REVIEW ARTICLE

Laparoscopic Myomectomy with Uterine Artery Ligation: Review Article and Comparative Analysis

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ABSTRACT

Uterine leiomyomas are one of the most common benign smooth muscle tumors in women, with a prevalence of 20 to 40% in women over the age of 35 years. Although many women are asymptomatic, problems such as bleeding, pelvic pain, and infertility may necessitate treatment. Laparoscopic myomectomy is one of the treatment options for myomas. The major concern of myomectomy either by open method or by laparoscopy is the bleeding encountered during the procedure. Most studies have aimed at ways of reducing blood loss during myomectomy. There are various ways in which bleeding during laparoscopic myomectomy can be reduced, the most reliable of which is ligation of the uterine vessels bilaterally. In this review we propose to discuss the benefits and possible disadvantages of ligating the uterine arteries bilaterally before performing laparoscopic myomectomy.

Key words: Laparoscopic myomectomy, fibroids, myomectomy, uterine artery ligation, uterine artery embolisation, uterine devascularisation

INTRODUCTION

Anatomical considerations of blood supply to the uterus and myomas

The uterus is primarily supplied by the uterine artery, which is a branch from the anterior division of the internal iliac artery. The vascularity of the uterus is rich as it also receives its blood supply from other sources. The myometrium has an extremely rich blood supply. First, the blood reaches the uterus primarily through the uterine arteries, whose sizes are about 2 to 6 mm in diameter.[1,2] Second, small (0.5 mm) communicating arteries connect the uterus with the ovarian arteries.[2] Third, many named arteries have the potential to supply blood to the uterus: inferior mesenteric, lumbar, vertebral, middle sacral, deep iliac circumflex, inferior epigastric, medial femoral circumflex, and lateral femoral circumflex arteries.[3] Fourth, innumerable very small, unnamed arteries reach the uterus from the broad ligament and retroperitoneum. Unlike the uterus, which has various blood supplies, the vascular supply to the fibroids comes exclusively from the uterine arteries.

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Effects of uterine artery occlusion on the myometrium and myoma

As most of the blood enters the uterus through the uterine arteries, it was postulated that after occluding the arteries with the help of a catheter or a laparoscopic technique, transient uterine ischemia occurs. The hypothesis proposes that soon after occlusion, the blood within the myometrium clots, the myometrium becomes hypoxic, and the metabolism shifts from oxidative pathways to anaerobic glycolysis. The hypothesis further postulates that hours

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later the clot within the myometrium lyses and the uterus is reperfused through the collateral arteries.[4]

Burbank and colleagues put forward this 'transient uterine ischemia' hypothesis, to explain the mechanism of uterine artery occlusion. They proposed that after uterine artery occlusion, both the myometrial and myoma vessels were occluded by clotting, resulting in organ ischemia.[5] A study on uterine artery occlusion found that necrosis in the myoma, but not in the myometrium, contributed to the shrinkage of tumors, which was shown both through pathological observations and with magnetic resonance imaging (MRI).

The major advantage of ligating the uterine vessels before myomectomy is that blood loss during the procedure is considerably reduced. Studies have also shown that there is shrinkage of very small fibroids that are not removed during the surgery, which prevents recurrence of new fibroids.

Laparoscopic myomectomy with uterine artery ligation

In our center we ligate the uterine vessels before myomectomy in all large myomas. Laparoscopic ligation of uterine arteries has been combined with myomectomy, with successful reduction in blood loss.[6] Most cases of large myomas can be devascularized before myomectomy by laparoscopic intracorporeal suturing of the uterine arteries [Figures 1 and 2]. The uterine arteries can be ligated by an anterior approach or posterior approach depending on the location of the myoma. In case of lower segment myomas or cervical myomas, the uterine artery can be ligated at its origin from the anterior division of the internal iliac.

We prefer to ligate the ascending branch of the uterine artery anteriorly during most laparoscopic myomectomies. The uterovesical fold of the peritoneum is opened and the bladder is pushed down [Figures 3-5]. This moves the ureters laterally and prevents them being included in the suture. The uterine vessels are identified on either side and ligated. We use No. 1 delayed absorbable sutures for ligating the uterine vessels [Figures 6 and 7]. We always prefer to suture intracorporeally by contralateral suturing, using two needle holders. There can be technical difficulties in approaching the uterine vessels in the case of large myomas. There can be some venous bleeding if the uterine vein is accidentally punctured. In such cases the suturing is completed and the venous bleed stops by itself. Once the uterines are occluded bilaterally, the myoma turns pale [Figures 8-10]. This devascularizes the myoma and decreases the blood loss during the procedure.

