

A Journey from Learning a Noninvasive High-intensity Focused Ultrasound Surgical Treatment for Gynecological Diseases to Providing High-intensity Focused Ultrasound Services in Hong Kong

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Abstract

This paper reflects a Hong Kong doctors group's journey to learn the high-intensity focused ultrasound (HIFU) ablation treatment for gynecological diseases in China. The procedures of HIFU ablation for fibroids, adenomyosis, and other gynecological diseases are described. After completing our training, the authors applied the HIFU ablation techniques they have learned to establish an outpatient HIFU clinic and provided HIFU ablation treatment in Hong Kong. This paper describes their early experience in providing HIFU services.

Keywords: Adenomyosis, fibroids, high-intensity focused ultrasound ablation, outpatient clinic

Fibroids and adenomyosis are common in women of reproductive ages. Both occur increasingly in the younger age group and may result in menorrhagia, dysmenorrhea, abdominal distension, urinary symptoms, and infertility. In the past 20 years, minimally invasive surgery (MIS) has been performed in many countries and has replaced most open surgeries. MIS consists of the advantages such as small wounds, short-term hospitalization, speedy recovery time, and less pain.^[1] As the patients are constantly increasing their quality of life (QoL), minimally invasive therapy has gradually become noninvasive therapy. Therefore, Hifu treatment is getting much attention and highly respected. Although surgical treatments like myomectomy and hysterectomies are the conventional treatment for fibroids, they may adversely affect the reproductive function or even end up removing the uterus.^[2] Recurrent tumor growth or

symptoms after surgery is not uncommon. Other conservative measures, including uterine artery embolization and/or radiofrequency ablation, are often limited by services' unavailability and poor results.^[3] Meanwhile, adenomyosis continues to pose a challenge to the clinician as there is still no satisfactory medical or treatment solution.

High-intensity focused ultrasound (HIFU) ablation for fibroids and adenomyosis, either Ultrasound-guided HIFU (USgHIFU or uHIFU) or magnetic resonance imaging-guided HIFU (MRgHIFU), presents an attractive alternative to conventional surgical therapy because it is noninvasive, with a high safety profile, and is organ preserving. Numerous reports have confirmed the safety and

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efficacy of this procedure.^[4-6] Although MRgHIFU offers better imaging and temperature monitoring of the target area, the treatment time is much longer and more expensive. USgHIFU is a local thermal ablation technique that destroys tumors by thermal cavitation through the absorption of ultrasound energy generated by an extracorporeal ultrasound transducer. The entire procedure is guided live with simultaneous two-dimensional ultrasound ensuring treatment accuracy and safety. The ultrasound beams safely penetrate the body's tissues and are focused onto a targeted spot in the tumor to induce a higher temperature (60°C–95°C). This high temperature will induce coagulative necrosis and cavitation to a target tumor while leaving surrounding tissues intact and unharmed. It is a noninvasive treatment that requires no wound and can be performed in one setting under analgesia and sedation as a day procedure.

After HIFU treatment, the reproductive or menstrual function is maintained, and symptoms are expected to improve. Side effects of skin burns and thermal injury to adjacent organs are uncommon. However, patients might experience minor sacrococcygeal pain and radiating pain to the lower limbs during the treatment procedure.^[6,7]

To explore what advantages USgHIFU can offer the modern-day clinicians in managing the most challenging gynecological problems, a group of Hong Kong doctors [Figure 1] started the journey from April 2019 to June 2019 to have their HIFU ablation training firstly at Chongqing HAIFU Medical Technology Company Ltd in Chongqing followed by hands-on experience in the actual treatment of cases at the HIFU center at Suining City Central Hospital in Suining, China. Each training course was designed over a week.

