

# **Risk Factors and Preventive Strategies for Surgical Complications Associated with Uterine Fibroids**

Kai YAN<sup>1</sup>, Xiuqing ZHANG<sup>2#</sup>, Hang GAO<sup>1</sup>, Xiaolin CHEN<sup>1</sup>, Zhifeng MO<sup>3,\*</sup>

*1. Department of Gynaecology, Shenzhen Maternity and Child Healthcare Hospital, Shenzhen, Guangdong Province, China, Email: 13500051598@163.com 2#. Co-first author, The Tenth Affiliated Hospital, Southern Medical University (Dongguan People's Hospital), Department of obstetrics, Dongguan, Guangdong Province, China, Email: 39218287@qq.com 3\*. Corresponding author: Zhifeng Mo; Department of Emergency and Disaster Medical Center, The Seventh Affiliated Hospital of Sun Yat-sen University, Shenzhen, Guangdong Province, China, Email: mozhf3@mail.sysu.edu.cn, <https://orcid.org/0000-0002-9273-003X>*

## **Abstract**

Uterine fibroids are common benign tumors that often necessitate surgical intervention. However, such procedures can result in complications that have a detrimental impact on patient recovery and quality of life. In this review, we sought to identify and assess risk factors associated with surgical complications in the treatment of uterine fibroids. A comprehensive analysis of clinical studies and relevant literature was conducted to explore common complications, including hemorrhage, infection, and damage to surrounding organs. Furthermore, we examined patient-specific risk factors such as age, comorbidities, and fibroid characteristics. Based on the findings from the literature, we propose preventive strategies to mitigate these risks, including preoperative planning, minimally invasive surgical techniques, and enhanced postoperative care protocols. Additionally, tailored surgical approaches and improved perioperative management can help reduce the incidence of complications, improving patient outcomes and quality of life. These conclusions provide actionable insights for clinicians to optimize treatment plans and minimize risks for patients undergoing surgery for uterine fibroids.

**Keywords** Uterine fibroids; Surgical complications; Risk factors; Preventive strategies; Clinical research

**To Cite This Article** Kai YAN, et al. (2024). Risk Factors and Preventive Strategies for Surgical Complications Associated with Uterine Fibroids. *Medical Research*, 6(3), 91-102. <https://doi.org/10.6913/mrhk.060309>

*Medical Research*, ISSN 2664-0333 (print), ISSN 2664-0341 (online), DOI 10.6913/mrhk, a bimonthly, founded on 2018, Indexed by CNKI, Google Scholar, AIRITI, Scilit, CrossRef, Elsevier PlumX, etc., published by Creative Publishing Co., Limited. Email: wtocom@gmail.com, <https://mrhk.cc>, <https://cpcl.hk>.

## 1 Introduction

Uterine fibroids, also known as leiomyomas or myomas, are the most common benign tumors in women of reproductive age, affecting approximately 70–80% of women by the age of 50<sup>[1]</sup>. They originate from aberrant smooth muscle cells in the smooth muscle layer of the uterus and can vary greatly in size, number, and location, causing a range of symptoms such as heavy menstrual bleeding, pelvic pain, abdominal discomfort, and reproductive problems<sup>[2]</sup>. Despite their benign nature, uterine fibroids can significantly impact a woman's quality of life and are a leading cause of hysterectomy worldwide<sup>[3]</sup>. The precise etiology of uterine fibroids remains unclear; however, there is consensus that genetic, hormonal, and environmental factors play crucial roles<sup>[4]</sup>. Uterine fibroids are more prevalent among women of African descent than among women of other ethnicities, and women of African descent are more likely to develop fibroids at a younger age and experience more severe symptoms<sup>[5]</sup>. The presence of fibroids can lead to significant morbidity, including anemia due to heavy menstrual bleeding, and can adversely affect fertility and pregnancy outcomes<sup>[6]</sup>.

Surgical intervention remains a cornerstone in the management of symptomatic uterine fibroids. Myomectomy, hysterectomy, and uterine artery embolization are among the most common surgical options<sup>[7]</sup>. Although these procedures can effectively alleviate symptoms and improve quality of life, they are not without inherent risks. Surgical complications such as hemorrhage, infection, and damage to surrounding organs can occur, necessitating a thorough understanding of the risk factors and the development of effective preventive strategies<sup>[8]</sup>. Surgical complications associated with uterine fibroid treatment can significantly impact patient outcomes and healthcare resources. Complications such as hemorrhage, infection, and postoperative adhesions can prolong hospital stays, increase healthcare costs, and adversely affect patient recovery and quality of life<sup>[9]</sup>. Therefore, understanding the risk factors associated with these complications is essential for optimizing surgical outcomes and minimizing patient morbidity<sup>[10]</sup>.