The myoma capsule is then opened with harmonic ultracision [Figure 11] or with bipolar scissors. Enucleation is made along the cleavage plane separating the myoma from the surrounding myometrium [Figures 12 and 13][7]. It is facilitated by traction with a 5 mm myoma screw and countertraction on the cervix with a tenaculum held by the assistant. A degenerated myoma may be too friable to allow a firm grip with a myoma screw. Hemostasis is ensured. The myoma bed is obliterated with mattress sutures. The myoma capsule is closed with interrupted intracorporeal sutures with No. 1 polyglyconate in one or two layers depending on the depth of the myoma in the uterine wall [Figures 14 and 15]. If the uterine cavity is opened, the endometrium is reposited and the uterine wall is closed excluding the endometrium. The myoma is retrieved through the 15 mm port by morcellation.

In cases of lower segment myomas or cervical myomas we ligate the uterine vessels at their origin from the anterior division of the internal iliac [Figure 16][8]. We start the dissection for vessel ligation from the anterior leaf of the broad ligament. The triangle enclosed by the round ligament, external iliac artery, and infundibulopelvic ligament is opened with the harmonic ultracision [Figure 17]. The areolar space is dissected and the origin of the uterine artery from the internal iliac is identified. It is important at this point to also identify the ureter and its relation to the uterine artery in order to avoid inadvertent ligation. The uterine artery is isolated from the surrounding structures and sutured with a No. 1-0 delayed absorbable suture [Figure 18]. Suturing can be done with a free tie or a needle. The myoma turns pale after bilateral suturing of the uterine arteries. The myoma is enucleated from its bed by traction and counter traction [Figures 19 and 20]. The myoma capsule is closed with interrupted intracorporeal sutures [Figures 21 and 22]. The myoma is retrieved by morcellation [Figure 23].

The other major advantage of ligating the uterine vessels is in the case of degenerated myomas, where morcellation is done while the myoma is still attached to its bed. This is especially the case when dealing with large, softened, degenerated myomas that do not allow an adequate grip. There can be profuse bleeding if the myoma is morcellated without enucleation. This can be prevented by ligating the uterine vessels bilaterally before myomectomy.[9]

Leiomyomas derive their blood supply almost totally from the uterine arteries. Devascularization of the myomas by selective uterine artery ligation is the basis for many treatment modalities used for symptomatic myomas,

