



Original article

Hysteroscopic myomectomy using a two-micron continuous wave laser (RevoLix)

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ABSTRACT

Objectives: The safety and efficacy of the RevoLix 2- μ continuous wave laser for hysteroscopic myomectomy (HM) was evaluated.

Materials and methods: A retrospective study was undertaken to evaluate 13 patients with symptomatic submucous myomas, who were treated with HM using a RevoLix laser application. The evaluation items included blood loss from surgery (estimated by the change between preoperative and postoperative hemoglobin levels), surgical time, amount of distension media, specimen volume retrieved, complications, and success rate.

Results: The mean age of the patients was 38 years old; 10 patients were in the premenopausal status and nine patients were nullipara. The surgical time was 91 minutes, and the distension media requirement was 4500 mL. The postoperative hemoglobin level decreased to 1.2 g/dL compared with the preoperative status. Mean specimen volume retrieved was 13.7 mm. No complications occurred. All patients reported significant improvement after HM during the 1-year follow-up.

Conclusion: The use of the RevoLix laser for HM seemed to be safe and effective in the management of symptomatic submucous myomas in this small population study.

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Introduction

Hysteroscopic surgery has become the standard diagnostic and therapeutic tool for intrauterine disease, including uterine cavity anomalies, endometrial polyps, benign submucous fibroids, and even endometrial malignancies.¹ Surgical procedures have improved along with the advances in minimally invasive surgery techniques,^{2–4} which are increasingly being used by more surgeons to treat malignant or benign tumors.⁵ Hysteroscopic procedures are often considered minimally invasive, but complications occasionally occur.⁶ Among these hysteroscopic procedures,^{7–12} hysteroscopic myomectomy (HM) is one of the most advanced and is associated with a significantly higher rate of complications than

other hysteroscopic procedures, particularly in complex cases.⁶ Complication rates have ranged from 0.3% to 28%, and fluid overload and uterine perforation are the most frequent complications during surgery.¹² Other complications include bleeding, cervical trauma, and air embolism; late complications include postoperative intrauterine adhesion.¹³

The most dangerous complication during HM is an excessive intravasation of the fluid used to distend and irrigate the uterine cavity, with resultant fluid overload. Although management of this risk relies on close monitoring of the fluid balance and interruption of the procedure prior to excessive fluid absorption occurring,^{12,13} the use of electrolyte-free solution might be a critical factor. However, standard electrosurgical operative hysteroscopy (such as conventional monopolar resectoscope) mandates the use of an electrolyte-free, low-viscosity solution (for example, 1.5% glycine, 3% D-sorbitol, 5% mannitol, and cystosol).⁹ These solutions, if absorbed in excessive amounts, lead to fluid-overload hyponatremia. Long-term morbidity and even death have been reported, making prevention of this fluid overload critical.¹³

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Over the past two decades, laser instruments have been introduced to the field of hysteroscopic procedures. One of the advances is the development of RevoLix (LISA Laser, Pleasanton, CA, USA), a 2- μ continuous wave diode-pumped solid-status (DPSS) laser,^{14,15} which brings together all of the advantages of existing laser principles in a single unit, and allows the surgeon to perform the operative hysteroscopy in an isotonic environment. This development may prevent the complications caused by traditional electrolyte-free extension media. The aim of this study was to evaluate the feasibility and the safety of this 2- μ continuous wave laser (RevoLix) using HM in the treatment of women with symptomatic submucous myoma.

Materials and methods

Patients

Data from women with symptomatic submucous myomas treated with HM between January 2005 and June 2005 were evaluated. Inclusion criteria included: (1) age between 20 years and 55 years, (2) body mass index between 16 kg/m² and 35 kg/m², (3) symptomatic submucous myoma, (4) a need for surgical treatment, and (5) a strong desire expressed by the patient to preserve her uterus. Exclusion criteria included: (1) a present or past history of cancer, (2) an absence of pathology confirmation, and (3) incompletely recorded data.

Surgical procedures

The surgical procedure for HM using the RevoLix laser was as follows. Under general anesthesia, the resectoscopic instrument was introduced into the uterine cavity after the cervical canal had been dilated with a number 10 Hegar dilator. A solution of 0.9% saline was used as the distension media. The fibroids were first cut into pieces until the residual fibroids could be extracted by forceps in both groups. After the fibroids were removed, the resectoscope was reintroduced for careful desiccation.

