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A new uterine endometrium preservation hysteroscopic myomectomy: Introduction of improved procedures and a retrospective analysis of 94 cases

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ABSTRACT

Objective: To reduce the damage of uterine endometrium caused during hysteroscopic myomectomy (HM) for reproductive aged patients, a new uterine endometrium preservation hysteroscopic myomectomy (UEP-HM) has been developed. In this study, we introduced this technique with comparing to the conventional hysteroscopic myomectomy (C-HM).

Study Design: The data from 94 patients aged 42 or younger who underwent HM (38 cases with UEP-HM and 56 cases with C-HM) for treating single Type 1 or Type 2 submucosal leiomyoma (SL) were analysed retrospectively for comparing the characteristics of both patient and target SL. In this process, we defined the operation time 60 min or over as the longtime operation (LTO) and the SM sized 3 cm or over as the large submucosal leiomyoma (LSL) for detecting the influential factors, including this procedure, on the difficulty of HM. For assisting the prediction of operation time (OT), we investigated the relationship between the OT and the cube of average diameter (AD) of target SL referring with some past reports.

Results: Although when comparing UEP and control groups, parity, AD, the number of patients with Type 2 SL, OT, and the number of infertile patients showed significant difference, in the multivariate analysis only LSL showed the significant influence on the possibility of LTO. Next, we compared OT/Cube of AD, which calculated by dividing OT by the cube of AD for evaluating OT from the target SL size and confirmed that there was no difference in those 2 groups (3.7 ± 3.0 (95 %CI: 0.9 - 13.3, $n = 38$) vs. 3.9 ± 3.2 (95 %CI: 0.4 - 17.3, $n = 56$), $p = 0.79$).

Conclusions: The new UEP-HM can become an alternative method of C-HM without procedure-specific difficulty. In the future, to investigate the prognosis of this procedure, more patients and further analyses should be accumulated.

Introduction

Hysteroscopic myomectomy (HM) can be relatively easily selected for patients with submucosal leiomyoma (SL) which causing abnormal uterine bleeding and heavy menstrual bleeding, because it is a minimally invasive procedure with little postoperative pain and a short recovery time without abdominal incisions [1,2]. And recently, in some of infertile patients, HM has been performed for treating the abnormality of uterine cavity and improving uterine endometrium situations [3,4], especially before embryo transfer [5]. However, when resecting relatively large Type 1 and Type 2 SLs, uterine endometrium is inevitably damaged to some extent and damaged endometrium can increase the risk of intrauterine adhesion [6,7]. Consequently, such situations may possibly lead to the delay of restarting infertility treatments and the decline of pregnancy outcomes [8]. Therefore, to minimize the damage of endometrium, we have improved HM with trying to preserve uterine endometrium as completely as possible. In this procedure, after cutting endometrium and myometrium minimally and detecting the boundary between normal myometrial layer of the uterus and leiomyoma, target SL is enucleated with preserving the pseudo capsule by using cold

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instruments like the other report [9,10]. On the other hand, this technique may also have several difficulties related to not only patient' characteristics but also the characteristics of target SL, including size, and degree of protrusion into the uterine cavity [11–13]. Here, we will introduce this new surgical procedure itself and its characteristics detected by statistical analyses of some cases in our hospital.

