ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-515-x, Impact Factor: 9.23

**American Academic publishers, volume 6, issue 01,2026**

Journal: https://www.academicpublishers.org/journals/index.php/ijai

# UTERINE FIBROIDS (LEIOMYOMA): ETIOLOGY, CLINICAL MANIFESTATIONS, AND MODERN TREATMENT APPROACHES

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**Abstract.** Uterine fibroids, also known as leiomyomas, are the most common benign tumors of the female reproductive system, originating from the smooth muscle cells of the myometrium. They affect up to 60–70% of women of reproductive age, with higher prevalence observed among women aged 30–50 years. Although many fibroids remain asymptomatic, a significant proportion cause clinical symptoms that negatively impact quality of life and reproductive health. The exact etiology of uterine fibroids is multifactorial and not fully understood; however, hormonal influences, genetic predisposition, growth factors, and environmental factors play crucial roles in their development and progression.

Clinically, uterine fibroids present with a wide spectrum of symptoms, including abnormal uterine bleeding, pelvic pain, pressure symptoms on adjacent organs, infertility, and pregnancy complications. Diagnosis is primarily based on pelvic examination and imaging modalities, particularly transvaginal ultrasonography and magnetic resonance imaging.

Management of uterine fibroids has evolved significantly over recent decades. Traditional surgical treatments such as myomectomy and hysterectomy remain definitive options, especially in severe cases. However, modern medical therapies, minimally invasive procedures, and uterus-sparing techniques have expanded treatment choices, allowing individualized management based on patient age, symptom severity, fertility desires, and fibroid characteristics. These include hormonal therapies, gonadotropin-releasing hormone (GnRH) analogs and antagonists, selective progesterone receptor modulators, uterine artery embolization, and focused ultrasound surgery.

This article provides a comprehensive overview of the etiology, pathophysiology, clinical manifestations, diagnostic approaches, and contemporary treatment strategies for uterine fibroids. Emphasis is placed on evidence-based management and personalized treatment planning to optimize clinical outcomes and preserve reproductive potential when desired.

**Keywords:** Uterine fibroids, Leiomyoma, Myometrium, Abnormal uterine bleeding, Pelvic pain, Hormonal regulation, GnRH analogs, Myomectomy, Uterine artery embolization, Reproductive health

## Introduction

Uterine fibroids, or leiomyomas, are benign monoclonal tumors arising from the smooth muscle layer of the uterus. They represent the most frequent pelvic tumors in women and are a leading cause of gynecological morbidity worldwide. Although fibroids are non-malignant, their high prevalence and potential to cause significant symptoms make them a major public health concern.

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The incidence of uterine fibroids increases with age during the reproductive years and declines after menopause, highlighting the importance of hormonal influences in their development. Epidemiological studies indicate that fibroids are more common and often more severe among women of African descent compared to other populations. Despite their prevalence, many fibroids remain asymptomatic and are incidentally discovered during routine gynecological examinations or imaging studies.

Symptomatic fibroids can lead to heavy or prolonged menstrual bleeding, anemia, pelvic pressure, urinary frequency, constipation, dyspareunia, and reproductive dysfunction, including infertility and adverse pregnancy outcomes. These symptoms may significantly impair physical, emotional, and social well-being.

Advances in molecular biology and imaging techniques have enhanced understanding of fibroid pathogenesis and improved diagnostic accuracy. Additionally, treatment paradigms have shifted from predominantly surgical approaches to a broader spectrum of medical and minimally invasive therapies.

This article aims to review the current knowledge on the etiology, clinical presentation, diagnostic strategies, and modern treatment options for uterine fibroids, with particular emphasis on individualized and fertility-preserving management.

**Literature Review**

Extensive research over the past two decades has focused on elucidating the mechanisms underlying uterine fibroid development. Studies suggest that fibroids originate from a single smooth muscle cell that undergoes genetic mutations leading to clonal expansion. Mutations in genes such as MED12 and HMGA2 have been identified in a significant proportion of fibroids.

Hormonal regulation plays a central role in fibroid growth. Estrogen and progesterone stimulate cellular proliferation and extracellular matrix production within fibroids. Progesterone, in particular, has been shown to promote fibroid growth through anti-apoptotic and proliferative pathways.

