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Original Article

Comparison of the efficacy of the pulsed bipolar system and conventional electrosurgery in laparoscopic myomectomy – A retrospective matched control study

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Abstract

Objective: Comparing the safety and effectiveness of the pulsed bipolar (PK) system and conventional electrosurgery in laparoscopic myomectomy (LM).

Materials and Methods: Retrospective chart review of 194 women with symptomatic uterine fibroids undertaken LM was performed. Cases of LMs with PK cutting forceps were compared with a matched control group of standard LMs with conventional electrosurgery. Outcome measures for both groups were studied comparatively in terms of the length of operative time, amount of blood loss, requirement of blood transfusion and length of hospital stay.

Results: The two groups were matched by age, body mass index, parity, previous cesarean delivery, size, number, and weight of fibroids. Amount of blood loss was significantly greater in electrosurgery group than in PK group at 243.8 ± 150.4 mL versus 190.4 ± 178.5 mL ($p = 0.025$). Length of operation, hospitalization time, hemoglobin decrease, and requirement of blood transfusion were not significantly different.

Conclusion: Our findings indicate that PK system is more effective in LM when compared with conventional electrosurgery. PK system has advantage over conventional electrosurgery in less blood loss and may offer an alternative option for patients undergoing LM.

Keywords: Electrosurgery; Fibroid; Laparoscopy; Myoectomy; Pulsed bipolar system

Introduction

The surgical methods to deal with symptomatic uterine fibroids are hysterectomy for permanent resolution purpose and myomectomy for women with preserving uterus or fertility desire. After two decades' improvements in laparoscopic techniques and instruments, laparoscopic myomectomy (LM) is now a safe, efficacy alternative of open method in well-selected patients [1–4]. However, it is still considered as a time-consuming and bloody procedure.

The operative bleeding of LM mainly occurs during myometrium incision and extraction of the fibroid(s). Traditionally unipolar and bipolar electrocautery are widely used in laparoscopic procedures. Unipolar diathermy provides good cutting ability with much plume generation, while bipolar owns satisfying coagulation but relatively extensive thermal damage, and the jaws tend to stick to the tissue [5,6]. These phenomena plus the complexity of uterine defect repair with laparoscopic suturing technique make the LM to be a thorny procedure comparing with open myomectomy. Therefore, searching an ideal energy source which can provide cutting and hemostasis

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equal to that of a conventional electrocautery without the above-mentioned drawbacks is necessary for laparoscopists to perform LM.

The PlasmaKinetic (PK) tissue management system (Gyrus Medical, Maple Grove, MN, USA) uses pulsed bipolar energy for coagulation. Our prior study reported that PK system is as safe and effective as conventional electrosurgery using in laparoscopically assisted vaginal hysterectomy [7]; therefore it would be interesting to evaluate the effect of using this system in LM.

A search of the literature showed few published studies discussing the pulsed bipolar energy although it had already been used in laparoscopic and open surgeries [7–9]. The purpose of our study was to compare the results of LM by using PK tissue management system to a matched control standard LM via conventional electrosurgery.

Materials and methods

In this retrospective case-control study, we reviewed 97 consecutive cases of LM by using PK cutting forceps that were performed from April 2002 through December 2008 at endoscopic center of Chang Gung Memorial Hospital. These data were compared with a matched control group of 97 LMs performed at the same institution and during the same period. All surgeries were performed by one of the authors (C.J. Wang). We introduced PK system for LM since 2002. But we did not routinely use this system as daily practice because this needed extra charge for a patient according to the insurance policy in our country. The indications for LM in these patients included menorrhagia, abdominal pain, bulk-related symptoms (urine frequency or rectosigmoid compression), and infertility. Before the operation, the patients were informed of the risks and benefits of LM, including the potential need to switch to laparotomy during the operation and the risks of intra-operative bleeding, transfusion, and adhesion. Written informed consent forms were obtained from all subjects.

