Development and usefulness of gasless reduced port laparoscopic myomectomy using a subcutaneous abdominal wall lifting method

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Research Article

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Abstract

Background:

Laparoscopic myomectomy is more difficult than other laparoscopic surgeries because it requires advanced techniques such as extensive suturing and ligation, traction removal of the fibroids, and removal of the fibroids from the body

Objective:

To evaluate the usefulness of gasless reduced port laparoscopic myomectomy using a subcutaneous abdominal wall lifting method developed by us.

Study Design:

In gasless reduced port laparoscopic myomectomy, after lifting the abdominal wall by a subcutaneous abdominal wall lifting method, a 1.5-cm incision is made in the lateral abdomen, Lap Protector® is placed, and a 5-mm trocar is punctured in the fossa of the umbilicus to create a laparoscopic port under the supervision of an endoscope. The surgeon inserts multiple instruments through the Lap Protector and performs the operation, while the assistant operates the laparoscope and uterine manipulator.

Results:

Gasless reduced port laparoscopic myomectomy was performed in 966 patients. The operative time (mean ± standard deviation) was 156 ± 56 min, blood loss was 157 ± 214 ml, fibroid weight was 174 ± 123 g, number of fibroids removed was 5.0 ± 4.3, and hospital stay was 5.7 ± 5.1 days. The number of complications of this method was remarkably low at 5 out of 966 cases (0.5 %), blood transfusion was 3 out of 966 cases (0.3 %), and there were no cases that were converted to laparotomy. The average number of sutures per case was 21, and the average suture time was 12 seconds, with the posterior wall taking longer to suture than the anterior wall. The average surgical wound size was 1.5 cm.

Conclusion:

Gasless reduced port laparoscopic myomectomy is a suitable surgical laparoscopic myomectomy because it allows powerful grasping and traction of the fibroid and rapid and reliable suture and ligation, despite having only one port for the procedure. In addition, it is a new laparoscopic myomectomy that is economical due to the reduction of manpower and disposable products.

Introduction

Laparoscopic myomectomy (LM) has become widely used because it is minimally invasive and cosmetically superior to open surgery. However, it is more difficult than other laparoscopic surgeries because it requires advanced techniques such as extensive suturing and ligation of the myometrium, traction removal of the fibroids, and removal of the fibroids from the body [1].

For this reason, it is often performed only by skilled laparoscopic surgeons. On the other hand, it has been reported that gasless laparoscopic surgery (G-LS) using a subcutaneous abdominal wall lifting method (SAWL) can be introduced relatively easily even by novices because the technique of laparotomy can be applied [2–5]. In addition, G-LS has advantages such as quick and reliable suturing and ligation and easy powerful traction using the Tenaculum forceps [6], and we believe that it has a great advantage in LM. Since we developed our own G-LS in 1993 [4], we have continued to improve it to enhance its safety, operability, economy, and cosmetic aspects.

In this study, we aimed to evaluate the development and the usefulness of gasless reduced port laparoscopic myomectomy (GRP-LM), which introduces gasless reduced port surgery to myomectomy.

Materials And Methods

The study is a retrospective cohort study and was conducted in accordance with the ethical principles set forth in the Declaration of Helsinki and the research protocol approved by the University Ethical Review Board (approval no. T2020-0070).

1. Cases and surgeons

Of the cases in which LM was performed at our hospital between January 2001 and December 2016, the currently performed GRP-LM was targeted. In all cases, the selection of eligible patients was based on preoperative MRI and ultrasonography before the surgery was planned. The surgeon was selected according to the difficulty of the operation, although the operation was performed by endoscopy-certified specialists, gynecologists and residents.

2. Techniques for securing the operative field in GRP-LM

An additional movie file shows this more detail [See Additional file 1].

2.1 Equipment required for SAWL

SAWL was performed using the instruments from Mizuho Medical Co., Ltd (Tokyo, Japan) shown in Fig. 1.

2.2 Lifting the abdominal wall

A Kirschner steel wire (1.2 mm diameter) was inserted onto the subcutaneous sagittal line in the midline of the abdominal wall. A Nelaton catheter was passed through a steel wire to prevent skin damage and fixed to the lifting handle (Fig. 2-A). The abdominal wall was lifted by using this as a support, and the chain was fixed to the lifting arm (Fig. 2-B).

2.3 How to make an abdominal port

A small incision was made in the right lower abdominal wall (Fig. 2-C). The fascia was clamped immediately below with Kocher forceps, and cut with scissors. Then the ventral fascia was bluntly punctured to reach the peritoneum (Fig. 2-D). After grasping the peritoneum at two places with Pean forceps (Fig. 2-E), a small incision was made with a scalpel to reach the abdominal cavity. The released peritoneum was grasped with four Pean forceps (Fig.2-F), and the Lap Protector® (Hakko, Chikuma, Nagano, Japan) was inserted (Fig.2-G, H). A 5 mm trocar was inserted from the umbilical fossa under supervision of the endoscope (Fig.2-I).