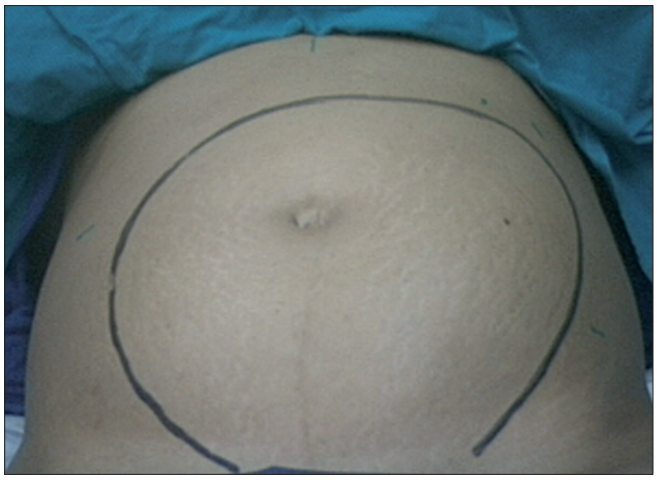

Figure 1: Large myoma-32 weeks

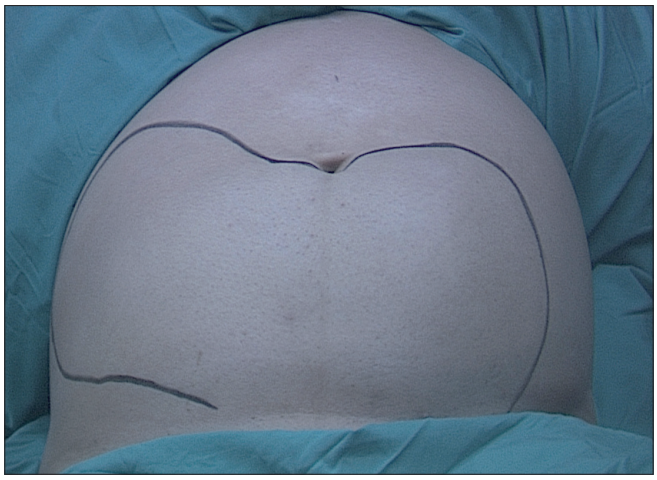

Figure 2: Large broad myoma

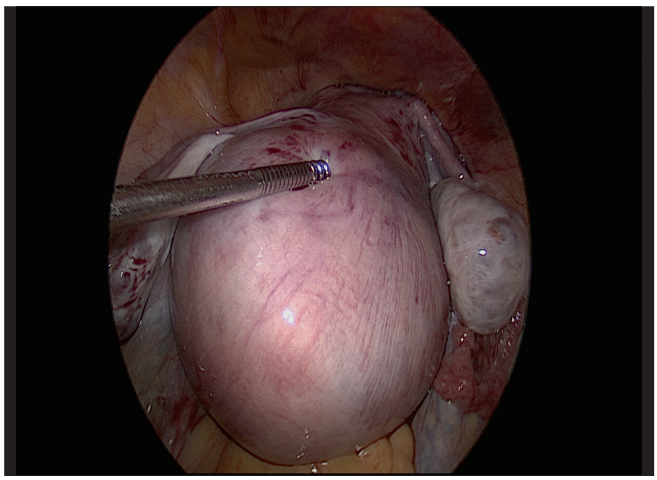

Figure 3: Posterior wall myoma

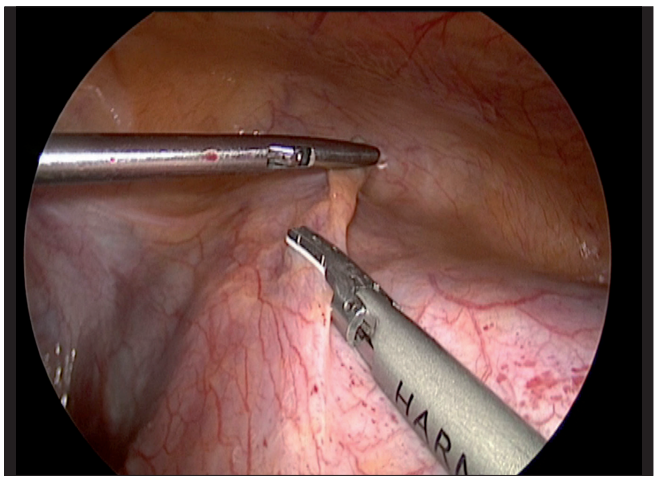

Figure 4: Opening the uterovesical fold of peritoneum

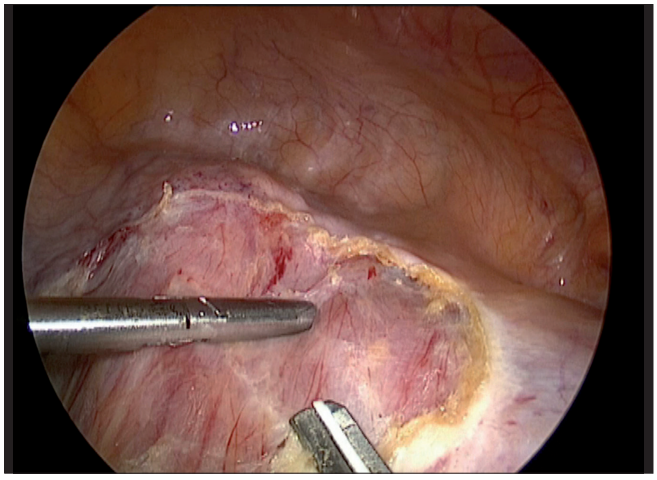

Figure 5: Dissecting the bladder down

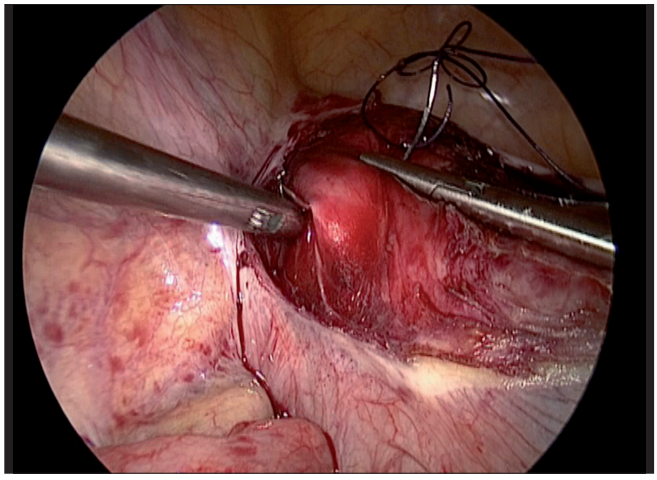

Figure 6: Suturing the left uterine artery

namely, laparoscopic bipolar coagulation of the uterine arteries[10] and uterine artery embolization. The author has also reported that ligation of uterine vessels as the first step in total laparoscopic hysterectomy considerably reduces blood loss during the procedure, especially in cases of large myomas.[11]

