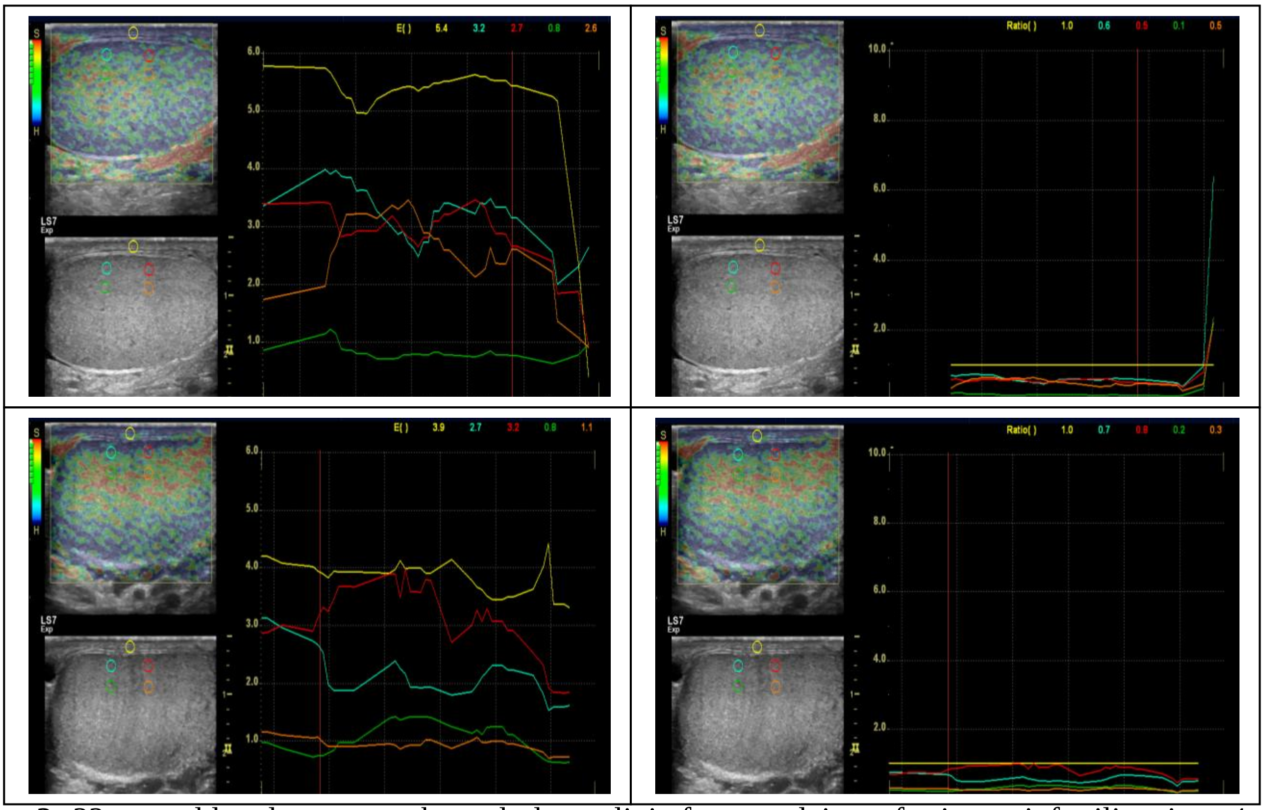


Figure 2: 32 year old male came to the andrology clinic for complaints of primary infertility since 4 years. Semen analysis showed azoospermia. Testicular strain elastography demonstrating the Strain value (SV) of 2.13 and the Strain ratio (SR) of 0.463.

