

High intensity focused ultrasound treatment for relapsing extra-abdominal desmoid tumours

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Aims and objectives

Desmoid tumors are locally infiltrative, non-malignant soft tissue tumors. Based on location, desmoids are divided into extra-abdominal (trunk and extremities) and intra-abdominal tumors. Risk factors are prior surgery or trauma and pregnancy. Due to the chronic and highly variable nature of disease course and multiple different treatment options, a multidisciplinary treatment approach including surgeons, radiation oncologists, oncologists and interventional radiologists is required to achieve optimal outcome. Treatment should be pursued in patients with progressive disease, symptoms, risk of adjacent structures or cosmetic concerns. Surgery, radiation therapy, and chemotherapy have been the mainstay of therapy, but relapse is common and side effects can result in significant morbidity [1,2]. MR-HIFU is increasingly recognized as a treatment modality. We assessed the success rate of MR-HIFU for the treatment of extra-abdominal desmoids at our institute over a period up to 60 months.

Methods and materials

Five patients with relapsing, pathologically proven desmoid tumors (three males, two females; age range 40-79 years) were treated with MR-HIFU. Two patients had desmoids located in the rectus abdominis muscle, one in the deltoid muscle, one in the intercostal muscles and one in the popliteal fossa. If applicable the whole tumor was targeted. Treatments were performed under regional anesthesia or a combination of local anesthesia and analgosedation, based on tumor location and patient preference. An MR-HIFU system with an in-table 1,2-MHz transducer was used with a 1,5-T MR system. Procedure planning was done using a sagittal 3D T2w TSE Image (TR 1000ms, TE 130ms field of view AP 250mm FH 250mm RL 132mm, bandwidth 832Hz). Sonication number, size of treatment cells and energy deposition were steadily adjusted based on the real-time temperature-energy response seen on the MR-thermomap. Tissue temperature of 60-70° Celsius was targeted. Immediately after treatment post-contrast images of the non-perfused tumor areas were used to evaluate treatment effect and if needed to validate subsequent sonications (Fig. 1). Changes in total tumor volumes were measured with a tumor tracking software. Adverse events were documented.

Images for this section:

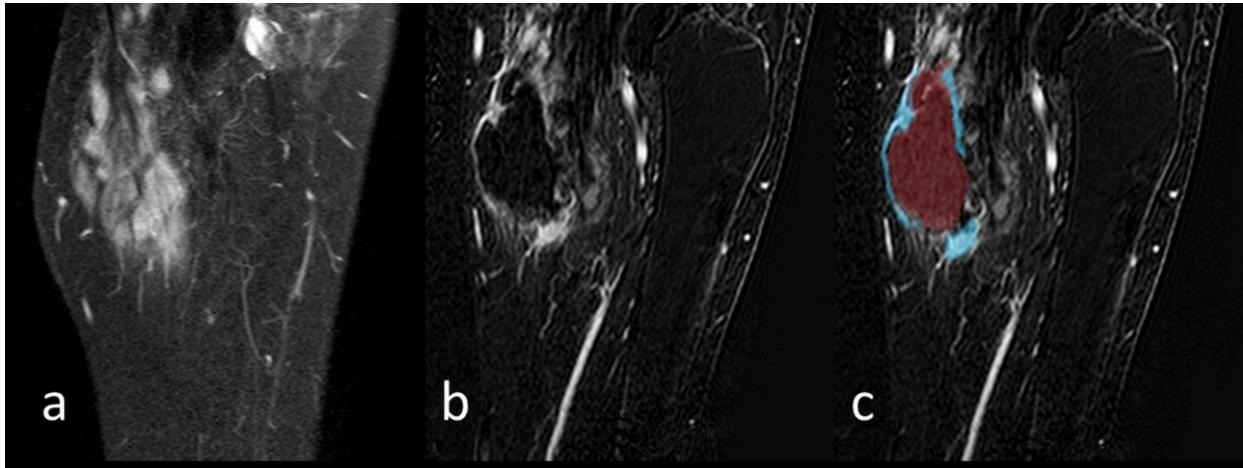


Fig. 1: a) MRI (T1 FS SPIR sequence with contrast) of popliteal fossa before treatment b) Subtraction sequence with contrast directly post-HIFU c) Post-processing of lesion with tumor tracking tool. Note that due to (unfortunate) different angulation of MR-sequences pre- and post-contrast the bone is not in the same plane as the tumor in the pre-contrast sequence.