Methods

Data collection

Since the main target patients of this procedure is the relatively young reproductive aged patients who are expected to become pregnant after operation, the cases in this retrospective study were limited to the patients 42 years old or less. And since the majority of the target leiomyomas for the uterine endometrium preservation hysteroscopic myomectomy (UEP-HM) were the single Type 1 or Type 2 SLs of over 1 cm, we excluded the patients with G0 SLs (33 cases), multiple SLs (32 cases) and less than 1 cm SLs (2 cases). We also excluded the 2 cases in which this procedure could not be completed. Then this retrospective study included totally 94 patients who underwent HM to remove Type 1 or Type 2 SLs between January 2020 and December 2023, and among them, 38 patients were performed UEP-HM, and the other 56 patients with conventional hysteroscopic myomectomy (C-HM) were considered as the control group. The degree of protrusion from the endometrium was measured during an outpatient hysteroscopic examination. In this study, SLs were classified according to the European Society of Gynaecological Endoscopy Classification as Type 0 (no penetration into the intramural cavity), Type 1 (less than 50 % penetration) or Type 2 (greater than 50 % penetration) [14]. Although the accuracy may be slightly lower than that of previous reports [15,16], in our hospital, we classified SLs by simple use of transvaginal ultrasound and hysteroscopy during outpatient inspection. We collected the data as follows: 1) the outcomes taken during operation, including operation time (OT) and resected leiomyoma weight; 2) patient's characteristics, including age, body mass index (BMI), parity symptom; and 3) target leiomyoma's characteristics, including number and size preoperatively determined via transvaginal ultrasonography. Since we did not always used gonadotropin releasing hormone analogues, actually in 80 out of 94 cases the patients were administered before surgeries, we adopted the size of target submucosal leiomyoma measured the last before surgeries. The symptoms were classified to menstruation-related symptoms, including hypermenorrhoea, abnormal vaginal bleeding, anaemia, and so on, and infertility. Since the majority of 94 patients were nulliparous women (n = 62/94), we also collected the data about postoperative pregnancy and delivery, though the tracing of this data after surgeries was limited.

When considering about the size of target submucosal leiomyoma, the average diameter (AD) was calculated by the average of the 2 or 3 direction. All of the records about resected leiomyoma weight and postoperative pregnancy could not be collected. With referring to the past reports [17–19], in which the great correlation coefficient (R) between the leiomyoma weight and the cube of leiomyoma size was detected, after calculating the abovementioned target SL size, we analysed about not only OT itself but also the index (named OT/cube of AD) which calculated by dividing OT by the cube of AD.

Uterine endometrium preservation hysteroscopic myomectomy

Similar to the past report [17], all operations were performed exclusively by one physician (M. M.), who was a highly skilled specialist of hysteroscopy accredited Japan Society of Gynecologic and Obstetric Endoscopy and Minimally Invasive Surgery. Prior to surgery, two laminaria tents were administered for cervical dilatation on the day of or one day prior to surgery. After sufficient vaginal space was provided with self-retaining speculum and cervical dilatation was performed with a Hegar dilator, a 26-Fr monopolar resectoscope equipped with 24 Fr 90-degree U-shaped cutting loop for monopolar 26 Fr resectoscope (Karl Storz GmbH Co., Tuttlingen, Germany) was used. After performing minimal incision of the endometrium and myometrium horizontally, the boundary between the normal uterine myometrial layer and target leiomyoma is detected (Fig. 1-a). By putting cold instruments, including rectangular Mazzon's mechanical loop (KARL STORZ GmbH & Co., Tuttlingen, Germany) and de-energized U-shaped cutting loop, into this boundary, the part of target submucosal leiomyoma is enucleated with preserving the pseudo capsule to the normal uterine myometrial layer and shaved into pieces repeatedly to reduce its volume (Fig. 1-b). After removing target to some extent, these procedures are repeated from the beginning, including the peeling of the pseudo capsule from leiomyoma wall with cold instruments and the reduction of leiomyoma with loop electrodes (Fig. 1-c, d).

Statistical analyses

Statistical analyses were performed using Microsoft Excel (Microsoft Corporation, Redmond, WA) and JMP version 12 for Windows (SAS Institute Inc., Tokyo, Japan). The odds ratios (ORs) and 95 % confidence intervals (CIs) were estimated to determine the strength of these correlations. P values less than 0.05 were considered significant.

Results

Patient's characteristics

Among the 94 cases, the average age, BMI, parity, AD, resected leiomyoma weight and OT were 37.0 ± 4.2 (26−42) years, 23.0 ± 4.8 (14,5–44.5) kg/m^2, 0.5 ± 0.8 (0−3), 23.1 ± 8.7 (10.0–52.5) mm, 13.4 ± 18.0 (0.5–105.8) g and 35.0 ± 21.9 (4−126), respectively. And we also summarized the number of patients with each factor in Table 1.

