



● *Original Contribution*

**REAL-TIME ELASTOGRAPHY AND CONTRAST-ENHANCED
 ULTRASONOGRAPHY IN THE EVALUATION OF TESTICULAR MASSES:
 A COMPARATIVE PROSPECTIVE STUDY**

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Abstract—This study investigates the usefulness of contrast-enhanced ultrasound (CEUS) and real-time elastography (RTE) for the characterization of testicular masses by comparing pre-operative ultrasound findings with post-operative histology. Sixty-seven patients with 68 sonographically detected testicular masses underwent B-mode, color-coded Doppler sonography (CCDS), CEUS and RTE according to defined criteria. For RTE, elasticity score (ES), difference of elasticity score (D-ES), strain ratio (SR) and size quotient (Qsize) were evaluated. Histopathologically, 54/68 testicular lesions were neoplastic (47 malignant, 7 benign). Descriptive statistics revealed the following results (neoplastic vs. non-neoplastic) for sensitivity, specificity, positive predictive value, negative predictive value and accuracy, respectively: B-mode, 100%, 43%, 87%, 100%, 88%; CCDS 81%, 86%, 96%, 55%, 82%; CEUS 93%, 85%, 96%, 73%, 91%; ES 98%, 25%, 85%, 75%, 85%; D-ES 98%, 50%, 90%, 83%, 89%; SR 90%, 45%, 86%, 56%, 81%; and Qsize 57%, 83%, 94%, 28%, 61%. B-mode with CCDS remains the standard for assessing testicular masses. In characterization of testicular lesions, CEUS clearly outperformed all other modalities. Our study does not support the routine use of RTE in testicular ultrasonography because of its low specificity. (E-mail: guntram.lock@albertinen.de) © 2016 World Federation for Ultrasound in Medicine & Biology.

Key Words: Testicular neoplasm, Ultrasonography, Contrast-enhanced ultrasonography, Elastography, Elasticity score, Strain ratio, Color-coded ultrasonography, Seminoma, Testicle.

INTRODUCTION

Conventional gray-scale ultrasonography and color-coded Doppler sonography (CCDS) have evolved as the most important imaging techniques for scrotal anomalies (Mirochnik et al. 2012) and are considered essential in the diagnosis of testicular tumors by current guidelines (Albers et al. 2015). Only recently, novel ultrasonographic techniques such as contrast-enhanced ultrasonography (CEUS) (Hedayati et al. 2012; Huang and Sidhu 2012; Isidori et al. 2014; Lock et al. 2011; Moschouris et al. 2009; Valentino et al. 2011; Yamaguchi et al. 2005) and real-time tissue elastography (RTE) (Aigner et al. 2012; De Zordo et al. 2013; Huang and Sidhu 2012; Goddi et al. 2012; Grasso et al. 2010; Pastore et al. 2014) have been suggested as additional tools

for scrotal imaging. However, at present, it is not clear if and how these techniques can improve the characterization of testicular tumors.

Intravenously applied ultrasonographic contrast agents improve the visibility of microvasculature, and hypervascularized testicular neoplasms will appear as areas of hyperenhancement in CEUS. RTE, on the other hand, measures the mechanical stiffness of biological tissue, and is applied under the assumption that neoplastic tissue will be stiffer than normal parenchyma. The degrees of tissue stiffness are coded in different colors. Most studies with RTE have been conducted on breast and thyroid nodules and prostatic tumors, so far (Adamietz et al. 2011; Cantisani et al. 2014; Itoh et al. 2006; Salomon et al. 2008; Stachs et al. 2013).

With the evolving use of high-resolution ultrasonography in urologic clinical practice, the occurrence of accidentally discovered testicular lesions increases. Current evidence suggests that approximately three-quarters of lesions accidentally detected by gray-scale

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ultrasonography are benign (Dieckmann et al. 2013). Therefore, further experience regarding the particular value of CEUS and RTE in differentiating neoplastic from non-neoplastic testicular lesions would be important.

In the present study, we prospectively evaluated the diagnostic significance of the new modalities CEUS and RTE in sonographically detected testicular masses by systematically analyzing various imaging parameters in comparison to post-operative histology.

