

The HIFU Technology during the Therapy of Uterine Myoma - First Attempts in Bulgaria

Kameliya Tsvetanova¹, Ivan Malkodanski², Grigor Gorchev³

¹Doctor G. Stranski—University General Hospital for Active Treatment Plc-Pleven Town-Clinic of Anesthesia and Intensive Therapy-Iii-Ward for Anesthesia and Intensive Care

^{2,3}Sveta Marina, General Hospital For Active Treatment-Pleven Town

Abstract: *The goal of this article is to present the used by us method for sedation and pain relief during the first attempts at therapy of uterine myoma in Bulgaria through the use of HIFU ablation.*

Keywords: HIFU, uterin myoma, sedation

1. Introduction

HIFU is an abbreviation, meaning high-intensity focused ultrasound. The therapy with HIFU (ultrasound ablation) is a revolutionary, radically new approach to the therapy of solid tumors in the human body – benign and malign. This method became very popular with patients and physicians and it was used widely in leading global clinical centers during the last years.

It represents a completely non-invasive extra-corporal method of therapy, at which through a high-intensity focused ultrasound ray, falling with unique precision in the target area of a tumor, one performs ablation (destruction) of non-cancerous, cancerous or pre-cancerous formations.

The effect of HIFU on tissues is produced through heating, cavitation or the exertion of mechanical forces. Heating in the relevant area sets in through the absorption of ultrasound energy from tissues. The temperature in it is the higher, the greater are ultrasound energy intensity and the acoustic (ultrasound) absorption coefficient. Under the influence of a high temperature, tissue coagulation and the denaturation of tissues occur within the timeframe of several seconds. [1]

This process is localized only in the relevant area, while the areas neighboring to the focused zone remain intact. It is characteristic of HIFU therapy, that it has several big advantages over the conventional surgical method of therapy, which can be summarized in the following way:

- 1) There is a lack of scars (a 100% non-invasive procedure, without skin incision)
- 2) There is no loss of blood;
- 3) There is a minimal risk of infections;
- 4) It lacks operational stress;
- 5) The recuperation of patients is within the timeframe of 24 hours, as in 1-2 days they get back to an active way of life;
- 6) It preserves uterus;
- 7) It does not affect future pregnancy;
- 8) It does not require general anesthesia;
- 9) It is a non-ionizing procedure innocuous to patients, physicians and a natural environment;

- 10) There is no need for hospitalization (the patient can go home after the above-mentioned procedure comes to an end); [2]

The trend of all surgical disciplines is towards highly efficient and less invasive therapy, while preserving the integrity of tissues. Thanks to the advantages, which HIFU gives, this revolutionary method of therapy finds even wider application for the therapy of a series of diseases concerning woman's health, like for example uterine myoma. Ablation can be used not only for sub-mucosal, but also for sub-serous and intramural uterine nodules.

Uterine myoma/fibroid is one of the most frequently diagnosed benign diseases, spreading among women at a reproductive age with a frequency rate of 20%-40%. [3]

The disease proceeds with frequent genital tract bleeding, leading to the development of anemia syndrome. In these cases, the HIFU method of therapy applied to these women turns out to be a good alternative, whereas usually female patients are with preceding inefficient hormone therapy or are after preceding myomectomies, after which the recurrence of a disease develops.

Criteria for HIFU therapy in the case of uterine myoma:

Indications:

- Clinically proved uterine myoma;
- Symptoms, including an incorrect menstrual cycle, dysmenorrhea, secondary anemia and infertility;
- The myoma structure is visualized better with ultrasound;
- A wish for the performance of therapy with HIFU;
- Preservation of uterus (a refusal of hysterectomy);

Relative contraindications:

- Gynecological infection (inflammation of the organs of a small pelvis)
- Intrauterine devices;
- Myoma at a distance of more than 12 centimeters from a skin surface;
- Thickness of an abdominal fold > 7 cm
- Cervical myoma;
- Myoma with more than 6 nodules;
- Requirements for the creation of progeny;

- Surgery at the lower region of one's abdomen during the past 3 months;

Contraindications

- An age close to menopause;
- Sub-mucosal (subserous) myoma with a pedicle;
- Heavy and hard-to-bear endometriosis;
- Agoraphobia and worriedness in confined spaces;
- Pregnancy;
- During breastfeeding;
- Big post-operative cicatrices on the abdominal wall, whereas an ultrasound wave cannot pass through them.
- A given radiation dose of 60 Gray in the area of one's pelvis;
- At the presence of a foreign medical metal product (a pacemaker, metal implants and so on);
- An uterine sarcoma, an endometrial carcinoma, a cervical carcinoma and so on [4];

2. Aim

The goal of this article is to present the used by us method for sedation and pain relief during the first attempts at therapy of uterine myoma in Bulgaria through the use of HIFU ablation.