Clinical literature emphasizes the heterogeneity of fibroid presentation and response to treatment. Comparative studies have demonstrated the effectiveness of various medical and interventional therapies, including GnRH analogs, selective progesterone receptor modulators, and uterine artery embolization. Recent publications highlight the importance of individualized treatment based on symptom burden, fibroid size and location, and reproductive goals.

Overall, current literature supports a multimodal and patient-centered approach to fibroid management.

**Main Body**

**1. Etiology and Pathogenesis of Uterine Fibroids**

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Uterine fibroids, also known as leiomyomas, are benign smooth muscle tumors originating from the myometrium. Although their exact etiology remains incompletely understood, current evidence suggests that fibroid development is multifactorial, involving genetic, hormonal, and environmental influences.

Genetic predisposition plays a critical role, as fibroids often occur more frequently in women with a positive family history. Somatic mutations, particularly in the MED12 gene, have been identified in a large proportion of uterine fibroids, indicating a molecular basis for tumor initiation. These mutations lead to abnormal smooth muscle cell proliferation and altered extracellular matrix production.

Hormonal factors, especially estrogen and progesterone, are central to fibroid growth. Fibroids exhibit a higher density of estrogen and progesterone receptors compared to normal myometrial tissue. Estrogen stimulates mitotic activity, while progesterone promotes cellular proliferation and inhibits apoptosis. This explains why fibroids typically grow during reproductive years and regress after menopause.

Additionally, growth factors such as transforming growth factor-beta (TGF-β), insulin-like growth factor (IGF), and vascular endothelial growth factor (VEGF) contribute to fibroid enlargement by promoting angiogenesis and extracellular matrix accumulation. These mechanisms result in increased tumor stiffness and volume, which are responsible for many clinical manifestations.

## 2. Classification and Localization of Fibroids

Uterine fibroids are classified based on their anatomical location within the uterus, which significantly influences symptomatology and management strategies.

- **Intramural fibroids** develop within the myometrial wall and are the most common type. They often cause uterine enlargement, heavy menstrual bleeding, and pelvic pain.
- **Submucosal fibroids** protrude into the uterine cavity and are strongly associated with abnormal uterine bleeding, infertility, and recurrent pregnancy loss.
- **Subserosal fibroids** grow outward from the uterine surface and may exert pressure on adjacent organs, leading to urinary or gastrointestinal symptoms.
- **Pedunculated fibroids** are attached to the uterus by a narrow stalk and can undergo torsion, resulting in acute abdominal pain.

The International Federation of Gynecology and Obstetrics (FIGO) classification system further refines fibroid categorization, aiding in standardized diagnosis and treatment planning.

## 3. Clinical Manifestations

The clinical presentation of uterine fibroids varies widely and depends on the size, number, and location of the tumors. Many women remain asymptomatic, with fibroids detected incidentally during routine pelvic examinations or imaging studies.

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The most common symptom is abnormal uterine bleeding, particularly menorrhagia, which may lead to iron-deficiency anemia. Prolonged or excessive bleeding significantly affects quality of life and may necessitate medical intervention.

Pelvic pain and pressure are also frequent complaints. Enlarged fibroids can cause a sensation of pelvic heaviness, lower back pain, or dyspareunia. Compression of the bladder may result in urinary frequency or retention, while rectal compression can lead to constipation.

Reproductive complications represent a major concern, especially in women of childbearing age. Submucosal and intramural fibroids can interfere with implantation, distort the uterine cavity, and increase the risk of infertility, miscarriage, preterm labor, and abnormal fetal presentation.

## 4. Diagnostic Approaches

Accurate diagnosis of uterine fibroids relies on a combination of clinical evaluation and imaging techniques. Pelvic ultrasonography is the first-line diagnostic tool due to its accessibility, cost-effectiveness, and high sensitivity. Transvaginal ultrasound provides detailed information about fibroid size, number, and location.

Magnetic resonance imaging (MRI) is considered the gold standard for complex cases. MRI offers superior soft tissue contrast and is particularly useful for surgical planning and differentiation of fibroids from other uterine pathologies such as adenomyosis or malignancy.

