MODERN APPROACH TO THE PREVENTION OF RECURRENCE OF OVARIAN ENDOMETRIOSIS: A REVIEW ARTICLE.

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Ovarian endometriosis is a chronic disease that requires a long-term management approach. Modern strategies not only reduce recurrence rates but also preserve fertility, improve quality of life, and prevent disease progression.

Ovarian endometriosis (endometrioma) is one of the most common forms of external genital endometriosis, affecting 17–44% of women of reproductive age. Characterized by the formation of endometriotic ("chocolate") cysts, the disease is associated with chronic pelvic pain, dysmenorrhea, dyspareunia, and infertility. The main challenge in clinical management remains the high recurrence rate after surgical treatment (up to 50% within 5 years), which necessitates the development of comprehensive preventive strategies.

Ovarian endometriomas represent one of the most prevalent and clinically significant forms of external genital endometriosis, affecting 17–44% of reproductive-aged women. The characteristic "chocolate cyst" (endometrioma) is not only a source of chronic pelvic pain and infertility but also frequently recurs after surgical treatment. Recurrence is observed in 20–50% of patients within 5 years after surgery, making ovarian endometriosis a chronic, relapsing condition that requires a long-term management strategy.

This review highlights current perspectives on the mechanisms of recurrence, approaches to surgical and medical treatment, and personalized strategies for secondary prevention of ovarian endometriosis recurrence, based on the principles of evidence-based medicine and individual risk factors.

Endometriosis is a common estrogen-dependent inflammatory disease with a chronic course and a tendency to recur. The association between endometriosis and cancer has been studied for several years. Numerous studies have demonstrated a strong link between specific ovarian malignancies and endometriotic lesions. Atypical endometriosis is widely described as a precursor to epithelial ovarian tumors, particularly clear cell carcinoma and endometrioid carcinoma. These histological types associated with endometriosis predominantly develop in the ovary rather than in extragonadal sites.

The detailed molecular mechanisms underlying this etiology remain unclear. Recent studies have analyzed the genetic and molecular pathways involved in endometriosis-associated ovarian cancer. A carcinogenic model based on iron-induced oxidative stress, characteristic of the endometriosis microenvironment, appears to play a critical role.

It has been hypothesized that the development of endometriosis-associated ovarian cancer is based on transtubal reflux of blood and endometrial cells, along with iron-induced oxidative stress. However, the multifactorial mechanisms underlying this malignant transformation remain incompletely understood. The aim of this review is to summarize

current epidemiological, histopathological, genetic, and molecular data on the progression of endometriosis-associated ovarian cancer.

Patients of reproductive age who underwent laparoscopic ovarian endometriotic cystectomy and had a histopathologically confirmed diagnosis of ovarian endometrioma were retrospectively evaluated. Histopathological specimens were re-examined, and the characteristics of endometriotic cysts were assessed, including cyst wall thickness, thickness of fibrosis (ToF), ovarian tissue thickness, number of follicles per cyst, and depth of penetration (DoP) of endometrial tissue into the cyst wall.

Based on the identified histopathological findings, potential risk factors for endometrioma recurrence were evaluated, including demographic characteristics (age at surgery, parity), clinical symptoms (dysmenorrhea, infertility), intraoperative findings (revised American Society for Reproductive Medicine [rASRM] score), imaging features (bilaterality, cyst diameter), and biochemical parameters (CA-125, CA 19-9, CA 15-3). Variables with $p < 0.2$ in univariate analysis were included in regression analysis to determine independent risk factors for recurrence.

Assessment of risk factors influencing recurrence after laparoscopic removal of endometrioma is essential. Histopathological features of ovarian endometriotic cysts may play an important role in predicting recurrence. Individualized prediction of recurrence risk is crucial for future disease management. Knowledge of recurrence risk can help determine optimal treatment strategies for each patient. Patients at high risk should be promptly offered appropriate treatment according to their clinical status, while those at low risk should be protected from overtreatment.