3. Material and Methodology

We have researched medically 30 female patients with uterine myoma, subjected to HIFU ablation. We have implemented a modified by us scheme of pain relief and sedation to all of them, as the effect of the provided therapy and pain intensity have been assessed through the use of VAS (a visual analogue scale).

Technique

During the procedure, a female patient lies on her stomach over an operating table, as high-energy focused ultrasound waves heat up a small section in the area of the myoma nodule up to a temperature of 85°C. During pulsation or sound processing, which lasts approximately 15 seconds, the attending physician keeps track of the situation, monitoring the progression and the temperature sensitivity of the image. (Figure 1)

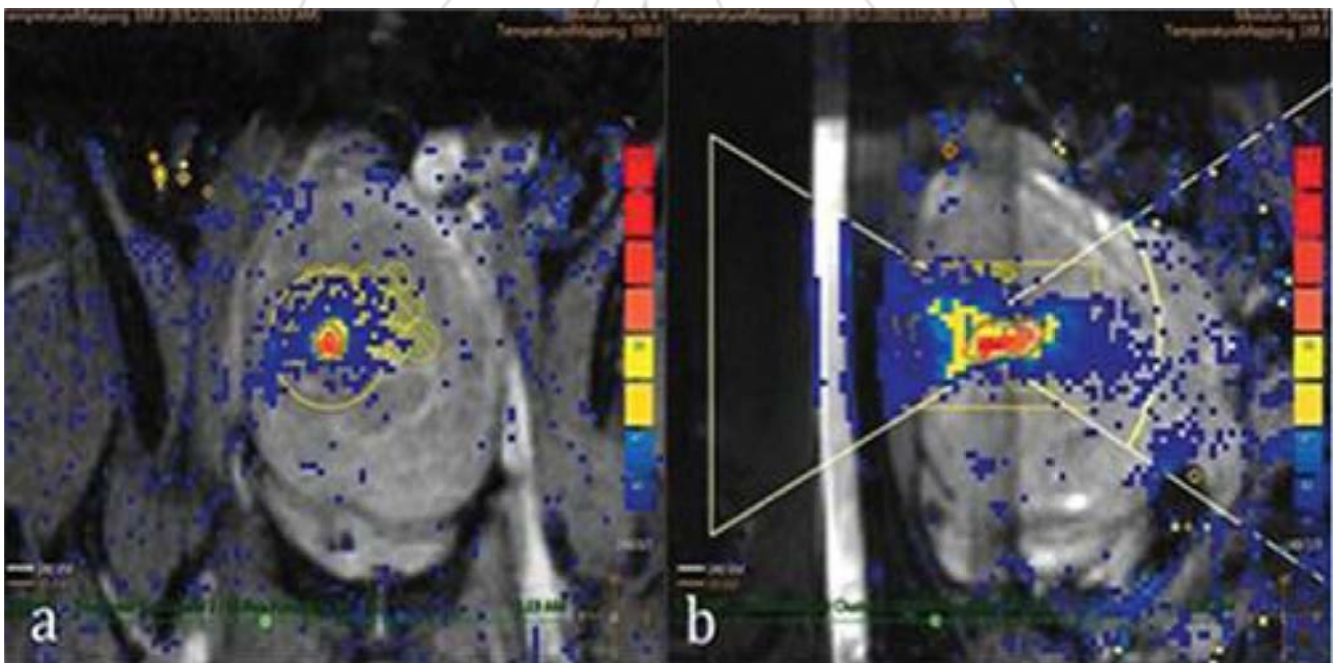


Figure 1: HIFU thermal ablation of a uterine fibroid monitored by MR imaging and thermometry. [5]

Whereas, every ultrasound treats a very small volume, this process is repeated until the achievement of the desired volume, usually up to 50 times. The procedure lasts about 3 hours, depending on the number of myoma nodules.

Anesthesia: Despite the fact, that HIFU is a surgical procedure, which is assessed as low-risk one, whereas an

abdominal cavity is not opened, the preparation of patients for it should not be underestimated and it observes the same operational protocol, as it is for every other type of surgery. In our practice, we use the following method of pain alleviation: (Figure 2)