3. Surgical procedure in GRP-LM

3.1 Local injection of Vasopressin (Pitressin®)

Diluted Vasopressin (1 ml 20 units) was locally injected into the incision and surrounding muscle layers.

3.2 Incision of the uterine wall

The boundary between the myometrium and the fibroid became clear by making an incision up to the fibroid with a monopolar on the uterine serosa surface where the fibroid existed. If the size of fibroid was large, trimming the serosa of the uterus into an elliptical shape facilitated enucleation and subsequent suturing.

3.3 Removal of fibroids

When the fibroid was raised about 50%, the fibroid was grasped with Tenaculum Forceps. A suction tube or an electric scalpel through the Lap Protector was used to separate the pulled fibroid bluntly and sharply (Fig.3-A, B).

3.4 Suture and ligation

An additional movie file shows this more detail [See Additional file 2].

The suture of the muscle layer was performed with a single-knot suture using CONTROL RELEASE™ synthetic absorbent threads (1-0 and 3-0) or large needles (needle length 48mm, suture size 1: Vicryl JB725®). The ligation was carried out by an instrumental knot, in which a knot was formed outside the body. Then, a thread was grasped and fed into the abdominal cavity for ligation (Fig. 3-C). When taking out the needle, the needle was not directly grasped, but the thread was grasped several cm away from the needle. This prevented the needle from slipping near the Lap Protector.

3.5 Removal of fibroids from the body

For fibroids that had enucleated, threads were sewn and used as support threads to avoid straying deep inside the body. Shredding was performed by grasping a fibroid with several Kochel forceps and using a sharp-edged scalpel to cut the fibroid into pieces, as if peeling an apple (Fig.3-D).

Currently, the excised fibroids were collected in a bag and then sectioned (Fig. 3-E).

3.6 Confirmation of hemostasis and use of anti-adhesion agent

After sufficient intraperitoneal lavage with 2000 to 3000 ml of physiological saline using the funnel (Fig. 3-F), hemostasis was confirmed.

3.7 For the use of the bag

The Rusch MemoBag® (Teleflex, Morrisville, NC) with inner diameter 100 mm was first inserted into the abdominal cavity, and then the fibroids detained by the thread were collected in the bag. After removing the Lap Protector, the mouth of the bag was guided outside the body, the Lap Protector was reattached, and hand morcellation of the fibroids was performed using a scalpel (Fig. 4).

4. Methodology

4.1 The patient background, operative time, blood loss, uterine fibroid weight, number of fibroids, hospital stay, complications, transition rate to laparotomy, and pathological diagnosis in GRP-LM was compared our previous gasless laparoscopic myomectomy (G-LM).

4.2 The relationship between the number of uterine fibroids (1-10 or more) and operative time, blood loss, and fibroid weight in GRP-LM was investigated.

4.3 The preparation time from the start of the lifting procedures to the securing of the surgical field, as well as the number of sutures and the time per suture and ligation were examined by playing back the videos taken during the operation for 50 randomly selected cases. The size of the incision wound made in the lower abdomen was also measured postoperatively.

5. Statistical analysis

Student’s t test was used for comparison between two groups, and Chi-square test was used to analyze the association between the groups. The correlation between groups was performed using Pearson's product moment correlation coefficient. The difference was judged to be statistically significant when $p < 0.05$. Statistical analysis was performed using the Statistical Package for the Social Sciences version 26.

Results

1. Patient background and surgical outcomes

The mean age and body mass index (BMI) of patients with GRP-LM (mean ± SD) were 37.3 ± 5.0 years and 21.1 ± 2.7 kg/m^2, respectively. Eighty-nine patients (9.2% of all patients) were obese with a BMI of 25 or more. Of these, 89 patients (9.2% of all patients) had previous surgeries.

The average of operative time was 156 ± 56 minutes, blood loss was 157 ± 214 ml, myoma weight was 174 ± 123 g, number of myomas removed was 5.0 ± 4.3, and hospital stay was 6.1 ± 0.7 days. There were no cases of malignancy diagnosed by postoperative pathology. Complications were observed in 5 cases (0.5%), of which 1 case (0.1%) was intraoperative complication and 4 cases (0.4%) were postoperative complication. Blood transfusion was performed in 3 cases (0.3%), and there were no cases of laparotomy.