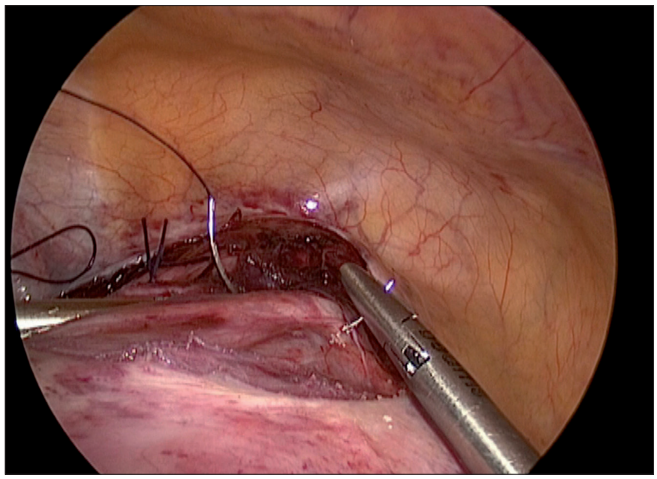

Figure 7: Suturing the right uterine artery

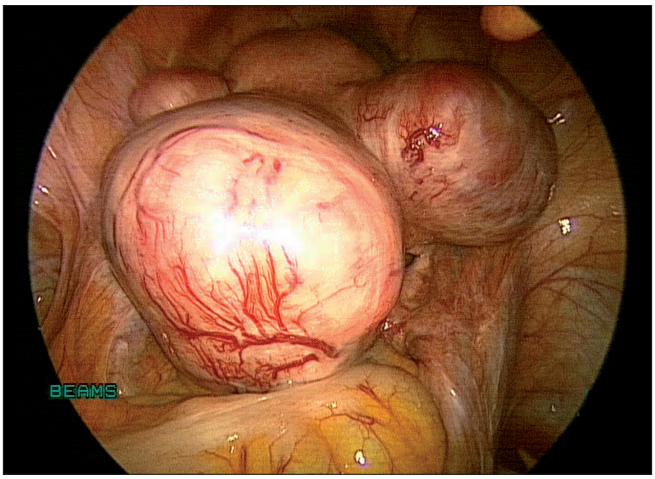

Figure 8: Multiple fibroids before devascularisation

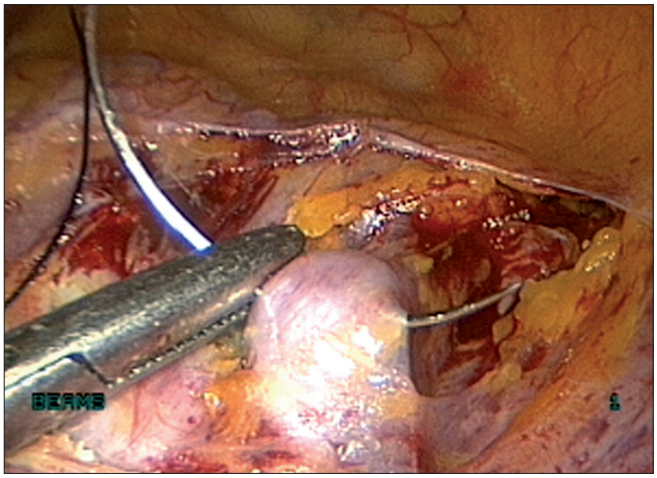

Figure 9: Right uterine artery ligated

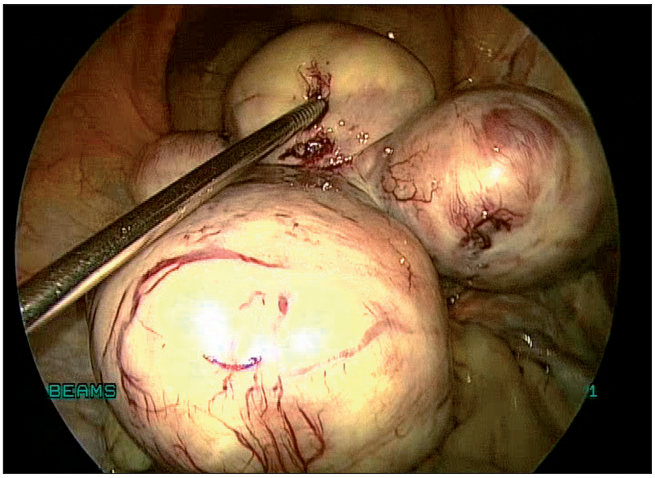

Figure 10: Multiple fibroids after devascularisation

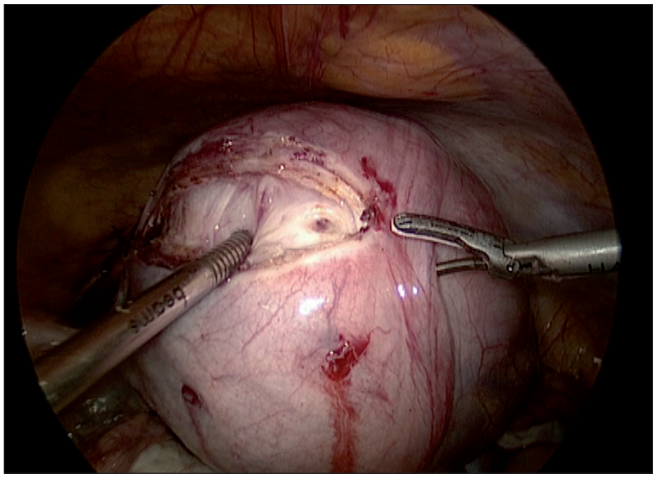