Drug Administration Flowchart

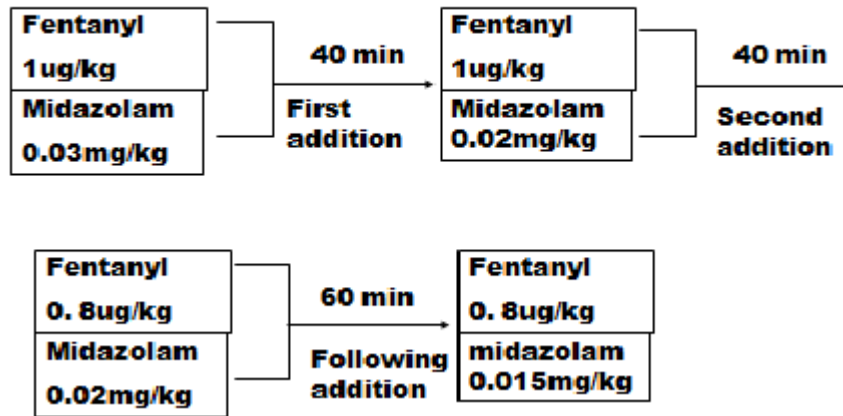


Figure 2: Sedation algorithm

It is the method of pain alleviation applied widely in China. At them, it turns out to be efficient, but at European patients, due to the large quantity of subcutaneous adipose tissue in the area of an abdomen, which is heated up at ablation, we add Morphine 0,15 mg/kg intravenously to it as premedication, 10 minutes before surgery, after which we implement the above-stated scheme. In case of a need for additional pain relief, one can add the combination of 1 ampoule of Dexophen and 1 ampoule of Analgin, dissolved in 1000 milligrams of Perfalgan, which are let down and infused intravenously. If there is a need for additional sedation, you can use one ampoule of Allergosan intravenously. At the time of implementing the scheme explained in detail, one gets satisfactory pain relief during ablation.

For the sake of achieving pain relief and determination of pain intensity, our team followed this medical protocol:

Relief/alleviation of patient's pain: Doctor: //

1. Medicaments

Morphin -	Dormicum-	Calypsol-
Fentanyl -	Perfalgam-	Lydol-
Allergosan-	Analgin-	
Dexofen-	Propofol-	

2. Pain Assessment

2.1. During ablation

1	2	3	4	5
---	---	---	---	---

2.2 Every 6 hours after ablation

1	2	3	4	5
---	---	---	---	---

2.3. Every 24 hours after ablation

1	2	3	4	5
---	---	---	---	---

Legend:

- 1 – no pain
- 2 – slight pain
- 3 – tolerable pain
- 4 – severe pain
- 5 – intolerable pain

2. Complications during anesthesia-.....

Date: _____ Signatures 1.
 Pleven town _____ 2.

4. Result and Discussions

During the first 6 hours after ablation, we ascertained from the 30 female patients, medically researched through the Visual Analogue Scale (VAS) of pain, that 21 of the women assessed pain with 4 points, 6 female patients with 5 points, 2 of them with 3 points and only 1 of them with 2 points (Figure 3).

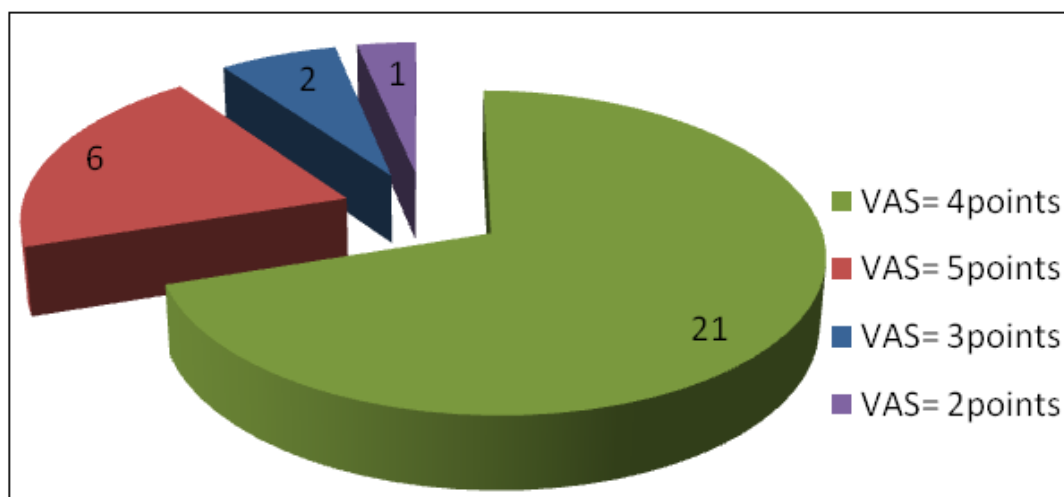


Figure 3: The frequency distribution of the above-mentioned female patients by means of VAS

24 hours after it, all 30 lady patients evaluate that they have no pain and stipulate intensity of 1 point.

Regardless of the circumstance that the HIFU procedure is performed by means of intravenous sedation, the female patients are under medical supervision and monitored during the first 24 hours in a semi-sitting position in bed.

The performance of skin monitoring is compulsory, whereas quite often after the procedure the edema and its reddening are observed (Figure 4), (Figure 5).

Illing R. (year 2005), recommends in case of edematous skin or local reddening with the appearance of blisters, the use of cold compresses until the achievement of a normal temperature. [14]

In the medical cases of all researched female patients, after the performance of ablation, one carried out cooling of the abdominal wall by means of cooling small blocks for a period of 2 hours.