Thirty-five patients had menometrorrhagia and underwent diagnostic hysteroscopy to exclude pathologic lesion in the uterine cavity. GnRH agnoist was not administered preoperatively. All women had bowel preparation in the morning of surgery. Intravenous cephalosporin prophylaxis was given just before surgery.

The procedure was conducted with the patient in the dorsolithotomy Trendelenburg position with both legs protected by elastic bandages; a Foley catheter was inserted for constant urinary drainage. A uterine manipulator was placed into the uterus (for women with prior sexual activity). Videolaparoscopy was performed with a 5-mm principal trocar introduced through the umbilicus. Three ancillary 5-mm cannulas were placed under laparoscopic visualization, two in the left lower quadrant lateral to inferior epigastric arteries, and the other in the right lower quadrant. For the patients with uterine size greater than 14 weeks' gestation, a 0.5 cm vertical skin incision was made with a number 11 blade at midpoint between umbilicus and xyphoid process (Lee-Huang point) where a 5-mm cannula was inserted [10]. Two punctured sites, one 5 mm and the other 5 mm were made in the bilateral lower abdomen at the paramedian line at the level of the umbilicus. The other cannula was introduced at the paramedian line, just above the pubic hairline. Once cannula placement was complete, adhesions were lysed as necessary.

After identifying the location of all fibroids, a transverse incision was made on the serosa overlying the largest tumor using conventional unipolar electrosurgery or PK cutting forceps. The incision was extended into the pseudocapsule down to the characteristically pearly white substance of the tumor. Additional fibroids located at the same area were removed through the same incision. However, for nonadjacent fibroids, creating a new incision was necessary. A myoma screw or second puncture was then inserted into the fibroid to apply traction while a probe (or any instrument that functions as a probe) was used to bluntly dissect in the cleavage plane to leverage the tumor against the uterine wall and pry it out of its bed. The unipolar electrode or PK cutting forceps were used to dissect pseudocapsule attachments further. After fibroid removal, the uterine defect was irrigated. Bleeding points were identified and controlled with electrocoagulation (Bipolar diathermy or PK system).

The uterine surgical defect was closed in a one-layer suturing attempt. If excessive myometrium and serosa were present, these were trimmed off. A zero monofilament poliglecaprone 25 (Monocryl, Ethicon Inc., Somerville, NJ, USA) on a large curved needle was used to make a deep and wide (1 cm from the cut edge of the incision) bite. A continuous nonrunning-lock suture at 1-cm increments was then carried out, with each suture penetrating the full thickness of the myometrium.

Specimens were removed through posterior colpotomy. Medium and large fibroids were morcellated with a scalpel or scissors first. After removal of all fibroids, the colpotomy incision was closed with 2-O polyglycolic acid suture. Pneumoperitoneum was reestablished at this time, and the peritoneal cavity was irrigated and lavaged until fluid was ran clear. A Jackson-Pratt drain was introduced through a 5-mm access site if complete hemostasis could not be achieved. If the specimen had to be removed from the abdominal wall, a 12-mm electromechanical morcellator (Storz, Tuttlingen, Germany) was used to ease extraction of the specimen. All port sites were sutured with 3-0 polyglycolic acid suture at the level of the fascia to prevent herniation. The skin was approximated by sterile adhesive tape.

Statistics

A retrospective chart review of all LMs with PK cutting forceps was performed. All cases were compared by age, body mass index, parity, number, located, and size of the removed fibroids to a matched control group of LMs with conventional electrosurgery, which were performed by the same surgeon. Continuous variables were compared with Student t test and categorical values with Pearson χ^2 analysis. All probability values were two-sided. Significance was accepted at probability below 5%. SPSS for Windows version 13.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical calculations.