The Chongqing HAIFU Medical Technology Company Ltd is where the uHIFU ablation machine is invented and built. It is the international HIFU ablation training center for various solid tumors, including pancreatic cancer, liver cancer, kidney

cancer, and bone cancer. From the Chongqing HIFU training center, we learned the basic knowledge of HIFU ablation and simulation treatment with a JC200 model machine. After 2 days of basic training, we traveled 100 km to Suining where the Suining City Central Hospital HIFU Centre was located. The center has performed over 1000 HIFU ablations per year for fibroids, adenomyosis, and other gynecological diseases. At present, Suining City Central Hospital has the highest number of HIFU ablation surgeries in a single-center globally. For another 3 days, we received intensive hands-on training on actual patients and cases. There are two HIFU tumor therapeutic systems – a JC model and another JC200 system (from the Chongqing Haifu Medical Technology Inc. Ltd). More than six patients per day are treated with HIFU ablation. Each doctor would learn up to 5–6 cases with hands-on training during the period of training

HIGH-INTENSITY FOCUSED ULTRASOUND ABLATION PROCEDURE

HIFU is a local thermal ablation technique that destroys tumors by thermal cavitation through the absorption of ultrasound energy generated by an extracorporeal ultrasound transducer. The ultrasound beams penetrate the body's tissues and are focused on the tumor to induce coagulative necrosis. The mechanism of treatment has been fully described in the literature.^[8] There are now many gynecological disorders that can be successfully treated by HIFU ablation. To better understand HIFU ablation applications, we presented what we learned at Suining City Central Hospital as follows.

UTERINE FIBROIDS

HIFU ablation can be applied to fibroid of any size provided it was visualized under the ultrasound guidance during treatment. Up to 90% of these fibroids can be effectively ablated as assessed by the nonperfusion volume (NPV) in each tumor by enhanced ultrasound imaging or postoperative MRI imaging. NPV ratio is the percentage of the NPV after treatment compared to the whole fibroid volume. In experienced hands, a 5 cm fibroid will need 30–40 min ablation time to achieve an 85%–90% ablation, and it may take longer for larger fibroids >10 cm, up to 2–2.5 h.

For multiple fibroids, the ablation technique is the same. There is no limit to the number of fibroids for HIFU treatment. However, some highly vascular fibroids or multiple fibroids will take a longer time to perform, and the recurrence rate may be higher. The general approach is to treat posterior fibroids first, then the anterior fibroids in a caudal to cephalad direction. Usually, to avoid injury by heat diffusion and spread to the bladder, bowel, or the endometrium, the ablation target point is 10–15 mm away



Figure 1: Training and practice for high-intensity focused ultrasound ablation treatment by a group of Hong Kong gynecologists at Chongqing, China

from the uterine serosa or the endometrium. Ablation is achieved when ultrasound gray scale can be observed during the procedure. SonoVue, an ultrasound contrast enhancer (25 mg SonoVue, Bracco, Milan, Italy), is used to monitor ablation's total areas after completing HIFU treatment. SonoVue is given before and after the ablation procedure for comparison to assess the NPV after treatment. On completion of fibroid ablation and following SonoVue injection, ultrasound images demonstrate the absence or much diminished vascular perfusion in the ablated fibroid [Figure 2]. The procedure is then deemed to be completed, and the patient is allowed to recover from the sedation.

ADENOMYOSIS

HIFU is increasingly used to treat adenomyosis to relieve its symptoms of menorrhagia, dysmenorrhea, and subfertility. The ablation treatment is similar to that of uterine fibroid. However, due to the lack of a pseudocapsule, the ablation energy and ablation areas need to be reduced to avoid tissue damage outside the uterus. Many patients with adenomyosis are also younger, sometimes with fertility problems; therefore, the sonication dosage and target areas must be carefully monitored during treatment. During or soon after HIFU ablation, patients may experience more pain and discomfort than those with ablated fibroids. Analgesics after HIFU ablation are required. Postoperative GnRha treatment may be selectively given for 3 months to improve symptoms and reduce symptoms' recurrence

PLACENTA ACCRETA

This condition is associated with catastrophic postpartum hemorrhage and often ending with hysterectomy when surgical intervention is required to remove the retained placenta after delivery. Nowadays, HIFU has been

successfully used to ablate the placenta accreta, followed by easy manual removal of the placenta without the risk of significant hemorrhage.^[9] The complications of heavy bleeding, blood transfusion, infection, and hysterectomy can thus be avoided, with the uterus preserved.

ABDOMINAL WALL ENDOMETRIOSIS

HIFU is used to ablate abdominal wall endometriosis for those patients who do not want to have open surgery to remove it.^[10,11] Upon identifying the abdominal lesion, the ablation point is targeted at the center of the tumor, at a low-energy power (150 W–200W) ablation and up to 150–300 ablation seconds. The duration of treatment will depend on the size and position of the lesion. The endometriosis lesion can then be reabsorbed over a few weeks without recurrent pain symptoms.

