

Myolysis Revisited

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ABSTRACT

Numerous procedures have been developed in recent decades that claim to provide significant improvement in myoma status without hysterectomy. However, what is the cost in time and money of these procedures? This is a review of the current literature regarding these recent procedures to determine which, if any, is the best treatment for myomas. We conducted a search of PubMed using the terms “bipolar-, cryo-, radiofrequency, laparoscopic-, focused high-energy MRI-guided ultrasound, and MRI-guided laser myolysis” to identify reports of the various procedures. Based on these published reports, we describe the various types of myolysis performed in multiple patients in outpatient facilities including patient outcomes, complications, cost, and efficiency of the procedures.

Key Words: Myolysis, Laser myolysis, Cryo-myolysis, Radiofrequency.

INTRODUCTION

The era of minimally invasive treatment of uterine fibroids and menorrhagia was begun by Milton Goldrath in the early 1980s when he performed Nd:Yag laser endometrial ablation on a young woman with persistent vaginal hemorrhage. Goldrath,¹ Neuwirth,² and Vancaille³ have published their data on endometrial ablation techniques. Falcone⁴ has summarized the minimally invasive management of uterine fibroids. He included laparoscopic myomectomy, myolysis, and uterine embolization. Laparoscopic myomectomy has been advocated by Dubuisson⁵ and Miller⁶ as a safe, effective technique for treatment of fibroids. The problem remains that the learning curve for laparoscopic surgeons is steep, and blood loss and operating time can be extensive.

Based on a literature search of PubMed using the terms “bipolar-, cryo-, radiofrequency, laparoscopic-, focused high-energy MRI-guided ultrasound, and MRI-guided laser myolysis,” we identified reports of the various procedures currently being used to treat myomas. Herein, we review the various methods of myolysis, which are alternatives to hysterectomy, for the treatment of fibroid myomas.

MYOLYSIS

Myolysis was first performed by Mergui in France in 1987. He used an Nd:YAG laser to make multiple punctures in myomas with resultant tissue death and myoma shrinkage. He presented this work in a video shown at the European Association of Endoscopic Surgery meeting in Lausanne, Switzerland in 1990.⁷

Leukens and Gallinat⁸ presented their work in a chapter of *Endoscopic Surgery in Gynecology* published in Berlin in 1993. They used 1-cm to 3-cm bipolar needles to destroy myoma tissue. Their technique was similar to that of Mergui.

LAPAROSCOPIC MYOLYSIS

We performed the first myolysis in the United States in 1990.⁹ Early cases were accomplished using the laser technique, but after 1992 specially designed 5-cm sturdy bipolar needles were used to perform the procedures. Eventually, the needle technique replaced the laser completely.

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A major premise of the procedure is that smaller fibroids will yield better results than larger ones will. Therefore, using depo GnRH agonists to preshrink the fibroid would result in a smaller final size and improve the results. Pretreating a 10-cm myoma with 12 weeks of depo agonist resulted in a 40% reduction in size, and the postmyolysis volume was again reduced by another 50%. In this manner, a 10-cm myoma could ultimately be reduced to 4 cm to 5 cm.

In 1992 in response to criticism that excessive adhesions would develop as a result of damage to the visceral peritoneum overlying the myoma, the technique was reassessed and changed. The modified approach was to perform circumferential punctures by using the 5-cm bipolar needles. Each pass at 50 watts of coagulating current left for 10 seconds to 15 seconds would result in a fraction of the total circumferential tissue death. Obliterating the feeding vessels with this approach would result in tissue death without extensive peritoneal superficial tissue trauma.

Additionally, we proposed the following criteria for maximizing the success of the procedure.⁹

1. Limit the procedure to postreproductive premenopausal women.
2. Limit the myoma size to 10 cm, which would have a final result of 3 cm to 4 cm.
3. Administer GnRH agonist for 10 weeks to 12 weeks to obtain maximal tissue shrinkage.
4. Discontinue the process of the GnRH agonist because it does not result in a 30% to 40% reduction in myoma size.
5. Treat menorrhagia concomitantly with a hysteroscopic resection of submucosal myomas, endometrial ablation, or both.

