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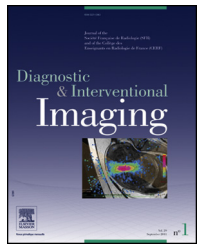

ORIGINAL ARTICLE /*Genito-urinary imaging*

Differentiation between endometrial carcinoma and atypical endometrial hyperplasia with transvaginal sonographic elastography

M.R. Metin[a], **H. Aydın**[b], **Ö. Ünal**[a], **Y. Akçay**[a], **M. Duymuş**[c,*], **E. Türkyılmaz**[d], **S. Avcu**[c]

[a] *Department of Radiology, Ankara Atatürk Training and Research Hospital, Ankara, Turkey*
[b] *Department of Radiology, Oncology Hospital, Ankara, Turkey*
[c] *Department of Radiology, Gazi University, Bahcelievler, 06100 Ankara, Turkey*
[d] *Department of Gynecology, Ankara Atatürk Training and Research Hospital, Ankara, Turkey*

KEYWORDS
Sonographic elastography;
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Strain index;
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Abstract
Purpose: To assess the value of transvaginal sonographic elastography (TSE) in discriminating between endometrial hyperplasia and endometrial carcinoma.
Materials and methods: A total of 61 women with post-menopausal hemorrhage and/or normal TSE were included. There were 32 women (mean age: 53.1 ± 14.1 years) with endometrial hyperplasia, 14 women (mean age: 60.0 ± 14.0 years) with endometrial carcinoma and 15 women (mean age: 51.9 ± 7.8 years) with no endometrial disease who served as a control group. The strain index (SI) values obtained during TSE in each group were compared using Mann-Whitney *U* test and Kruskal-Wallis analysis of variance test.
Results: The mean SI values were 0.80 (range: 0.30—1.30) in the endometrial hyperplasia group, 1.80 (range: 0.80—3.20) in the endometrial carcinoma group and 1.00 (range: 0.50—4.00) in the control group. No significant differences were found between endometrial hyperplasia group and control group, but significant differences were found between endometrial carcinoma and hyperplasia groups and between endometrial carcinoma and control groups ($P < 0.0001$). TSE had a sensitivity of 81.3%, a specificity of 100%, a positive predictive value of 100% and a negative predictive value of 70% in differentiating endometrial carcinoma from endometrial

* Corresponding author.
E-mail addresses: melikem_3@yahoo.com (M.R. Metin), dr.hasanaydin@hotmail.com (H. Aydın), dr.ozlemsarici@gmail.com (Ö. Ünal), dr.yildizakcay@hotmail.com (Y. Akçay), mahmutduymush@yahoo.com (M. Duymuş), turkyilmaz06@yahoo.com (E. Türkyılmaz), serhatavcu@hotmail.com (S. Avcu).

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hyperplasia. The area under ROC curve (AUC) to distinguish between endometrial carcinoma and endometrial hyperplasia was 0.933 (95% CI, 0.853—1.000) using a threshold SI value of 1.05. The AUC to distinguish between endometrial carcinoma and control was 0.881 (95% CI, 0.735—1.000) using a threshold SI value of 1.15.
Conclusion: Our results indicate that TSE can provide important information that help discriminate between endometrial carcinoma and endometrial hyperplasia.

Sonographic elastography is an imaging technique that provides information regarding tissue elasticity by measuring the hardness and stiffness of tissues by external compression and decompression that may predict malignancy [1].

Due to the progressive decrease of ovarian hormone production during the post-menopausal period, endometrial cavity becomes thinner and atrophy along with no cyclic changes are observed. Kurjak et al. reported a mean cavity thickness of 2.3 mm on transvaginal sonographic elastography (TSE). A thickness < 5 mm is considered normal in this post-menopausal period [2,3]. The causes of post-menopausal bleeding are endometrial carcinoma, endometrial polyps, endometrial hyperplasia and/or atrophy, leiomyomas, hormone therapy and treatment with tamoxifen [4]. Transvaginal sonography is the first line imaging modality in the evaluation of post-menopausal bleeding because other imaging techniques such as computed tomography and magnetic resonance imaging have limited predictive values [5,6].

The reference standard to differentiate benign from malignant endometrial abnormalities remains endometrial biopsy with histopathological analysis [6]. Benign endometrial hyperplasia represents 5—10% of the causes of post-menopausal bleeding. In women with atypical hyperplasia, malignancy has to be ruled out as a concomitant well-differentiated adenocarcinoma can be present in up to 25% of women [7,8].

Sonographic elastography is a technique that is conceptually based on tissue elasticity [9]. Sonographic elastography is used for tissue characterization via the application of compressions due to elasticity degrees, quantitative measurement of elasticity and stiffness of compressible tissues in different areas [10,11]. There are different types of elastography that include strain elastography, acoustic radiation force impulse elastography (ARFI), shear-wave elastography (SWE) and transient elastography (TE) [12—15]. In strain elastography the compressions and decompressions are applied by the user manually and the resulting variable is the strain index (SI). SI is the strain ratio of the lesion and adjacent normal tissue. ARFI, SWE and TE use shear-waves to measure tissue elasticity. Shear-waves are created by the sonographic transducer electronically and present the strain or stiffness of the tissue independently from normal adjacent tissue. There is no ratio in shear-wave method. ARFI and SWE calculate the transverse shear-waves, but method of measurement is not displayed on the same way. Unlike other methods, TE does not provide B-mode image.

Elastography was first introduced for the differential diagnosis of malignant breast lesions. In this regard, fibroadenomas are less rigid than squirrous breast cancers [9]. In the liver, degree of fibrosis causing rigidity in the liver can also be measured by elastography [16,17]. Bojunga et al. reported that elastography significantly decreased the number of unnecessary fine-needle aspiration biopsies in thyroid nodules [18]. Not only the thyroid but also the musculoskeletal system and abdominal organs are now evaluated by elastography [19—22].

In this study, we aimed to assess the role of TSE in differentiating endometrial hyperplasia from endometrial carcinoma;

Materials and methods

Institutional review board approval and written informed consent forms were obtained for this prospective study.

A total of 136 women who had TSE between February 2013 and October 2013 were initially included in the study. All women were referred to the imaging department for TSE because of post-menopausal hemorrhage and/or for routine ultrasonographic examination of the pelvis. Ages and menopause ages of all women were reported and TSE was performed with the same protocol by the same radiologist who had 15 years of experience for pelvic ultrasound and five years of experience for TSE. The patients underwent both B-mode ultrasound and TSE examinations in the supine position with a digital sonography scanner (Logiq E9, GE Healthcare, Wisconsin, USA) equipped with real-time tissue elastography software, by using 5—7,5 MHz multifrequency transvaginal transducer.

During TSE, mild repetitive compression and decompressions were manually performed. The apparently normal myometrium adjacent to the measured endometrial surface was also included in the elastographic box for all patients. The imaging files of each patient were re-analyzed. The most appropriate time for compression before measurement was predicted as 5—7 bars range. First of all, the normal sonographic appearing myometrium then the endometrium were measured inside the box by inserting region of interest (ROI). We took care to adjust the ROI to the maximum homogeneous and thick tissue to avoid the ROI bias. In order to optimize the width of ROI, the same ROI size was handled to both myometrium and endometrium (Figs. 1—3). SI was automatically measured and recorded for each woman. Three random SI measurements were performed and the mean value was used as the final value.

Inclusion criteria of this research for all patients were that the histopathological correlation had to be done within