In the comparative study of patient background and surgical results with other G-LMs, patients receiving GRP-LM had an older age than those receiving G-LM, but there was no significant difference in BMI and previous surgeries in both groups (Table 1). Of the over BMI 25 obese patients, GRP-LM was performed in 89 (9.2% of the total) and G-LM in 47 (9.2%).

GRP-LM showed significantly less mean blood loss ($p < 0.001$) than G-LM. On the other hand, the other surgical results were similar. Complication rates and transfusion rates were significantly lower in GRP-LM (Table 2).

2. Relationship between the number of fibroids removed and operative time

When there was only one fibroid removed, the operative time (mean ± SD) was 127.1 ± 42.2 min, fibroid weight was 120.4 ± 207.3 g, and blood loss was 145.1 ± 105.5 ml. When there were 10 or more fibroids removed, the operative time was 186.8 ± 59.6 min, fibroid weight was 202.4 ± 203.3 g, and blood loss was 221.4 ± 153.4 ml. Thus, an increase in the number of fibroids removed resulted in a prolongation of operation time, an increase in blood loss, and an increase in fibroid weight removed (Fig. 5). However, the correlation coefficients with the number of myomas removed were $r = 0.351$, 0.122, and 0.195, respectively, and only a weak positive correlation was found with the operation time.

3. Preparation time to secure the surgical field, number of sutures per case, suture and ligation time per case, and wound size

The preparation time (mean ± SD) from the start of the lifting operation to the securing of the surgical field and placing Lap Protector was 2.8 ± 1.4 minutes, and the number of sutures per case was 21 ± 10, and the average suture time per case was 77.4 ± 17.5 seconds with the posterior wall taking longer to suture than the anterior wall. The average wound size was 1.5 ± 0.2 cm.

4. Suturing and ligation techniques

The suture and ligation method in GRP-LM is clearly different from conventional LM. The advantages and disadvantages of this suture ligation are detailed in (Table 3).

Discussion

The GRP-LM has several advantages over the conventional LM, including the ability to perform a powerful dissection by pushing with the suction tube while pulling with the Tenaculum forceps on the fibroid, and the ability to perform secure suturing and ligation (multi-layer sutures with single knot sutures) with a needle holder familiar from open surgery. Furthermore, it was speculated that surgeon progression would be a major factor with respect to improved surgical outcomes once the surgeon became accustomed to using multiple forceps through a single port. In addition, GRP-LM can be performed quickly by using a controlled release needle because suturing and ligation can be performed in a short period of time, which increases the frequency. As for the safety of using this needle, in our experience, two cases of needle loss were observed in more than 4,000 cases (loss rate < 0.05%) [7]. This is comparable to the rate of needle loss during insufflation (0.07%) [8], so we believe that there is no problem if the needle is used with sufficient care to avoid loss.

As for the removal of excised fibroid, the risk of power morcellation was proposed by U.S. Food and Drug Administration (FDA) in 2015 [9]. In response to this, countermeasures are now being taken by introducing new techniques such as in-bag morcellation [10], small incision [11], and vaginal approach [12]. On the other hand, it is inevitable that new problems related to complicated operations and cosmetic aspects will arise. We have been using a scalpel to make fine sections without a motorized morcellator for a long time, but now we are using a bag-based method as shown in the text. In G-LS, it is easy to insert the removed fibroids into the bag, and the fine incision with a scalpel is less likely to scatter fragments, unlike morcellators. Therefore, the use of a scalpel with a bag in G-LS is easier than in-bag morcellation and is cosmetically superior because it does not enlarge the wound or create new small incisions.

In conclusion, GRP-LM is a technique that can solve the problems of LM, such as traction of the fibroid, suture ligation of the muscle layer after removal, and removal of the fibroid.

We believe that comparisons regarding operative time, blood loss, and removed fibroid weight showed comparable results to those of conventional LM. However, it is difficult to compare the results of this surgery, such as surgical time and blood loss, with those of conventional insufflation LM because of biases such as differences in surgical techniques and the number of experienced surgeons [13, 14]. One of the reasons for this is that the average number of fibroids removed in GRP-LM is as high as 5. In a literature review of 23 facilities [15, 16], the mean number of fibroids removed for conventional LM was between 1 and 2 (52%) in 12, between 2 and 3 (35%) in 8, between 3 and 4 (13%) in 3, and no facility had more than 4, and multiple fibroids (≥ 4) in different parts of the uterus increase the difficulty of surgery [17].

As shown in this study, a larger number of fibroids removed results in more fibroids being enucleated and sutured, thus increasing the operative time and blood loss.

On the other hand, with regard to the long average hospital stay of 5.7 ± 5.1 days, LM is covered by health insurance in our country, and patients are discharged after careful observation of postoperative pain and fever pattern. Therefore, it is difficult to compare our results with those in the foreign literature.