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Results

MR-HIFU was technically successful in all patients without severe side effects. In one patient with desmoid in the popliteal fossa, the deeper parts of the tumor could not be targeted because of proximity to nerve and vessel structures. Follow-up periods range from 2 to 60 months. Initial targeted median tumor volume was 23 ml (range 3 - 70 ml), volumes decreased significantly in all patients (Table 1). Two patients required more than one treatment session due to insufficient sonication during the first session (patient nr. 4 needed two session, patient nr. 5 needed three session). After successful MR-HIFU treatment there was no relapse or progression of disease. No patient needed general anesthesia and all patients were treated as outpatients. Skin injury was correlated with distance to skin (average 0,7 cm [0,5-0,9 cm]) and/or proximity to bone (i.e. ribs). Both patients accepted the risk beforehand. Skin burns completely healed after a few weeks.

Images for this section:

Patient number	Age at tumor onset	Tumor location	Prior treatment	Initial total tumor volume (ml)	Most recent total tumor volume (ml)	Change in total tumor volume (ml)	Months of follow-up	Number of treatments	Type of anaesthesia	Adverse Events	shortest distance to skin
1	40	Popliteal fossa	Surgery (multiple)	70	56	-20%	2	1	Regional	Skin Redness	0,6 cm
2	40	Intercostal muscles	Surgery (multiple)	3	0	-100%	20	1	Local	2nd degree burn	1,5 cm
3	42	Rectus abdominis muscle	Surgery (1x)	3	0	-100%	27	1	Oral pain medication	None	2,5 cm
4	79	Deltoid muscle	Surgery (1x)	22	6	-73%	15	2	Regional	Skin Redness	0,9 cm
5	44	Rectus abdominis muscle	Surgery (1x), Radiation	23	0	-100%	60	3	Analgesedation and regional (epidural)	2nd degree burn	0,5 cm

Table 1: Patient and treatment summary

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Conclusion

MR-HIFU is an effective, outpatient treatment for patients with desmoid tumors that has minimal side effects and that can be combined with other treatment modalities. Given that desmoids are non-malignant tumors, the main treatment approach should be local tumor control while minimizing side effects. Small lesions have a high probability of complete ablation (Fig. 2). In cases of incomplete ablation, MR-HIFU can be repeated until desired therapeutic effect is achieved. It is important to realize that symptom relief does not require total tumor ablation.

There is increased risk of skin burns when lesions are in proximity to bone or less than 10 mm away from skin (near-field). Although none of our patients experienced it, there is also an increasing risk of far-field burns with larger tumor volumes presumably because of the increased number of sonifications and off-target heating of surrounding structures [3].

Images for this section:

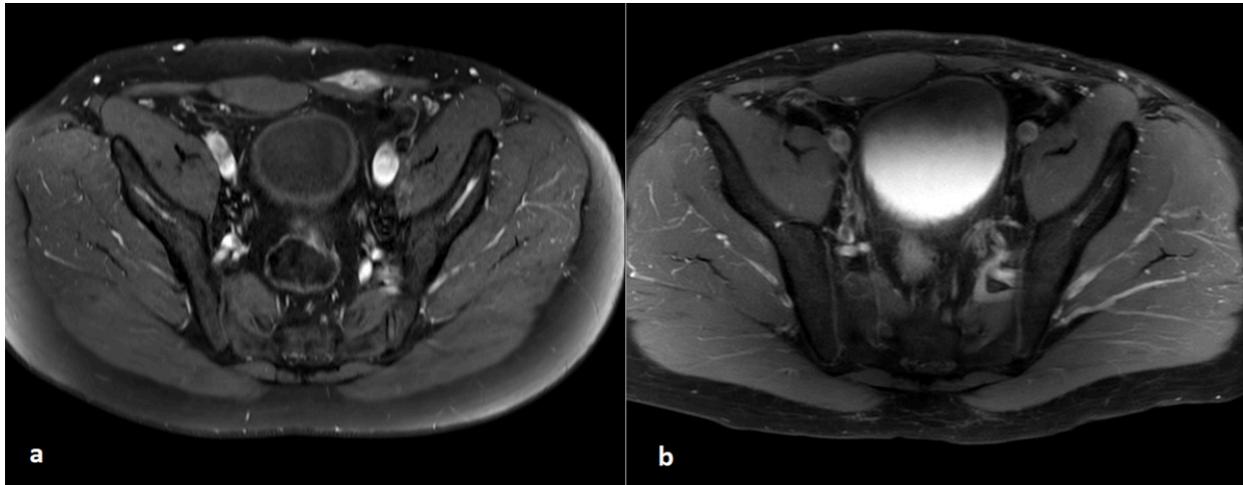


Fig. 2: MRI (T1 FS SPIR sequence with contrast) of lower abdomen with desmoid within the left lower rectus abdominis muscle a) before treatment and b) five years after treatment with no residual tumor.

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