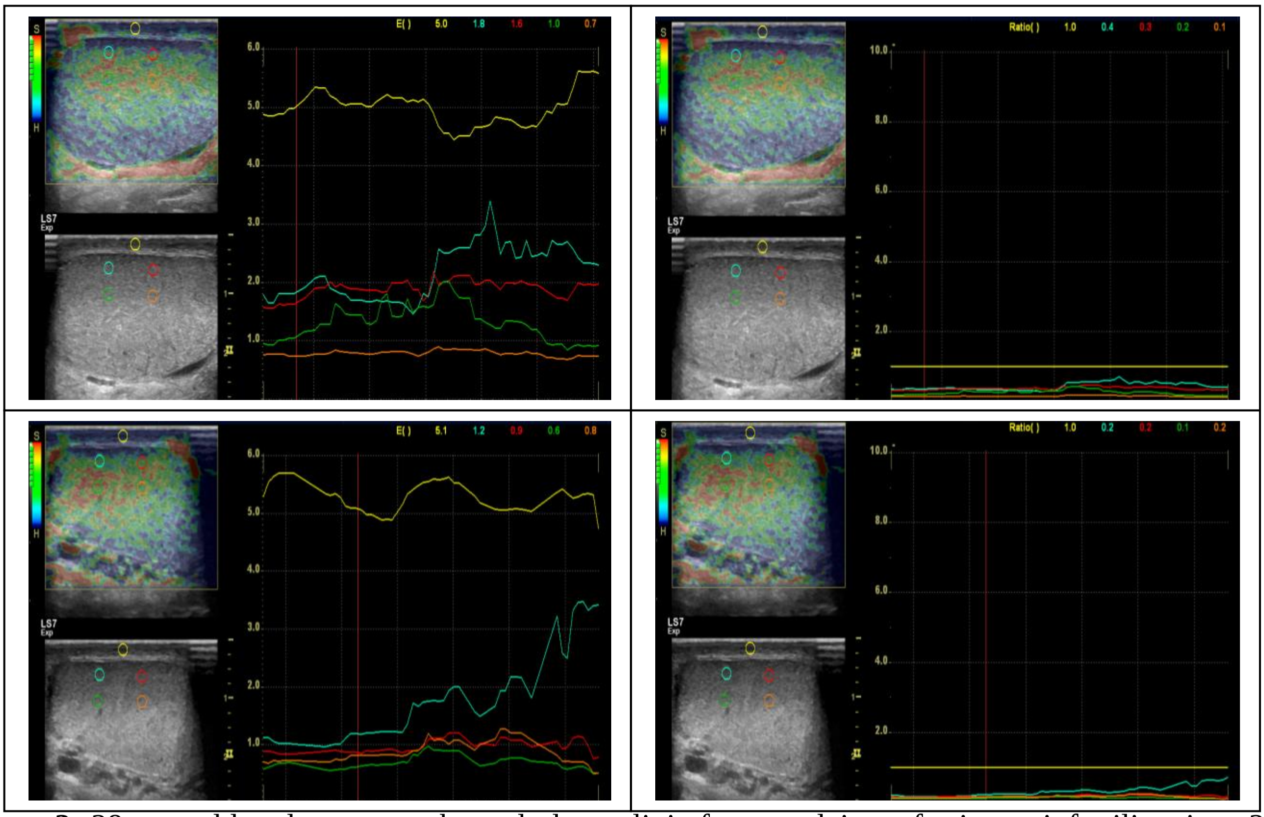


Figure 3: 28 year old male came to the andrology clinic for complaints of primary infertility since 2 years. Semen analysis was normal. Testicular strain elastography demonstrating the Strain value (SV) of 1.06 and the Strain ratio (SR) of 0.20.

