

# A Study on the Therapeutic Effect of Intrauterine Microwave Irradiation for Dysfunctional Uterine Bleeding

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**Summary:** The present study was undertaken to determine the efficacy of intrauterine microwave irradiation of optimal dose in the treatment of dysfunctional uterine bleeding. Serial *in vitro* and *in vivo* tests were performed on the uteri of patients with leiomyoma to optimize the dosage of irradiation so as to destroy the functional lamina of endometrium. Microwave irradiation producing a field temperature of 60°C for 5 min was tried on 109 patients with dysfunctional uterine bleeding. Hemostasis was achieved 17.92 ± 8.9 h after irradiation. In 96.33% of the patients, the menstrual flow was reduced by 2/3 in 3 months of follow-up. As compared with the conventional hormonal treatment, the intrauterine microwave irradiation is superior both in short-term hemostatic effect and in long-term regulation of the amount of menstrual flow.

Dysfunctional uterine bleeding is a common and frequently-occurring disease. It usually affects women's health physically and mentally. Although the conventional medical treatment and/or hysterectomy are still practiced, they are not as satisfactory (Scommegna 1973, Wang 1978, 1981). For the former is slow in effect and is often accompanied by varied degrees of side effects, while the latter may leave the patient a psychophysical wreck besides an economic burden. In the search for a new therapy for the disease, we have proceeded from serial animal experiments (Li 1994, Wang 1994, Sun 1993) to the trial on human beings by using intrauterine microwave irradiation to destroy the endometrium under an optimized temperature. The results of our preliminary study are as follows.

## Materials and Methods

### A. Optimal Dosage of microwave Irradiation

1. Instrument. The instrument was administered inside the uterine cavity by using Type GZY-I Multifunctional Therapeutic Apparatus for Abnormal Heavy Period (developed by Confort Electronic Medical Instruments, Ltd., Xuzhou, China). The power of microwave generated can be adjusted continuously and displayed in digits to show the real-time temperature of the mi-

crowave field in the uterus. This temperature serves as an arbitrary indicator telling the dose of microwave administered and guides the operator to manipulate the machine.

### 2. Test Subjects and Methods

For *in vitro* tests, 35 freshly resected uteri from patients with leiomyoma were immediately irradiated by putting the microwave radiator in the uterine cavity for 5 min in each specimen. The temperature was set from 40°C to 74°C, with an increment of 1 degree each for the next specimen. The irradiated specimens were fixed and sectioned routinely for light microscopic examination. *In vivo* tests were carried out in 34 volunteer patients with uterine leiomyoma, who underwent intrauterine microwave irradiation 3 days prior to the scheduled hysterectomy. The range of preset temperature was from 45°C to 68°C and the length of irradiation was 5 min too. One case for one temperature scale, except that 3 of them were assigned for the same temperature of 62°C. The uteri surgically removed afterwards were treated routinely for histopathology. The pathological findings were described by comparing them with those of the unirradiated controls.

## B. Experimental Microwave Therapy

### 1. Selection of Patients

The test group consisted of 109 in-or out-patients with dysfunctional uterine bleeding treated in Xuzhou Hospital, Dept. of Obs. & Gyn.. They all had borne children, had no desire for more children and agreed to receive the microwave therapy. The control group consisted of 86 acute cases treated with conventional hormonal drugs.

### 2. Procedures and Precautions of Microwave Irradiation

The vulva, vagina and uterine cervix were disinfected routinely and the radiator was introduced into the uterine cavity. The machine was then set on. When the displayed intrauterine field temperature reached 60°C, it was maintained for 5 min to complete the treatment. Liver and renal function tests and blood routine should be performed before and after irradiation. If the procedure was carried out during an episode of bleeding, oral antibiotics should be given for 3 days to prevent infection.