MATERIALS AND METHODS

Patients

From September 2012 to April 2014, 67 consecutive patients with 68 testicular masses were referred for further sonographic evaluation of suspicious testicular masses before urologic surgery. The median age was 39.8 y with a range of 18–83 y.

The study was approved by the local ethical committee. All patients gave written informed consent and were investigated following a standardized protocol. Histopathological evaluation was performed according to international guidelines (Winstanley et al. 2004) by a pathologist with particular experience in genitourinary neoplasms (T.L.).

Sonographic methods and parameters

Ultrasonography started with B-mode and CCDS, followed by RTE and CEUS. The entire examination including documentation was usually completed within 30 min. Figure 1 gives an example of a seminoma examined by all four modalities.

B-mode and CCDS

Ultrasonography was performed on an iU-22 ultrasound machine (Philips, Hamburg, Germany) by investigators with special expertise in scrotal sonography. For gray-scale B-mode, both testicles were examined using a 5–17 MHz linear array transducer looking for size, echogenicity and homogeneity of the lesions. In very large tumors, a 2–5 MHz transducer was used additionally to determine the full size of the tumor. Color-coded and power Doppler ultrasound were employed to determine vascularization of the masses. Clearly delineated lesions with a hypoechoic or inhomogeneous pattern (Fig. 1a) and/or hypervascularization upon CCDS (Fig. 1b) were classified as probably neoplastic.

CEUS

CEUS was performed with a 3–9 MHz, or, on large tumors, a 2–5 MHz transducer in a low mechanical index

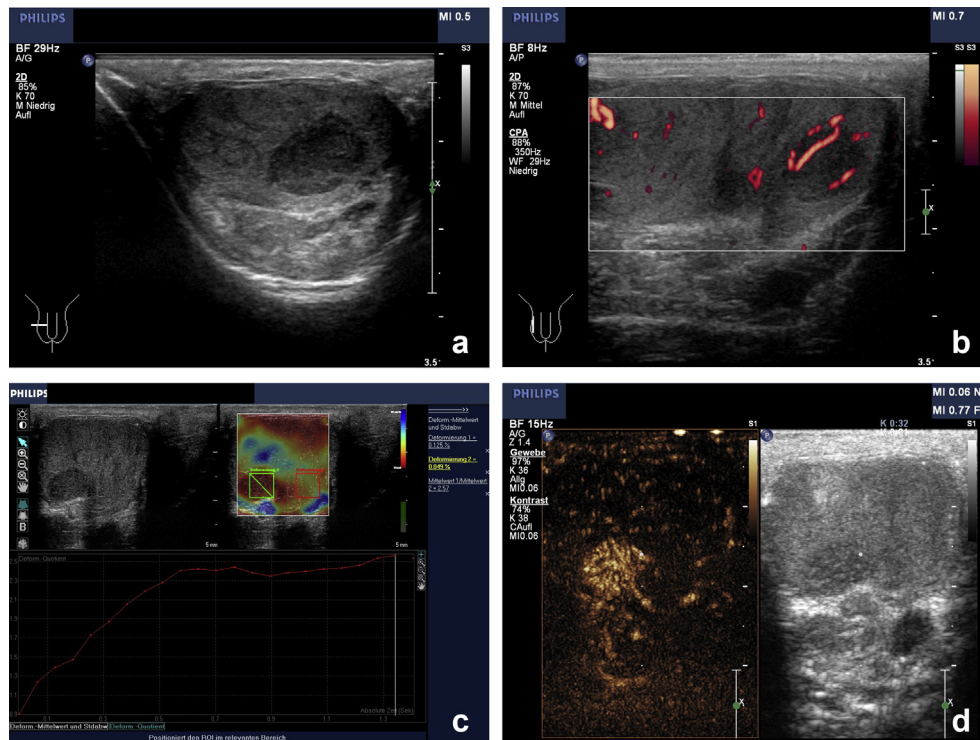


Fig. 1. Case of a seminoma in different ultrasound modalities. (a) Clearly delineated hypoechoic lesion in B-mode; (b) increased vascularization in color-coded Doppler ultrasound. (c) The lesion is clearly "harder" on RTE. The graph shows the determination of SR (here 2.57). (d) Hyperenhancement on CEUS, here 32 s after bubble injection. The left shows CEUS mode, and the right shows gray-scale mode. The marker is at the same position in both pictures.

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