

Review Article

Laparoscopic hysterectomies for large uteri

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Abstract

Laparoscopic hysterectomies increase recently due to several advantages of minimally invasive surgery. Controversy exists for laparoscopic hysterectomies for large uteri weighing >500 g because some reports show increased complications and morbidities and high laparoconversion rate in the past. With familiarity of laparoscopic procedures and progress in surgical techniques, the issue should be discussed and reviewed by evidence again. Hence, we conducted a systematic review of laparoscopic hysterectomies for large uteri.

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Introduction

Hysterectomy is one of the most common gynecologic procedures and approximately 90% are benign diseases [1]. It can be performed abdominally, vaginally or laparoscopically depending on the patients' clinical characteristics and surgeons' expertise and preference.

In 1988, laparoscopic assisted vaginal hysterectomy (LAVH) was first reported by Harry Reich [2]. LAVH not only provides an alternative for patients contraindicated to vaginal hysterectomy (VH) [3–8] but also advantages over abdominal hysterectomy (AH), including superior anatomic images due to magnification of videolaparoscope, less blood loss, shorter hospitalization, faster recovery, fewer wound complications, less adhesion formation and less scar [9–11]. Since then, the approach of hysterectomy has evolved. However, large uteri

present several difficulties when performing laparoscopic hysterectomy, including limited operation field, restrictive instrument range of motion and difficult removal of the specimen. Large uteri also increase complications and morbidities, such as prolonged operation time, excessive blood loss from retrograde bleeding [12–14] and high rates of blood transfusion and laparoconversion.

In 2000, Ferrari et al. [15] conducted a prospective randomized study to compare LAVH with AH by dividing 62 patients with myomas and not suitable for VH into two groups, LAVH or AH. Both groups were divided into two subgroups by uterine weight, 500 g and >500 g. In the group of uteri weighing >500 g, LAVH required longer operation time and had a high laparoconversion rate up to 27%. They concluded uteri weighing >500 g were hazardous for laparoscopic hysterectomy. Similar results and laparoconversion rate were reported by Salmanli et al. [16].

With time, surgical techniques have progressed and laparoscopic instruments have improved, both of which have led to hysterectomies for large uteri being performed by laparoscopy safely and effectively [17–19]. In our previous study [18], we divided patients undergoing laparoscopic hysterectomies into

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two groups by uterine weight, <500 g vs. >500 g and found there was no significant difference in overall complications except blood transfusion rate was significantly higher in the group of ≥ 500 g. No patient had laparoconversion except one who required minilaparotomy for specimen removal. Similar results were reported by other groups [17].

Several strategies should be applied to perform successful laparoscopic hysterectomy, including right positioning of trocars, pre- and intraoperative medical treatment, devascularization of uteri to reduce blood loss, effective methods of tumor removal and the use of in situ morcellation. The above strategies will be discussed in detail in the following.

Where is the best site for trocar insertion?

Trocar positioning is the first and also the most important step for laparoscopic surgery. Correct trocar positioning provides sufficient view of operation field and adequate range of motion for instruments resulting in facilitating the operation. Generally, the higher the primary trocar is, the better the operation field. The distance between the primary trocar and the uterine fundus should be 8 cm at least to allow adequate operation view and operation space during uterine manipulation without interference by masses. For a uterus weighing >500 g which is equal to the size of 16 gestational weeks, the fundus is around at the level of 4 cm below the umbilicus. Thus, the primary trocar should be at least placed at the midpoint between the umbilicus and the xiphoid process (Lee-Huang point) [20] or an even higher position. Besides the better operation view and wider working space, Lee-Huang point provides central vision allowing surgeons to approach both sides of the pelvis more easily no matter how masses distort the uterus [21]. It is also in avascular area and is safe for primary trocar insertion in patients with a high risk for adhesion due to previous midline laparotomy. Therefore, although Choi et al. [22] proposed a four-trocar method for LAVH on large uteri with the primary trocar placed in the infraumbilical area, the Lee-Huang point or an even higher position is still preferred according to our experience. As for ancillary trocars, the numbers and the positions vary, depending on the uterine size and the complexity of the surgery. Generally, they should be placed at the level of umbilicus to easily approach the opposite side of the utero-ovarian ligament and the broad ligament without obstruction by the fundus during uterine manipulation. Sometimes, a suprapubic port is necessary for a myoma screw to manipulate the uterus more efficiently and to restore the pelvic anatomy which is distorted by bulky masses [19].