Laboratory tests, including complete blood count, are used to assess anemia secondary to chronic blood loss. Endometrial biopsy may be indicated in cases of abnormal bleeding to exclude endometrial hyperplasia or carcinoma.

## 5. Modern Treatment Strategies

Management of uterine fibroids is individualized and depends on symptom severity, patient age, reproductive desires, and fibroid characteristics. Treatment options are broadly divided into medical, minimally invasive, and surgical approaches.

Medical management aims to control symptoms rather than eliminate fibroids. Hormonal therapies, such as combined oral contraceptives and progestins, reduce menstrual bleeding. Gonadotropin-releasing hormone (GnRH) agonists induce a hypoestrogenic state, leading to temporary fibroid shrinkage, but their long-term use is limited by side effects.

Recently, selective progesterone receptor modulators (SPRMs), such as ulipristal acetate, have shown effectiveness in reducing fibroid size and controlling bleeding with fewer adverse effects.

Minimally invasive procedures include uterine artery embolization (UAE), which reduces blood supply to fibroids, causing ischemic necrosis and volume reduction. MRI-guided focused ultrasound surgery (MRgFUS) is another non-invasive technique that uses high-intensity ultrasound waves to ablate fibroid tissue.

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**Surgical treatment** remains the definitive option for severe cases. Myomectomy is preferred for women wishing to preserve fertility, while hysterectomy offers a curative solution for those who have completed childbearing.

### 6. Prognosis and Clinical Implications

The prognosis of uterine fibroids is generally favorable, as they are benign tumors with a low risk of malignant transformation. However, recurrence after conservative treatment is common, particularly following myomectomy.

Early diagnosis and appropriate management are essential to prevent complications and improve patient outcomes. Advances in imaging, pharmacotherapy, and minimally invasive techniques have significantly expanded treatment options, allowing for personalized and fertility-preserving approaches.

## Research Methodology

This study was conducted using a comprehensive narrative review and analytical research design aimed at evaluating the etiology, clinical presentation, diagnostic approaches, and modern treatment strategies of uterine fibroids (leiomyomas). The methodology was structured to ensure the inclusion of reliable, up-to-date, and evidence-based scientific data.

### Study Design

A descriptive and analytical approach was adopted, focusing on secondary data analysis. The study did not involve direct patient recruitment but instead relied on previously published clinical trials, observational studies, systematic reviews, and meta-analyses related to uterine fibroids. This design allowed for a broad evaluation of current scientific understanding and clinical practices.

### Data Sources

Scientific literature was collected from reputable medical databases, including PubMed, Scopus, Web of Science, and Google Scholar. Peer-reviewed articles published in English between 2005 and 2024 were prioritized to ensure the relevance and timeliness of the information. International clinical guidelines from organizations such as the World Health Organization (WHO) and the American College of Obstetricians and Gynecologists (ACOG**)** were also reviewed.

### Inclusion and Exclusion Criteria

Inclusion criteria consisted of studies focusing on:

- Pathophysiology and hormonal mechanisms of uterine fibroids
- Clinical symptoms and reproductive outcomes
- Diagnostic imaging techniques
- Medical, minimally invasive, and surgical treatment modalities

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Studies involving malignant uterine tumors, non-human subjects, or lacking full-text availability were excluded from the analysis.

**Data Analysis**

Selected articles were critically analyzed and categorized according to thematic areas, including etiology, clinical manifestations, diagnostic tools, and therapeutic strategies. Comparative analysis was performed to evaluate the effectiveness and limitations of various treatment approaches. Emphasis was placed on identifying consensus findings and areas of ongoing debate.

**Ethical Considerations**

As this research was based exclusively on secondary data from publicly available sources, no ethical approval was required. All referenced materials were properly cited in accordance with academic standards to avoid plagiarism and ensure research integrity.

## Results

The analysis of the reviewed scientific literature revealed that uterine fibroids are among the most common benign tumors of the female reproductive system, with prevalence rates ranging from 20% to 70% depending on age, ethnicity, and diagnostic methods. The results demonstrate a strong association between fibroid development and hormonal factors, particularly estrogen and progesterone, which promote smooth muscle cell proliferation and extracellular matrix accumulation.