CESAREAN SCAR PREGNANCY

This increasingly common gynecological condition results from the pregnancy sac's implantation at the uterus's previous cesarean scar. Routine surgical removal can end with massive intraoperative bleeding and a risk of hysterectomy. HIFU ablation can now be used to ablate the pregnancy sac with coagulative necrosis of the implanting villi, thus reducing the risk of heavy bleeding during curettage to remove the pregnancy.^[12,13] A low-energy dose is used for this condition, and the result is very satisfactory without a wound or other complications such as infection, bleeding, or pain.

THE HIGH-INTENSITY FOCUSED ULTRASOUND SERVICES IN HONG KONG

After completing our training, the authors were able to apply the technique learned in China to establish an outpatient USgHIFU service in a business district – the Central in Hong Kong, starting. The clinic facilities and theater requirements for a day-only surgery center for HIFU ablation services in Hong Kong had been reported previously.^[14] From October 2019 to December 2020, we had treated 147 patients with 85 fibroids, 51 adenomyosis, and 11 combined fibroids and adenomyosis successfully as a day-surgery procedure. Of all the 147 patients, we only encountered three mild postoperative complications such as skin burn, back pain, and temporary sciatic nerve impairment. They all recovered well with conservative management without medication. The patients' information will not be elaborated because it is not in the scope of this paper. We would point out that HIFU ablation is an alternative to perform and replace the major surgeries, including myomectomy and adenomyomectomy, as an outpatient procedure. All patients were treated as day-surgery patients and could be discharged home 2–4 h after HIFU ablation treatment.

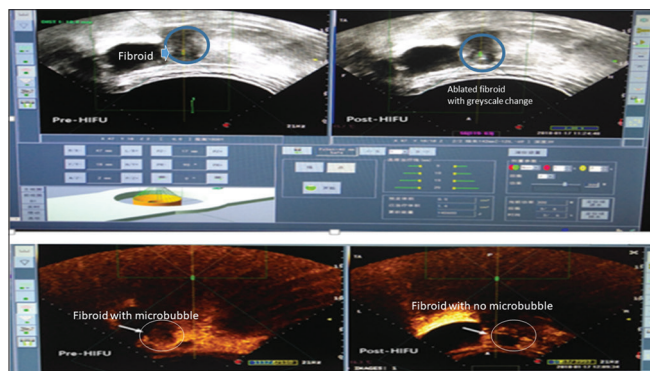


Figure 2: (Upper pictures) Ultrasound images of fibroid pre and post high-intensity focused ultrasound ablation. (Lower pictures) Infusion of intravenous SonoVue, an ultrasound enhancer, showed perfusion pre high-intensity focused ultrasound and revealed an avascular area in the fibroid post high-intensity focused ultrasound ablation

Although the available evidence in the literature for the long-term efficacy of HIFU treatment is not robust, the opportunity and application of this new therapy should be explored in-depth as an alternative treatment for fibroids and adenomyosis. Many patients do not wish to have operative surgery, and present surgical management options for adenomyosis, large fibroid, and multiple fibroids are not entirely acceptable to some patients. Worse still, some may lose their uterus because of the need for a hysterectomy. HIFU ablation for fibroids and adenomyosis, with its favorable results, is certainly an alternative treatment accepted by many patients. It also has only minor complications such as operative or postoperative pain, skin burn, or bleeding; in our clinic, we did not encounter any major morbidity associated with our experience with USgHIFU in Hong Kong. Our experience was shared with that reported by Liu *et al.*^[15] They showed that HIFU was as efficient as laparoscopic myomectomy with fewer adverse effects and complications, shorter hospital stays, and quicker postoperative recovery in the treatment of uterine fibroids. The IDEAL study,^[16] which included 20 centers and 2411 Chinese women in a nonrandomized controlled prospective study, evaluated the clinical outcomes of HIFU compared to surgery for uterine fibroid treatment. The committee reported that HIFU caused less morbidity than surgery with similar QoL.