Figure 11: Opening the myoma capsule with harmonic ultracision

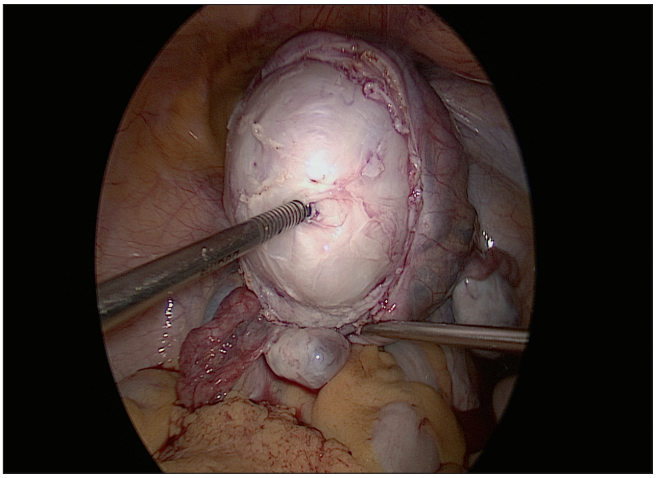

Figure 12: Enucleation of myoma

Uterine artery embolization (UAE) for the treatment of uterine myomas was first reported in 1995.[12] Since then, the long-term efficacy of UAE was indicated for the treatment of heavy uterine bleeding and for the reduction of uterine volume. A complication associated with UAE was the post