Table 1
Characteristics of patients undergoing laparoscopic myomectomy with either the plasmakinetic (PK) tissue management system or electrosurgery

	PK ($n = 97$)	Electrosurgery ($n = 97$)	p
Age (yr)	38.0 ± 6.6 (26–51)	36.9 ± 5.9 (23–50)	0.244
Body mass index (kg/m^2)	22.9 ± 3.2 (16.9–33.2)	22.9 ± 3.3 (17.5–35.2)	0.933
Parity	1.2 ± 1.2 (0–4)	1.2 ± 1.3 (0–6)	0.954
Cesarean section	0.2 ± 0.6 (0–3)	0.3 ± 0.8 (0–3)	0.277

Data are presented as mean ± standard deviation (range).

Results

All laparoscopic procedures were performed uneventfully without any conversion to laparotomy. Both groups of patients were similar in terms of age, body weight, parity, and histories of cesarean section deliveries (Table 1). Four patients in the PK group and seven in the electrosurgery group underwent concomitant adnexal surgery, and three patients in the PK group and one patient in the electrosurgery group underwent tubal sterilization. Otherwise, no additional procedures were performed.

The outcomes of the two groups are summarized in Table 2. The mean operating time, total weight of fibroids, number of fibroids removed, size of main fibroid, postoperative stay, and requirement of blood transfusion were similar in both groups. The mean blood loss was significantly greater in the LM with electrosurgery group. Ten patients suffered from intra-operative blood loss of more than 500 mL, four in the electrosurgery group, and six in the PK group. The extreme blood loss was mainly caused by multiple uterine incision wounds (>5) in three patients and removal of large intramural tumor (>12 cm) in seven patients. No major complications, such as ureteric injury, bladder injury, or bowel injury, occurred in any of the cases. Twelve patients in PK group and 12 in electrosurgery group required blood transfusion with packed red blood cells (2–4 units) because of heavy blood loss (>300 mL). Three patients in electrosurgery group had postoperative ileus. The condition lasted for 5 days and subsided after nasogastric tube decompression. Two patients also in electrosurgery group had postoperative urine retention and resolved after urinary catheterization for 3 days.

Histologic examination of the resected tissue showed leiomyomatous tissue in all patients. Three specimens had hyaline degeneration and one had myxoid degeneration. Four specimens were cellular leiomyomas. Nine patients had adenomyosis concomitantly. No sarcomatous change was observed. Ten women had uterine cavity broken during operation and control hysteroscopy performed postoperative 4 weeks showed no intrauterine adhesion.

Twenty-six of the 194 patients in this study attempted to conceive, and 15 pregnancies were achieved in 14 patients. The time interval between surgery and the first pregnancy ranged between 2 months and 44 months (mean: 10 months). All pregnant courses were uneventful, and spontaneous uterine rupture did not occur at any delivery. Vaginal delivery occurred in two women, and 12 (13 pregnancies) underwent cesarean section. Adhesions were noted at the site of myomectomy in five patients who underwent cesarean section.

Discussion

LM involves three major steps: (1) excision of the fibroid (s); (2) repair of the uterine defect; and (3) the removal of fibroid specimen(s). The first and second steps are the main procedures to lead operative blood loss. Some methods are employed to reduce blood loss during LM. These methods are injection of diluted vasopressin into the myometrium [11], oxytocin intravenous infusion [12], and bilateral uterine artery ligation [13,14]. However, these measures are associated with required extra steps before the actual procedure. With the improvements of laparoscopic instruments, alternative energy source was introduced trying to achieve the purpose of controlling operative bleeding [15].

