



Review article

Laparoscopic uterine artery occlusion for the treatment of symptomatic uterine fibroids



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ABSTRACT

With the development of gynecologic laparoscopy technology in recent years, uterine artery occlusion by laparoscopy (UAOL) has become a primary treatment for symptomatic uterine fibroids. Uterine artery occlusion by laparoscopy to treat uterine fibroids has favorable clinical outcomes such as relieving menometrorrhagia, decreasing uterine volume, and reducing the recurrence rate of fibroids. However, the therapeutic mechanism of UAOL remains unclear. It may be that the mechanism of UAOL is mostly associated with the uterine blood supply and uterine intramural arterial paths and with the difference between the uterine myometrium and fibroid tissues in the coagulation–fibrinolysis system. Therefore, this study reviewed and generalized many documents on the clinical effects and therapeutic mechanism of UAOL.

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Introduction

Uterine leiomyoma is the main cause of hysterectomy in women of reproductive age. American data show that every year nearly 200,000 women undergo a hysterectomy because of uterine fibroids. However, there is no related epidemiological data in China. Dr. Victor Bonney is a gynecological operation expert and once said that “For uterine fibroid hysterectomy is undoubtedly a rather excision surgery failed completely” (Bonney Gynaecological Surgery, 10th Edition). An increasing number of doctors and patients are concerned about the physiological function of the uterus and preserving the organ's integrity. Scholars have reviewed operation modes. A variety of uterus-preserving treatment methods have been developed. The outcome of laparoscopic uterine artery occlusion as the primary treatment used in the management of uterine fibroids is satisfactory. We searched the literature in the English language using the keywords ‘laparoscopy’, ‘uterine

fibroids’, ‘uterine artery occlusion’, ‘leiomyoma’, and ‘therapeutic’ in the PubMed database. We therefore performed a review on the clinical application of this technology in recent years and the therapeutic mechanisms.

Background of the development of the technology

In 1995, the French physician Jacques Ravina¹ and team first reported using uterine artery occlusion by embolization (UAOE) to treat symptomatic uterine fibroids. At first they only treated patients who were going to undergo myomectomy before the operation. The amount of intra- and postoperative hemorrhages was significantly reduced. At the same time, the treatment was good for rescuing hemorrhages due to uterine leiomyomas, relieving menorrhagia symptoms, and reducing the uterine volume significantly. Encouraged by the results of this study, Ravina's team began to apply UAOE in the treatment of uterine fibroids. They chose 16 patients with uterine fibroids who were older than 35 years and did not have fertility requirements as the object for UAOE. The success rate of surgical treatment was 87.5% and the volume of the tumor was reduced by 36%. Since 1995, doctors from many countries have successfully applied this method to treat uterine fibroids with a satisfactory outcome.

Uterine artery occlusion (UAO) created a new approach for the treatment of uterine fibroids. Since the advent of UAOE, doctors

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began trying to ligate the uterine artery in laparoscopy,² and obtained a satisfactory short-term clinical effect. In 2000, Liu³ first reported blocking the bilateral uterine artery by using a laparoscopic bipolar coagulation technique to treat three cases of symptomatic uterine myoma. The follow up during 6 months showed that the relief rate of abnormal menstruation was 100%, the uterine volume reduced by 36–42%, and the prominent myoma shrank to 73–79%.

The application of UAO in the treatment of gynecologic hemorrhage diseases has many years of history, although few gynecologists are aware of the important status of UAO in the treatment of uterine fibroids.² A clinical study shows UAO has significant clinical effects and the advantage of allowing a minimally invasive approach for patients with a uterine leiomyoma. Uterine artery occlusion by laparoscopy (UAOL) combined with electrocoagulation technology is gradually replacing the traditional mode of treating uterine fibroids. In addition, UAOL avoids ovarian radiation injury and accidental embolism in the ovarian artery. It is usually unnecessary for UAOL to depend on the radiologist's assistance. UAOL has often more time consuming, higher cost and the complications associated with embolism syndrome. Uterine artery occlusion by laparoscopy has more advantages, and gynecological doctors and patients are increasingly accepting it.

The characteristics and clinical curative effect of UAOL

We usually choose to block the initial portion of the uterine artery because its anatomical landmarks are easy to identify. However, it is unclear whether there is a difference between occluding the trunk of the uterine artery and occluding it near the uterus. Uterine artery occlusion by laparoscopy is usually performed under general anesthesia, and the surgeon requires a great amount of experience in endoscopic surgery.

In general, to open the peritoneum and search for the uterine artery, we choose the triangle surrounded by the round ligament of the uterus, the infundibulopelvic ligament, and the external iliac vessels. The uterine artery usually begins from the anterior branch of internal iliac artery and has a diameter of approximately 2–6 mm and tortuous shape. The rhythmic pulse from the uterine artery can be observed clearly under laparoscopic vision. The ureter goes underneath the uterine artery at a paracervical distance of 2 cm. Bipolar electric coagulation or plasma knife (PK) were used to block uterine artery. The power was controlled between 40–45 W, and the band width of coagulation was required for 1–1.5 cm.⁴ The traffic branches of the uterus ovarian artery can provide abundant compensatory blood supply to the uterus; therefore, the traffic branches should be blocked simultaneously for patients who have no fertility requirements. When dissecting and coagulating the uterine artery, physicians should be sufficiently careful to avoid damaging the basin wall, iliac vessels, and bilateral ureters.

