

## Retrospective Cohort Study

## Effectiveness of treating menorrhagia using microwave endometrial ablation at a frequency of 2.45 GHz

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**Abstract****BACKGROUND**

Microwave endometrial ablation (MEA) is a minimally invasive treatment for menorrhagia. It has been covered by the national insurance in Japan since April 2012, and its demand has been increasing as the importance of women's health has advanced in society.

**AIM**

To examine the efficacy of MEA as a treatment option for menorrhagia.

**METHODS**

In this study, we retrospectively analyzed 76 patients who underwent MEA between January 2016 and March 2020 in our department. MEA was performed in the lithotomy position, under general anesthesia, and with transabdominal ultrasound guidance, including the entire endometrial circumference while confirming endometrial coagulation. The Microtaze AFM-712 and the Sounding Applicator CSA-40CBL-1006200C were used for MEA, and the endometrium was ablated using a Microtaze output of 70 W and coagulation energization time of 50 s per cycle. The visual analog scale (VAS) was used to evaluate menorrhagia, menstrual pain, and treatment satisfaction. Additionally, the hemoglobin (Hb) levels before and after MEA and associated complications were investigated.

**RESULTS**

The average age of the patients was  $44.8 \pm 4.0$  years. While 14 patients had functional menorrhagia, 62 had organic menorrhagia, of whom 14 had endometrial polyps, 40 had uterine fibroids, and 8 had adenomyosis. The VAS score before MEA and 3 and 6 mo after the procedure were 10,  $1.3 \pm 1.3$ , and  $1.3 \pm 1.3$ , respectively, for menorrhagia and 10,  $1.3 \pm 1.8$ , and  $1.3 \pm 1.8$ , respectively, for

menstrual pain, both showing improvements ( $P < 0.001$ ). The MEA Hb level significantly improved from  $9.2 \pm 4.2$  g/dL before MEA to  $13.4 \pm 1.2$  g/dL after MEA ( $P = 0.003$ ). Treatment satisfaction was high, with a VAS score of  $9.6 \pm 0.7$ . Endometritis was observed in one patient after surgery and was treated with antibiotics.

## CONCLUSION

MEA is a safe and effective treatment for menorrhagia.

**Key Words:** Menorrhagia; Visual analog scale; Dysmenorrhea; Endometrial ablation techniques; Microwaves; Leiomyoma; Adenomyosis

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**Core Tip:** In the short-term follow-up after microwave endometrial ablation (MEA), we were able to confirm the efficacy and safety of MEA not only in functional hypermenorrhea but also in hypermenorrhea with organic causes. MEA could be a useful option for the treatment of menorrhagia in patients who are at high risk for hysterectomy due to complications or comorbidities, or who desire minimally invasive surgery.

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## INTRODUCTION

Menorrhagia is characterized by heavy menstrual bleeding, severe anemia, and decreased quality of life (QoL). As a result, it has become a significant factor limiting social activities in women. Although hemostatic or hormonal agents are often the first treatment for menorrhagia, hysterectomy is chosen as the curative option when conservative treatments are ineffective or when the patient has no desire to bear children. However, some patients require less invasive treatments due to pre-existing conditions, complications, and social backgrounds[1]. Microwave endometrial ablation (MEA) at a frequency of 2.45 GHz is a minimally invasive treatment that can be used instead of conventional hysterectomy. Since April 2012, MEA has been covered by insurance in Japan. It has gradually become a widely used treatment for functional menorrhagia that is caused by a systemic disease or medication and resistant to conservative treatments, as well as organic menorrhagia caused by uterine fibroids and adenomyosis. MEA breaks down the endometrium, including the basal layer, using a protein coagulation device that utilizes dielectric heat generated by microwaves[2]. Thus, MEA reduces menstrual bleeding or induces amenorrhea by impairing the function of the endometrium.

MEA was introduced as a treatment option for menorrhagia at our hospital in January 2016. This retrospective study aimed to clinically examine cases in which MEA was performed for menorrhagia at our hospital.