Figure 4: A view of the abdominal wall before the HIFU procedure



Figure 5: Changes after a HIFU procedure

The ablation with HIFU through its capability to cause coagulation necrosis only in the desired section without the affection of surrounding tissues and organs is the reason for the even wider distribution and application of the above-stated method. Its efficiency with respect to the considerable decrease in the size of myoma nodules is well documented in different researches. [6-12]

Despite it, there are certain potential restrictions on the application of HIFU. One must take into account the circumstance, that ultrasound is more difficultly spread across the air, filling different organs, for examples intestines. For this reason, the ablation of myoma nodules, situated in close proximity to them, conceals the risk of visceral perforation, which restricts the application of HIFU. [13] In order to avoid this complication, all female patients have undergone pre-operative gastric emptying.

ng and Stewart report about the observation also of other complications, like febrility (feverishness), infections of urinary tracts, hematuria and backache after the procedure. One has not registered similar complications in the group, which we researched medically. It raises the issue about the necessity for strict monitoring control in the period after the ablation and the need for achieving good pain alleviation yet during ablation. [15-16]

5. Summary

High technologies are being introduced even more widely in medicine. The creation of the HIFU technology for the therapy of a series of benign and malign diseases, without affecting the completeness of skin, makes this method innovative and more and more preferred not only by patients, but also by physicians.

The use only of intravenous medication during this procedure gives an opportunity for the faster recovery of patients and their return to an active way of life within the timeframe of 24 hours after it.

References

- [1] Daum DR, Smith NB, King R, Hynynen K. In vivo demonstration of noninvasive thermal surgery of the liver and kidney using an ultrasonic phased array. *Ultrasound Med Biol.* 1999;25:1087–1098. [PubMed]
- [2] http://www.hifu.ro/index.php?option=com_content&view=article&id=83&Itemid=92.
- [3] Buttram VC, Jr, Reiter RC. Uterine leiomyomata: etiology, symptomatology, and management. *Fertil Steril.* 1981; 36 :433–45. [PubMed]
- [4] <http://hifu.hursamed.com/Myoma-Treatment-with-Hifu>.
- [5] <https://www.aapm.org/research/spotlight/HIFUJuly2015.asp>
- [6] Haar G.T., Coussios C. High intensity focused ultrasound: past, present and future. *Int J Hyperthermia,* 23 (2007), pp. 85–87.
- [7] Chapman A., Harr G. Thermal ablation of uterine fibroids using MR-guided focused ultrasound—a truly non-invasive treatment modality. *Eur Radiol,* 17 (2007), pp. 2505–2511.
- [8] Stewart E.A., Gedroyc W.M., Tempany C.M., *et al.* Focused ultrasound treatment of uterine fibroid tumors: safety and feasibility of a noninvasive thermoablative technique. *Am J Obstet Gynecol,* 189 (2003), pp. 48–54.
- [9] Stewart E.A., Gostout B., Rabinovici J., *et al.* Sustained relief of leiomyoma symptoms by using focused ultrasound surgery. *Obstet Gynecol,* 110 (2007), pp. 279–287.
- [10] LeBlang S.D., Hoctor K., Steinberg F.L. Leiomyoma shrinkage after MRI-guided focused ultrasound treatment: report of 80 patients. *Am J Roentgenol,* 194 (2010), pp. 274–280.
- [11] Ren X.L., Zhou X.D., J. Zhang J., *et al.* Extracorporeal ablation of uterine fibroids with high-intensity focused ultrasound: imaging and histopathologic evaluation. *J Ultrasound Med,* 26 (2007), pp. 201–212.
- [12] Wang W., Y. Wang Y., Wang T., *et al.* Safety and efficacy of US-guided high-intensity focused ultrasound for treatment of submucosal fibroids. *Eur Radiol,* 22 (2012), pp. 2553–2558.
- [13] Kennedy JE. High-intensity focused ultrasound in the treatment of solid tumours. *Nat Rev Cancer.* 2005;5 :321–27. [PubMed]
- [14] Illing RO, Kennedy JE, Wu F, *et al.* The safety and feasibility of extracorporeal high-intensity focused ultrasound (HIFU) for the treatment of liver and kidney tumours in a Western population. *Br J Cancer.* 2005;93 :890–
- [15] Meng X, He G, Zhang J, *et al.* A comparative study of fibroid ablation rates using radiofrequency or high-intensity focused ultrasound. *Cardiovasc Intervent Radiol.* 2010; 33 :794–99. [PubMed]
- [16] Stewart EA, Rabinovici J, Tempany CM, *et al.* Clinical outcomes of focused ultrasound surgery for the treatment of uterine fibroids. *Fertil Steril.* 2006; 85 :22–29. [PubMed]