Evaluation parameters

The parameters for evaluation included surgical time (in minutes), postoperative hemoglobin change on the next day, distension media volume used, specimen volume retrieved, and complications. Hyperglycemia was defined as when the blood sugar level was greater than 300 mg/dL during the perioperative period.

Statistical analysis

SPSS (version 12.0; SPSS Inc., Chicago, IL, USA) statistical software was used to analyze the patient data. Data were presented as mean \pm standard deviation.

Results

A total of 13 patients were analyzed. Table 1 shows the general characteristics of the enrolled patients who were treated with the procedure. The mean surgical time was 91 \pm 32 minutes and distension media volume requirement was 4538 \pm 3039 mL. The mean hemoglobin level after surgery was 1.21 \pm 0.59 gm/dL lower than the status prior to surgery. The average volume of retrieved mass was 13.69 \pm 23.55 mm³. No distention media or thermal effect-related complications occurred during the surgery (Table 2). All patients were discharged uneventfully without postoperative complications.

Table 1

Baseline characteristics of the enrolled women.

Age (y)	38.0 \pm 7.5
Body mass index (kg/m ²)	19.1 \pm 2.3
Menstruation status	
Premenopause	10
Postmenopause	3
Parity	
Nulliparity	9
Multiparity	4

Data are presented as mean \pm standard deviation or case numbers.

Discussion

Approximately 20–40% of women of reproductive age have uterine myomas,^{16–18} suggesting that these lesions are remarkably common. Most uterine myomas are asymptomatic,¹⁹ although some may cause symptoms that require definitive treatment.^{20,21} Hysterectomy has been considered a good choice if the woman has completed child bearing.²² More recently, attention has been paid to the development of pharmaceutical agents and less invasive procedures or those performed by routes that incur less morbidity than laparotomy.²³ Frequently, such procedures are designed to preserve the uterus. There are many therapeutic strategies available in the management of symptomatic uterine myomas, but the choice depends on the patient's age, the reasons for treatment, the issue of fertility preservation, and the patient's preference.²⁴ While the uterus is not only a sexual organ but maintains important physiological functions, to develop therapeutic approaches for the preservation of the uterus have become an important issue.^{16–18,20,24,25}

Hysteroscopic surgery has seen significant improvement in its associated techniques and instruments, and has been developed and used in the management of various intrauterine diseases.^{26,27} The application of resectoscopic surgery has been made possible through the use of electrical current or lasers. The electro-surgical system can be monopolar or bipolar. In the monopolar system, the flow of current from the extremity of the resectoscope (active electrode) must reach the plate (passive electrode) in order to complete the circuit. The use of monopolar electrodes requires the use of nonconducting distending solution (sorbitol 5% or glycine 1.5%). Laser types include argon, krypton, neodymium-yttrium-aluminum garnet (Nd:YAG), and diode lasers (e.g., RevoLix) and all have been successfully used, but only the Nd:YAG laser has found widespread application in hysteroscopic procedures.^{28,29}

The RevoLix laser is a 2- μ continuous wave laser excited by an internal diode laser, and delivered by reusable and flexible silica fibers.^{14,15} The RevoLix laser is reported to have the superior characteristics of precise cutting and ablation, good hemostasis ability, and direct vaporization without deep penetration, all of which are attributed to its excellent water absorptive wavelength (2 μ). This property limits its laser effect to within 2 mm in front of the tip of the fiber in an aqueous medium.¹⁴ When used in the management

Table 2

Baseline characteristics Surgical and postoperative parameters following hysteroscopic myomectomy by RevoLix.

Surgical time (min)	91 \pm 32
Distension media volume used (mL)	4538 \pm 3039
Postoperative decreased hemoglobin level (g/dL)	1.21 \pm 0.59
Specimen volume retrieved	13.69 \pm 23.55 (mm ³)
Complications	0 (0/13)
Distension media-related complications	0 (0/13)
Complications—possibly related to thermal effect	0 (0/13)

Data are presented as mean \pm standard deviation or case numbers.

of bladder neck stricture opening¹⁵ and the vaporization and resection of hypertrophic prostate,¹⁴ the RevoLix laser has had good results. Based on a similar concept, it may be possible to use the RevoLix laser in the treatment of symptomatic submucous myomas. This study was conducted to assess the safety and efficacy of the RevoLix laser in the treatment of women with symptomatic submucous myomas.