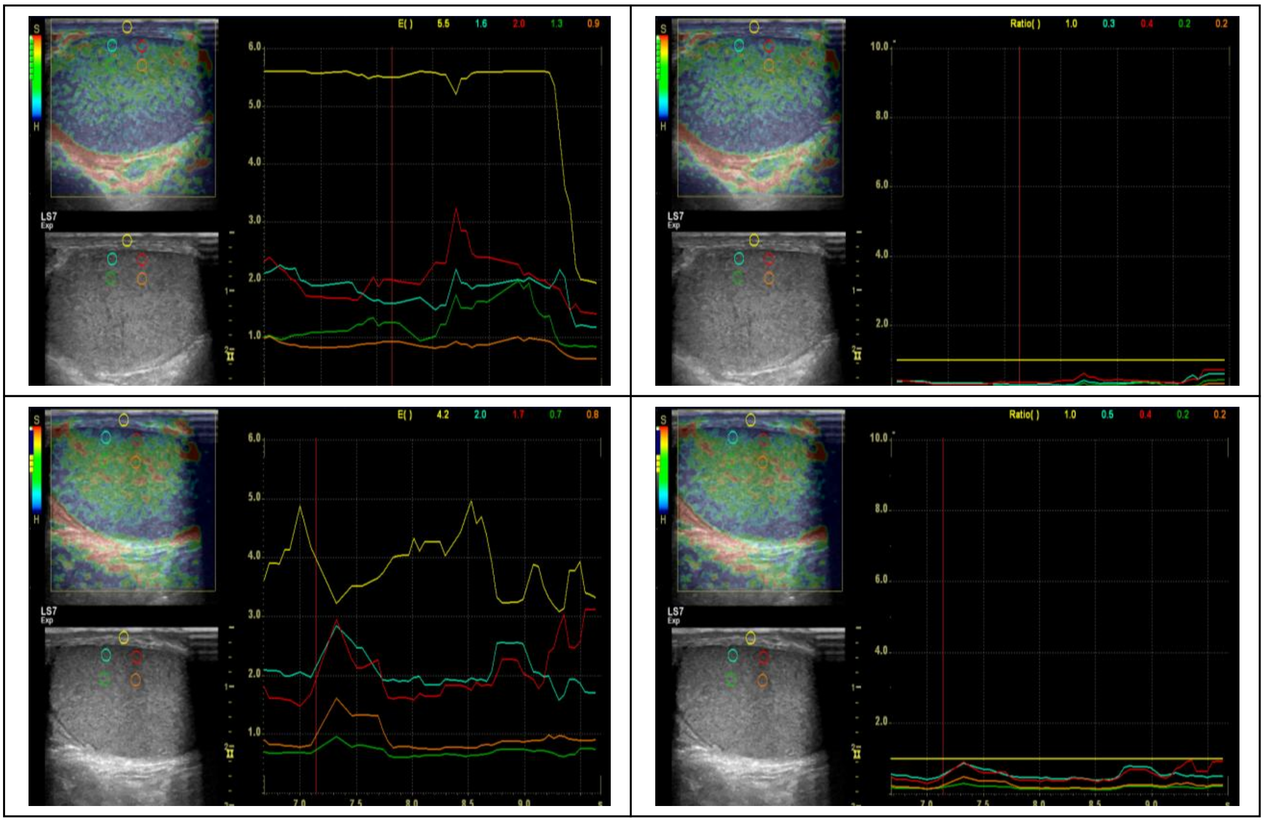


Figure 4: 29year old male came to the andrology clinic for complaints of primary infertility since 3 years. Semen analysis was normal. Testicular strain elastography demonstrating the Strain value (SV) of 1.375 and the Strain ratio (SR) of 0.30.