Recent clinical studies have yielded valuable insights into the risk factors and prevention strategies for surgical complications associated with the removal of uterine fibroids. The objective of this clinical review is to provide a comprehensive summary of the most prevalent surgical techniques for the treatment of uterine fibroids, along with an analysis of the associated complications and risk factors. Furthermore, this review outlines strategies for the prevention of these complications.

## 2 Common Types of Surgical Approaches for the Removal of Uterine Fibroids

### 2.1 Laparoscopic Surgery

Laparoscopic surgery, also known as minimally invasive surgery, has gained considerable popularity as a treatment option for uterine fibroids, mainly due to the numerous advantages it offers over traditional open surgery. This technique involves the use of a laparoscope, a thin, lighted

tube with a camera, which allows the surgeon to visualize the pelvic organs on a monitor and perform the procedure through small incisions. Laparoscopic myomectomy is the preferred surgical approach due to its ability to reduce postoperative pain, shorten hospital stays, and facilitate a quicker recovery compared to open myomectomy<sup>[11]</sup>. Studies have shown that laparoscopic myomectomy is an effective intervention for improving health-related quality of life (HR-QoL) and reducing symptom severity in patients with symptomatic uterine fibroids<sup>[12]</sup>. However, the procedure requires a high level of surgical skill and experience, and the risk of complications such as bleeding and infection, although lower than in open surgery, remains a concern<sup>[13]</sup>. Additionally, the size, number, and location of the fibroids can influence the feasibility and success of laparoscopic surgery<sup>[14]</sup>.

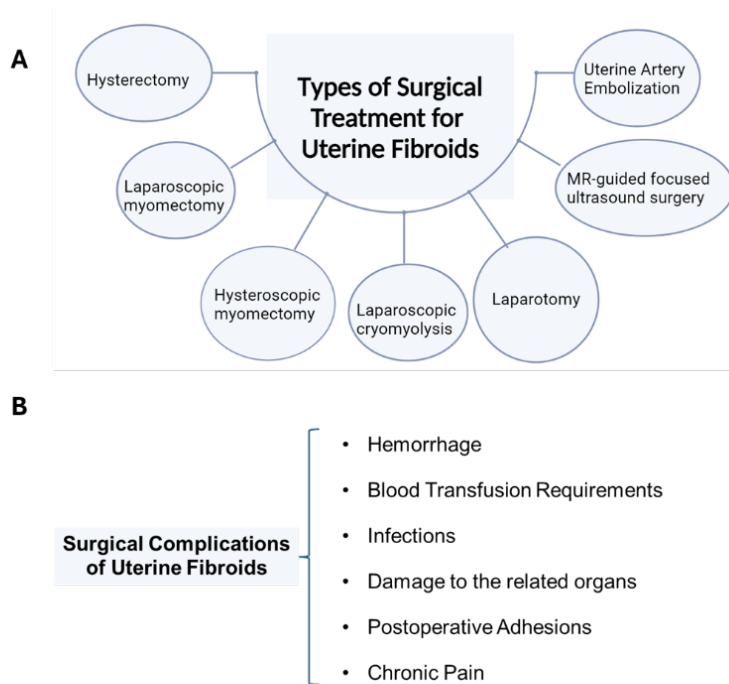
## 2.2 Open Abdominal Surgery

Open abdominal surgery, or laparotomy, remains the standard treatment for uterine fibroids, particularly in cases where fibroids are large, numerous, or located in positions difficult to access laparoscopically. This approach involves a larger incision in the abdomen to allow direct access to the uterus. While open myomectomy is highly effective in removing fibroids and alleviating symptoms, it is associated with prolonged hospital stays, increased postoperative pain, and a longer recovery period compared to minimally invasive techniques<sup>[15]</sup>. Despite these drawbacks, open surgery is sometimes necessary to ensure complete removal of fibroids and to manage complications such as severe bleeding<sup>[16]</sup>. Furthermore, studies have indicated that open myomectomy can result in significant improvements in HR-QoL and symptom severity, although it carries an elevated risk of adhesions and other postoperative complications<sup>[17]</sup>.

