

Received: 2010.09.29
Accepted: 2011.02.17

Uterine artery embolisation and magnetic resonance-guided focused ultrasound treatment of uterine fibroids

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Summary

Uterine fibroids are the most common benign female tumours during reproductive age. The traditional treatment for this condition is typically hysterectomy. However, there are new technologies on the rise, such as Uterine Artery Embolisation and Magnetic Resonance-guided Focused Ultrasound which are directed towards a minimally invasive or even noninvasive treatment of uterine fibroids. These modern procedures allow for a fast recovery and preservation of fertility. In this work, we presented these alternative procedures and highlighted their advantages and limitations.

Key words: UAE (Uterine Artery Embolisation) • MR HIFU (Magnetic Resonance High-Intensity Focused Ultrasound) • MRgFUS (Magnetic Resonance-guided Focused Ultrasound)

PDF file: <http://www.polradiol.com/fulltxt.php?ICID=881819>

Uterine fibroids were first described in 1793 by Matthew Baillie from St. George's Hospital in London.

These are the most common benign tumours in women aged 35–45 years. They are more prevalent among the black females than among the white ones [1]. Risk factors of these lesions include i.a.: lack of offspring, overweight, use of steroids, diabetes mellitus, hypertension, polycystic ovary syndrome, and family predisposition. Most of the lesions are asymptomatic. However, some of them may cause heavy bleeding or amenorrhoea [2] and pressure within the pelvis minor, abdominal integuments, and adjacent organs, i.e. urinary bladder, lower GI tract, which leads to frequent constipations or urinary reflux.

Undiagnosed and untreated fibroids contribute to infertility and miscarriage.

Therapy

Treatment of uterine fibroids may be divided into a conservative (GnRH analogues), an invasive with the use of conventional surgery (selective resection of the fibroids, hysterectomy), a low-invasive, i.e. Uterine Artery Embolisation (UAE),

an ablation [3], and a noninvasive treatment with the use of Magnetic Resonance-guided Focused Ultrasound MRgFUS

How to Diagnose Uterine Fibroids?

The basic diagnostic measure is the gynaecological examination with the use of transvaginal and transabdominal ultrasound. However, a golden standard in evaluation of the morphology of the lesion and its perfusion, as well as spatial location, is the MRI (magnetic resonance imaging). So far, no genetic test has been found which would allow for diagnosing uterine fibroids.

UAE Treatment

Embolisation of uterine arteries in case of fibroids is a non-surgical treatment method. It was introduced in 1995. Since then, it has become a relatively popular method of treatment of uterine fibroids, due to its low invasiveness, selectivity, and decreased hospitalisation and recovery time.

On 15 January 2010 in Munich, there was a meeting of experts from Germany, Switzerland, and Austria in radiology and gynaecology [4]. They were supposed to define the

procedures in the treatment of uterine fibroids, as well as diagnostics with the use of UAE.

Immediately before embolisation, the patient should undergo pregnancy test, laboratory test, i.e. creatinine level, coagulation factors, thyroid test, as well as CBC and CRP. Any inflammation should be excluded with a physical examination.

Indications

Treatment indications include symptomatic uterine fibroids.

Every case should be discussed at a radiological-gynaecological meeting.

Contraindications (relative) [4]

- Administration of GnRH analogues for longer than 3 months (an increased risk of a vascular spasm),
- Vascularisation of uterine fibroids with ovarian arteries as well (probability of additive embolisation),
- Allergy to iodinated contrast media,
- Allergy to local anaesthesia,
- Renal insufficiency (creatinine level of >1.5),
- Immunosuppression,
- Postmenopausal patient.

Contraindications (absolute) (4)

- Infections of GU organs,
- Active hyperthyroidism.

Radiological protection (4)

Patients undergoing UAE should be exposed to radiation as little as possible. The main operator should remember to minimise patient's radiation to the lowest possible degree.

Side effects of UAE

- Nausea and vomiting
- Pain within the treated lesion

Follow-up

The patient should be followed up for up to 6 months after treatment.

The diagnostics should be based on a physical examination and imaging studies including ultrasonography, Doppler ultrasonography, and contrast-enhanced MRI.

UAE Procedure

Directly before the procedure, the patient should be informed in detail about the sequelae or possible failures.

With a special catheter, especially dedicated to embolisation of the fibroids, introduced through the right femoral artery, the internal iliac artery is probed. Then, with a microcatheter, the left uterine artery, and then the right one is

examined. Embolisation uses spheres of 500–700 μm in size (own experience), adequate to the diameter of the vessel. Endoscopic examination is used to evaluate whether the left uterine vessel was obliterated and to assess treatment effects.

After closing the vessel, embolisation of the right uterine vessel is performed. The patient is constantly monitored for vital signs during the procedure. Due to frequent pain sensation, the patient receives anaesthetics.

After a completed intervention, follow-up angiography and MRI are performed, during which treatment outcomes are assessed.

Recent studies of the Medical University Charite in Berlin concerned the evaluation of perfusion/contrast administration before and after UAE procedure, in two early postoperative time periods (A and B), and after approx. 5 months. Examinations performed during period A showed ischemic changes within the body and fundus of the uterus, but not within its cervix. The second course of examinations, in period B, showed reperfusion of the myometrium. The follow-up examination after 5 months showed a full reperfusion in all examined individuals, within the whole organ. In the study group, in approx. 2/5 of patients, the fibroids remained unenhanced, and in 1/5 of the patients, they showed a partial reperfusion [5]. Our own experiences showed a similar rate of treatment success in case of uterine fibroids. It was often that the patients with reperfusion found during a follow-up examination required a selective myomectomy or hysterectomy.