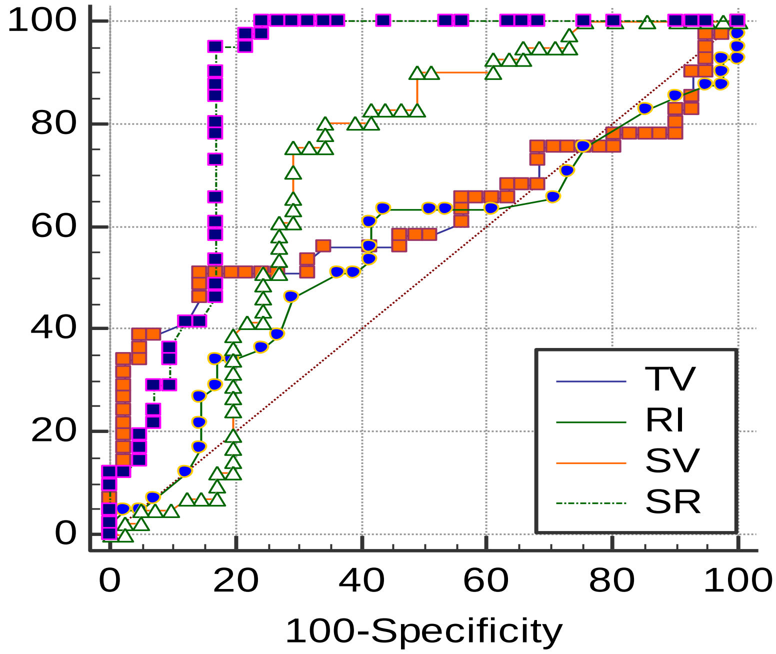
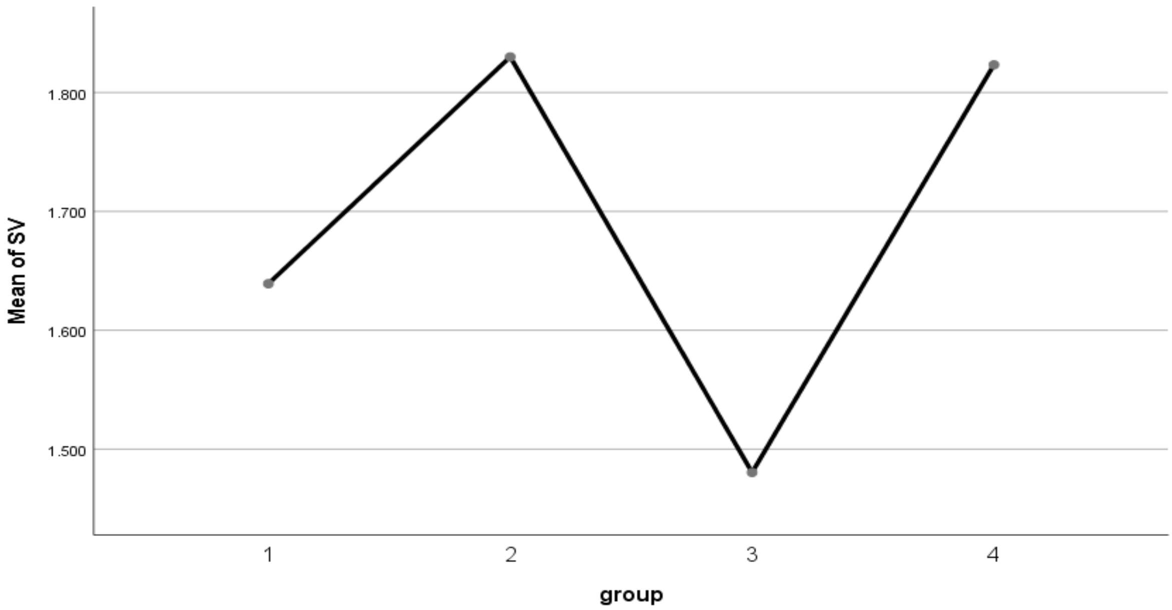
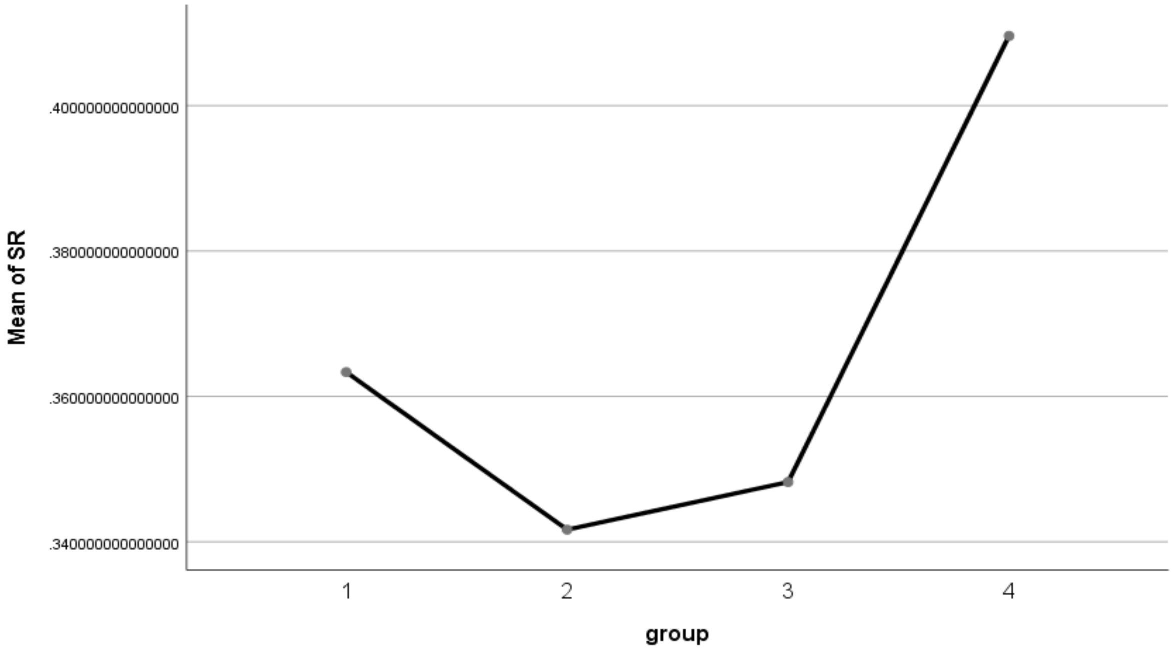