The PK system has vapor pulse coagulation mode and PK tissue cutting mode. It is designed to deliver high-level pulses of energy to the tissue, in place of conventional continuous

Table 2
Comparison of outcome variables in patients undergoing laparoscopic myomectomy with the plasmakinetic (PK) tissue management system or electrosurgery

	PK ($n = 97$)	Electrosurgery ($n = 97$)	p
Fibroid weight (g)	273.2 ± 283.4 (40–1450)	270.3 ± 229.6 (30–1370)	0.938
Fibroids removed	2.8 ± 2.9 (1–15)	2.4 ± 3.4 (1–24)	0.414
Main fibroid size (cm)	8.1 ± 3.0 (5–20)	8.5 ± 2.6 (5–18)	0.341
Operating time (min)	117.8 ± 65.4 (30–340)	116.9 ± 38.7 (50–230)	0.906
Blood loss (mL)	190.4 ± 178.5 (10–800)	243.8 ± 150.4 (80–800)	0.025
Preoperative Hb (mg/dL)	12.0 ± 2.0 (7.5–16.7)	11.9 ± 2.0 (4.9–15.2)	0.814
Postoperative Hb (mg/dL)	10.7 ± 1.7 (7.0–16.3)	10.5 ± 1.5 (7.4–13.6)	0.502
Hb decrease (mg/dL)	1.5 ± 1.0 (0.0–5.1)	1.6 ± 0.8 (0.0–3.8)	0.449
Postoperative stay (d)	2.7 ± 0.7 (2–6)	2.8 ± 0.8 (2–6)	0.315
Blood transfusion	12 (12.4)	12 (12.4)	1.000[a]

[a] χ^2 test. Data are presented as mean ± standard deviation (range) or n (%). Hb = hemoglobin.

bipolar energy. The pulse-off periods allow tissue to cool and moisture; therefore, hot spots and coagulum formation can be reduced. Tissue sticking at therapy delivery site and lateral tissue thermal injury thereby can be diminished [16].

We confirmed PK system was as safe and effective as conventional electrosurgery using in laparoscopically assisted vaginal hysterectomy and even more effective in laparoscopic radical hysterectomy [7,9]. During the course of studies we found knacks, which differ slightly from those used in traditional electrosurgery. Targeted tissue should be grasped firmly with the instrument jaws to maintain constant pressure and wherever possible to elevate the tissue away from fluid pools during activation; otherwise, the feedback system will indicate a decrease in impedance and deliver more energy to held tissue, increasing the potential thermal injury. In addition, surgeons should be careful in holding thin tissue, otherwise the short circuit will occur when the jaws touch each other. This can be overcome by slightly moving the jaws aloof and twisting them when the power is activated.

In this study, all laparoscopic procedures were performed uneventfully without conversion to laparotomy. The removed fibroid(s) weight, number of fibroid removed, and length of hospital stay were similar in the two groups. However, the PK group has the advantage of allowing performance of coagulation and division at the same time, so the procedure can proceed without alternating between coagulation and cutting devices. Although the length of operation was not significantly different, however, the user-friendly design of PK cutting forceps eases the workload for the surgeon.

Ultrasonic technology also had been used in LM except the electrosurgery [15,17]. The vibration occurring in the blade of instrument at an imperceptible frequency of 55,000 cycles per second, thus it can provide a knifelike action through tissue and generate coagulum to seal blood vessels [18]. Although Ou et al confirmed its effectiveness of controlling bleeding in LM [15], according to our experiences it was somewhat difficult to control large areas of bleeding and took longer to coagulate with the harmonic scalpel (model HDH05 and LCS, Ethicon Endosurgery, Cincinnati, OH, USA) than with electrosurgery [6]. That is the rationale we used PK system instead of harmonic scalpel to perform LM.

In conclusion, more women with symptomatic uterine fibroids request to undergo laparoscopic management with preservation of uterus. It is the wish of both patient and surgeon to decrease intra-operative blood loss and avoid complications. By virtue of great progress of endoscopic instruments, it is natural and right to choose new development of energy source in LM to meet the principle of controlling bleeding. Although in this study we successfully demonstrated the PK system was much effective in diminishing blood loss than traditional electrosurgery. However, the characters of retrospective case-control study own the statistic biases. For achieving a solid conclusion, larger prospective studies to investigate the feasibility and effectiveness of this instrument are crucial.

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