## 2.3 Uterine Artery Embolization

Uterine artery embolization (UAE) is a minimally invasive procedure that involves the injection of embolic agents into the uterine arteries to block blood flow to the fibroids, causing them to shrink and die. This technique is particularly advantageous for women who wish to avoid surgery and preserve their uterus<sup>[18]</sup>. UAE has been shown to markedly improve HR-QoL and reduce symptom severity in patients with symptomatic uterine fibroids<sup>[19]</sup>. However, this procedure is not without risks. Potential complications include post-embolization syndrome (characterized by pain, fever, and nausea), infection, and, in rare cases, premature ovarian failure<sup>[20]</sup>. Long-term studies have demonstrated that while UAE is effective in the short term, there is a higher likelihood of requiring additional interventions compared to surgical options<sup>[21]</sup>. Nevertheless, UAE remains a valuable alternative for patients seeking a less invasive treatment with a shorter recovery time<sup>[22]</sup>.

## 3 Complications Associated with the Surgical Removal of Uterine Fibroids



**Figure 1. Types of surgical treatment for uterine fibroids and the associated complications.**

### 3.1 Hemorrhage and Blood Transfusion Requirements

Hemorrhage is one of the most common and significant complications associated with uterine fibroid surgery. The risk of excessive bleeding is particularly high during procedures such as myomectomy and hysterectomy due to the vascular nature of the uterus and the fibroids themselves. Studies have shown that intraoperative blood loss can be substantial, often necessitating blood transfusions to manage the patient's hemodynamic status. For instance, a study conducted in Tanzania reported that 19.1% of women undergoing hysterectomy for uterine fibroids required a blood transfusion, highlighting the prevalence of this complication<sup>[9]</sup>. The need for transfusion not only increases the complexity and cost of the surgical procedure but also poses additional risks of complications, including transfusion reactions and infections. To mitigate the risk of excessive bleeding, it is recommended to optimize hemoglobin levels prior to surgery, utilize intraoperative hemostatic agents, and employ meticulous surgical techniques to control bleeding<sup>[8]</sup>.

### 3.2 Infection

Another significant postoperative complication is infection at the surgical site following uterine fibroid surgery. These infections can range in severity from superficial wound infections to more severe intra-abdominal infections, including pelvic abscesses and peritonitis. The incidence of postoperative infections can be influenced by several factors, including the duration of surgery, the patient's baseline health status, and the presence of comorbid conditions such as diabetes. A study from Haiti emphasized the significant impact of infections on the quality of life and recovery of women undergoing surgery for uterine fibroids, with a notable percentage of patients

experiencing postoperative infections<sup>[5]</sup>. Preventive measures such as prophylactic antibiotics, strict aseptic techniques, and careful postoperative monitoring are essential to reduce the risk of infections<sup>[23]</sup>.

### 3.3 Organ Injury

Injury to adjacent organs is a serious complication that can occur during uterine fibroid surgery, particularly during complex procedures like myomectomy and hysterectomy. The bladder, ureters, and intestines are susceptible to injury due to their proximity to the uterus. Such injuries can lead to significant morbidity, including urinary and gastrointestinal complications. A population-based study in Korea highlighted the long-term risks associated with organ injury during myomectomy, emphasizing the need for careful surgical planning and technique<sup>[3]</sup>. The use of advanced imaging techniques preoperatively and intraoperative guidance can help in identifying and preserving these vital structures<sup>[24]</sup>.