### 3. Regime of Hormonal Therapy

The acute bleeding of the control patients was first treated with estradiol benzoate 4mg im b.i.d., and the result was taken as a criterion to assess the short-term efficacy of microwave therapy. After that, the menstrual function was regulated by giving sequential estrogen-progesterone treatment P.O.

## Results

### A. The Heat Effects of Microwave Irradiation on Endometrium

#### 1. In Vitro Experiment

When the temperature was increased from 47°C to 56°C, the superficial part of the endometrium in the freshly removed uterus presented dilatation of small blood vessels, decreased density of interstitium and pale staining of glandular epithelial cytoplasm. At 57-63°C, the superficial 2/3 (the functional lamina) of endometrium displayed increasing karyopyknosis, focal

Therapeutic effect of intrauterine microwave irradiation

coagulative necrosis and petechial and small focal hemorrhages. At 64-70°C, more extensive haemorrhage and coagulative necrosis were seen in the whole thickness of the endometrium. Over 70°C, the degenerative and necrotic changes involved the basal lamina and the muscular layer as well.

#### 2. In Vivo Experiment

When the temperature produced by preoperative irradiation in vivo was 54-61°C, the endometrial injuries were similar to those observed in vitro at 57-63°C. The necrotic changes were similar, but the haemorrhage was more marked and the necrotic foci were surrounded by inflammatory cell infiltration, mainly of neutrophils. In one of the 3 cases treated at 62°C, the degenerative and necrotic changes were rather extensive and involved the basal lamina. When the temperature was elevated to 66°C, obvious karyopyknosis, karyorrhexis and small necrotic foci infiltrated by inflammatory cells appeared in the basal lamina. Above 66°C, haemorrhage and focal coagulative necrosis began to appear in the muscular layer.

These data indicated that 60°C 5 min would be rational dose of microwave irradiation for stripping the diseased bleeding functional lamina to achieve a cure of the dysfunctional menorrhagia.

### B. Effectiveness of Microwave Therapy

1. Short-term Effects: The effect expressed in terms of hemostatic time after irradiation was  $17.92 \pm 8.9$  h in the 73 acute cases from the test group (n=109). While in the control group, where the 86 acute cases were treated with estradiol I.M., the hemostatic time averaged  $79.32 \pm 37.6$  h ( $x \pm S$ ,  $t=13.644$ ,  $P<0.001$ ).

#### 2. Long-term Effects:

The reduction of flow by 1/2 was considered to be 'effective', and 2/3, 'very effective'. Eight month followup revealed the microwave therapy was 100% effective and 96.33% very effective in the test group, while the hormonal therapy in the control group was 44.19%

effective and 17.44% very effective ( $\chi^2=80.7024$ , and 126.3989,  $P<0.001$ ). The differences in efficacy between the 2 groups were very significant.

There were 4 patients in the test group whose flow was reduced only by  $\frac{1}{2}$  after irradiation. Two months later, the procedure was repeated and a satisfactory result was achieved, with the copious flow reduced by more than  $\frac{2}{3}$ .

Another 7 patients in the test group suffered from serious menorrhagia and totally irregular menstruation. Microwave irradiation was very effective to them, with the amount of flow reduced by more than  $\frac{2}{3}$ , but their vaginal blood dripping was left unchecked. These patients were then put on sequential estrogen-progesterone treatment and the dripping was checked.

No cases of intrauterine adhesion were observed in the 8 months of follow-up.

3. Laboratory Examinations Blood routine revealed that Hb increased from  $74.63 \pm 13.27$  g/L before to  $98.32 \pm 14.68$  g/L 1 month after irradiation ( $x \pm S$ ,  $t=12.4987$ ,  $P<0.001$ ). WBC count was  $(7.432 \pm 1.126) \times 10^9/L$  before and  $(7.284 \pm 1.219) \times 10^9/L$  after irradiation ( $x \pm S$ ,  $t=0.9314$ ,  $P>0.05$ ), showing no significant changes. The results of liver and kidney function tests summarized in the following table showed no significant changes resulted from irradiation.

