Introduction

Fibroid treatment with MR-guided focused ultrasound (MRgFUS; syn.: HIFU = high-intensity focused ultrasound) is a thermoablative method in which the tissue to be treated is heated by focused ultrasound in single small volume increments (sonifications, syn: sonications) under constant MRI control until complete denaturation of the planned fibroid volume is achieved. After thermalization, imaging showed a lack of contrast enhancement of the treated tissue (NPV = non-perfused volume).

MRgFUS is organ-preserving and noninvasive and can be performed on an outpatient basis.

The treatment method is offered only by a few specialized centers.

The goal of MRgFUS treatment is to reduce or eliminate fibroid-related symptoms in affected women. A reduction in fibroid size can be achieved with ultrasound treatment. Complete fibroid regression is not to be expected and is also not the goal of the treatment.

The disciplines of gynecology and radiology agree that the indication for the treatment of uterine fibroids should be determined by a gynecologist following examination and counseling of the patient. Comprehensive patient counseling regarding the treatment options in symptomatic uterine fibroids should include medication, surgery, and the two non-surgical treatment options uterine artery embolization (UAE) and MRgFUS. The decision for or against a treatment alternative should be made under consideration of the patient’s wishes and with knowledge of other treatment options, the chance of success, limitations, typical side effects, and possible complications (informed consent).

MRgFUS treatment provides a treatment method for patients with fibroid-related symptoms and allows further treatment individualization for uterine fibroids in Germany, Austria, and Switzerland.

Goal of the consensus meeting

The intention of this third consensus meeting was to evaluate and categorize MRgFUS in the fibroid treatment spectrum. The 12 participants of the radiological-gynecological expert meeting came to a consensus following thorough discussion with evaluation of the current literature1 and their own experiences.

The group of experts was aware that the possibilities and limitations of a radiological treatment method was being discussed together with gynecology specialists who do not actually perform

* To be differentiated from non-MR-guided focused ultrasound.

1 The appendix contains references to select relevant publications.
the procedure but have expertise and experience with the
diagnosis and medication-based and surgical treatment of dis-
eases of the female genitals.

The expert group comprised of 4 radiologists and 8 gynecolo-
gists that met on January 14, 2017 in Berlin for the third radiolog-
ical-gynecological consensus meeting regarding MRgFUS treat-
ment also included gynecologists from Switzerland.

Following extensive and at times also controversial discussion,
the group agreed in consensus upon the following recommenda-
tions. The consensus paper is supported by the gynecologists and
radiologists listed at the end of the article. The paper reflects the
current state of knowledge.

Structural requirements for performing
MRgFUS treatment

MRgFUS should only be performed at hospitals with the necessary
expertise and experience. This also includes the conservative and
surgical management of side effects and complications. More-
over, there should be options for introducing postinterventional
pain therapy.

Examinations required prior to MRgFUS
treatment

Treatment decisions are based on gynecological examination
including vaginal and/or abdominal ultrasound (depending on
the size of the uterine fibroid). An MRI scan with contrast agent
ideally in prone position must be acquired for planning purposes.
The contrast-enhanced image helps to assess whether and to
what degree the fibroid is perfused.

Prior to every MRgFUS procedure, the indication for hystero-
scopy and fractionated abrasion should be examined as a function
of bleeding pattern and endometrium thickness and structure.
A cytological smear of the cervix uteri with a normal result needs
to have been performed within the last 12 months.

During the informed consent discussion prior to MRgFUS, the
patient should also be informed of the lack of preinterventional
histological confirmation, as in all other organ-preserving fibroid
treatment methods.

Indications for MRgFUS treatment

A symptomatic uterine fibroid with an anatomical position allow-
ing safe access for MRgFUS is an indication for MRgFUS treatment.
Treatment is complicated by the presence of more than five
fibroids. In the case of fibroids with a diameter of more than
10 cm, the indication for MRgFUS treatment should be carefully
considered due to the large fibroid volume and the associated
long treatment time.

MRgFUS represents an alternative to surgical and medication-
based methods such as UAE. Treatment decisions should be based
on the treatment objective and the wishes of the patient. If tech-
nically feasible, MRgFUS is a good option for patients desiring the
least invasive treatment possible.

Success criteria for MRgFUS treatment

The goal of treatment with focused ultrasound is to achieve the
greatest possible NPV (= non-perfused volume).

The improvement or elimination of fibroid-related symptoms
is viewed as treatment success following MRgFUS treatment.
A volume reduction is desired but is considered a secondary treat-
ment goal.