When comparing UEP-HM and C-HM groups, parity, AD, resected leiomyoma weight, the number of Type 2 SL, OT, and the number of infertile patients showed significant difference. As expected, the main target patients of UEP-HM might be infertile nulliparous women. Although the data were limited and insufficient, 7 patients in the UEP-HM group and 2 patients in the C-HM group could become pregnant after operation in uterine endometrium preservation group (p = 0.016). Among these 9 patients, only 1 patient with UEP-HM was a multiparous woman. And we could track 3 delivery cases in UEP-HM group and 2 delivery cases in C-HM group. Additionally, since the index of OT/cube of AD was not significantly different, the level of difficulty may be similar in between the UEP-HM and C-HM groups.

Evaluation of impact of uterine endometrium preservation procedure on difficulty of hysteroscopic myomectomy

Refer to the aforementioned result about the average and standard deviation of OT in 94 cases, the 10 cases in which the operation time was 60 min or over were defined as longtime operation (LTO) for evaluating the difficult operation. The large submucosal leiomyoma (LSL) was also defined by 3 cm or over AD with referring to the average and standard deviation of AD in 94 cases and the past reports [17–19]. Then, for detecting the influence of uterine endometrium preservation procedure on the difficulty of HM without potential confounding factors, we performed the multivariate analysis about the possibility of LTO for comparing the influences of the three factors, including UEP-HM, Type 2 SL, and LSL. As a result, UEP-HM (OR=1.5, 95 %CI: 0.4–5.8, p = 0.99) and Type 2 SL (OR=1.4, 95 %CI: 0.4–5.4, p = 0.45) did not show the difference, though LSL showed the significant difference (OR=15.5, 95 %CI: 3.5–69.0, p < 0.01).