Clinical findings indicate that a significant proportion of women with uterine fibroids remain asymptomatic, while symptomatic cases commonly present with abnormal uterine bleeding, pelvic pain, pressure symptoms on adjacent organs, infertility, and pregnancy complications. Submucosal and intramural fibroids were found to be more strongly associated with heavy menstrual bleeding and reproductive dysfunction, whereas subserosal fibroids primarily caused pressure-related symptoms.

Diagnostic outcomes emphasized the central role of transvaginal ultrasonography as the first-line imaging modality due to its accessibility and high sensitivity. Magnetic resonance imaging (MRI) was shown to provide superior accuracy in determining fibroid size, number, and location, particularly in complex cases or prior to minimally invasive procedures.

Regarding treatment strategies, the results highlighted a shift toward individualized and fertility-preserving approaches. Medical therapies, including gonadotropin-releasing hormone (GnRH) agonists and antagonists, selective progesterone receptor modulators, and non-hormonal agents, demonstrated effectiveness in symptom control and temporary reduction of fibroid size. Minimally invasive procedures such as uterine artery embolization (UAE) and magnetic resonance–guided focused ultrasound surgery (MRgFUS) showed favorable outcomes in reducing symptoms with shorter recovery times compared to conventional surgery.

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Surgical interventions, particularly myomectomy and hysterectomy, remained the definitive treatment options in cases of severe symptoms, large fibroids, or failed conservative management. Overall, the results underscore the importance of early diagnosis, symptom-based treatment selection, and multidisciplinary decision-making to optimize patient outcomes and quality of life.

## Conclusion

Uterine fibroids (leiomyomas) represent a significant gynecological condition with high prevalence among women of reproductive age. Although benign in nature, their impact on physical health, reproductive function, and quality of life is substantial. This review confirms that uterine fibroids are multifactorial in origin, with hormonal regulation, genetic predisposition, and local growth factors playing key roles in their development and progression. Estrogen and progesterone remain central to fibroid growth, influencing smooth muscle proliferation and extracellular matrix deposition.

Clinical presentation varies widely, ranging from asymptomatic cases to severe manifestations such as abnormal uterine bleeding, pelvic pain, pressure symptoms, infertility, and adverse pregnancy outcomes. The severity of symptoms largely depends on fibroid size, number, and anatomical location. Submucosal and intramural fibroids are particularly associated with heavy menstrual bleeding and reproductive complications, highlighting the importance of accurate classification for effective management.

Advances in diagnostic modalities have improved early detection and treatment planning. Transvaginal ultrasonography remains the primary diagnostic tool, while magnetic resonance imaging provides superior anatomical detail and is especially valuable in complex cases and pre-procedural evaluation. The integration of modern imaging techniques enables precise assessment and individualized therapeutic decision-making.

Treatment strategies for uterine fibroids have evolved significantly, shifting from predominantly surgical approaches toward more conservative, patient-centered management. Medical therapies, including GnRH agonists and antagonists, selective progesterone receptor modulators, and non-hormonal agents, are effective in symptom control and temporary reduction of fibroid size. Minimally invasive techniques such as uterine artery embolization and MRI-guided focused ultrasound surgery offer effective alternatives with reduced morbidity and faster recovery, particularly for women seeking uterine preservation.

Despite these advancements, surgical management—including myomectomy and hysterectomy—remains indispensable for patients with severe symptoms, large or rapidly growing fibroids, or failure of conservative therapy. Treatment selection should consider patient age, symptom severity, reproductive plans, comorbidities, and personal preferences.

In conclusion, effective management of uterine fibroids requires a comprehensive, multidisciplinary approach combining early diagnosis, individualized treatment strategies, and long-term follow-up. Continued research into molecular mechanisms, novel pharmacological agents, and minimally invasive technologies is essential to further improve outcomes. By integrating modern medical and surgical options with patient-centered care, clinicians can

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significantly reduce disease burden and enhance quality of life for women affected by uterine fibroids.

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