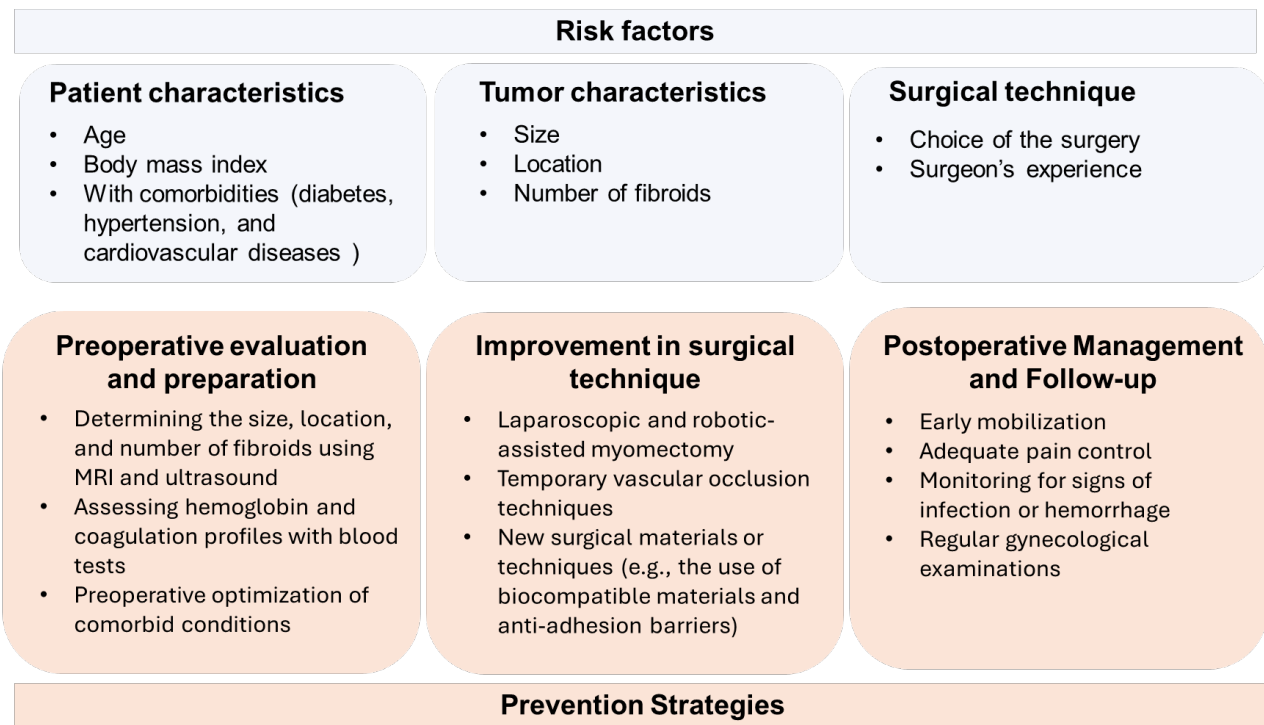
### 3.4 Postoperative Adhesions and Pain

Postoperative adhesions and chronic pain are common complications following uterine fibroid surgery. Adhesions may form as a consequence of surgical trauma and subsequent inflammation, leading to chronic pelvic pain, bowel obstruction, and infertility. Chronic pain, on the other hand, can significantly affect the patient's quality of life and may require long-term management strategies. A systematic review identified several modifiable risk factors for the development of postoperative adhesions, including surgical technique and the use of adhesion barriers<sup>[25]</sup>. Effective pain management protocols, including the use of multimodal analgesia and minimally invasive surgical techniques, can help reduce the incidence and severity of chronic pain<sup>[26]</sup>.

## 4 Risk Factors

### 4.1 Patient Characteristics

Patient characteristics, including age, body mass index (BMI), and the presence of comorbidities, significantly influence the risk of complications following uterine fibroid surgery. Advanced age is associated with an increased risk of perioperative complications, including elevated rates of bleeding and infection<sup>[27]</sup>. Additionally, there is substantial evidence that obesity, as indicated by a high BMI, is a well-documented risk factor for surgical complications. Obese patients are more likely to experience longer operative times, increased blood loss, and higher rates of wound infections<sup>[28]</sup>. Comorbid conditions such as diabetes, hypertension, and cardiovascular diseases further complicate the surgical landscape. These conditions can impair wound healing, increase the risk of thromboembolic events, and exacerbate intraoperative and postoperative complications<sup>[29]</sup>. Therefore, a thorough preoperative assessment of these patient characteristics is crucial for risk stratification and planning appropriate perioperative management strategies.



**Figure 2. Risk factors and preventative strategies for surgical complications of uterine fibroids .**

## 4.2 Tumor Characteristics

The characteristics of the fibroids themselves, including size, location, and number, are critical determinants of surgical risk. The presence of larger fibroids is associated with increased surgical complexity, longer operative times, and higher intraoperative blood loss<sup>[30]</sup>. The location of the fibroids also plays a significant role. For example, fibroids located near vital structures such as the bladder or bowel increase the risk of organ injury<sup>[31]</sup>. Multiple fibroids can complicate the surgical procedure, making complete resection more challenging and increasing the likelihood of residual disease<sup>[32]</sup>. Preoperative imaging and careful surgical planning are essential to address these challenges and minimize the risk of complications.