For submucous fibroids, hysteroscopic resection (resectoscopy) is an option for treatment because the tissue texture of the fibroids, unlike endometrial polyps, are firm and can seldom be removed simply by dilatation and curettage. HM demonstrated less morbidity, shorter hospital stays, shorter recovery time, and lower costs than traditional laparotomy procedures.³⁰ Consistent with these results, we suggested that HM by RevoLix laser was a viable choice for the treatment of women with symptomatic submucous myomas.

However, many major complications, such as uterine mechanical trauma, media-related complications, and unintended collateral damage by electrosurgical instruments are associated with HM. In the largest reported series, the complication rate of operative hysteroscopy was 0.95%, and was directly related to the type of procedure performed.¹² The key inducers for all these complications can be generalized into three factors: the force, the media, and the energy. We used electricity conventionally as the energy source for cutting and coagulation (for example, monopolar electrodes). As a result, the distension media are limited to electrolyte-free and nonconductive fluid (such as distilled water or sorbitol solutions). These distension media are not physiologically isotonic, which might induce a fluid, electrolyte, and glucose imbalance during and after the procedures. Water intoxication, hyponatremia, hyperglycemia, hematuria, and pulmonary edema are already well documented.^{13,31} To avoid these complications, the use of lasers as replacement energy sources has been frequently studied. With the introduction of laser instruments, physiologic saline solution can be used as distension media and as a result, fluid measurement might become less complicated.

In addition to the media-related complications when using monopolar electrodes, thermal injury is another potential complication and is worthy of our attention. The RevoLix laser exhibits good water absorption, even 2.5 times stronger than the holmium-YAG laser.^{14,15} This property brings the laser effect to tissue restricted to less than 2 mm in front of the tip of the fiber in an aqueous medium. The mechanism protects the tissue and organs adjacent to the cut. A distance of 2 mm is a safe margin, because the tissue further from 2 mm is unaffected by the RevoLix laser. A precise and clear cut, good hemostasis, shallow penetration, and direct vaporization can be achieved. Tissue damage is restricted to less than 1 mm beneath the cut (data not shown). Objective experience with its use yielded powerful cutting, vaporization, and coagulation with greater safety. In addition, fewer bubbles and less tissue debris formation allow the surgical field much more visibility. In this study, thermal injury was indeed absent when we used the RevoLix laser as a tool to complete HM.

Not every laser currently available is perfectly suitable for endoscopic use because there are at least four minimum requirements: (1) clear cutting ability, (2) good hemostasis effect, (3) shallow penetration, and (4) delivery by fibers. However, most lasers are more or less deficient in some aspects. For example, the carbon dioxide laser works with clear cutting and shallow penetration, but it cannot be delivered with fibers but with articulate mirror arms. Another well-known laser system used in the hysteroscopic field is the neodymium-YAG laser.^{28,29} Although the neodymium-YAG laser exhibits good cutting and hemostasis properties, its low water-absorptive wavelength results in the risk of deep penetration. The holmium-YAG laser works only in a pulsed

mode, which splatters tissue debris and disturbs the surgical procedure. In addition, the cutting edge of the holmium-YAG laser is rough and causes more damage to the adjacent tissue. For these reasons, the RevoLix laser might be a better choice.

Bipolar electrode instruments mediated through a small caliber hysteroscope without cervical dilatation and saline solution as a distension medium were claimed to be superior.^{32,33} However, because of their smaller size, these instruments seemed to be preferable only for smaller and nonfundal polyps.³⁴ Other instruments, such as the intrauterine morcellator required less surgical time, however, the homeostatic imbalance during and after the procedure might be a concern.³⁵

The main disadvantage for the clinical application of RevoLix laser might be the cost. Laser equipment currently tends to be expensive, which significantly reduces its widespread use.¹³ However, based on this study, although without well-designed control group, the outcome demonstrated that the use of the RevoLix laser for the treatment of women with symptomatic submucous myomas is reasonable and worthy of further study.

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