From 1986 to 1990 prior to the introduction of the myolysis technique, we reported on 52 endometrial ablations¹⁰; 20/52 or 38% of the patients undergoing ablation alone had significant recurrent bleeding and required a second procedure. Of 88 myolysis procedures accompanied by endometrial ablation and an additional 28 utilizing myolysis and extensive resection of submucosal myomas, only 11/88 or 12.5% required a second procedure; 18% of the resection patients and only 5.75% of endometrial ablation-myolysis patients subsequently underwent hysterectomy.

Volumetric analysis of fibroid volume was conducted in 13 patients. Preoperative fibroid volumes ranged from 30 cm³ to 363 cm³ with a median of 111 cm³. Following pretreatment and surgery, the volume ranged from 1 cm³ to 73 cm³. Half of the patients experienced a reduction in fibroid volume of at least 83%. The entire group experienced an average reduction of 72.6%.

CRYOMYOLYSIS

In 2005, Exacoustos et al¹¹ reported on 10 premenopausal patients with a sonographic diagnosis of a single subserosal or intramural uterine myoma, who underwent laparoscopic cryomyolysis. The masses varied from 4 cm to 8 cm, and all patients were postreproductive. Exacoustos et al¹¹ excluded patients with suspected adenomyosis and other significant gynecological conditions. Power Doppler imaging was carried out in addition to standard 2D and 3D sonography. Patients were evaluated at 1, 3, and 6 months. A total 52.6% reduction in myoma size was noted, as was a significant reduction in central blood flow.

Cryomyolysis uses gas-cooled cryoprobes in which pressurized gas is expanded through a small orifice to produce cooling. The temperature will drop to -90°C in 8 minutes to 10 minutes, creating an expanding ice ball around the probe with a transverse diameter of 3 cm to 4 cm and a length of 5 cm to 7 cm. The ice ball can be monitored by ultrasound. Although the entire ice ball does not reach maximum cooling, Exacoustos et al¹¹ note that tissue death occurred at -20°C. Vascular reduction was immediately noted.

Although this procedure is quite effective in moderate-sized myomas, the cost of the equipment, more than \$30,000 US, and the cost per case of \$750 is significant.

Ciavattini et al¹² in 2006 reported on 9 cases of pregnancy after laparoscopic cryomyolysis. During the first 20 weeks of gestation, the mean increase in cryo-treated myoma volume was 71% (range, 21.8 to 97.7). Two myomas were stationary, and 2 new ones appeared. Two patients had early miscarriages, and the course of 7 other pregnancies was normal. Four vaginal deliveries and 3 cesarean deliveries took place.

It appears that the significant regrowth in fibroid volume could be related to incomplete tissue death at the time of initial treatment.

RADIOFREQUENCY ABLATION

Bruce Lee, MD¹³ performed the radiofrequency interstitial tissue ablation (RITA) procedure, percutaneous insertion

of radio frequency ablation needle (15 gauge) under laparoscopic intraabdominal ultrasound guidance. After the needle is inserted, smaller prongs are deployed into the stroma of a given uterine myoma. Coagulative necrosis results, and the fibroid is absorbed. The goal of this procedure is to coagulate only the internal structure of the fibroid and not to impact normal endometrium. One patient has attempted pregnancy, and the infant was successful and uneventfully delivered. Lee¹³ undertook a prospective study of 125 patients; 70% of the patients had at least one fibroid ≥ 4 cm, and 38% had a fibroid ≥ 6 cm. The volume reduction was 40% at 36 months. In addition, 98% of the dysmenorrheal complaints disappeared by 6 months after treatment.