## 4.3 Surgical Technique

The selection of surgical technique and the surgeon's experience are pivotal in determining the outcome of uterine fibroid surgeries. Minimally invasive techniques, including laparoscopic and robotic-assisted surgeries, have been linked to reduced blood loss, shorter hospital stays, and quicker recovery times compared to open surgeries<sup>[33]</sup>. However, the extent to which these benefits are realized depends on the surgeon's expertise and experience with these techniques. Surgeons with extensive experience in minimally invasive procedures tend to have lower complication rates and better outcomes<sup>[34]</sup>. Conversely, less experienced surgeons may face higher rates of conversion to open surgery, increased operative times, and higher complication rates<sup>[35]</sup>. Continuous training and adherence to standardized surgical protocols are essential to optimize

surgical outcomes and minimize risks.

## 5 Current Status and Challenges of Prevention Strategies

### 5.1 Preoperative Evaluation and Preparation

Preoperative evaluation and preparation are crucial steps in minimizing the risk of complications during and after uterine fibroid surgery. Comprehensive preoperative assessments, including imaging studies such as MRI and ultrasound, help in accurately determining the size, location, and number of fibroids, which are essential for surgical planning<sup>[36]</sup>. Additionally, preoperative blood tests to assess hemoglobin levels and coagulation profiles are necessary to anticipate and manage potential intraoperative bleeding<sup>[37]</sup>. Preoperative optimization of comorbid conditions, such as diabetes and hypertension, is also critical, as these conditions can increase surgical risks<sup>[38]</sup>. Despite these measures, challenges remain in accurately predicting and mitigating all potential complications, particularly in patients with large or multiple fibroids or those with previous surgical histories<sup>[3]</sup>.

### 5.2 Improvement in Surgical Technique

Advancements in surgical techniques have significantly contributed to reducing the risk of complications associated with uterine fibroid surgeries. Minimally invasive procedures, such as laparoscopic and robotic-assisted myomectomy, have been shown to reduce intraoperative blood loss, postoperative pain, and recovery time compared to traditional open surgeries<sup>[28]</sup>. The use of temporary vascular occlusion techniques, such as the application of microsurgical vascular clips, has been effective in controlling intraoperative bleeding during the enucleation of large fibroids<sup>[39]</sup>. However, the learning curve associated with these advanced techniques and the availability of specialized equipment can be limiting factors in their widespread adoption<sup>[40]</sup>. Additionally, the risk of morcellation-related dissemination of undiagnosed malignancies remains a concern, necessitating careful patient selection and thorough preoperative evaluation<sup>[37]</sup>.

In a review by Herrmann et al. examining the incidence, risk factors, complications, and prevention of adhesions following laparoscopic myomectomy (LM)<sup>[41]</sup>, it was highlighted that despite the well-known advantages of laparoscopic surgery, such as reduced pain, decreased blood loss, and shorter hospital stays, myomectomy remains a high-risk procedure for adhesion formation. Notably, the data indicated that at least one in five patients developed post-surgical adhesions, which can lead to severe complications like small bowel obstruction, chronic pelvic pain, and impaired fertility. The study also emphasized the importance of surgical experience and minimizing tissue trauma to reduce adhesion formation. Developing effective prevention strategies for post-operative complications of uterine fibroid removal has been a pivotal focus of recent research. For instance, the use of biocompatible materials and anti-adhesion barriers has shown promise in reducing the incidence of post-surgical adhesions<sup>[41]</sup>. Additionally, tissue trauma and the surgeon's experience are critical factors influencing adhesion formation. Therefore, it can be

reasonably deduced that the implementation of meticulous surgical techniques and the utilization of advanced laparoscopic instruments can help mitigate these risks.

### 5.3 Postoperative Management and Follow-up

Effective postoperative management and follow-up are essential components of a comprehensive strategy to prevent complications following uterine fibroid surgery. Early mobilization, adequate pain control, and monitoring for signs of infection or hemorrhage are critical in the immediate postoperative period<sup>[38]</sup>. Long-term follow-up, including regular gynecological examinations and imaging studies, is necessary to monitor for the recurrence of fibroids and to manage any late-onset complications such as adhesions or chronic pelvic pain<sup>[42]</sup>. The use of pharmacological agents, such as GnRH analogs, in the postoperative period can help reduce the risk of fibroid recurrence<sup>[28]</sup>. However, adherence to follow-up protocols can be challenging for patients, and there is a need for improved patient education and support systems to ensure compliance<sup>[37]</sup>.

