Clinical Image

Magnetic Resonance-Guided Focused Ultrasound Surgery for Leiomyoma and Adenomyosis: An Alternative Nonvascular Approach

Minh Duc Nguyen*

Department of Radiology, Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam

Abstract

Magnetic resonance-guided high-intensity focused ultrasound (MRgFUS) surgery is a promisingly alternative method for the treatment of symptomatic leiomyoma and adenomyosis. In this article, we mainly aim to introduce two totally typical patients with leiomyoma and adenomyosis who underwent MRgFUS surgery successfully without any severe complications at our interventional radiology center. Our results revealed that focused ultrasound surgery is an innovatively safe and nonvascular approach which should be taken into consideration for the treatment of patients with symptomatic leiomyoma and adenomyosis.

Keywords: Adenomyosis, an alternative nonvascular approach, leiomyoma, magnetic resonance-guided focused ultrasound surgery

A 38-year-old woman, with a body mass index of 22.3 and a transformed symptom severity score (tSSS) of 75, underwent a magnetic resonance imaging (MRI) for assessing the leiomyoma characteristics before magnetic resonance-guided high-intensity focused ultrasound (MRgFUS). MRI findings revealed the anatomic and leiomyoma characteristics: subserosal leiomyoma located on the anterior wall of a retroverted uterus and a volume of 118 ml. According to T2-classification (Type I if T2 signal-intensity [T2SI] of leiomyoma ≤T2SI of skeletal muscle; Type II if T2SI of skeletal muscle <T2SI of leiomyoma <T2SI of myometrium; Type III if T2SI of leiomyoma ≥T2SI of myometrium), leiomyoma was classified as Type II [Figure 1a].[1] According to Perfusion Classification (Type A if time signal-intensity curve [TSIC] of leiomyoma <TSIC of myometrium; Type B if TSIC of leiomyoma ≥TSIC of myometrium), leiomyoma in this case was considered as Type A [Figure 1b].[2] The serum anti-Müllerian hormone (AMH) before treatment was 1.18 ng/mL. MRgFUS yielded a posttreatment nonperfused volume (NPV) ratio of 94% [Figure 1c]. At 6-month follow-up, the leiomyoma volume decreased significantly to 62 ml with the corresponding leiomyoma volume reduction ratio of 47% [Figure 1d] and tSSS attenuated significantly to 0 with corresponding symptom improvement ratio of 100%. Furthermore, the serum AMH at 6-month follow-up conserved at the level of 1.18 ng/mL. During and after ablation procedure, there were no severe adverse events observed.

A 40-year-old woman, with a body mass index of 20.5 and a tSSS of 50, underwent MRI for assessing the adenomyosis characteristics before MRgFUS. MRI findings displayed the anatomic and adenomyosis characteristics: adenomyosis lesion located on the posterior wall of a retroverted

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Address for correspondence: Dr. Minh Duc Nguyen, Department of Radiology, Pham Ngoc Thach University of Medicine, 2 Duong Quang Trung, Ward 12, District 10, Ho Chi Minh City, Vietnam.
E-mail: bsnguyenminhduc@pnt.edu.vn

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uterus with junctional zone width of 40 mm [Figure 2a]. According to Perfusion Classification (Type A if TSIC of adenomyosis <TSIC of myometrium; Type B if TSIC of adenomyosis ≥TSIC of myometrium), adenomyosis in this case was considered as Type A [Figure 2b].[3] The serum AMH was 2.11 ng/mL. MRgFUS generated a posttreatment NPV ratio of 92% [Figure 2c]. At 6-month follow-up, the junctional zone width significantly decreased to 30 mm with the corresponding junctional zone width reduction ratio of 25% [Figure 2d] and tSSS improved significantly to 6.25