How to reduce intraoperative blood loss?

Increased intraoperative blood loss is the major concern in laparoscopic hysterectomies for large uteri and also the main reason for surgeons' hesitation to perform this kind of the surgery. Therefore, reducing intraoperative blood loss, decreasing the need for blood transfusion and the related morbidities are important issues. At present, there are three

methods to achieve these goals. First, gonadotropin releasing hormone (GnRH) analogues administration prior the operation can significantly decrease both the myoma size and the uterine volume. Lethaby et al. [23] reviewed the role of pretreatment with GnRH analogues for women with uterine fibroid and found both uterine and fibroid volume reduced after GnRH analogues therapy. Hysterectomies appeared to be easier with shortening of operation time and decreasing the blood loss. Duration of hospital stay was also decreased. They concluded the use of GnRH analogues for 3 to 4 months prior to surgery had benefits in reducing surgery-related morbidities. Second, intravenous infusion of oxytocin during surgery causes uterine contractions and decreased uterine perfusion resulting in less blood loss intraoperatively. Wang et al. [24] reported on 88 women who had large uteri (weight ≥ 500 g) and underwent LAVH. They were divided into two groups randomly, with or without oxytocin infusion. In the experimental group, oxytocin 20 U was added to 1000 mL of saline solution running at the rate of 40 mU/min during the course of surgery. They found blood loss and blood transfusion rate were significantly higher in the group without oxytocin infusion ($n = 49$) than with oxytocin infusion ($n = 39$), 485.7 ± 321.6 mL vs. 364.1 ± 173.2 mL ($p < 0.05$) and 26.7% vs. 6.1% ($p < 0.05$), respectively. They concluded oxytocin infusion was an effective and inexpensive method to reduce intraoperative blood loss for large uteri. Another medication, vasopressin injection into the lower uterine segment was reported with the same effect as oxytocin infusion in decreasing blood loss without increasing morbidity during abdominal hysterectomy [25]. However, Bossmar et al. [26] reported the efficiency of oxytocin was lower than vasopressin in non-pregnant uteri. In clinical application, oxytocin is more frequently used than vasopressin because it is less expensive, has low systemic effects and a wide range of safety. Third, complete devascularization of the uteri minimizes the uterine perfusion; hence a reduction in intraoperative blood loss is achieved. Complete devascularization includes coagulation of uterine arteries, utero-ovarian ligaments if adnexa are preserved or infundibulo-pelvic ligaments if adnexectomies are performed. Blocking uterine arteries requires the opening of the pararectal space, retrograde umbilical ligament tracking [27] and identification of the ureters [28] to enable safe coagulation of uterine arteries.

How to remove the specimen effectively?

After cutting all the vessels and the ligaments of a uterus, the method of removal of the large specimen determines the rest of the operation time. Specimen can be removed more efficiently by many techniques for volume reduction, including transvaginal volume reduction, laparoscopic morcellation, a combination of vaginal and laparoscopic procedures and minilaparotomy [29]. Generally, the transvaginal technique is preferred unless in women with morbid obesity, narrow vaginal cavity, or round and firm uteri prohibiting downward extraction. During the transvaginal procedure, bisection, morcellation, myometrial coring, vaginal myomectomy and wedge resection