#### 4. Side Effects and Complications

Distending discomfort in the lower abdomen was reported in 58 cases (55.36%) and medium to severe

lower abdominal pain occurred in 11 cases (10.09%) after irradiation, which lasted for 24 h at most and could be alleviated by dolantin 50 mg I.M. Vaginal discharge increased after irradiation, which looked like egg white, had no bad odor and stopped in about 10 days. Menopause occurred in three of the irradiated patients (2.75%).

### Discussion

Dysfunctional uterine bleeding is a form of abnormal menstruation manifested by profuse uterine bleeding as a result of endocrinal disorder. Internal and external factors, such as mental stress, environmental and climatic changes, malnutrition and metabolic disorders, may specially cause dysfunction of the ovaries, which in turn influences the endometrium and induces the uterine bleeding through the reciprocal mechanism of cerebral cortex hypothalamo-pituitary ovarian axis. However, a unanimous agreement is still wanting to explain how ovarian dysfunction results in uterine bleeding.

The medical therapy for dysfunctional uterine bleeding is acceptable only when the patient is in her adolescence or child-bearing period and the ovarian function is growing or stabilized. But it can do little in elderly patients at menopausal age with the ovarian functions declining. Thus many patients have to resort to hysterectomy at the expense of a big physical loss and economic burden.

It is known that the periodical changes in the endometrium in dysfunctional bleeding are basically the same as that in

**Table**  
**The result of liver and kidney function tests before and 72 h after irradiation**

Test	Before	After	t	p
Total bilirubin (m mol/L)	$9.48 \pm 1.03$	$9.89 \pm 2.10$	1.8304	>0.05
Total protein (g/L)	$68.74 \pm 10.17$	$66.14 \pm 9.67$	1.9344	>0.05
Serum albumin (g/L)	$37.71 \pm 6.98$	$36.45 \pm 7.61$	1.2739	>0.05
Urea nitrogen (m mol/L)	$5.46 \pm 1.03$	$5.23 \pm 1.84$	1.1392	>0.05
Creatinine (m mol/L)	$92.86 \pm 12.19$	$89.63 \pm 13.21$	1.9779	>0.05

a normal menstrual period, i.e. cyclic bleeding resulted from necrosis and stripping of the functional lamina followed by endometrial regeneration from the intact basal lamina. In the present experiment, the microwave generated by the machine forms a 'field', radiating heat, elevating the intrauterine temperature and destroying the endometrium in a controlled manner. The special design of the machine helps adjust the dosage of irradiation to keep the thermoeffect limited in the functional lamina with the basal lamina and muscular layer not injured. The in vivo study showed that 57°C-61°C 5 min would be a feasible dosage to destroy and peel off the diseased functional lamina to achieve a cure. In our present trial on 109 patients, a microwave field temperature of 60°C was set as the dose of irradiation and the therapeutic effects obtained were quite satisfactory.

Microwave therapy is a purely physical means. Unlike the medical treatment, it does not interfere with the patient's endocrine mechanisms. As the thermoeffect is localized in the uterine cavity, it can be practiced safely, causing no undesired injuries to the patient. The procedure is simple and painless, for the radiator is a small device (4 mm in calibre), and can be easily introduced into the uterus without dilating the cervix. The advanced thermocontrol system enables the operator to adjust the temperature at will so as to quantitatively destroy the endometrium and control the bleeding. The microwave therapy is excellent for patients with profuse menstrual

Therapeutic effect of intrauterine microwave irradiation flow but relatively normal regular periods. For the refractory patients who have failed in various conservative treatments, microwave irradiation can still induce an artificial amenorrhoea to suspend the bleeding without undergoing the surgery of hysterectomy. However, intrauterine microwave irradiation is not effective in patients with vaginal blood dripping, irregular periods but normal menstrual flow to which further study and improvement of the therapy are needed.

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