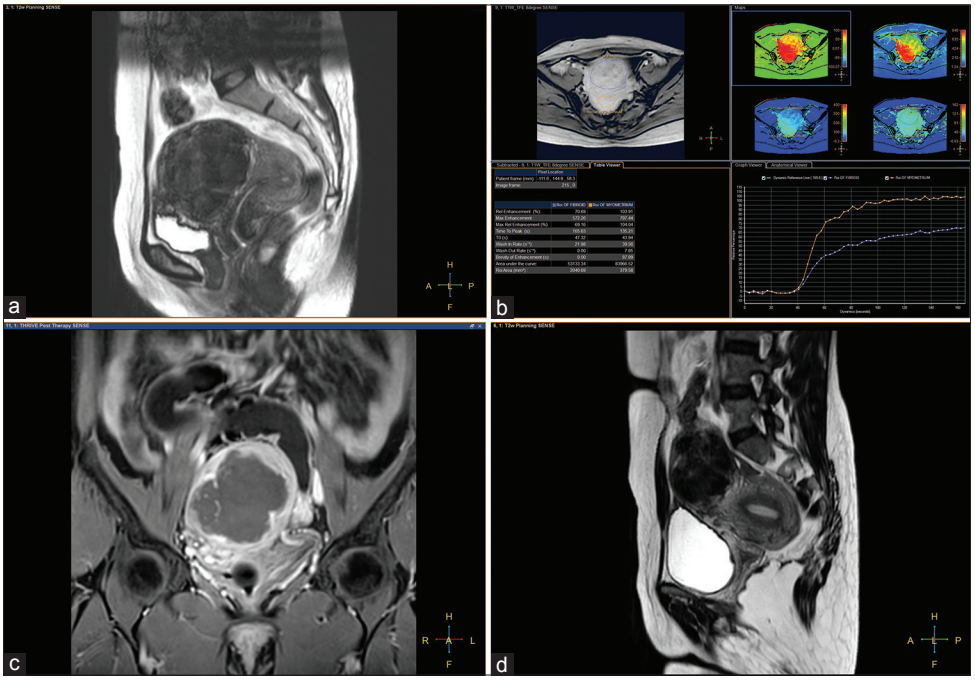

Figure 1: (a) Sagittal T2-weighted image at screening phase showing a Type II uterine leiomyoma on the anterior wall of retroverted uterus. (b) Axial perfusion-weighted image at screening phase showing the time signal intensity curve of uterine leiomyoma lower than that of myometrium. (c) Coronal contrast enhancement T1-weighted image after treatment showing near-complete ablation of uterine leiomyoma. (d) Sagittal T2-weighted image at 6-month follow-up showing significant shrinkage of uterine leiomyoma