## 6 Future Research Directions

Future research should focus on the long-term outcomes of different surgical approaches and the development of novel materials and techniques to further reduce surgical complications. Studies are needed to evaluate the effectiveness of new anti-adhesion agents and their long-term safety profiles. Moreover, research into personalized medicine approaches, where surgical techniques and preventive measures are tailored to individual patient characteristics, could offer significant advancements in reducing complications. The integration of advanced imaging technologies and robotic-assisted surgeries also holds potential for improving surgical precision and outcomes. Continuous education and training programs for surgeons are essential to keep up with the latest advancements and ensure the highest standards of patient care.

## 7 Conclusion

In summary, uterine fibroid surgery, despite being a prevalent and often necessary intervention for many women, carries the risk of several complications that can significantly impact patient recovery and quality of life. This review has synthesized findings from numerous clinical studies and identified the primary risk factors associated with these surgical complications, as well as proposed effective preventive strategies.

### Article History

**Received:** May 29, 2024    **Accepted:** June 27, 2024    **Published:** September 30, 2024

### References

1. Yang Q, Ciebiera M, Bariani MV, et al (2022) Comprehensive Review of Uterine Fibroids: Developmental Origin, Pathogenesis, and Treatment. *Endocr Rev* 43:678–719. <https://doi.org/10.1093/er/ckab001>



[org/10.1210/edrv/bnab039](https://doi.org/10.1210/edrv/bnab039)

2. Gupta S, Jose J, Manyonda I (2008) Clinical presentation of fibroids. *Best Pract Res Clin Obstet Gynaecol* 22:615–626. <https://doi.org/10.1016/j.bpobgyn.2008.01.008>
3. Yuk J-S, Kim M (2022) Long-term risk of uterine malignancies in women with uterine fibroids confirmed by myomectomy: a population-based study. *J Obstet Gynaecol* 42:3067–3072. <https://doi.org/10.1080/01443615.2022.2091925>
4. Wu B-J, Wei W, Hu C-Y, et al (2021) Investigation on factors related to uterine fibroids in rural women of northern Anhui province. *J Obstet Gynaecol Res* 47:3279–3287. <https://doi.org/10.1111/jog.14899>
5. Millien C, Manzi A, Katz AM, et al (2021) Assessing burden, risk factors, and perceived impact of uterine fibroids on women's lives in rural Haiti: implications for advancing a health equity agenda, a mixed methods study. *Int J Equity Health* 20:1. <https://doi.org/10.1186/s12939-020-01327-9>
6. Tai A-S, Lin R-T, Lin Y-C, et al (2022) Genome-wide causal mediation analysis identifies genetic loci associated with uterine fibroids mediated by age at menarche. *Hum Reprod* 37:2197–2212. <https://doi.org/10.1093/humrep/deac136>
7. Cianci S, Gulino FA, Palmara V, et al (2023) Exploring Surgical Strategies for Uterine Fibroid Treatment: A Comprehensive Review of Literature on Open and Minimally Invasive Approaches. *Medicina (Kaunas)* 60:64. <https://doi.org/10.3390/medicina60010064>
8. Brewster LM, Haan Y, van Montfrans GA Cardiometabolic Risk and Cardiovascular Disease in Young Women With Uterine Fibroids. *Cureus* 14:e30740. <https://doi.org/10.7759/cureus.30740>
9. Michael D, Mremi A, Swai P, et al (2020) Gynecological hysterectomy in Northern Tanzania: a cross-sectional study on the outcomes and correlation between clinical and histological diagnoses. *BMC Womens Health* 20:122. <https://doi.org/10.1186/s12905-020-00985-9>
10. Yang J, Fan X, Gao J, et al (2022) Cost effectiveness analysis of total laparoscopic hysterectomy versus total abdominal hysterectomy for uterine fibroids in Western China: a societal perspective. *BMC Health Serv Res* 22:252. <https://doi.org/10.1186/s12913-022-07644-9>
11. Anchan RM, Spies JB, Zhang S, et al (2023) Long-term health-related quality of life and symptom severity following hysterectomy, myomectomy, or uterine artery embolization for the treatment of symptomatic uterine fibroids. *Am J Obstet Gynecol* 229:275.e1–275.e17. <https://doi.org/10.1016/j.ajog.2023.05.020>
12. Manyonda I, Belli A-M, Lumsden M-A, et al (2020) Uterine-Artery Embolization or Myomectomy for Uterine Fibroids. *N Engl J Med* 383:440–451. <https://doi.org/10.1056/NEJMoa1914735>
13. Wang Y, Zhang S, Li C, et al (2020) Minimally invasive surgery for uterine fibroids. *Ginekol Pol* 91:149–157. <https://doi.org/10.5603/GP.2020.0032>
14. Anchan RM, Wojdyla D, Bortoletto P, et al (2023) A Comparative Analysis of Health-Related Quality of Life 1 Year Following Myomectomy or Uterine Artery Embolization: Findings from the COMPARE-UF Registry. *J Womens Health (Larchmt)* 32:423–433.