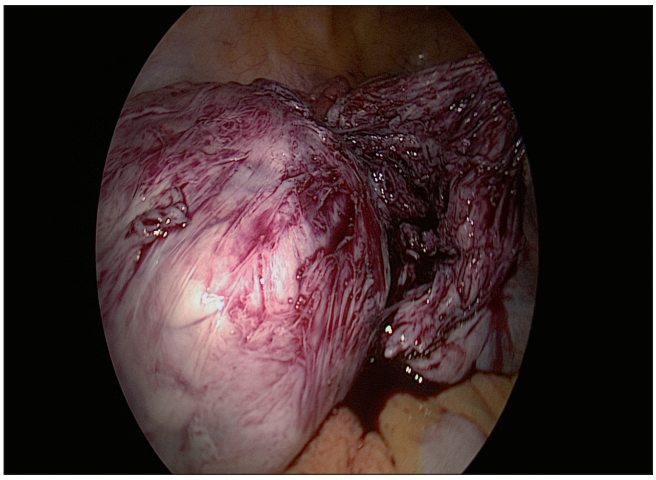

Figure 13: Enucleating the myoma from the bed

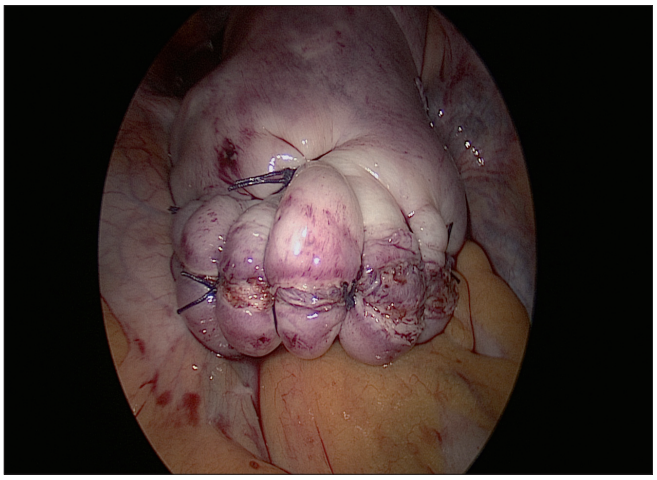

Figure 14: Sutured myoma bed

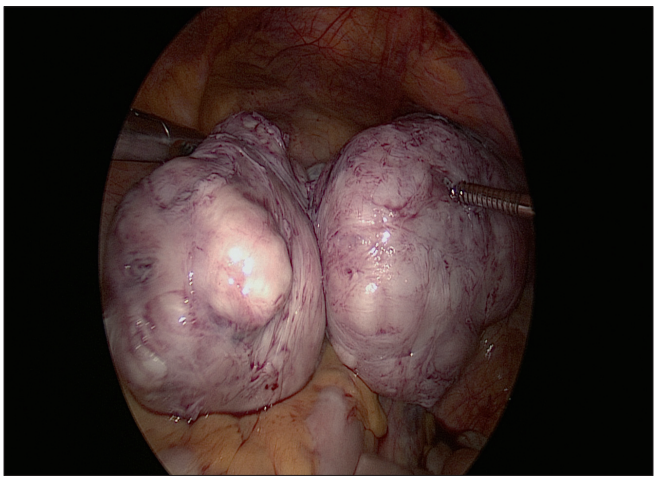

Figure 15: Anterior and posterior wall myoma

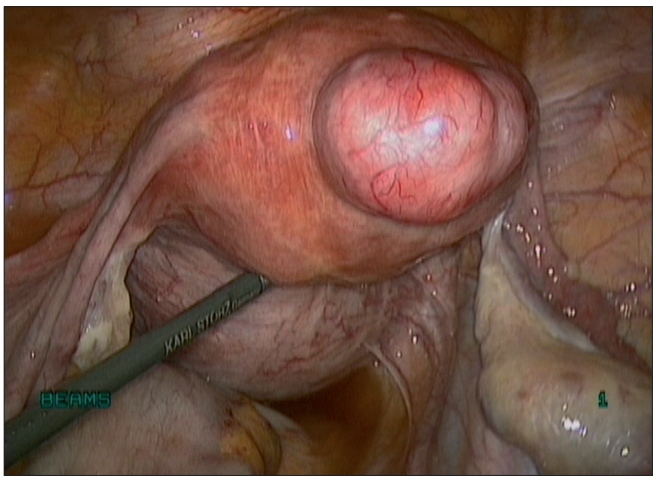

Figure 16: Cervical and fundal myoma

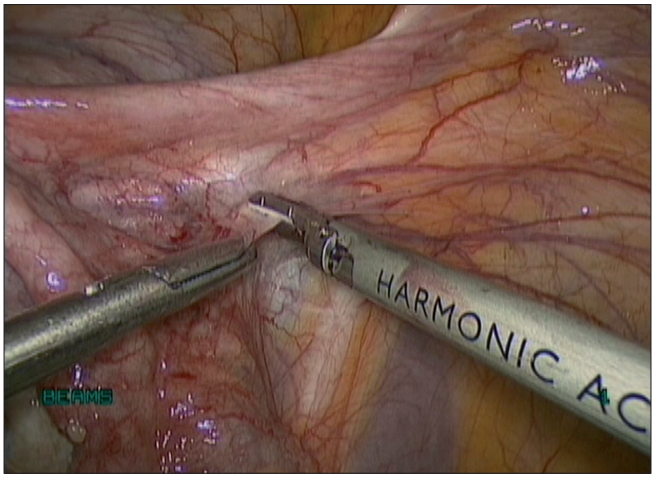

Figure 17: Opening the peritoneum of the lateral pelvic wall

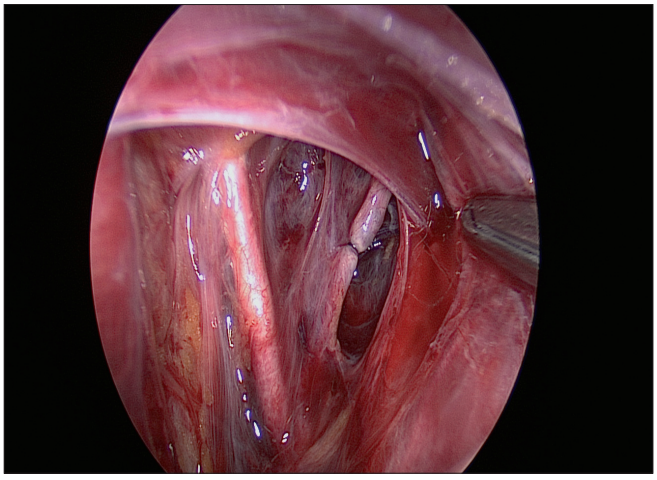

Figure 18: Left uterine artery ligated at its origin

embolization syndrome, characterized by fever, pain, nausea, and vomiting, and leukocytosis, which affects up to 26% of the patients and contributes to prolonged institutional stays (including readmission), heavy analgesic use, and delayed return to normal activities. [13]