As for complications, 2.08–11.1% have been reported in the literature [16], and 5.67% have been reported in a recent study of about 20,000 LMs in our country [18], so the 0.52% of complication rate of GRP-LM is very low. In addition, the rate of laparotomy transition was 0%, which may be attributed to the fact that the GRP-LM is capable of rapid response such as suture ligation and aspiration. We also believe that this is due to the excellent operability of the forceps in the lifting technique.

In obese patients, surgeons performing G-LS find it difficult to establish a good operative field [6]. Generally, in severely obese cases, the abdominal wall is thick, so even if the abdominal wall is lifted, the fat in the abdominal wall often hangs down and a good operative field is often not obtained. However, in this study, the effect was hardly observed. This is thought to be due to the fact that the average BMI of women is 22.6 in our country [19], which is very low compared to other countries [20, 21].

We were unable to make comparisons with conventional LM due to the paucity of LM using pneumoperitoneum, so we were limited to a review of the literature. In addition, the number of cases for severe obesity was small and could not be adequately evaluated. In the future, it will be necessary to increase the number of cases for comparative study.

Conclusion

The GRP-LM is a suitable surgical method for myomectomy because it allows powerful grasping and traction of the fibroid with the Tenaculum forceps, and rapid and reliable suture and ligation, despite having only one port for the procedure. In addition, it is economical due to the reduction of manpower and disposable products, as well as cosmetic aspects that are the same as those of the single-port surgery.

Abbreviations

LM
laparoscopic myomectomy
G-LS
gasless laparoscopic surgery
SAWL
subcutaneous abdominal wall lifting method
GRP-LM
gasless reduced port laparoscopic myomectomy
G-LM
gasless laparoscopic myomectomy
BMI
body mass index
FDA
Food and Drug Administration

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Tokyo Medical University (approval number: T2020-0070), and conducted in accordance with the principles of the Declaration of Helsinki.

All patients were given the written informed consent to the surgical procedure and to the use of individual data for research.

Consent for publication

All patients were given the written informed consent to the surgical procedure and to the use of individual data for research.

Availability of data and materials

The datasets used and analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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No funding was provided for this study.

Authors' contributions

HI, JN and SY were responsible for data collection. HI, TA and KI drafted initial versions of the manuscript. TK and KI provided the statistical analyses. HI and KI were involved in data interpretation and manuscript development. All authors approved of the final manuscript version.

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Not applicable.