<https://doi.org/10.1089/jwh.2022.0133>

15. Chen R, You J (2022) Comparison of hysterectomy and uterine artery embolization in the treatment of symptomatic uterine fibroids: A protocol for systematic review and meta-analysis. *Medicine (Baltimore)* 101:e32440. <https://doi.org/10.1097/MD.00000000000032440>
16. Napoli A, Alfieri G, Andrani F, et al (2021) Uterine Myomas: Focused Ultrasound Surgery. *Semin Ultrasound CT MR* 42:25–36. <https://doi.org/10.1053/j.sult.2020.08.001>
17. Daniels J, Middleton LJ, Cheed V, et al (2022) Uterine artery embolization or myomectomy for women with uterine fibroids: Four-year follow-up of a randomised controlled trial. *Eur J Obstet Gynecol Reprod Biol* 267:100139. <https://doi.org/10.1016/j.eurox.2021.100139>
18. Sirkeci F, Moss J, Belli AM, et al (2023) Effects on heavy menstrual bleeding and pregnancy of uterine artery embolization (UAE) or myomectomy for women with uterine fibroids wishing to avoid hysterectomy: The FEMME randomized controlled trial. *Int J Gynaecol Obstet* 160:492–501. <https://doi.org/10.1002/ijgo.14626>
19. Kinariwala DJ, Khaja MS, McCann S, et al (2023) Pre-operative uterine artery embolization before hysterectomy or myomectomy: a single-center review of 53 patients. *Clin Imaging* 101:121–125. <https://doi.org/10.1016/j.clinimag.2023.06.003>
20. Ozen M, Patel R, Hoffman M, Raissi D (2023) Update on Endovascular Therapy for Fibroids and Adenomyosis. *Semin Intervent Radiol* 40:327–334. <https://doi.org/10.1055/s-0043-1770713>
21. Middelkoop M-A, Harmsen MJ, Manyonda I, et al (2021) Uterine artery embolization versus surgical treatment in patients with symptomatic uterine fibroids: Protocol for a systematic review and meta-analysis of individual participant data. *Eur J Obstet Gynecol Reprod Biol* 256:179–183. <https://doi.org/10.1016/j.ejogrb.2020.11.027>
22. Erciyestepe SG, Boran AB, Turan Bektaş C, Uzun Ö (2023) Can an apparent diffusion coefficient of uterine fibroid before uterine artery embolization predict potential fibroid response? *Ginekol Pol*. <https://doi.org/10.5603/gpl.95227>
23. Kho PF, Mortlock S, Endometrial Cancer Association Consortium, et al (2021) Genetic analyses of gynecological disease identify genetic relationships between uterine fibroids and endometrial cancer, and a novel endometrial cancer genetic risk region at the WNT4 1p36.12 locus. *Hum Genet* 140:1353–1365. <https://doi.org/10.1007/s00439-021-02312-0>
24. Zhang D-L, Liu X-X, Tang J-Q, et al (2020) The value of acoustic radiation force impulse imaging in preoperative prediction for efficacy of high-Intensity focused ultrasound uterine fibroids ablation. *Int J Hyperthermia* 37:423–429. <https://doi.org/10.1080/02656736.2020.1758803>
25. Keizer AL, Semmler A, Kok HS, et al (2024) Modifiable prognostic factors in uterine fibroid development: a systematic review of literature. *J Obstet Gynaecol* 44:2288225. <https://doi.org/10.1080/01443615.2023.2288225>
26. Yao L, Liu G, Li T, et al (2023) Acupuncture combined with mifepristone improves sex hormones and inflammatory factors in patients with uterine fibroids. *Am J Transl Res* 15:5519–5527