## MATERIALS AND METHODS

This study was approved by the Ethics Committee of the International University of Health and Welfare (approval number, 20-B-399; approval date, May 7, 2020). All patients provided written and verbal informed consent for study participation. We retrospectively examined 76 patients with the main complaint of menorrhagia who underwent MEA at our department between January 2016 and March 2020. In all cases, before MEA, cervical and endometrial cytodiagnosis and histodiagnosis were performed as needed to rule out malignant lesions. In addition, magnetic resonance imaging and hysteroscopy were performed to assess the thickness of the myometrium, as well as the shape and length of the uterine cavity to rule out organic diseases. Cervical dilatation was performed using a Lamicel osmotic dilator (Medtronic, Tokyo, Japan) the day before surgery. MEA was performed with the patient in the lithotomy position and under general anesthesia and transabdominal ultrasound guidance and was applied to the entire endometrial circumference while confirming endometrial coagulation. The Microtaze AFM-712 (Alfresa Pharma Co., Ltd., Osaka, Japan) and the Sounding Applicator CSA-40CBL-1006200C (Alfresa Pharma Co., Ltd.) were used for MEA, and the endometrium was ablated with an output of 70 W and coagulation energization time of 50 s per cycle. After MEA, the uterine cavity was observed with a hysteroscope to confirm coagulative necrosis of the endometrium and the lack of ablation in the internal ostium of the uterus or cervical mucosa.

The operative time, number of ablation sessions, length of hospital stay, amount of menstrual bleeding 3 and 6 mo after MEA, menstrual pain, and treatment satisfaction were evaluated using the visual analog scale (VAS). Furthermore, the incidence of amenorrhea, hemoglobin (Hb) levels before and after MEA, and complications from the procedure were examined.

Numerical data are shown as the mean  $\pm$  standard deviation. All statistical analyses were performed using JMPVR software, version 14.2 (SAS Institute Japan Ltd., Tokyo, Japan). One-way analysis of variance with repeated measures and paired *t*-tests were used for statistical analyses, and *P* values  $< 0.05$  were considered statistically significant (online resource).

## RESULTS

**Table 1** shows the characteristics of the 76 patients included in this study. The average age of the patients was  $44.8 \pm 4.0$  (range, 32-53) years. Fourteen patients had functional menorrhagia, whereas 62 had organic menorrhagia. Of the 62 patients with organic menorrhagia, 14 had endometrial polyps, 40 had uterine fibroids, and 8 had adenomyosis. Comorbidities included autoimmune disease in four patients, deep vein thrombosis in three, thyroid dysfunction in three, cerebral infarction in three, severe diabetes mellitus in two, and multiple sclerosis in one.

The mean time taken for the procedure was  $37.0 \pm 21.6$  min, and the mean number of ablation sessions was  $7.8 \pm 2.9$ . The patients stayed in the hospital for a mean of  $2.6 \pm 0.7$  d.

In all MEA cases, the preoperative VAS score for menstrual bleeding significantly improved from 10 to  $1.3 \pm 1.3$  and  $1.3 \pm 1.3$  at 3 and 6 mo after the procedure, respectively ( $P < 0.001$ ) (**Figure 1A**). In addition, we evaluated changes in menstrual bleeding following MEA in patients with menorrhagia caused by different conditions. The preoperative VAS score for menstrual bleeding was 10. At 3 and 6 mo after MEA, it decreased to  $1.8 \pm 1.6$  and  $1.1 \pm 1.2$ , respectively, in patients with functional menorrhagia;  $0.6 \pm 0.8$  and  $0.5 \pm 0.9$ , respectively, in patients with endometrial polyps;  $0.9 \pm 1.2$  and  $0.9 \pm 1.4$ , respectively, in patients with uterine fibroids; and  $1.9 \pm 1.3$  and  $2.2 \pm 1.5$ , respectively, in patients with adenomyosis. Therefore, regardless of the causative disease, a marked decrease in menstrual bleeding was observed compared with that of the early postoperative period ( $P < 0.001$ ) (**Figure 1B-E**).

As observed with menstrual bleeding, the preoperative VAS score for menstrual pain in all MEA cases decreased from 10 to  $1.3 \pm 1.8$  and  $1.3 \pm 1.8$  at 3 and 6 mo after the procedure, respectively, showing a significant improvement from the early postoperative period ( $P < 0.001$ ) (**Figure 2A**). We evaluated changes in menstrual pain following MEA based on the causative condition for menorrhagia. The preoperative VAS score for menstrual pain was 10. At 3 and 6 mo after the procedure, it dropped to  $0.9 \pm 1.7$  and  $0.5 \pm 1.1$ , respectively, in cases with functional menorrhagia;  $0.8 \pm 1.5$  and  $0.9 \pm 1.5$ , respectively, in cases with endometrial polyps;  $1.1 \pm 1.6$  and  $1.1 \pm 1.7$ , respectively, in patients with uterine fibroids; and  $1.8 \pm 2.3$  and  $1.9 \pm 2.5$ , respectively, in patients with adenomyosis. A significant improvement in menstrual pain was observed from the early postoperative stage, regardless of the causative disease ( $P < 0.001$ ) (**Figure 2B-E**).