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Figures

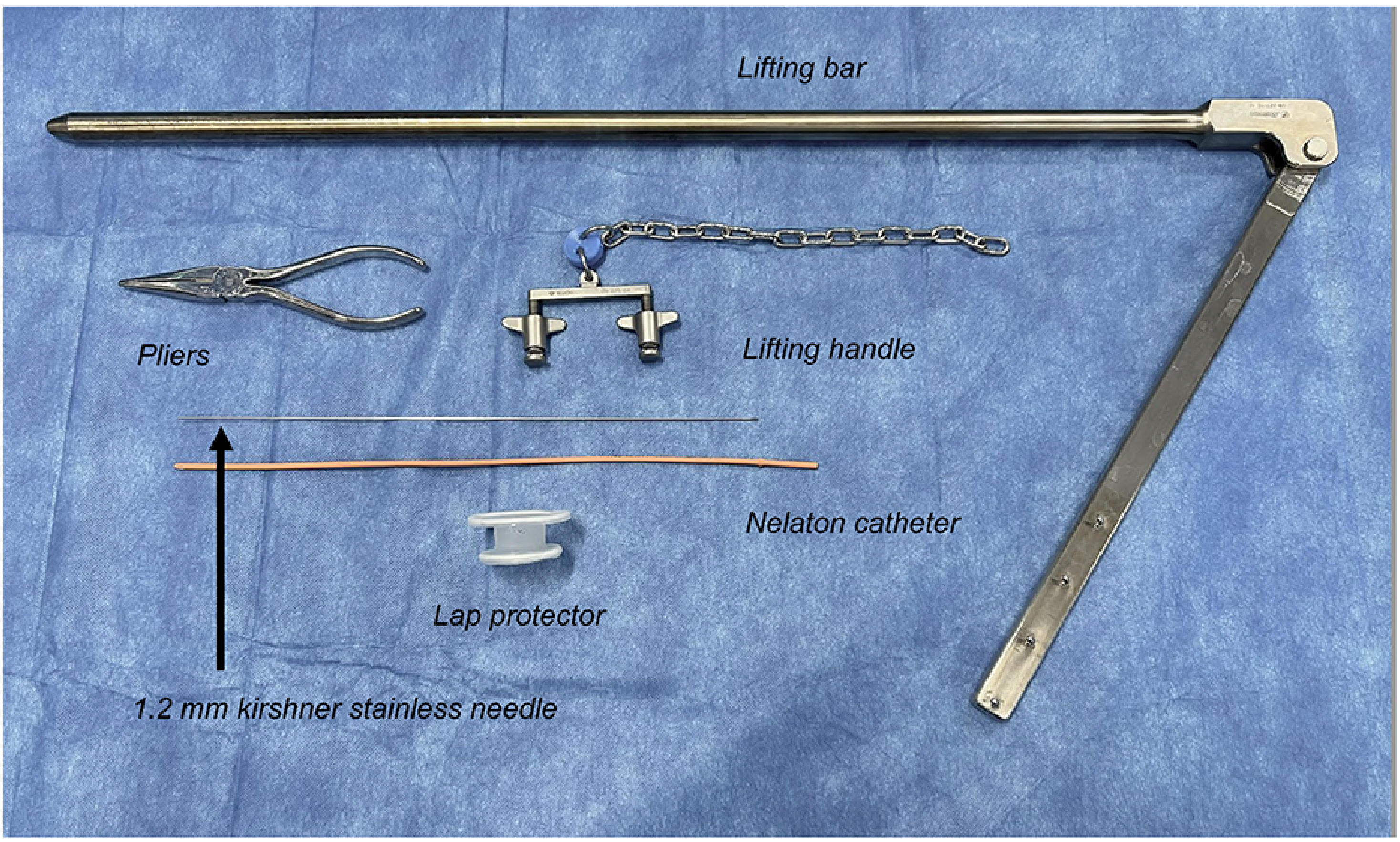

Figure 1

Equipment required for the subcutaneous abdominal wall lifting

They are the lifting bar, the lifting handle, the Kirshner stainless needle (1.2 mm), the Nelaton catheter and pliers