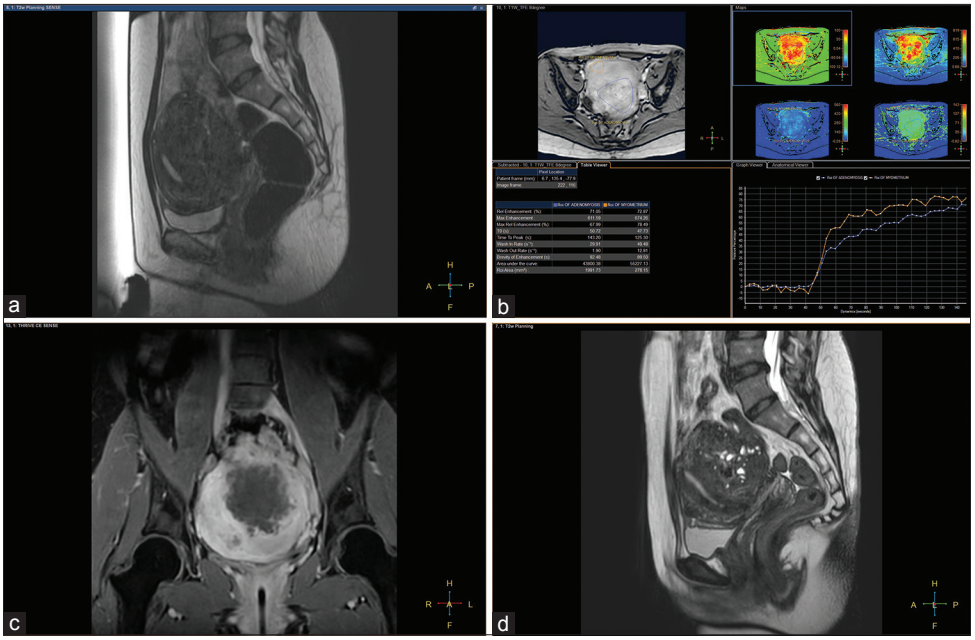

Figure 2: (a) Sagittal T2-weighted image at screening phase showing a focal uterine adenomyosis on the posterior wall of anteverted uterus. (b) Axial perfusion-weighted image at screening phase showing the time signal intensity curve of adenomyosis lower than that of myometrium. (c) Coronal-contrast enhancement T1-weighted image after treatment showing near-complete ablation of uterine adenomyosis. (d) Sagittal T2-weighted image at 6-month follow-up showing significant shrinkage of uterine adenomyosis

with corresponding symptom improvement ratio of 87.5%. In addition, the serum AMH preserved at the level of 2.11 ng/mL and no complications were reported.

Leiomyoma and adenomyosis are two of the most common gynecological benign diseases that influence negatively on the health of reproductive age patients. The prevalence of leiomyoma is approximately 70%–80% meanwhile that of adenomyosis ranges from 5% to 70%, namely because of ethnicity.[4,5] MRgFUS was based on the biological thermal effect of high-intensity focused ultrasound on the convergent tissue to elevate its temperature up to the threshold of coagulative necrosis and protein degeneration. There are many treatment cells for one tumor depended on the size of tumor. In addition, time of one treatment cell will rely on the size of treatment cell and the vascularity, the cellularity of the targeted tissue. During each sonication, user will base on a real-time gradient echo image to monitor the anatomy of tumor and surrounding structures. In addition, there is a temperature map for a clinician to control out-targeted or overdosed ablation. A cooling period between two sonication times is essential so that the temperature of the skin can recover. NPV ratio will be calculated from the volume of necrotic tissue without blood flow derived from three-dimensional T1-weighted images with contrast enhancement simultaneously posttreatment relative to the volume of tumor raised from 3-dimensional T2-weighted images before the treatment. The same imaging protocol will be exploited at 6-month follow-up to evaluate the fibroid shrinkage and the residual NPV. The symptom improvement ratio is calculated from the ratio between tSSS at 6-month follow-up relative to tSSS before treatment.[3,4,6-8] MRgFUS was adopted worldwide as an alternative therapeutic option to conventional treatment methods for leiomyoma and adenomyosis as drugs, surgery, intrauterine device, and uterine arterial embolization. Several studies showed that MRgFUS is a safe interventional method with low rate of adverse events and quick recovery to normal activities in 24-h posttreatment.[1-6] In some previous studies, the findings manifested that NPV ratio can be accomplished up to 80%–90% without resulting in more adverse events.[2,3,7,8] In this article, the NPV ratio of two cases was obtained over 90% for adenomyosis and leiomyoma; therefore, the symptom improvement ratio and lesion shrinkage ratio were significantly better, supporting the principle "the higher the NPV ratio is, the greater the symptom improvement is." In previous studies, the results showed that the shrinkage velocity is positively correlated with the amount of coagulated tissue which will be absorbed automatically with time.[2,3,7-9] With a quick reduction of tumor volume, the symptom will be resolved effectively. These findings are absolutely agreement with previous studies.[2,3,7-9] In addition, there were no adverse effects on ovarian function by comprehensive preservation of serum AMH level before treatment and posttreatment follow-up.[6] In fact, MRgFUS is focused solely on the targeted lesion without sonication through ovarian tissue and ovarian arteries. The present report is in line with previous studies,[1-9] revealing that MRgFUS is an effective method for the management of leiomyoma and adenomyosis without complications.

Ethical approval

Pham Ngoc Thach University of Medicine Institutional Review Board has approved this project, IRB No. 6_CDHA obtained on 22th May in 2015.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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