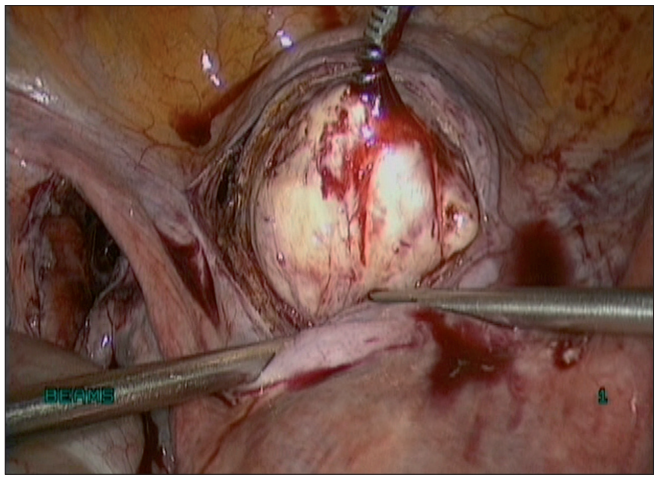

Figure 19: Opening the myoma capsule

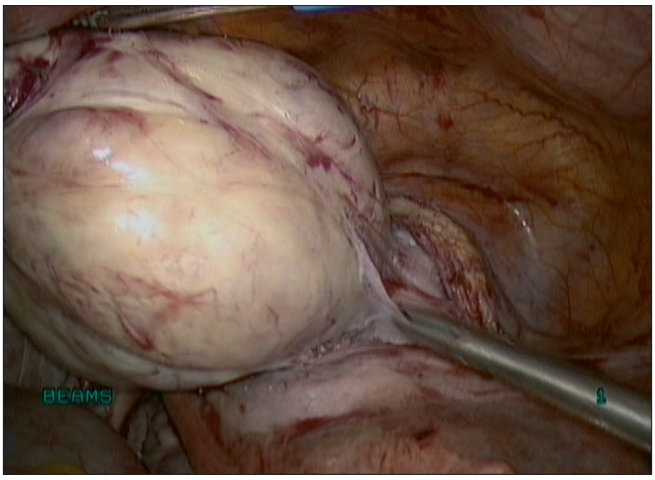

Figure 20: Enucleation of the myoma

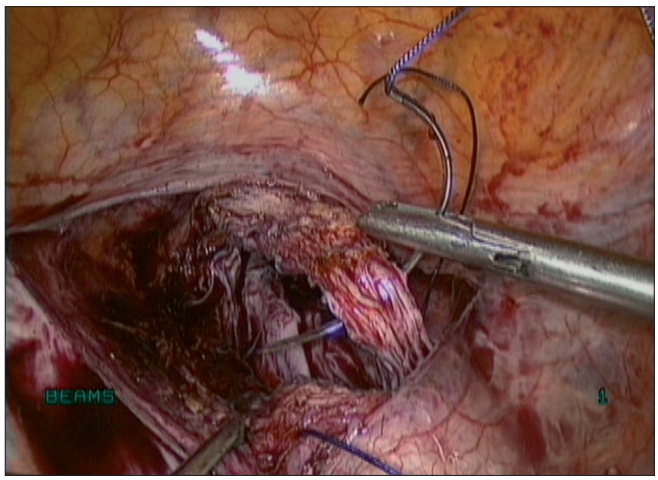

Figure 21: Suturing the myoma bed

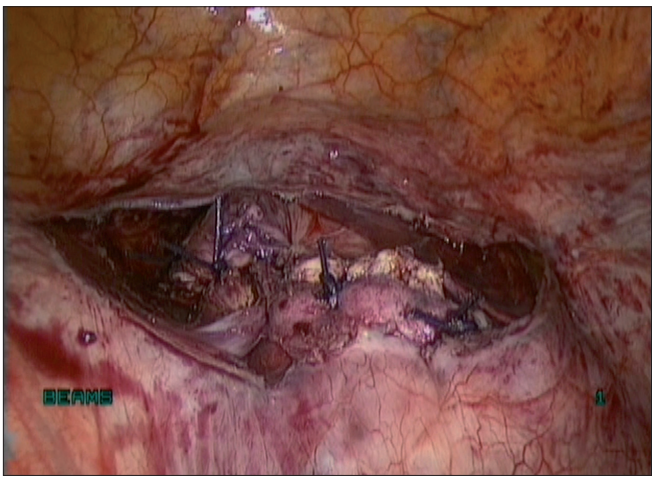

Figure 22: Sutured myoma bed

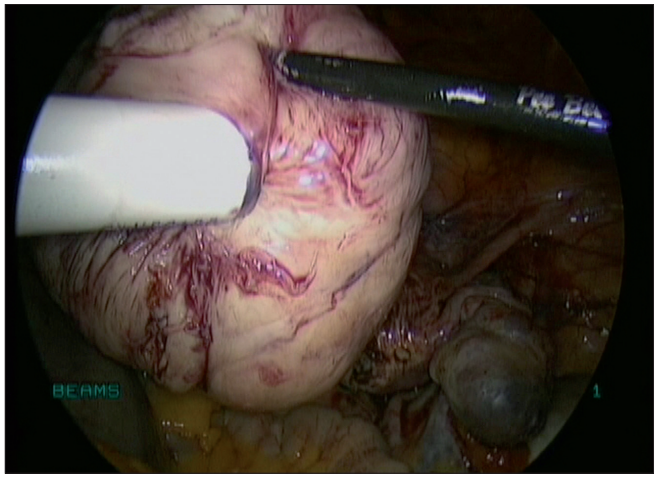

Figure 23: Morcellation of the myoma

Clinical results similar to those obtained with UAE were revealed using laparoscopically directed uterine artery occlusion (UAO) with bipolar coagulation / desiccation or surgical clips.