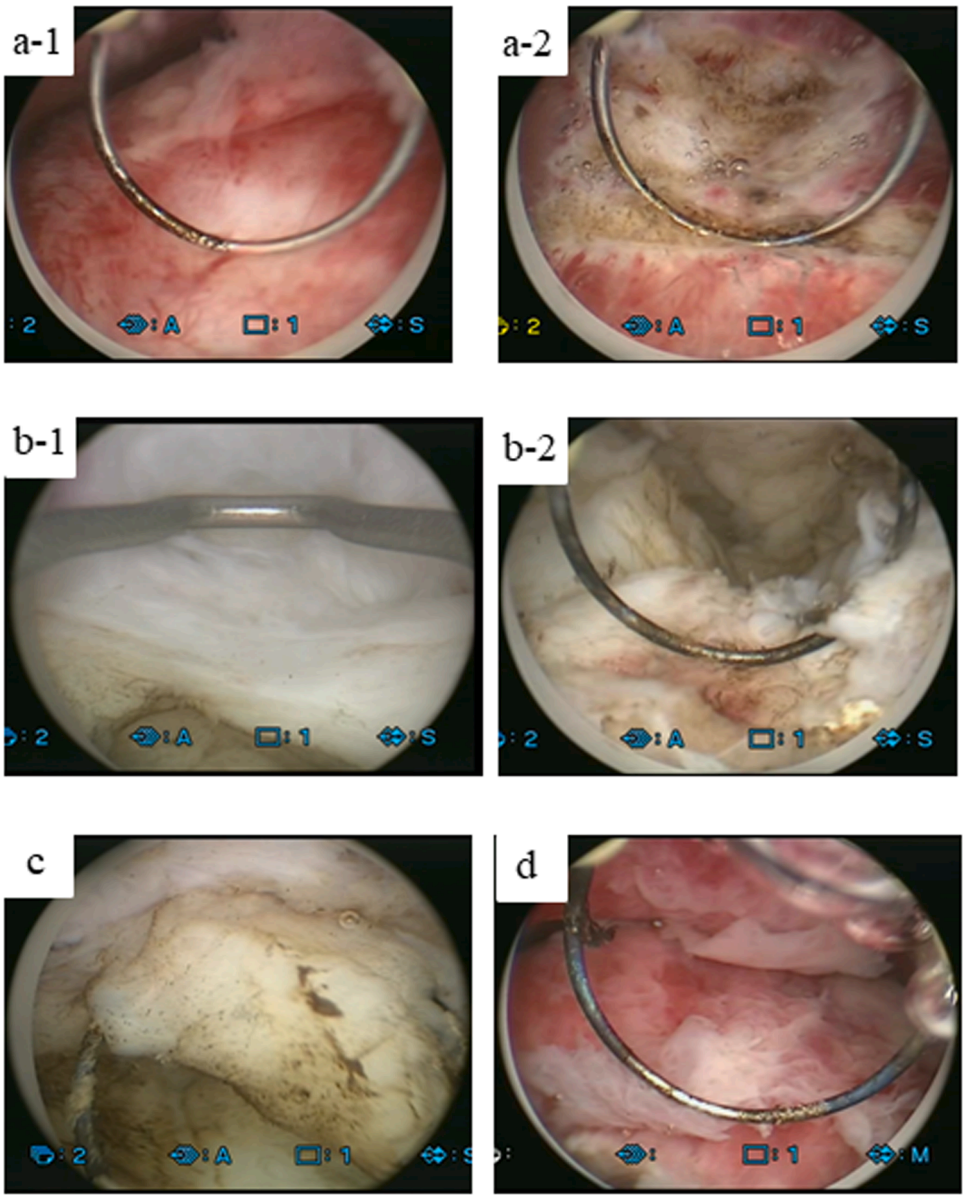

Fig. 1. UEP-HM procedure. This patient with uterine endometrium preservation hysteroscopic myomectomy was a nulliparous 32-year-old woman with the symptom of anaemia. The average diameter of target submucosal leiomyoma was 3.5 cm in the posterior wall of uterus, as detected by transvaginal ultrasound on outpatient inspection The operation time was 92 min, and the blood loss was very small. The weight of the leiomyoma was 32.3 g. (a) After inserting a 26-Fr monopolar resectoscope and detecting protuberance region of the uterine endometrium, minimal incision of the endometrium and myometrium was performed horizontally. (b) By putting cold instruments into the boundary between the normal uterine myometrial layer and target leiomyoma, the part of target submucosal leiomyoma is enucleated with preserving the pseudo capsule to the normal uterine myometrial layer (b-1: Mazzon's mechanical loop, b-2: 90-degree U-shaped cutting loop). (c) The target submucosal leiomyoma is shaved into pieces repeatedly to reduce its volume with loop electrodes. (d) After removing the target submucosal leiomyoma by repeating these procedures, the maintained uterine endometrium was confirmed.

Relationship between cube of AD and OT

Next, for evaluating OT from the target SL size with referring the past study [17], we set the original index, namely OT/Cube of AD calculated by dividing OT by the cube of AD. Then, the relationship between the cube of AD and OT was tried to be plotted in Fig. 2, because the correlation coefficient between the cube of AD and OT was sufficiently high in these 94 cases, namely 0.66. Totally, OT/Cube of AD was 3.8 ± 3.1 (95 %CI: 0.4 - 17.3, $n = 94$) and these indexes were not significantly different between the UEP-HM and C-HM groups (3.7 ± 3.0 (95 %CI: 0.9 - 13.3, $n = 38$) vs. 3.9 ± 3.2 (95 %CI: 0.4 - 17.3, $n = 56$), $p = 0.79$). And visually, the indexes were inversely related to each AD in both groups. After performing the overall analysis in the 94 cases, we focused on 18 cases with AD sized 3 cm or larger (9 cases in the UEP-HM group and 9 cases in the C-HM group), since the important classification about LSL in this study was 3 cm. Interestingly, OT/Cube of AD in the UEP-HM group was significantly higher than in the C-HM group (1.6 ± 0.5 vs. 1.0 ± 0.5, $P = 0.013$), though there was not different when AD was smaller than 3 cm (4.4 ± 3.3 vs. 4.3 ± 3.1, $P = 0.91$). The reason of this result was probably because the space for inserting the peeling and cutting device of hysteroscopy became relatively small when the target SL became large.