**Figure 3** shows the changes in Hb levels following MEA. In all cases, the Hb levels before and after treatment were  $9.2 \pm 4.2$  g/dL and  $13.4 \pm 1.2$  g/dL, respectively, showing a significant improvement ( $P = 0.003$ ) (**Figure 3A**). Moreover, we studied the changes in Hb levels following MEA based on the different diseases underlying menorrhagia. The Hb levels before and after MEA treatment were  $9.2 \pm 2.7$  g/dL and  $13.8 \pm 1.3$  g/dL, respectively ( $P = 0.003$ ), in cases with functional menorrhagia;  $8.9 \pm 1.9$  g/dL and  $13.5 \pm 1.1$  g/dL, respectively ( $P < 0.001$ ), in cases with endometrial polyps;  $8.5 \pm 1.9$  g/dL and  $13.5 \pm 1.2$  g/dL, respectively ( $P < 0.001$ ), in cases with uterine fibroids; and  $9.1 \pm 2.6$  g/dL and  $12.3 \pm 1.3$  g/dL ( $P = 0.034$ ), respectively, in cases with adenomyosis. These findings show a significant increase in Hb levels after MEA, regardless of the causative disease (**Figure 3B-E**).

Patient satisfaction following MEA was high, with a VAS score of  $9.6 \pm 0.7$ . Twenty patients (26.3%) became amenorrheic by 6 mo after MEA. One patient (1.3%) who underwent MEA for menorrhagia caused by adenomyosis developed endometritis as a postoperative complication; however, this was alleviated by administering antibiotics alone. No other serious complications or recurrence of menorrhagia was observed during the postoperative follow-up period.

## DISCUSSION

Studies from outside Japan have reported that the incidence of menorrhagia in women of reproductive age is between 19% and 24% [3,4] and tends to increase with age. Therefore, menorrhagia should be managed to maintain the patient's lifestyle.

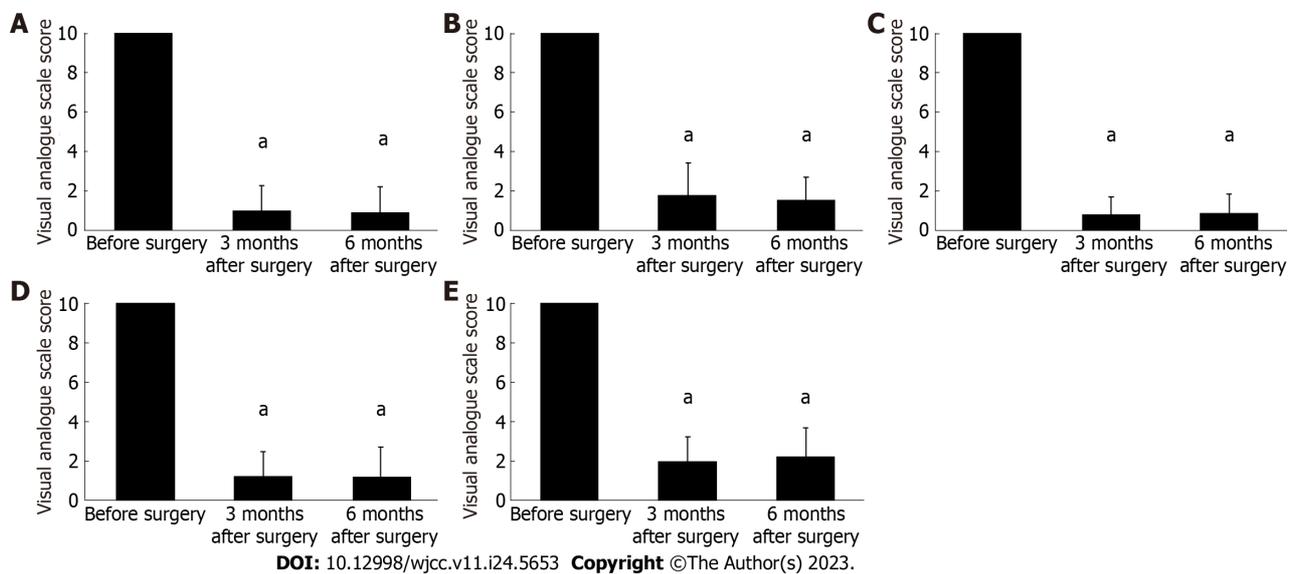
The first choice of management for menorrhagia is drug therapy, such as a combination of estrogen and progestin. However, it is not effective in some cases, and menorrhagia continues to interfere with work and daily life and significantly impairs the QoL of women. Although hysterectomy has been found to improve the symptoms of menorrhagia, it is an invasive procedure that is associated with serious complications, lengthy hospitalization, and leave of absence from work, all of which impose a heavy financial burden on patients. In addition, some patients decline hysterectomy despite not wanting to bear children, and the procedure has shown low postoperative patient satisfaction in many cases. Furthermore, with the recent remarkable advancement of women in society, the number of patients who desire a minimally invasive treatment with a short hospital stay has been increasing.