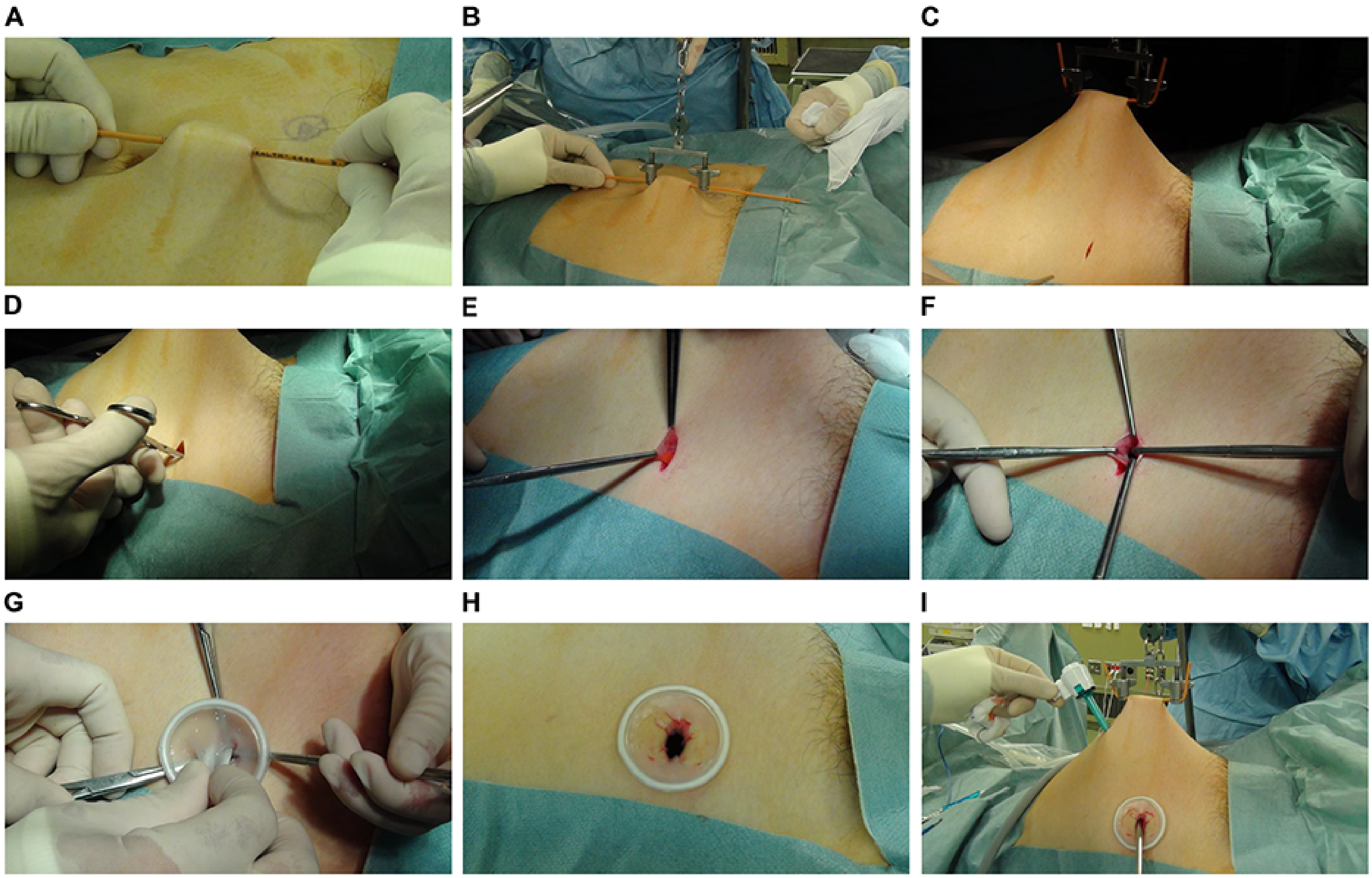

Figure 2

(A–I) Technique for securing operative field and method for port creation in gasless reduced-port laparoscopic myomectomy (GRP-LM)

A: The Kirschner wire is inserted subcutaneously along the sagittal line of the median abdominal wall.

B: The lifting handle chain is fixed to the lifting bar.

C: A small incision of about 1.5 cm is made in the right lower abdominal wall.

D: The ventral fascia was bluntly punctured to reach the peritoneum.

E: The peritoneum is held with Pean forceps at two sites.

F: The freed peritoneum is held with Pean forceps at four sites.

G: A Lap Protector® is inserted into the abdominal wall aperture.

H: Right lower abdomen with a Lap Protector® in place

I: A 5 mm trocar is inserted via the umbilical fossa under the surveillance of the endoscope.