Bergamini et al¹⁴ in 2004 reported on 18 patients treated with the radiofrequency technique (RITA Medical System, Mountain View, CA), which involves a percutaneous needle system under laparoscopic guidance that is used to puncture a given myoma and subsequently deploy multiple prongs in a Christmas tree configuration. The system utilizes radiofrequency energy, which is an alternating current with a frequency between 10 kHz and 900 kHz. The heat generated by the electrical current is dissipated at the electrode-tissue interface. Temperature above 50°C melts cell membranes, proteins denature, and cell death occurs. In only 3 of his patients were myomas greater than 6 cm. Median baseline volume was only 67 cm³. However, 9 patients followed up for 12 months had an 85% reduction in volume.

UTERINE ARTERY EMBOLIZATION

In the 1990s in France, Ravina first introduced uterine artery embolization as an elective procedure to treat fibroids. Ravina et al¹⁵ found that myoma size can be reduced from 20% to 70% with improvement in uterine bleeding and pain in up to 90% of patients. Proper selection of patients and reports of severe complications have somewhat limited the popularity of the procedure. Premature menopause, expulsion of submucosal myomas, infections, and misplacement of particulate matter have been reported. The most glaring problem is that invasive radiologists early on were embolizing very large fibroids with bad results. If a 10-cm³ myoma was reduced 40%, the resulting volume was 8 cm³. If a 20-cm³ myoma was embolized and reduced 40%, the resulting volume was 16 cm³. In both instances, the reduction in size may not be enough to relieve the patient's symptoms. Katsumori et al¹⁶ used gadolinium-enhanced MRI to determine the degree of infarction after embolization. The volume of dominant fibroids that were 100% infarcted was reduced

60 \pm 18%, whereas volume of partly infarcted myomas declined by 35%.

The following is a statement by Malcolm Munro, MD¹⁷ in the American Association of Gynecologic Laparoscopists online chat room in response to comments concerning uterine artery embolization (UAE):

The decision regarding appropriate patients for UAE should not be in the hands of the interventional radiologist . . . it should be a collaborative decision made by the patient and the gynecologist after considering all of the options available for the treatment of her symptoms that are presumed to be caused by uterine leiomyomas. In general, these symptoms should not be related to myomas that can be treated by hysteroscopically directed resection. Interventional radiologists are, in this situation, technicians . . . they do not have the training or ability to make such decisions absent the counseling provided by a gynecologist unimpeded by biases that relate to lost revenue or presumptions of the universal superiority of surgical interventions. Please do not teach your residents that "definitive surgery" is only hysterectomy as implied in your note . . . for most women appropriately selected, UAE is "definitive" . . . as is hysteroscopic myomectomy for submucous myomas, the levonorgestrel releasing IUD for heavy menstrual bleeding, or laparoscopic or laparotomic myomectomy for myoma-related pressure symptoms. . . . The term "definitive" has been manipulated to suggest that hysterectomy is the only therapy that is "guaranteed" to produce results; while true, such a contention often levers patients into selecting an approach that is often more than they need.

MRI-GUIDED PERCUTANEOUS ABLATION

Law and Regan¹⁸ reported on uterine myomas treated with cryotherapy and lasers. Although this procedure can be performed with local anesthesia, a high incidence of major perioperative complications has been reported.¹⁸

MRI-GUIDED FOCUSED ULTRASOUND

Stewart et al¹⁹ have shown the technique of delivering intensely focused ultrasound to destroy uterine fibroids with MRI guidance to be effective in reducing fibroid volume.

Fennessy et al²⁰ report significant improvement in symptoms with magnetic resonance (MR) imaging-guided focused ultrasound surgery to treat uterine leiomyomas in a prospective study using 2 treatment protocols, an original (96 patients) and a modified protocol (64 patients). The

symptom severity score (SSS) obtained at baseline and 3, 6, and 12 months after treatment was used to analyze outcomes. Adverse events (AEs) were also noted. Patients in the modified group had a significantly greater SSS decrease at 3 months ($P=0.037$) than did those in the original group, and 73% of the original group and 91% of the modified group had a ≥ 10 -point decrease in SSS at 12 months. The modified group had fewer AEs than did the original group (13% vs 25% reporting no event). Alternative treatments were chosen by fewer in the modified group (28%) than in the original group (37%). This study indicates that MR imaging-guided focused ultrasound surgery results in improved symptoms for up to 12 months after treatment. Greater clinical effectiveness and fewer AEs resulted from treatment with the modified protocol. The time required to perform the procedure varies from 2 hours to 4 hours. The cost of the equipment of over \$1 million makes the cost of the procedure prohibitive. Complications reported include skin burns and nerve injury.²¹