MRgFUS procedures

The earliest information on the treatment with MRgFUS, in rats, were published in 1995 [6].

This noninvasive, MRI-guided method of treatment of uterine fibroids and fibromas with the use of high intensity focused ultrasound (HIFU) is relatively new and was introduced to clinical practice in the USA in 2004, after the US Food and Drug Administration (FDA) accepted it [7]. Its function and the procedure itself is based on the use of selectively focused ultrasounds of high frequency, causing thermoablation of the pathological tissue. The assessment of the temperature within the lesion and adjacent area is possible with MRI-based temperature mapping of the treated region.

During the procedure, the patient remains in prone position, on a special therapeutic table, dedicated to such procedures. Immediately before the procedure, the patient receives a tranquilliser. During the procedure, the evaluation of location and the whole 'command is taken' by the radiologist, who assesses the site of treatment, ablation temperature, and onset time. After the procedure, the patient should remain under specialist care for about 2 hours. If during that time period, no complaints are reported, she may be discharged home and return to work after about two days.

Treatment outcomes are followed up. Normally, the control visit takes place after 6 months (this depends on the centre

at which the procedure was performed) [8]. A follow-up MRI evaluates the perfusion or its absence within a normal tissue and a fibroidal tissue – a full or partial regression.

Contraindications of MRgFUS [3]

- Electronic, magnetic, and mechanical implants
- Ferromagnetics or mechanical devices, i.e. cardioverters,
- Auditory implants,
- Implants within the CNS,
- Haemoglobin level below 10,
- Unstable angina pectoris,
- History of a previous myocardial infarction,
- Diastolic hypertension above 100 mmHg,
- Anticoagulative therapy,
- Other lesions than fibroid within the uterus,
- Infection within the pelvis,
- Undiagnosed mass within the pelvis,
- Claustrophobia (examination time of approx. 3 h),
- Body mass of > 110 kg,
- Contraindications to contrast administration.

Conclusions

Embolisation of the uterine arteries is a good treatment method in case of fibroids. It requires a good angiographic equipment, material and trained personnel. Treatment time is about 1 hour (own experience). The procedure is frequently accompanied by pain. Patients are administered pain killers from the group of synthetic opioids, e.g. Piritramid. Very often, the administration of such a drug

is followed by nausea, somnolence and vertigo. UAE is an alternative method, but is it good enough as compared to other methods? The described method, as well as MRgFUS is connected with a logistic problem, i.e. problem of cooperation between the radiologist and gynaecologist. The first one carries out the procedure, and the second one prepares the patient and manages her treatment process before and after surgery. If both of them are sufficiently engaged in this cooperation, the treatment procedures are then reduced, which is directly connected with benefits for the patient.

An alternative of UAE is the previously mentioned MRgUS which is associated with high price of the MRI scanner and HIFUS device. The method is noninvasive and is connected with short hospitalisation, as compared to other methods.

A significant fact differentiating it from other forms of thermoablation is the use of ultrasounds, with an insignificant influence on tissues other than the treated ones.

Another important aspect of treatment with the use of HIFU and MRI is the simultaneously conducted therapy and diagnostics, within so called MRgFUS system (MR-guided Focused UltraSound).

However, the application of magnetic resonance in examinations and treatment is connected with a long and relatively unpleasant examination process. The time of the procedure is relatively long for a person who remains fully conscious.

References:

1. Okolo S: Incidence, aetiology and epidemiology of uterine fibroids. *Best Pract Res Clin Obstet Gynaecol*, 2008; 22(4): 571–88
2. Kunde K, Cortes E, Seed P et al: Evaluation of perioperative morbidity associated with single and multiple myomectomy. *J Obstet Gynaecol*, 2009; 29(8): 737–41
3. Munro MG: Endometrial ablation: where have we been? Where are we going? *Clin Obstet Gynecol*, 2006; 49(4): 736–66
4. Kröncke T, David M: Uterine artery embolization (UAE) for myoma treatment – results of the 3rd radiologic gynecologic expert meeting Röfo, 2010; 182(7): 615–17
5. Scheurig-Muenkler C, Wagner M, Franiel T et al: Effect of Uterine Artery Embolization on Uterine and Leiomyoma Perfusion: Evidence of Transient Myometrial Ischemia on Magnetic Resonance Imaging. *J Vasc Interv Radiol*, 2010; 21(9): 1347–53
6. Cline HE, Hynynen K, Watkins RD et al: Focused US system for MR imaging-guided tumor ablation. *Radiology*, 1995; 194(3): 731–37
7. Al Hilli MM, Stewart EA: Magnetic resonance-guided focused ultrasound surgery. *Seminars in Reproductive Medicine*, 2010; 28(3): 242–49
8. Morita Y, Ito N, Hikida H: Non-invasive magnetic resonance imaging-guided focused ultrasound treatment for uterine fibroids – early experience. *Eur J Obstet Gynecol Reprod Biol*, 2008; 139(2): 199–203
9. Zaher S, Gedroyc WM: Patient suitability for magnetic resonance guided focused ultrasound surgery of uterine fibroids. *Eur J Obstet Gynecol Reprod Biol*, 2009; 143: 98–102