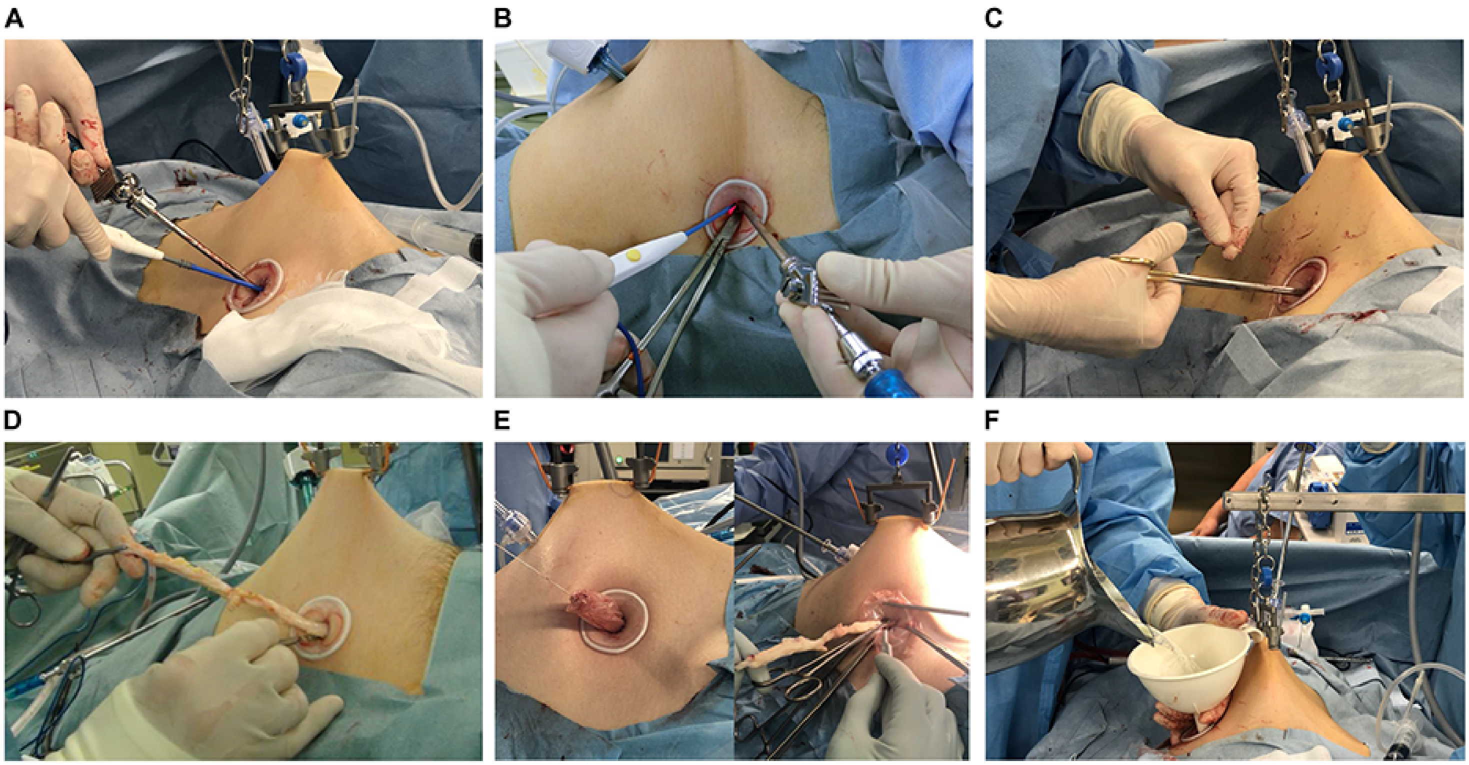

Figure 3

(A–F) Surgical procedure in gasless reduced-port laparoscopic myomectomy (GRP-LM)

A: Appearance of a surgical operation with the suction tube and the electrocautery inserted into the Lap Protector.

B: Appearance of the Lap Protector with the Tenaculum forceps, the suction tube and the electrocautery inserted simultaneously.

C: Suturing of the uterine myometrium using a mechanical knot that is tied outside the body and ligated inside the body.

D: Removal of fibroids from the abdominal cavity by fine cutting with a scalpel

E: Removal of fibroids using a MemoBag.

F: Massive intra-abdominal lavage (2,000~3,000ml) with physiological saline using a funnel.