27. Chamseddine P, Pasic R, Cesta M (2020) Latest Advances in the Laparoscopic Treatment of Uterine Fibroids. *Surg Technol Int* 36:179–185
28. Singh S, Kumar P, Kavita null, et al (2023) Contemporary approaches in the management of uterine leiomyomas. *Eur J Obstet Gynecol Reprod Biol* 287:195–210. <https://doi.org/10.1016/j.ejogrb.2023.06.021>
29. Purohit R, Sharma JG, Meher D (2023) A Vagino-Laparoscopic Strategy for Hysterectomy of Large Uteri to Ease Surgical Challenges. *Int J Womens Health* 15:369–379. <https://doi.org/10.2147/IJWH.S400587>
30. Kim R, Pepin K, Dmello M, et al (2022) Current Methods of Tissue Extraction in Minimally Invasive Surgical Treatment of Uterine Fibroids. *JLS* 26:e2022.00036. <https://doi.org/10.4293/JLS.2022.00036>
31. Ahmad A, Kumar M, Bhoi NR, et al (2023) Diagnosis and management of uterine fibroids: current trends and future strategies. *J Basic Clin Physiol Pharmacol* 34:291–310. <https://doi.org/10.1515/jbcpp-2022-0219>
32. Deng Y, Dong S, Song B (2021) Surgical Strategy for Intravenous Cardiac Leiomyomatosis. *Heart Lung Circ* 30:240–246. <https://doi.org/10.1016/j.hlc.2020.07.006>
33. Chen X, Gao L, Yu H, et al (2021) Intramural Ectopic Pregnancy: Clinical Characteristics, Risk Factors for Uterine Rupture and Hysterectomy. *Front Med (Lausanne)* 8:769627. <https://doi.org/10.3389/fmed.2021.769627>
34. Fang Z, Zhang H, Zheng S, et al (2022) A retrospective analysis of emergency hysterectomy intervention strategy in obstetrics. *Pak J Med Sci* 38:645–651. <https://doi.org/10.12669/pjms.38.3.5335>
35. Liu J, Guan Z, Wang Q, et al (2023) Robotic vNOTES Techniques for Hysterectomy in a Patient with a 16-week Sized Uterus and a Body Mass Index of 70. *J Minim Invasive Gynecol* 30:693–694. <https://doi.org/10.1016/j.jmig.2023.06.007>
36. Murphy CA, Zarudskaya O, Kakish C, et al (2021) Uterine Fibroid in a 16-Year-Old Adolescent Managed with a Fertility-Sparing Approach: A Case Report and Review of the Literature. *J Pediatr Adolesc Gynecol* 34:427–431. <https://doi.org/10.1016/j.jpag.2020.12.016>
37. Zouzoulas D, Tsolakidis D, Pavlidi OI, et al (2023) Rate of Leiomyosarcomas during Surgery for Uterine Fibroids: 8-Year Experience of a Single Center. *J Clin Med* 12:7555. <https://doi.org/10.3390/jcm12247555>
38. Zhou H, Shan L, Wang Y, et al (2023) Effect of focused ultrasound ablation and myomectomy on pelvic adhesions in patients with uterine fibroids. *Am J Transl Res* 15:6959–6969
39. Younes S, Radosa M, Schneider A, et al (2022) Use of a microsurgical vascular clip system for temporary bilateral occlusion of the four main uterine vessels for laparoscopic enucleation of very large intramural uterine fibroids. *Arch Gynecol Obstet* 306:1597–1605. <https://doi.org/10.1007/s00404-022-06675-1>
40. Kwon JY, Byun JH, Shin I, et al (2021) Risk factors for intraoperative hemorrhage during cesarean myomectomy. *Taiwan J Obstet Gynecol* 60:41–44. <https://doi.org/10.1016/j.tjog.2020.11.007>

41. Herrmann A, Torres-de la Roche LA, Krentel H, et al (2020) Adhesions after Laparoscopic Myomectomy: Incidence, Risk Factors, Complications, and Prevention. *Gynecol Minim Invasive Ther* 9:190-197. [https://doi.org/10.4103/GMIT.GMIT\\_87\\_20](https://doi.org/10.4103/GMIT.GMIT_87_20)
42. Hu Y, Feng T (2024) Recurrence complicated with peritoneal dissemination after single-port gasless myomectomy for cellular uterine leiomyoma: A case report and literature review. *Medicine (Baltimore)* 103:e37444. <https://doi.org/10.1097/MD.00000000000037444>