are used in vaginal hysterectomy to facilitate the process of removing the specimen [18,30,31]. Lin [32] and Wong et al. [33] described the similar uterine morcellation techniques for removal of large uteri. Under the protection of the vaginal wall, bladder and bowels by two retractors, two tenaculum forceps were used for downward traction of the cervix. A curved clockwise or counterclockwise incision by a cold knife under direct vision was made along the deepest uterine wall simultaneously with rotation and traction of the uterus. If the remaining specimen was stuck in the pelvis due to the large mass or irregular configuration of the uterus, the uterus should be pushed inward a little followed by traction again to keep the largest portion presenting in the vagina. The incision procedure should be repeated until the whole uterus was extracted completely. With these methods, most of the large uteri can be removed from vagina very safely and effectively. In Wang's report [18], removing a large uterus from vagina took 15 to 40 minutes and only one case with uterus weighing 2400 g required minilaparotomy. Actually, with popularity and easy use of the morcellator, few cases have required minilaparotomy due to the removal of uteri. But occasionally, laparoscopic morcellation or laparoscopic supracervical amputation of the bulky corpus followed by transvaginal trachelectomy [34] is necessary when transvaginal volume reduction technique is not feasible.

Sometimes even when the primary trocar inserted at the Lee-Huang point or a higher position, a large uteri confined in the pelvic cavity can still limit the operation field and instrument range of motion. Thus, the idea of debulking part of the specimen before transection of all the uterine ligaments emerged, and it was called "*in situ* morcellation". Chen et al. [35] conducted a comparative study to evaluate the feasibility and efficiency of laparoscopic *in situ* morcellation (LISM) for large uteri in LAVH. They divided 147 patients with myoma or adenomyosis and uteri weighing >500 g into four subgroups, patients with uteri weighing 500 g to 749 g who had traditional LAVH without LISM (group 1A, $n = 69$) or with LISM (group 1B, $n = 16$); and patients with uteri weighing ≥ 750 g who were treated by traditional LAVH without LISM (group 2A, $n = 38$) or with LISM (group 2B, $n = 24$). LISM was started after ligation of adnexal collateral vessels and uterine arteries. They found the operation time was significantly shorter in patients with LISM than those without in both groups 1 and 2, and blood loss was not significantly increased in the LISM group. They concluded that LISM was an efficient and safe procedure for removal of large uteri during LAVH.

At present, complications of laparoscopic hysterectomies for large uteri have not increased although increased morbidities, longer operation time and high laparoconversion rate [15,16] have been reported in the past. Wang et al. [18] reported 43 patients with uteri weighing >500 g undergoing laparoscopic hysterectomies and no major complications encountered, including ureter, bladder and bowel injuries and laparoconversion. Four patients had blood loss >1000 mL and required blood transfusion. One patient had postoperative low grade fever, one had ileus, five had macroscopic hematuria resolving spontaneously within 24 h, and one had 3-cm

Pfannestiel incision for removal of the firm and 2400 g uterus. Chang et al. [19] reported 181 patients with two bladder injuries repaired from vagina, three pelvic abscesses with histories of diabetes mellitus requiring transvaginal drainage followed by parenteral antibiotics treatment, and one laparoconversion for the large uterus tightly confined to the pelvis resulting in prohibiting further laparoscopic procedures. Neither mortality nor reoperation was noted. Operation time and estimated blood loss remained almost constant as long as the uterine weight was <750 g, but increased significantly when uterine weight >750 g. Frequency of excessive bleeding (14%) or transfusion (5%) were significantly greater in those with large uteri but in acceptable ranges. Choi et al. [22] had a report of 34 patients without blood transfusion, laparoconversion and complications, except one case of superficial port site bleeding. These studies all proved the safety and feasibility of laparoscopic hysterectomies for large uteri and no major complications would occur if the strategies mentioned above were strictly followed.

Conclusion

Nowadays, large uteri weighing >500 g are no longer the contraindication for laparoscopic hysterectomies and several studies have demonstrated the safety, feasibility and efficacy. There are three key points of successful and efficient laparoscopic hysterectomies for large uteri. First is to insert the primary trocar at the Lee-Huang point and the ancillary trocars at the level of umbilicus at least. Second is to reduce blood loss by GnRH given preoperatively, oxytocin infused intraoperatively, and devascularization of the uterus completely. Third is to remove the specimen from the vagina if possible. According to recent studies, laparoscopic hysterectomies for large uteri by experienced laparoscopists is safe and feasible if the strategies mentioned above were strictly followed. Therefore, the uterine size is no longer a determinant for laparoscopic hysterectomy anymore.

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