The Egyptian Journal of Radiology and Nuclear Medicine (2016) 47, 593–597

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

www.elsevier.com/locate/ejrnm
www.sciencedirect.com

ORIGINAL ARTICLE

Normal testicular tissue elasticity by sonoelastography in correlation with age

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Received 24 January 2016; accepted 12 March 2016
Available online 23 March 2016

KEYWORDS

Testis;
Scrotum;
Sono-elastography;
Strain ratio;
Elasticity score

Abstract

Purpose: This research aimed to study the correlation between the normal testicular tissue elasticity as detected by real time sonoelastography with the age.

Materials and methods: The study was conducted upon 63 adult healthy volunteers. Each volunteer was subjected to real time sonoelastography measuring the strain ratio of testicular tissues and their elasticity scores.

Result: Strain ratios of the examined testes ranged from 0.27 to 0.38, with a mean strain of 0.33 and a standard deviation of 0.03. Elasticity score of the examined testes included ES1 in 62 testes (49%), ES2 in 58 testes (46%) and ES3 in 6 testes (5%). No ES4 or ES5 was elicited in this group. High negative correlation is found between the age and both the testicular volume and the strain ratio, while there is no correlation between age and the elasticity score of testes.

Conclusion: Normal testicular tissues as studies by sonoelastography show strong correlation between the age and the testicular volume as well as the strain ratio.

1. Introduction

Ultrasonography has long been the gold standard imaging modality for the testis, due to its availability, low cost, and absence of ionizing radiation. Its sensitivity and specificity increase even more by using Doppler. However, it still has relatively low specificity (1,2).

Sonoelastography is a modern ultrasound method, which enables the representation of tissues and organs with the evaluation of their elasticity, "stiffness". The principle of sonoelastography is to use repeated, slight pressure on the examined organ with the ultrasound transducer (3–5).

Sono-elastography depicts the stiffness of tissues through evaluation of its strain. The strain of a tissue is defined by the change in length during compression divided by the length before compression and calculated in the Young's modulus

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Peer review under responsibility of The Egyptian Society of Radiology and Nuclear Medicine.

http://dx.doi.org/10.1016/j.ejrnm.2016.03.003
0378-603X

(E), E = stress/strain, which estimates the stiffness of a certain tissue (4,5).

Most sonoelastography systems display tissue stiffness in a continuum of colors from red to green to blue, designating soft (high strain), intermediate (equal strain) and hard (no strain) tissue. Changes in elasticity and deformation of tissues arising while the compression is processed and presented in real time with color-coded maps, are called elastogram (4,5).

Sonoelastography is a complementary option to ultrasound B-mode with high diagnostic sensitivity in detecting and assessing the nature and structure of pathological changes in the body (6).

In recent years, the introduction of sonoelastography, as a measure of the elasticity of tissues has been investigated in different body parts and organs. The method is applicable mainly in diagnosing malignant lesions. Tumor tissues have different elasticity and undergo different deformations under pressure than healthy tissues. As a result of computer analysis, images in various colors are generated. Based on the nature of areas of normal and increased stiffness classifications of the images in point scales have been developed (7,8).

Ultrasound devices equipped with sonoelastography option enable more accurate imaging and evaluation of the nature of lesions situated at small depth, e.g. breast, thyroid, testicles, prostate, some groups of lymph nodes and musculoskeletal system. They increase the accuracy of ultrasound in the diagnosis and evaluation of the stage of malignant lesions (7–13).

Recently, sonoelastography has become a method to determine tissue elasticity and detect pathological variances in the testes; both the structural analysis of testicular tissue and the different pathological conditions such as testicular masses (14,15); however, no study has correlated the properties of normal testicular sono-elastography.

1.1. Aim of work

The aim of this research was to study the properties of normal testicular tissues when examined by sonoelastography, and to correlate it with age.

2. Materials and methods

Subjects

The study was conducted upon 63 healthy volunteers consulting an infertility clinic, with normal semen analysis and hormonal profile, and no scrotal complaints.

Exclusion criteria included

Symptomatic testes, varicocele of any degree, hydrocele, abnormal testes on gray-scale ultrasound or Doppler, and prior surgical interventions to testes.

The ethics committee approved the study and written informed consent was obtained from each volunteer.

Each volunteer was subjected to the following

Conventional ultrasonography (US), Doppler and Sonoelastography were done by a senior consultant uro-radiologist with an 8 year experience in genito-urinary radiology, using the Hitachi HI VISION Avius system (Hitachi medical corporation, Japan) equipped with a 10 MHz linear probe.

Testicular volume in cubic centimeter was calculated by the Lambert formula, length × height × width × 0.71.

Sonoelastography

Sonoelastography was performed using Real-time Tissue Elastography application with Strain Graphs. Compression was performed manually by the transducer upon the testis against the inner side of the thigh; care was taken to apply the same amount of compression in all volunteers as monitored by the machine. To visualize tissue elasticity, different compressibility values were marked with different colors. The scale gradually ranged from red for the greatest strain (soft) to blue for components with the least strain (hard), with green and yellow as intermediate degrees. Color-coding was standardized and the same color display was used for all volunteers. Distribution of colors on strain graph was studied for each testis to form an elasticity score (ES) adopted from Li et al. (16), and each testis was assigned an elasticity score based on a 5-point scale. A score of 1 indicated a predominantly high strain pattern of the testis, i.e. the entire testis was mostly shaded in red. A score of 2 showed a pattern of high central strain with a peripheral low strain pattern, i.e. the peripheral part of the testis was blue and the central part was red. A score of 3 was assigned to an average strain pattern, i.e. the entire testis was marked by an evenly distributed green color and the peripheral part of the testis was blue. A score of 4 indicated a predominantly low strain pattern of the testis, ie the entire testis was mostly blue and green. A score of 5 indicated a low strain pattern, ie almost the entire testis was blue (Fig. 1).

Region of interest (ROI) was applied to include as much as possible from the testis, and not extending beyond its limits. To calculate the strain ratio, three measurements were gained from each testis, respective measurements from the overlying skin were used as a reference, and the final strain ratio was calculated as the average of the three readings.

Statistical analysis

Data were analyzed using IBM SPSS 20. Relative frequencies, means and standard deviations were calculated. Correlation between the age and testicular volume, strain ratio and Elastography score was performed by Spearman Correlation test.

3. Results

Demographic and clinical data

The study was conducted upon 63 healthy volunteers (126 testes), ages ranged between 19 and 62 years, with a mean of 38 years and standard deviation of 12.3 (Fig. 2).

Ultrasound and elastography data

Volumes of the examined testes (n = 126) ranged from 13 to 20.5 cc. with a mean of 16 cc and standard deviation of 2.2.

Strain ratios of the examined testes ranged from 0.27 to 0.38, with a mean strain of 0.33 and a standard deviation of 0.03, while the elasticity score (ES) of the examined testes