In Japan, along with the advancement of MEA, the levonorgestrel-releasing intrauterine system (LNG-IUS), developed in the mid-1990s, has been covered by insurance as a treatment for menorrhagia and menstrual pain since 2014, marking a significant change in the management of menorrhagia.

MEA breaks down the endometrium, including the basal layer, using a protein coagulation device that utilizes dielectric heat generated by microwaves [2]. Thus, MEA reduces menstrual bleeding or induces amenorrhea by impairing endometrial function. MEA has been covered by insurance in Japan as a minimally invasive treatment for menorrhagia since April 2012. It was introduced at our hospital in January 2016, and 76 patients have undergone MEA treatment as of

**Table 1 Patients' characteristics**

Age (yr)		44.8 ± 4.0
Cause of hypermenorrhea (Number of cases)	Functional excessive menstruation	14
	Endometrial polyps	14
	Uterine fibroids	40
	Adenomyosis	8
Comorbidities (Number of cases)	Autoimmune disease	4
	Deep vein thrombosis	3
	Thyroid dysfunction	3
	Cerebral infarction	3
	Severe diabetes mellitus	2
	Multiple sclerosis	1
		(n = 76)

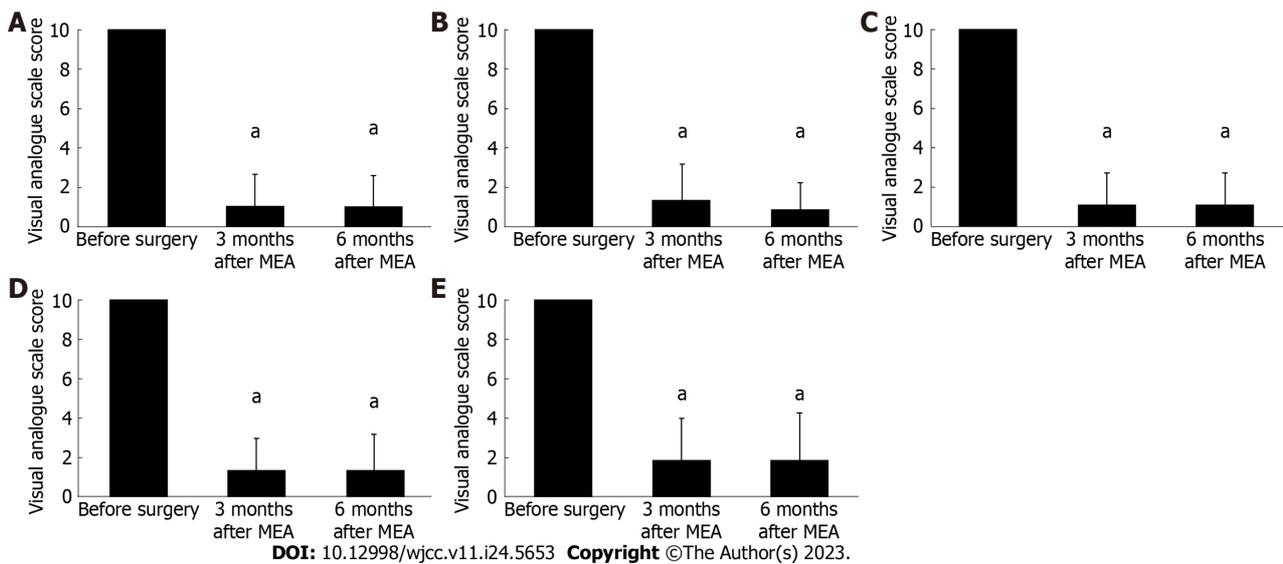


**Figure 1 Changes in visual analog scale score for menorrhagia following microwave endometrial ablation.** A: All cases; B: Those with functional menorrhagia; C: Those with endometrial polyps; D: Those with uterine fibroids; E: Those with adenomyosis. Values are expressed as the mean, with error bars representing the standard deviation. <sup>a</sup>Significantly different between before surgery and each group,  $P < 0.001$ .