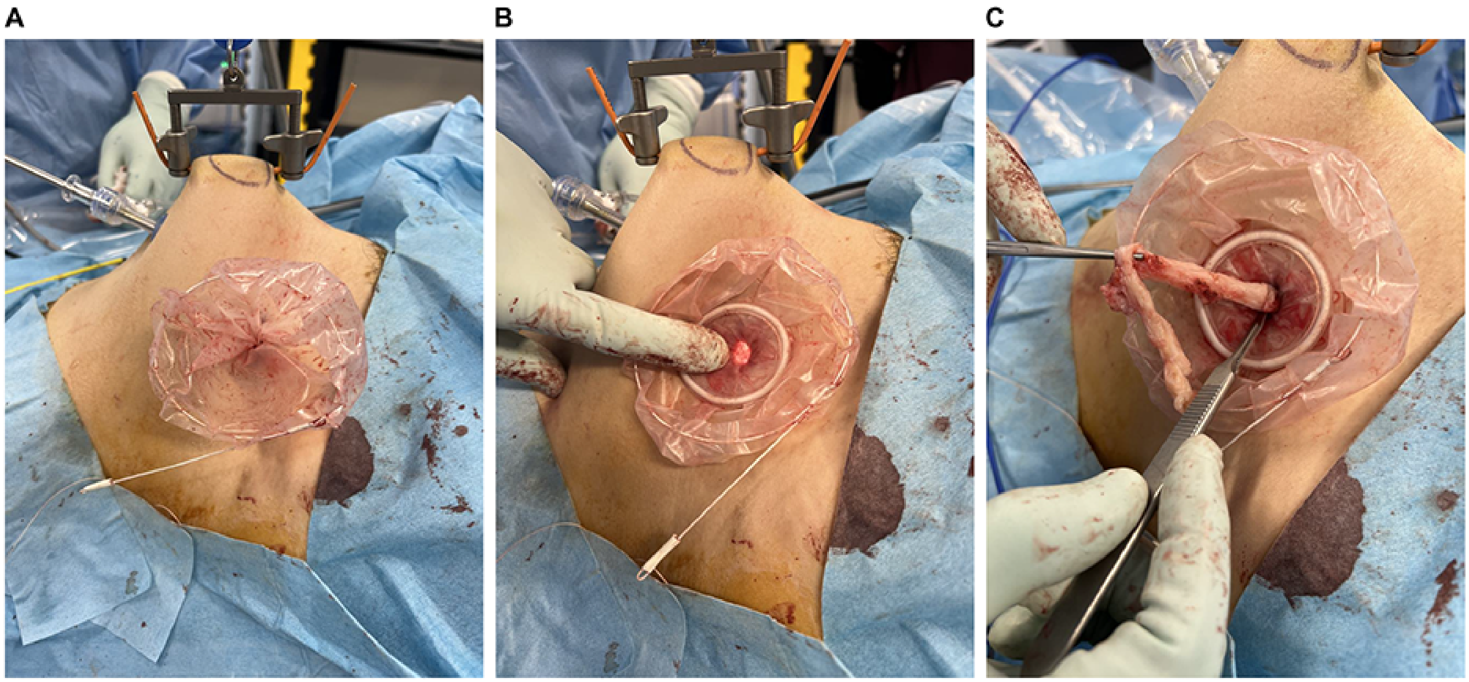

Figure 4

Fibroid sectioning using a MemoBag®

A: Extraction of the MemoBag with fibroids retrieved out of the abdominal cavity

B: Reattach the Lap Protector to the abdominal wall

C: Morcellation of the fibroid using a scalpel

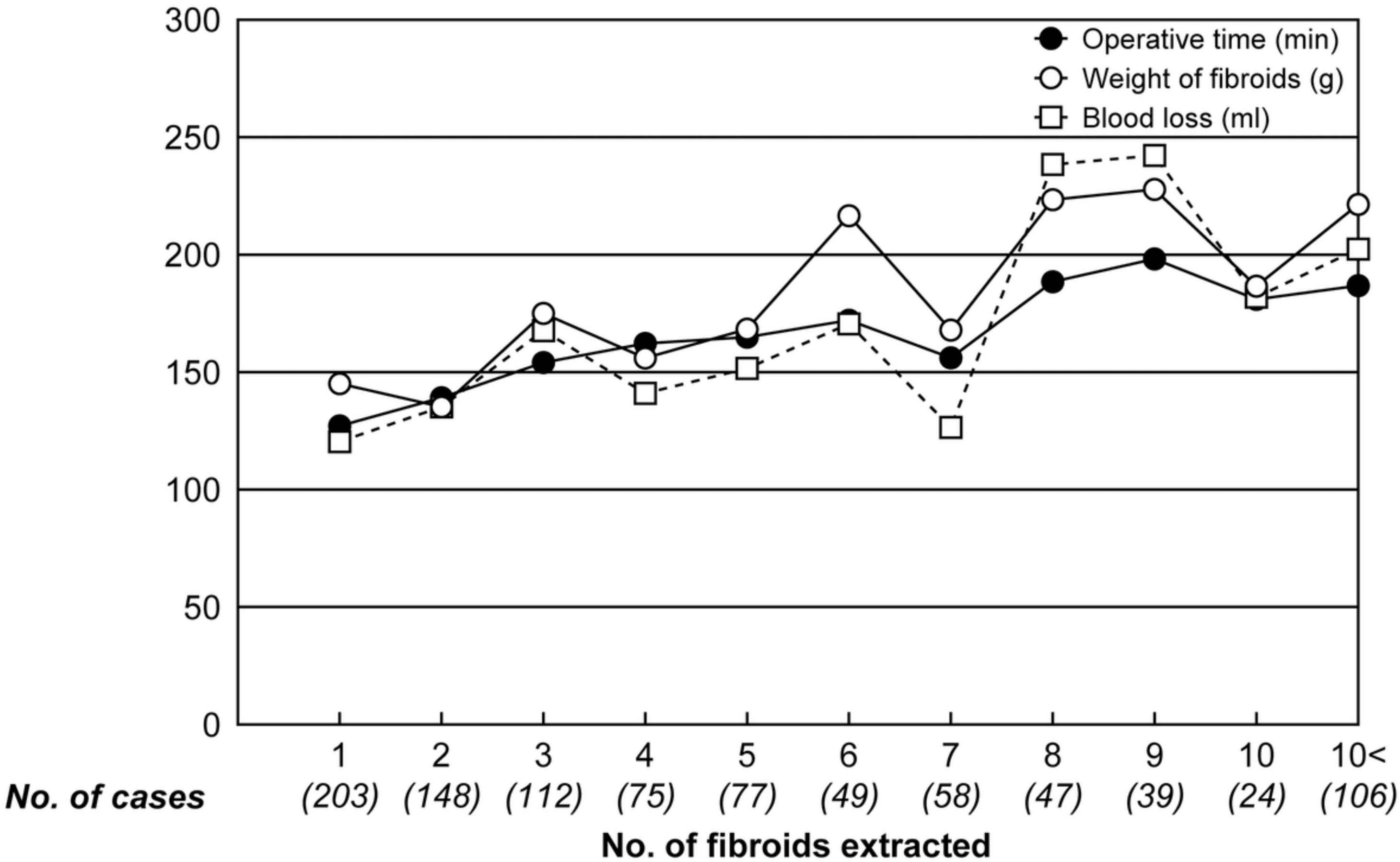

Figure 5

Relationship between number of extracted fibroids (1 to 10 or more) and operative time, blood loss, and weight of extracted fibroids in GRP-LM

●: Operative time (minutes), : Blood loss (ml), ●: Weight of fibroids (g)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1.jpg
- Table2.jpg
- Table3.jpg
- Additional1.mov
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