Ideally, the correlation coefficient between the resected leiomyoma weight and OT should be directly presented. Actually, though the data about the resected leiomyoma weight could be collected only in 59 cases, we could detect the strong correlation coefficient between the

Table 1
Patient characteristics.

	Total	UEP-HM	C-HM	P value
Age	37.0 ± 4.2 (26 - 42, n = 94)	36.8 ± 3.8 (28 - 42, n = 38)	37.2 ± 4.4 (26 - 42, n = 56)	0.66
BMI	23.0 ± 4.8 (14.5 - 44.5, n = 94)	22.4 ± 3.8 (14.5 - 32.9, n = 38)	23.4 ± 5.4 (17.3 - 44.5, n = 56)	0.32
Parity	0.5 ± 0.8 (0 - 3, n = 94)	0.3 ± 0.6 (0 - 2, n = 36)	0.7 ± 0.9 (0 - 3, n = 56)	0.02
AD	23.1 ± 8.7 (10.0 - 52.5, n = 94)	25.4 ± 6.9 (12.2 - 37.9, n = 38)	21.6 ± 9.5 (10.0 - 52.5, n = 56)	0.034
Resected leiomyoma weight	13.4 ± 18.0 (0.5 - 105.8, n = 59)	13.3 ± 13.1 (2.3 - 56.2, n = 25)	13.5 ± 21.1 (0.5 - 105.8, n = 34)	0.97
G2 SL	n = 31/94	n = 20/38	n = 11/56	< 0.01
OT	35.0 ± 21.9 (4 - 126, n = 94)	46.1 ± 20.7 (20 - 126, n = 30)	27.5 ± 19.5 (4 - 84, n = 56)	< 0.01
OT/Cube of AD	3.8 ± 3.1 (0.4 - 17.3, n = 94)	3.7 ± 3.0 (0.9 - 13.3, n = 38)	3.9 ± 3.2 (0.4 - 17.3, n = 56)	0.79
Menstruation-related symptoms	n = 57/94	n = 19/38	n = 38/56	0.084
Infertility	n = 14/94	n = 9/38	n = 5/56	0.049

After dividing the 94 patients into two groups according to performing UEP-HM or C-HM, we compared 13 indexes. In this analysis, the factors of parity, AD, Type 2 SL, OT and infertility showed significant differences.
Abbreviations AD: Average diameter, BMI: Body mass index, C-HM: conventional hysteroscopic myomectomy, OT: Operation time, SL: Submucosal leiomyoma, UEP-HM: uterine endometrium preservation hysteroscopic myomectomy.

resected leiomyoma weight and the cube of AD, namely 0.87 and the correlation coefficient between the resected leiomyoma weight and OT, namely 0.73.

Discussion

Since for some infertile patients, HM has been considered to have the role for improving the situation of uterine cavity and endometrium [4, 20], the number of patients who are performed HM during infertility treatments, have been gradually increased also in our hospital, especially before embryo transfer. Then, we have tried to refine the conventional methods of HM in which the uterine endometrium is damaged especially when the target is large Type 1 or Type 2 SL. In this report, mainly, this new UEP-HM was introduced with comparing with the C-HM. Additionally, similar to this method, the effective use of cold instruments can further reduce the risk of myometrial damage and intrauterine adhesions [21]. Although the data may be insufficient, in our hospital, the rate of infertility patients was significantly higher (n = 9/38 vs. n = 5/56, p = 0.049, in Table 1) and more patients became pregnancy after HM (n = 7/38 vs. n = 2/56, p = 0.016).

Although it was not the prospective study, all 94 operations were performed by one skilled specialist were conducted using the same procedure to avoid bias derived from the skills of individual physicians. In this analysis, first of all, we confirmed the equivalence in the difficulty of the new and conventional methods by setting the long OT to 60 min with referring the average and standard deviation of 94 cases. And some reports also recommended that hysteroscopic surgeries should be completed within 60 min for reducing media-related complications [22, 23]. We also focused on the size of target SL and considered the SL sized 3 cm or over as the LSL. As expected, the LSL showed the significant impact on the possibility of LTO. However, the UEP-HM procedure itself did not show the impact. From these results, we concluded that the UEP-HM could be performed similar to the C-HM.