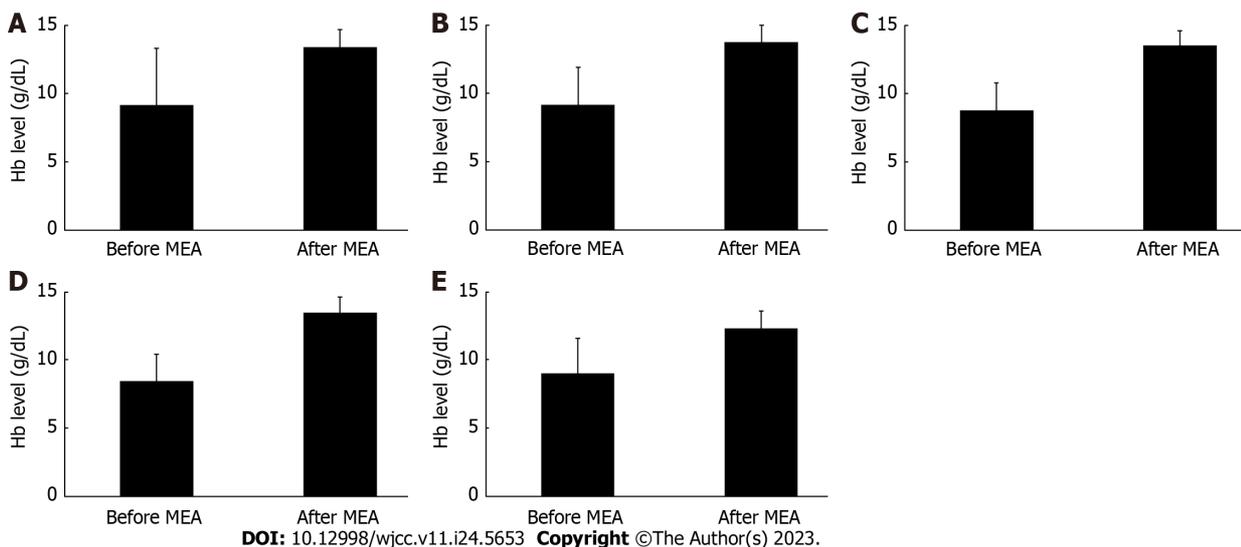
March 2020. Consistent with previous studies that have shown the therapeutic effects of MEA[5,6], our study demonstrated an improvement in menorrhagia from the early postoperative stage due to reduced menstrual bleeding, regardless of the cause of menorrhagia. In addition, MEA requires a short hospitalization duration, thereby sufficiently improving patient QoL. Our study included 16 cases of menorrhagia associated with comorbidities, for which the minimally invasive nature of MEA was particularly advantageous. Moreover, our study showed a significant increase in Hb levels after MEA, confirming its therapeutic effects on anemia associated with menorrhagia.

It has been reported that the LNG-IUS treatment, which is a minimally invasive drug therapy for menorrhagia, reduced menstrual bleeding by more than 50% compared with pretreatment levels in 84.8% of the cases and that the incidence of amenorrhea after the treatment was approximately 20%[6,7]. Our findings suggested that MEA is more effective than LNG-IUS, although our study was a subjective evaluation of menstrual bleeding, and these studies cannot be compared. However, from a long-term perspective, 42% of the patients switched from LNG-IUS to other treatments due to relapse of menorrhagia, whereas only 21% switched from MEA[8,9]. Therefore, MEA is believed to have more long-lasting effects on menorrhagia with a lower rate of recurrence.

Furthermore, MEA was initially not expected to improve menstrual pain, as it is not a treatment for dysmenorrhea; however, its effectiveness against menstrual pain has been reported[5,6]. In our study, MEA improved menstrual pain from the first postoperative menses. This is presumed to be a secondary effect due to the relief from uterine contractions accompanied by improved menorrhagia and reduced menstrual bleeding. Although the direct mechanism is unknown, MEA is presumed to be effective in improving menstrual pain associated with menorrhagia.