CONCLUSION

Gynecology is an ever-changing, evolving, challenging field with newer devices demanding new skills in new procedures like HIFU. We found that our trips to China helped advance our skills in managing fibroids, adenomyosis, and other gynecological diseases. We learned a new treatment technology, quite different from conventional surgery. Different treatment guidelines and protocols enable us to intensively and effectively learn HIFU treatment skills and make it practical to apply HIFU treatment to our patients with safety. This noninvasive HIFU treatment is now undergoing rapid development with increasing indications for its applications. The novel HIFU ablation treatment is an exciting and extraordinary journey we have embarked on and will certainly lead to further HIFU research, treatment, and improvement in the gynecological practice in Hong Kong. Under the leadership of APAGE, Hong Kong will be an overseas training center, together with centers in Singapore and Taiwan, to provide training for overseas doctors.

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Conflicts of interest

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REFERENCES

1. Kameda S, Toyoshima M, Tanaka K, Fujii O, Iida SI, Yaegashi N, *et al.* Utility of laparoscopic uterine myomectomy as a treatment for infertility with no obvious cause except for uterine fibroids. *Gynecol Minim Invasive Ther* 2018;7:152-5.
2. Sleiman Z, Baba RE, Garzon S, Khazaka A. The significant risk factors of intra-operative hemorrhage during laparoscopic myomectomy: A systematic review. *Gynecol Minim Invasive Ther* 2020;9:6-12.
3. Ukybassova T, Terzic M, Dotlic J, Imankulova B, Terzic S, Shauyen F, *et al.* Evaluation of uterine artery embolization on myoma shrinkage: Results from a large cohort analysis. *Gynecol Minim Invasive Ther* 2019;8:165-71.
4. Chen J, Chen W, Zhang L, Li K, Peng S, He M, *et al.* Safety of ultrasound-guided ultrasound ablation for uterine fibroids and adenomyosis: A review of 9988 cases. *Ultrason Sonochem* 2015;27:671-6.
5. Liu Y, Zhang WW, He M, Gong C, Xie B, Wen X, *et al.* Adverse effect analysis of high-intensity focused ultrasound in the treatment of benign uterine diseases. *Int J Hyperthermia* 2018;35:1-6.
6. Zhang L, Zhang W, Orsi F, Chen W, Wang Z. Ultrasound-guided high intensity focused ultrasound for the treatment of gynaecological diseases: A review of safety and efficacy. *Int J Hyperthermia* 2015;31:280-4.
7. Orsi F, Arnone P, Chen W, Zhang L. High intensity focused ultrasound ablation: A new therapeutic option for solid tumors. *J Cancer Res Ther* 2010;6:414-20.
8. Marinova M, Rauch M, Schild HH, Strunk HM. Novel non-invasive treatment with High-intensity Focused Ultrasound (HIFU). *Ultraschall Med* 2016;37:46-55.
9. Ye M, Yin Z, Xue M, Deng X. High-intensity focused ultrasound combined with hysteroscopic resection for the treatment of placenta accreta. *BJOG* 2017;124:71-7.
10. Luo S, Zhang C, Huang J, Huang G, He J. Ultrasound-guided high-intensity focused ultrasound treatment for abdominal wall endometriosis: A retrospective study. *BJOG* 2017;124:59-63.
11. Zhu X, Chen L, Deng X, Xiao S, Ye M, Xue M. A comparison between high-intensity focused ultrasound and surgical treatment for the management of abdominal wall endometriosis. *BJOG* 2017;124:53-8.
12. Xiao J, Zhang S, Wang F, Wang Y, Shi Z, Zhou X, *et al.* Cesarean scar pregnancy: noninvasive and effective treatment with high-intensity focused ultrasound. *American journal of obstetrics and gynecology*. 2014;211:356.e1-7.
13. Zhu X, Deng X, Wan Y, Xiao S, Huang J, Zhang L, *et al.* High-intensity focused ultrasound combined with suction curettage for the treatment of cesarean scar pregnancy. *Medicine (Baltimore)* 2015;94:e854.
14. Zhang L, Wong FW. A high-intensity focused ultrasound surgery theater design in a private clinic. *Gynecol Minim Invasive Ther* 2020;9:1-5.
15. Liu Y, Ran W, Shen Y, Feng W, Yi J. High-intensity focused ultrasound and laparoscopic myomectomy in the treatment of uterine fibroids: A comparative study. *BJOG* 2017;124:36-9.
16. Chen J, Li Y, Wang Z, McCulloch P, Hu L, Chen W, *et al.* Evaluation of high-intensity focused ultrasound ablation for uterine fibroids: An IDEAL prospective exploration study. *BJOG* 2018;125:354-64.