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MAGNETIC RESONANCE

In vivo high-resolution magnetic resonance elastography of the uterine corpus and cervix

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Abstract
Objectives To apply 3D multifrequency MR elastography (3DMMRE) to the uterus and analyse the viscoelasticity of the uterine tissue in healthy volunteers considering individual variations and variations over the menstrual cycle.
Methods Sixteen healthy volunteers participated in the study, one of whom was examined 12 times over two menstrual cycles. Pelvic 3DMMRE was performed on a 1.5-T scanner with seven vibration frequencies (30–60 Hz) using a piezoelectric driver. Two mechanical parameter maps were obtained corresponding to the magnitude ($|G^*|$) and the phase angle (φ) of the complex shear modulus.
Results On average, the uterine corpus had higher elasticity, but similar viscosity compared with the cervix, reflected by $|G^*|_{\text{uterine corpus}}$=2.58±0.52 kPa vs. $|G^*|_{\text{cervix}}$=2.00±0.34 kPa (p<0.0001) and $\varphi_{\text{uterine corpus}}$=0.54±0.08, φ_{cervix}=0.57±0.12 (p=0.428). With 2.23±0.26 kPa, $|G^*|$ of the myometrium was lower in the secretory phase (SP) compared with that of the proliferative phase (PP, $|G^*|$=3.01±0.26 kPa). For the endometrium, the value of $|G^*|$ in SP was 68 % lower than during PP (PP, $|G^*|$=3.34±0.42 kPa; SP, $|G^*|$=1.97±0.34 kPa; p=0.0061).
Conclusion 3DMMRE produces high-resolution mechanical parameter maps of the uterus and cervix and shows sensitivity to structural and functional changes of the endometrium and myometrium during the menstrual cycle.
Key Points
- *MR elastography provided for the first time spatially resolved viscoelasticity maps of uterus.*
- *Uterine corpus had a higher elasticity, but similar viscosity compared with cervix.*
- *The stiffness of both endometrium and myometrium decreases during the menstrual cycle.*

Keywords Magnetic resonance elastography · Uterus · Cervix · Endometrium · Menstrual cycle

Introduction

Transvaginal ultrasound is an effective first-line imaging modality for the detection of uterine pathologies [1]. However, it is operator-dependent and the field of view is limited. In some cases, accurate visualization of the uterus may be impossible owing to marked uterine enlargement or vaginal stenosis. Magnetic resonance imaging (MRI) provides morphological information with excellent tissue contrast, facilitating high accuracy and specificity for the evaluation of the uterus [2].

Viscoelasticity is a tissue property well known to physicians through manual palpation; changes in the biomechanical properties of soft biological tissue are often associated with pathophysiological variations. However, uterine palpation is not quantitative and the accessibility of intrapelvic tissue is limited.

MR elastography (MRE) has emerged as a novel imaging modality that is capable of overcoming the limitations of

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