Contraindications for MRgFUS treatment

- Primarily Malignancy (absolute)
- Pregnancy (absolute)
- Acute inflammatory process (absolute)
- Subserosal pedunculated fibroids (absolute)
- Submucosal fibroids type 0 and I (relative; absolute in case of
  a desire to have children)
- Insufficient acoustic window for treatment (e. g. bowel overlo-
  ring the fibroid) (absolute)
- More than 5 fibroids (relative, decided on a case-by-case basis)
- Uterine fibroids with a diameter greater than 10 cm (relative,
  decided on a case-by-case basis)
- Large scars in the acoustic window (relative)
- Fibroid positioned near the os sacrum (relative)
- General contraindications to MR contrast agents (relative)
- Relative and absolute MRI contraindications

Ulipristal acetate can result in increased perfusion of fibroids; con-
sequently the evaluation of the feasibility of MRgFUS treatment
and the actual treatment can be negatively affected.

In the case of suspicion of a malignancy of the uterus, MRgFUS
is absolutely contraindicated.

MRgFUS treatment in patients with a
desire to have children

There is no published prospective data regarding women who
wish to have children and have been treated with MRgFUS/HIFU.
Therefore, MRgFUS/HIF treatment cannot be recommended
prior to a planned pregnancy. However, if a patient wants to
become pregnant after MRgFUS/HIFU treatment, a minimum
wait time of approximately 6 months between fibroid treatment
with MRgFUS and conception should probably be observed.

Side effects/complications of MRgFUS
treatment

Relevant side effects and complications during and after MRgFUS
treatment are rare:

- Pain
In addition to increased and/or irregular bleeding within three months after treatment, fibroid treatment with MRgFUS can result in discharge of (necrotic) fibroid material in terms of a "fibroid in the nascent state" that is unpleasant and painful for the patient. Uterus-preserving ablation performed via the vagina possibly also in combination with surgical hysteroscopy is also possible here. Perioperative antibiotic prophylaxis is recommended in these cases.

**Follow-up after MRgFUS treatment**

Follow-up by a specialist after MRgFUS is recommended. Imaging methods are helpful (e.g. ultrasound in connection with Doppler ultrasound, MRI). If treatment is not successful (no improvement in symptoms and/or increase in fibroid size) or in the case of pathologies on imaging (increase in size of fibroid(s) or uterus), further diagnostic workup is required.

**Future**

The recommendations regarding MRgFUS treatment of fibroids are to be revised in approximately two years under consideration of the data and experiences available at that time.

**Appendix**

**Participants in the consensus meeting 2017**

Prof. Dr. med. Michael Bohlmann/ Mannheim
Dr. med. Alexander Burges/ Munich
Prof. Dr. med. Matthias David/ Berlin
Prof. Dr. med. Markus Düx/ Frankfurt a.M.
Prof. Dr. med. Dr. phil. Dr. h. c. mult. Andreas D. Ebert/ Berlin
Prof. Dr. med. Peyman Hadjji/ Frankfurt a.M.
Dr. med. Thomas Hess/ Winterthur (CH)
PD Dr. med. Peter Hunold/ Lübeck
Dr. med. Hans-Christian Kolberg/ Bottrop
Dr. med. Matthias Matzko/ Dachau
PD Dr. med. Vera Schreiter/ Berlin
Prof. Dr. med. Uwe Ulrich/ Berlin

**Participating societies and working groups:**

AGE, Arbeitsgemeinschaft Gynäkologische Endoskopie der DGGG
AG URZ, Arbeitsgemeinschaft Universitärer Reproduktionsmedizinischer Zentren der DGGG
Berufsverband der Frauenärzte (BVF)
DeGiR, Deutsche Gesellschaft für Interventionelle Radiologie und minimal-invasive Therapie

DGGEF, Arbeitsgemeinschaft Gynäkologische Endokrinologie und Fortpflanzungsmedizin e.V.
DGGG, Deutsche Gesellschaft für Gynäkologie und Geburtshilfe
DRG, Deutsche Röntgengesellschaft
SGGG, Schweizerische Gesellschaft für Gynäkologie und Geburtshilfe

**References to relevant publications**

6. G-BA-Beschluss (Dezember 2016) betreffend „Erprobungs-Richtlinie zur Behandlung von Uterusmyomen mittels MRgFUS”: https://www.g-ba.de/institution/presse/pressemitteilungen/657/
http://dx.doi.org/10.1016/j.jogc.2016.02.006

Conflict of Interest

The authors declare that they have no conflict of interest.