

## Pre-treatment acoustic window area as a predictor of the post-treatment nonperfused volume for MRg Focused Ultrasound Surgery (MRgFUS) of uterine fibroids.

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**Background:** Conventional surgery for symptomatic fibroids can have complications or can be refused by the patient. Uterine artery embolization, another treatment option, can have serious morbidity. MR guided Focused Ultrasound Surgery (MRgFUS) is a noninvasive treatment option that can potentially target a large population. MRgFUS uses on-line MR temperature monitoring of an outlined volume that is thermally ablated with ultrasound waves focused through the intact anterior abdominal wall. The acoustic window (AW), determined by pre-treatment T2WI, is defined as the area of the anterior abdominal wall through which the MRgFUS beam can safely avoid bowel, bladder (decompressed by Foley catheterization), bone, and abdominal scars. An imaging endpoint of MRgFUS is the post-treatment post-Gd volume of nonenhancement corresponding to the treatment volume. The percentage of nonperfused volume (%NV) is defined as the volume of nonenhancement divided by the total fibroid volume that can potentially be treated. For a given patient, multiple factors contribute to the %NV achieved: patient, technical, and anatomic. Of these factors, the AW area (anatomic factor) can be computed from MR imaging when treatment options are being considered. Thus, the AW area may be an effective measure to determine those patients who may best benefit from MRgFUS. The purpose of this study is to determine the relationship between the %NV and the area of the AW.

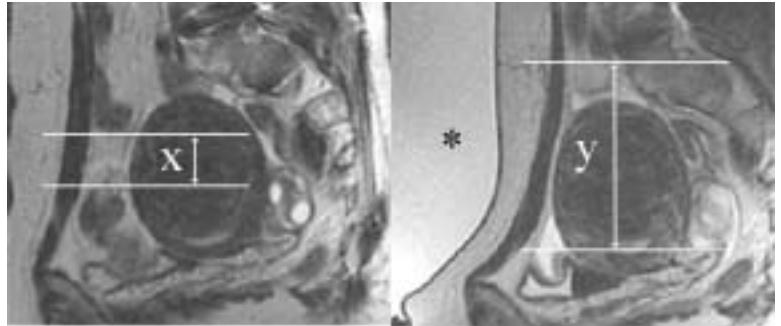


Figure 1. Sagittal T2W pretreatment images. 1a (left) demonstrates a small SI dimension (x) of the acoustic window, limited by bowel. 1b (right), after placement of gel pad spacer (\*), the SI dimension (y) is increased.

**Methods:** Between 12/02 and 11/03, 39 fibroids were treated (38 patients, 1 with 2 fibroids, ages 36-58 years). 1/39 was excluded (technical failure); the remaining 38 were retrospectively reviewed. Pretreatment fibroid volume and AW area (Fig. 1) were obtained via T2WI (FSE/ETL=12, TR=5500, EffTE=102, 6mm/2mm sk, FOV=28x28cm, 256x224 matrix, 2NEX, 3.4 min scan time). The post-treatment volume of nonperfusion and the %NV (Fig. 2) were obtained via post-Gd images (conventional SE, TR=175, TE=8, 6mm slices 2mm skip, FOV=28x28cm, 256x224 matrix, 2NEX, 78sec for 12 slices). Volume calculations assumed spherical geometries; the AW area assumed an ellipse on the anterior abdominal wall. In 5/38 cases, an additional gel pad spacer (Fig. 1b) was placed on the abdomen to displace bowel and therefore increase the AW area. Simple linear regression characterized the relationship (0.90 confidence interval) between the %NV and the AW area.

**Results:** The mean (range) of the fibroid volume (cm<sup>3</sup>), AW area (cm<sup>2</sup>), nonperfused volume (cm<sup>3</sup>), and %NV were 236 (27, 713), 61.9 (26.5, 160), 40 (2.2, 200), 28% (7%, 57%), respectively. The linear relationship between the %NV and the AW area has slope = 0.39 with 0.90 confidence interval (0.32, 0.46). In the 5 patients for whom the spacer was introduced, the mean (range) of the AW (cm<sup>2</sup>) before and after the spacer was 19.5 (0, 28.9) and 35.3 (32.7, 38.2), respectively.

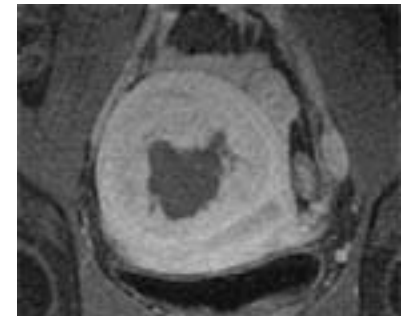


Figure 2. Post-treatment post-Gd coronal image demonstrating central nonenhancement corresponding to treatment volume.

**Conclusion:** Pre-treatment AW area measurements should be performed in MRgFUS of uterine fibroids to determine those patients for whom a large volume of nonperfusion is most likely to be achieved. The correlation between the AW area and the %NV argues that the AW area measurement is important to identify patients who may benefit most from MRgFUS. A subpopulation of patients in whom bowel limits the AW may benefit from the introduction of a spacer to optimize the post-treatment percentage of nonperfused volume.