Figure 5: Comparison of ROC curves of Testicular volume (TV), Resistive index (RI), Strain value (SV) and Strain ratio (SR)



1 – Oligozoospermia
2 – Azoospermia
3- Asthenospermia
4 – Both Oligozoospermia and Asthenozoospermia

Figure 6: Mean plot of Strain value of testis in various Sperm disorders.



1 – Oligozoospermia
2 – Azoospermia
3- Asthenospermia
4 – Both Oligozoospermia and Asthenozoospermia

Figure 7: Mean plot of Strain ratio of testis in various Sperm disorders

Discussion

The mean testicular volume was higher in Group 2 compared to Group 1. This implies that higher the testicular volume, more the number of seminiferous tubules, which in turn produces more sperm. Therefore, the testicular volume is directly proportional to the sperm count. However the testicular volume was not significantly different between the groups.

A previous study by Pinggera et al.[5] showed that there was increased vascular resistance in those patients with abnormal sperm features compared to the normal patients. It also stated that there was no significant difference in the testicular volumes.

A study by Biogiotti et al.[6] showed that the RI and peak systolic velocity (PSV) were significantly higher in infertile men with varicocele and the RI values were different between azoospermic and oligozoospermic patients.

Study by Ackar et al.[7] showed that intra-testicular arterial resistance and testicular volume did not differ between infertile men with subclinical varicoceles and infertile men without varicoceles.

Present study showed that resistive index of the intraparenchymal arteries did not show any difference between the groups. Other studies also showed similar results[8].

A study by Faruk et al.[9] showed that testicular volumes were directly proportional with SR. But our study did not show a significant variation of the testicular volume with SR. It also showed that strain values are inversely related with the sperm concentration and sperm counts in infertile men, which was in agreement with the result of our study.

The testicular SV and SRs showed a significant difference between the groups. SR was higher in group 1 compared to group 2.

The ROC curve analysis showed that SR had the maximum AUC and showed a significant difference between the 2 groups with a P value of <0.0001.

We also studied the different subgroups under group 1 and showed no significant difference in the elastography scores between different sperm abnormalities.

A study by Min Li et al.[10] showed that SR were significantly different between nonobstructive and obstructive azoospermia patients. In our study, we did not categorize the patients as obstructive or nonobstructive azoospermia.

Ashok agarwal et al.[11] stated that varicocele was associated with reduced sperm count, motility and morphology, but not the semen volume. In our study, we excluded all the patients with varicocele to eliminate this difference.

In our study, we could not find out any correlation between the elastography scores and the FSH values.

Conclusion

- Testicular volume was not significantly different between infertile and fertile men.
- Resistive index of the intraparenchymal arteries did not show any difference between infertile and fertile men.
- The strain value and strain ratios were significantly higher in infertile men with abnormal semen parameters as compared to those with normal semen analysis, and the strain elastography results were found to be significantly different in patients with abnormal sperm counts.
- This technique therefore proves to be a useful tool for the evaluation of male infertility. But further large scale studies may be needed to clarify the value of this imaging modality in the assessment of male infertility.

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