MECHANICAL UTERINE ARTERY OCCLUSION

During uterine artery embolism, the occlusion of uterine vessels yields only transient ischemia. Fred Burbank, MD²² has postulated that after occlusion, blood within the myometrium clots and the myometrium becomes hypoxic. Hours later, the clots lyse, and the myometrium becomes reperfused through collateral arteries and becomes normal after one month.

Olave Istre, MD²³ of Oslo Norway used a Doppler-guided paracervical clamp to occlude the uterine arteries. Each of the 2 clamp blades is connected to a Doppler device, and blood flow can be heard and measured. When placed correctly, the flow disappears and the result is similar to uterine embolization. The patient is kept with an epidural block for 4 hours to 6 hours and is then released. Postoperative MRI studies have shown fibroid death similar to that occurring with embolization. Although patients still have postembolization pain, there are no surgical complications. A major issue is the potential crushing effect on the ureter. Lichtinger²⁴ observed the effect on the ureter with no untoward results.

TRANSCERVICAL MYOLYSIS-ASSISTED BY TRANSVAGINAL ULTRASONIC GUIDANCE

Kanaoka et al²⁵ report a preliminary study of 10 patients with severe abnormal bleeding scheduled for microwave endometrial ablation but subsequently undergoing transcervical microwave myolysis using a guiding needle set in a puncture adaptor attached to a transcervical ultrasonic

probe and a microwave applicator 1.6-mm in diameter. Myoma shrinkage was measured at 3 months and 6 months. In 9 patients with either mostly submucosal or intramural myomas of 4.0 cm to 7.5 cm, the tissue was necrotized. Myomas were reduced in size by 36% to 69% at 6 months. Rene Marty and Jacques Hamu in Paris also advocate this procedure. They used the hysteroscopic approach with needle electrosurgery.

This approach opens a new venue for treating intrauterine myomas that we previously treated with hysteroscopic resection. The problem with the latter approach is that a significant portion of the myomas was often invading deep into the myometrium. Resection of these myomas often resulted in continuing prolapse of the myoma into the endometrium. A word of caution about performing this procedure—the authors have incorporated into their technique the performance of laparoscopy to ensure that bowel is not attached to the uterus and the instillation of 3 liters of lactated Ringer's solution intraabdominally to obviate intestinal hyperthermia. Laparoscopy can be avoided in the virginal abdomen without a history of endometriosis or infection, or if the tumor is well within the myometrium and more than 5 mm from the serosa.

CONCLUSION

The procedures described above usher in a new generation in the field of women's health. No longer is the patronizing comment "you have had your children and would be better off without your uterus" an ACCEPTABLE APPROACH. Yes, there are significant indications for hysterectomy, and the decision should be a joint one between the patient and her physician. Most of the procedures described above are offshoots of the original "myoma coagulation" procedure, but many are more expensive than myoma coagulation and have not yet been shown to be more effective. The important point here is that alternative treatments for fibroids are available, and hysterectomy is only ONE option, not THE option.

Reducing fibroid size and limiting detrimental effects of menorrhagia is an outgrowth of the WOMEN'S movement and the realization that hysterectomy avoidance satisfies the emotional needs of many women to retain their organs. It is physicians' responsibility to familiarize themselves with alternative options and to guide and assist their patients by offering the most patient-friendly, cost-effective, and safe procedure. Physicians also have an obligation to refer patients for procedures they do not feel comfortable performing. We should be advocates for our patients. In the long run, everyone will benefit.

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