**Figure 2** Changes in visual analog scale score for dysmenorrhea following microwave endometrial ablation. A: All cases; B: Those with functional menorrhagia; C: Those with endometrial polyps; D: Those with uterine fibroids; E: Those with adenomyosis. Values are expressed as the mean, with error bars representing the standard deviation. \*Significantly different between before surgery and each group,  $P < 0.001$ .



**Figure 3** Comparison of blood hemoglobin levels before and after microwave endometrial ablation. A: All cases; B: Those with functional menorrhagia; C: Those with endometrial polyps; D: Those with uterine fibroids; E: Those with adenomyosis. Values are expressed as the means, with error bars representing the standard deviation. MEA: Microwave endometrial ablation.

Complications after MEA include thermal damage to the pelvic viscera, hydrometra due to cervical stenosis and ablation of endometrial tissue, hematometra, endometritis, ascending infection and pelvic inflammation, and pyometra [10]. In this study, only one patient (1.3%) had a postoperative endometrial infection, which was mild, as the condition was relieved by antibiotics alone. The origin of the infection, in this case, was believed to be an effusion from the ablated surface that lasted for several weeks after MEA, as well as necrotic tissue that remained in the postoperative uterus. However, we carefully removed as much accumulated necrotic tissue as possible by examining the endometrial status using hysteroscopy immediately after the MEA. In addition, the incidence of infection after hysteroscopic surgery is reported to be approximately 2% [11]. Thus, a comparable incidence of postoperative infection in our study indicates the safety of MEA.

MEA was associated with high patient satisfaction with a VAS score of  $9.6 \pm 0.7$ . Our treatment results showed that 20 patients (26.3%) had become amenorrheic, whereas the remaining continued to menstruate. It is presumed that women with menorrhagia desire to improve their QoL by reducing menstrual bleeding while preserving the uterus, even if they do not become amenorrheic. Further, the established safety of MEA contributed to high patient satisfaction.

This study demonstrated the efficacy of MEA in the management of menorrhagia and its high patient satisfaction rates regardless of the underlying etiology.

The current study results should be interpreted in the light of some limitations. First, our study only followed the patients for up to 6 mo. Second, although not observed in this study, ineffective and recurrent cases of organic menorrhagia, such as uterine fibroids and adenomyosis, have been occasionally seen in the medium- to long-term follow-up after MEA[12]. Therefore, future research should include longer follow-up and more cases to investigate the recurrence rate of menorrhagia, time until recurrence, and features of the cases prone to recurrence to evaluate all outcomes of MEA.

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## CONCLUSION

This short-term postoperative assessment of MEA confirmed its efficacy and safety not only for functional menorrhagia but also for menorrhagia with organic diseases. Our results suggest that MEA may be a useful therapeutic option for patients with menorrhagia who cannot undergo hysterectomy due to complications or pre-existing conditions or who desire a minimally invasive treatment.

## ARTICLE HIGHLIGHTS

### **Research background**

Microwave endometrial ablation (MEA) is a minimally invasive treatment for menorrhagia. It has been covered by the national insurance in Japan, and its demand has been increasing as the importance of women's health has advanced in society.

### **Research motivation**

MEA was introduced as a treatment option for menorrhagia at our hospital in January 2016.

### **Research objectives**

This retrospective study aimed to clinically examine cases in which MEA was performed for menorrhagia at our hospital.

### **Research methods**

We retrospectively analyzed 76 patients who underwent MEA between January 2016 and March 2020 in our department.

### **Research results**

The visual analog scale scores of menorrhagia and menstrual pain showed improvements after MEA. The hemoglobin levels significantly improved after MEA. Endometritis was observed in only one patient after surgery and was treated with antibiotics.

### **Research conclusions**

MEA is a safe and effective treatment for menorrhagia.

### **Research perspectives**

MEA could be a useful option for the treatment of menorrhagia in patients who are at high risk for hysterectomy due to complications or comorbidities, or who desire minimally invasive surgery.

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## FOOTNOTES

**Author contributions:** Kakinuma T contributed to conceptualization, methodology, software, validation, original draft preparation, manuscript review and editing, visualization, supervision, and project administration; all authors contributed to formal analysis, investigation, resources, and data curation; all authors have read and agreed to the published version of the manuscript.

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**Informed consent statement:** All patients provided written and verbal informed consent for study participation.

**Conflict-of-interest statement:** All the authors have no conflict of interest related to the manuscript.

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