In 2001, Liu⁵ treated 87 patients with uterine leiomyoma by UAOL; the success rate of the operation was 97.7% (85/87 patients), the mean follow-up time was 10.2 months, the symptom relief rate was 89.4%, the uterine volume reduced by 46%, and the dominant myoma shrank by 76%. Liu's⁵ study also found that the size of dominant fibroids with a diameter of ≥ 5 cm shrank more remarkably (86%). Yen⁶ treated 46 patients with leiomyomas by using laparoscopic uterine artery and uterus ovarian artery occlusion therapy. The patients' postoperative follow up lasted 6 months. The relief rate of excessive menstruation, dysmenorrhea, and oppressive symptoms was 71.7%, 56.5%, and 38.7%, respectively. The volume of the uterus and leiomyoma was reduced by 38.3% and 59.1%, respectively. Mara et al⁷ retrospectively analyzed 100 patients who had uterine fibroids and received UAOL treatment. The patients were followed up for 6 months. Mara et al⁷ found that the

volume of the leiomyomas was reduced by 39%. Helal et al⁸ treated 45 patients with leiomyomas by using UAOL; they were then followed up for 1 month, 3 months, 6 months, and 12 months. The abnormal menstruation relief rate reached 86.7%, on average. To sum up, the clinical outcomes are satisfactory for UAOL technology in the treatment of uterine fibroids.

In 2000, Dr. Zhongping Cheng⁹ and team from China performed the UAOL procedure, and designed an operation method in which uterine artery occlusion by laparoscopy is combined with myomectomy (UAOL-M) for patients with symptomatic uterine leiomyomas. Cheng found that UAOL-M ($n = 348$) has a better clinical effect than laparoscopic myomectomy (LM; $n = 172$). Clinical outcomes were compared between the two groups: the postoperative morbidity (24 hours after operation, 2 days, 6–8-hour intervals, consecutive body temperature $> 38.0^{\circ}\text{C}$ for 2 times) was lower in the UAOL-M group than in the LM group (5.7% vs. 19.2%, respectively; $p < 0.001$); the uterine volume reduction was more remarkable in the UAOL-M group than in the LM group (48.9% vs. 39.3%, respectively; $p < 0.05$); the remission rate of menorrhagia was increased in the UAOL-M group than in the LM group (97% vs. 86.4%, respectively; $p < 0.001$); and the postoperative recurrence rate of leiomyoma was significantly reduced in the UAOL-M group than in the LM group (3.0% vs. 10.7%, after an average follow up of 28.2 months; $p = 0.001$). No uterine necrosis or rupture occurred in the UAOL-M group. The improved effects in the UAOL-M group are associated with the following factors. First, intraoperative bleeding was significantly reduced in the UAOL-M group because of the UAOL procedure; therefore, the process of hemostasis by electric coagulation was decreased. Fewer eschars grew and were absorbed by the surrounding tissues. As a consequence, postoperative fever and postoperative morbidity were lower in the UAOL-M group than in the LM group. Second, a leiomyoma originates from a unicellular growth in a single smooth muscle cell that clones and proliferates. The nucleus of the fibroid cell can be very small, and 77–80% patients have multiple leiomyomas. It is difficult to remove fibroids completely by LM. Remnants of leiomyomas increase the risk of recurrence. After performing UAOL, the growth of residual small fibroids may be stopped because of hypoxia, and the recurrence rate of fibroids would be reduced. Third, because of UAO, the primary purpose of suturing the uterine wall is more to recover the uterine shape and anatomic position than to achieve hemostasis. Therefore, the degree of difficulty of stitching is reduced and the operation of suturing is simplified. By contrast, the visual field under laparoscopy is much clearer because of reduced bleeding, which aids the endoscopic doctor in performing complicated operations such as a difficult myomectomy of a myoma in the broad ligament or in a cervical position or the removal of multiple myomas. Therefore, the indication for LM was expanded.^{10,11}

The treatment mechanism of UAO

The clinical effect of UAO in the treatment of uterine fibroids is satisfactory, although the mechanism of the treatment remains unclear. The clinical outcomes in which the leiomyoma dies but the uterus survives may be associated with the following three factors.

The characteristics of the uterine blood supply

First, the sources of the uterine blood supply and the characteristics of blood flow paths should be known. The blood supply of the uterus is very rich and primarily comes from the bilateral uterine artery, which has a diameter of 2–6 mm. The second supply is the uterine ovarian artery, which has a diameter of 0.5 mm. In addition, many named arteries are also included: inferior mesenteric artery, lumbar artery, spinal artery, median sacral artery, deep

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