Cheng *et al*.,[14] studied the effect of laparoscopic uterine artery occlusion combined with myomectomy for uterine myomas and stated that although hemostasis did not appear to be a problem after artery occlusion, anatomic apposition was the main target of suturing under laparoscopy. Peng Hui *et al*.,[15] studied the necessity of laparoscopic myomectomy in the treatment of women with symptomatic uterine myomas, who were undergoing laparoscopic uterine vessel occlusion. They concluded that uterine vessel occlusion with laparoscopic myomectomy was better compared to only uterine artery occlusion without myomectomy.

Concerns of uterine artery ligation during laparoscopic myomectomy

Technical difficulties of ligating the uterine vessels, especially in large myomas may be a restricting factor. However, with adequate training and the skill of the surgeon, it is not impossible. The other issue is that injecting vasopressin may *per se* be adequate to control the bleeding

during myomectomy. However, in large myomas, injecting a large amount of vasopressin can also be detrimental. If it is technically possible to ligate the uterine vessels before myomectomy, especially in large myomas, then bleeding during the procedure would not be a major concern. Including the ureters in the suture is another concern. If the uterovesical fold of the peritoneum is opened and the bladder pushed down, the ureters move laterally and the chance of including them in the suture is less.

Fertility after uterine artery ligation

Studies on uterine artery embolization have clearly stated the possibility of ovarian failure following the procedure. Tulandi *et al*.,[16] have described that due to transient ovarian ischemia, some degree of ovarian reserve appears to be lost when the ovaries are inadvertently embolized. In most women, the ovarian blood supply is dual. Blood flow reaches the ovary either from the ipsilateral ovarian artery or from the ipsilateral utero-ovarian communicating arteries, and does so depending on the local arterial and arteriolar resistances.[17] Most utero-ovarian communicating arteries are 0.5 mm or greater in diameter. Consequently, when uterine artery embolization (UAE) is performed with sufficiently small embolic particles, approximately 60% of ovaries are vulnerable to embolization. Pathology examinations of the ovaries following UAE demonstrate embolic particles in the ovaries following UAE.

In our technique we selectively isolate the uterine arteries and ligate them. This excludes the possibility of ligating the utero-ovarian communicating artery and does not cause decreased ovarian reserve or ovarian failure. Most studies suggest that unlike uterine artery embolization, uterine artery occlusion is a selective procedure and does not cause decreased ovarian reserve. Xiaoyan *et al*.,[18] have conducted a study to assess the effect on ovarian reserve function after laparoscopic uterine artery occlusion (LUAO) compared with laparoscopic myomectomy (LM). Blood samples were collected before surgery and at one, three, and six months postoperatively. Concentrations of the follicle-stimulating hormone (FSH), leuteinizing hormone (LH), and estradiol (EZ) were determined using an immunoassay, and serum inhibin B (INHB) concentration was evaluated using an enzyme-linked immunosorbent assay. The study concluded that at a short-term follow-up, no significant effect was found on ovarian reserve in patients with myoma, who underwent laparoscopic uterine artery occlusion. There are no long-term randomized trials on this effect published so far. We are conducting a study in our institute to assess the effects of uterine artery ligation on ovarian reserve and future pregnancy.

Pregnancy after uterine artery ligation

Successful pregnancy rates have been reported in literature following bilateral internal iliac ligation.[19] Fertility and pregnancy following selective ligation of the uterine arteries has also been reported in literature. Between 1964 and 1980, nearly two dozen full-term, successful pregnancies in women who had uterine artery ligation performed have been recorded in the world's medical literature.[20,21] From this we can conclude that following selective ligation of the uterine arteries, pregnancy is possible. Reports on pregnancy rates after uterine artery embolization has been variable, as most of these women were in the older age group.

Given that the uteroplacental arteries were formed by the retrograde invasion of trophoblasts into and around arterioles in the decidua, trophoblasts encountering PVA particles or the like, in and around these arteries, might be expected to present a dilemma. Embolization with temporary materials such as Gelfoam or clotted autologous blood might be superior at preserving the reproductive potential. Similarly, surgical methods that temporarily occlude the uterine arteries, such as ligation of the uterine arteries with resorbable suture material or a temporary paracervical clamp, might allow more successful future pregnancies than small, permanent embolic particles.

Holub *et al*.,[22] assessed pregnancy outcomes and deliveries after laparoscopic uterine artery transection in symptomatic women with fibroids. One hundred and fifty-three patients underwent laparoscopic transection of uterine vessels during a four-year period.The study concluded that laparoscopic transection of uterine vessels is a minimally invasive operative procedure, that preserves the uterus and ovarian blood supply and allows for the achievement of pregnancy in women with symptomatic fibroids. Fetal growth and umbilical Doppler findings remained normal in all cases. An increased risk for preterm delivery and Cesarean section was found in this small series.

CONCLUSION

Laparoscopic myomectomy with uterine artery is a technically feasible procedure. Ligating the uterines bilaterally with either the ascending branch or at its origin from the internal iliac, considerably reduces blood loss during myomectomy. It also helps to shrink small fibroids and prevent the recurrence of fibroids.

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