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Can ultrasound elastography be used as a new technique in the differentiation of undescended testes and reactive lymph nodes in children?

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AIM: To determine the diagnostic performance of ultrasound elastography in the differentiation of reactive lymph nodes and undescended testes in children.

MATERIALS AND METHODS: Seventy-two undescended testes and 34 reactive lymph nodes were prospectively examined with the elastography technique. Four elastographic patterns were used for classification based on the distribution of the blue area. The strain ratios and elasticity patterns of the undescended testes and reactive lymph nodes were evaluated independently by two radiologists. Interobserver agreement and diagnostic performance were analysed.

RESULTS: Thirty of the 34 reactive lymph nodes were classified as exhibiting high-strain elastographic patterns (considered Type 1 or Type 2, with blue areas in $<$50% of the tissue) by both observers; in contrast, 67 and 71 of 72 undescended testes were classified as exhibiting low-strain elastographic patterns (considered Type 3 or Type 4, with blue areas in $>$50% of tissue) by radiologists 1 and 2, respectively. The respective mean strain ratios measured by the two radiologists were 0.60 ± 0.03 and 0.62 ± 0.02 for the reactive lymph nodes and 0.25 ± 0.08 and 0.25 ± 0.09 for the undescended testes. There were significant differences in the elasticity patterns and strain ratios between the reactive lymph nodes and the undescended testes ($p<0.001$). The interobserver agreement was excellent for the four elasticity patterns with a weighted kappa coefficient of 0.872. The concordance of the strain ratios between the observers was excellent in the present study (intra-class correlation score: 0.988).

CONCLUSIONS: In the majority of cases, conventional two-dimensional ultrasound could be used to differentiate undescended testes from reactive lymph nodes with acceptable accuracy. Although the incremental value of elastography is limited, this technique might have a role in some specific cases.

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Introduction

Undescended testes are a common congenital abnormality that requires early recognition due to the associated reduction in fertility and increased risk of malignancy.[1] Undescended testes are one of the most common disorders of childhood and affect 3% of male infants. The prevalence decreases to 1% by the age of 6 months due to spontaneous descent, and this condition can be diagnosed after the age of 1.[2]

The location of the undescended testes and the selection of appropriate surgical therapies are important factors that determine the prognosis.[3] The location of undescended testes can be determined by physical examination, radiological evaluations, or diagnostic laparoscopy.[4] Laparoscopy offers high sensitivity in the detection of non-palpable undescended testes.[5] The current guidelines regarding the imaging of undescended testes state that ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) do not provide additional information beyond that acquired by physical examination[6]; however, the surgical approach may vary depending on the location of the testes, and diagnostic imaging can be useful for determining the anatomical locations of non-palpable testes. Additionally, imaging is very important in cases with ambiguous genitalia and hypospadia.[7]

Abdominal and inguinal sonography is a widely used imaging technique for the evaluation of undescended testes, but the specificity and sensitivity of this technique are variable. Sonography is preferred because it is inexpensive, non-invasive, has no risk of radiation exposure, and does not require sedation or general anaesthesia. In contrast to these benefits, reactive lymph nodes can occasionally be mistaken for undescended testes with ultrasound and cause false-positive results and medico-legal consequences.[8,9]

Real-time elastography is a new technique that produces images by superimposing colour-scale images that depend on the stiffness of the tissues onto the corresponding greyscale (B-mode) ultrasonography images.[10] Sonoelastography studies have been conducted in the thyroid gland, breast, prostate, testes, and liver. A few studies have reported elastographic evaluations of testicular masses.[11] To the authors' knowledge, there are no reports of the use of elastography to differentiate undescended testes from reactive lymph nodes.

The aim of the present study was to evaluate the role of real-time ultrasound elastography in the differentiation of undescended testes from reactive lymph nodes.

Materials and methods

Patients

This prospective observational study was approved by the local ethics committee. Signed informed consent was obtained from each parent. A total of 69 patients aged between 1 and 10 years who were found to have undescended testes upon physical examination in the Departments of Paediatric Surgery and Paediatric Endocrinology between February 2013 and June 2014 were included in this study. The diagnoses of undescended testes were confirmed by laparoscopic examinations under general anaesthesia in all patients. Patients with a history of testicular surgery (five patients), intra-abdominal testes (two patients), parenchymal heterogeneity on ultrasonography (one patient), solid–cystic lesions (two patients), low testicular volumes (four patients) on ultrasonography beyond the limits specified in the literature,[9] atrophic testes identified intraoperatively (one patient), and those with congenital abnormalities (three patients) were excluded from the study. Additionally, six patients who were unable to remain still and calm were excluded due to suboptimal elastographic compressions. After these exclusions, a total of 45 patients (27 bilateral undescended testes and 18 unilateral undescended testes) were included in the study. Seventy-two testes (59 palpable, 13 non-palpable) were examined.

A total of 34 male patients who underwent ultrasonographic examinations for various reasons (e.g., abdominal pain, testicular pain, and inguinal pain) and were found to have reactive lymph nodes in the inguinal region were included in the control group. The reactive natures of these lymph nodes were confirmed using clinical and laboratory methods. When multiple lymph nodes were present at ultrasonography, the lymph node with the largest dimensions was selected. Patients with histories or diagnoses of malignancies and those with suspected malignancies were excluded from the control group.

Equipment and scanning

The sonoelastographic examinations were performed by two radiologists with 3 and 6 years of experience with sonoelastography. The examinations were performed with a sonographic scanner (Logiq E9, GE Medical Systems, Wauwatosa, WI, USA) with an 11–15 MHz linear probe on which real-time tissue elastography software has been installed. The B-mode and elastography examinations were performed with patients lying in the supine position. The testicular volumes were measured after the maximum length, width, and height were obtained from the ultrasonogram. The volumes were calculated with the formula for an ellipsoid, i.e., $\pi/6 \times$ length $\times$ width $\times$ height.[12] The inguinal reactive lymph node volumes were calculated in the same manner. The greatest volume of three measurements was taken for each testis and each reactive lymph node. The elastography examinations were performed by applying slight compression to the inguinal region with the ultrasound probe. The pressures and speeds of the manual compressions were adjusted to view the subcutaneous fat tissue as a mix of red and green.[13] Both the B-mode and elastographic images were displayed on the screen during the sonoelastographic examinations. The elastograms were obtained by superimposing the colour-scale images on the B-mode images. Accordingly, red (soft tissue), green (average tissue), and blue (hard tissue) indicated the stiffness of the tissue.[14] Both the undescended testes and the reactive lymph nodes were displayed in the elastographic