Next, we investigated the relationship between OT and the size of the target SL, although the number of cases was small, and the statistical methods were limited to simple comparisons. With referring the past report investigating the relationship between the size of target SL and OT, we adopted the cube of AD as the size of target SL and could indicate no difference in the average of OT/Cube of AD (3.7 ± 3.0 vs. 3.9 ± 3.2). This result also showed the possibility of predicting OT from the size of target SL preoperatively. Interestingly, as shown in Fig. 2, OT/Cube of AD was related inversely to AD and when the subjects were limited to 18 cases which AD of target submucosal leiomyoma was 3 cm or over, this index in the UEP-HM group became 1.5 times as much as that in the C-HM group. In the future, by setting the larger scale of cases, an accurate formula may be provided.

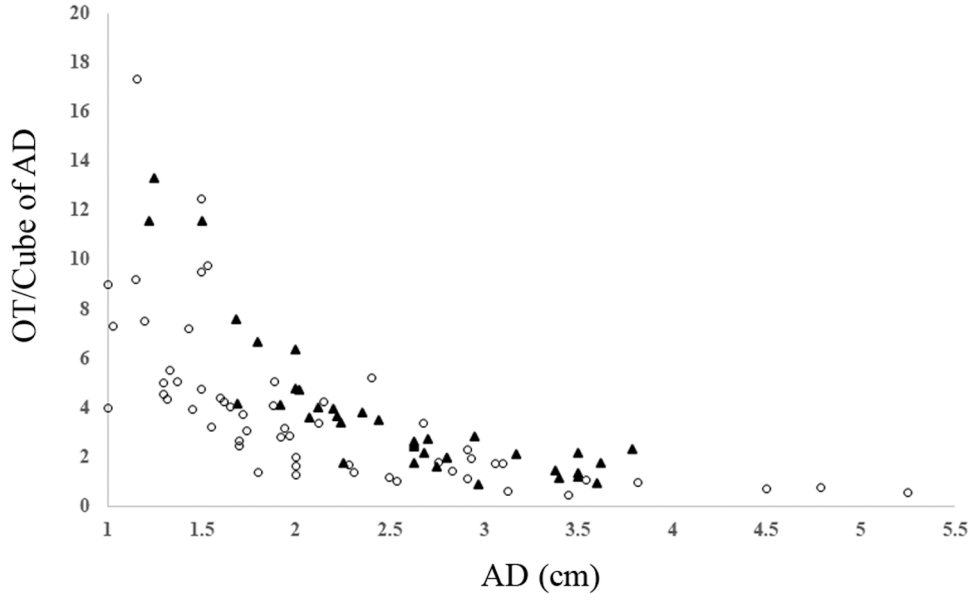

Fig. 2. Relationship between AD and OT/Cube of AD. The scatter plots of the association between AD and OT/Cube of AD were shown. X-axis: AD (cm). Y-axis: OT/Cube of AD (minutes/cm^3). Abbreviations: AD: Average diameter, OT: Operation time.

Conclusions

The new UEP-HM can become an alternative method of the C-HM without procedure-specific difficulty. On the other hand, to investigate the prognosis of this procedure, more patients and further analyses should be accumulated.

List of abbreviations

AD: Average diameter, BMI: Body mass index, CI: Confidence interval, C-HM: Conventional hysteroscopic myomectomy, HM: Hysteroscopic myomectomy, LSL: Large submucosal leiomyoma, LTO: Longtime operation, OR: Odds ratio, OT: Operation time, SL: Submucosal leiomyoma, UEP-HM: Uterine endometrium preservation hysteroscopic myomectomy.

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None.

CRediT authorship contribution statement

Masanori Maruyama: Supervision, Project administration, Methodology, Investigation. **Wataru Isono:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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Prior presentation

None.

Consent for publication

Written informed consent was obtained from all patients for the publication of the data.

Precis

The new uterine endometrium preservation hysteroscopic myomectomy can be performed without any specific difficulty.

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