A cross-sectional study was conducted between 2009 and 2011, including patients who underwent at least one year of postoperative follow-up after laparoscopic removal of ovarian endometrioma. All patients had a history of surgery for ovarian endometrioma. Recurrence was defined as the presence of an endometrioma larger than 2 cm detected by ultrasonography within one year after surgery. Variables such as age at surgery, presence of infertility, uterine fibroids, previous treatment for endometriosis, size of the largest cyst at laparoscopy, unilateral or bilateral involvement, serum CA-125 levels, ASRM stage and score, and postoperative therapy were evaluated using logistic regression analysis to determine their independent effects on recurrence.

Recurrence of endometriosis after conservative surgery is observed in 40–50% of patients within the first 5 years. Various treatment regimens have been used to reduce recurrence rates after surgery, including combined oral contraceptives (COCs), gonadotropin-releasing hormone (GnRH) agonists, danazol, and progestins. Oral contraceptives have been administered either cyclically or continuously (without a pill-free interval).

The aim of this article was to summarize available data on the effectiveness and patient adherence to continuous versus cyclic use of oral contraceptives following conservative surgical treatment of endometriosis.

Endometriosis is a benign uterine disease characterized by menstrual pain and infertility, significantly affecting women's health. It is a chronic condition that requires long-term treatment. Currently, hormonal therapy is the most widely used medical approach and is based on the endocrine aspects of pathogenesis.

Estrogen dependence and progesterone resistance are key factors contributing to ectopic implantation of endometrial cells, reduced apoptosis, and increased oxidative stress, inflammation, and neuroangiogenesis. Endometriotic cells express anti-Müllerian hormone (AMH), transforming growth factor (TGF)-related growth factors (inhibin, activin, follistatin), corticotropin-releasing hormone (CRH), and stress-related peptides.

Endocrine and inflammatory alterations explain pain and infertility, as well as systemic comorbidities observed in these patients, including autoimmune disorders (thyroiditis, arthritis, allergies), inflammatory conditions (gastrointestinal and urinary tract diseases), and mental health disorders.

Hormonal treatment of endometriosis aims to suppress menstruation either by inhibiting the hypothalamic–pituitary–ovarian axis or by inducing pseudodecidualization followed by amenorrhea, thereby preventing progression of endometriotic lesions. Gonadotropin-releasing hormone (GnRH) agonists and antagonists are effective by acting on pituitary and ovarian function.

Progestins are mainly used for long-term treatment (dienogest, norethisterone acetate [NETA], medroxyprogesterone acetate [MPA]) and exert effects at multiple levels. Combined oral contraceptives are also used to alleviate symptoms by suppressing ovarian function. Currently, clinical trials are underway investigating selective progesterone receptor modulators, selective estrogen receptor modulators, and aromatase inhibitors.

To date, all these hormonal agents are considered first-line therapy for women with endometriosis, aiming to improve symptoms, delay surgery, or prevent disease recurrence after surgical intervention. This review provides a comprehensive and up-to-date overview of current and emerging hormonal treatment strategies for endometriosis, focusing on the endocrine basis of the disease.

During the study period, a total of 158 patients with endometrioma who underwent cystectomy were admitted to the surgical department. After initial evaluation, 130 patients were included in the study. The overall recurrence rate was 11.5% (15/130).

Significant independent factors associated with higher recurrence included the size of the largest cyst (odds ratio [OR] = 4, 95% confidence interval [CI] = 1.6–10.4, P = 0.002), a high revised American Society for Reproductive Medicine (rASRM) score (OR = 1.2, 95% CI = 1.0–1.4, P = 0.04), and the patient's age at the time of surgery (OR = 0.6, 95% CI = 0.4–0.9, P = 0.01).

A high rASRM score, larger cyst size, and younger age at surgery were identified as the three major factors associated with increased recurrence of endometrioma.

Without postoperative preventive therapy, recurrence rates range from 30–50% within 5 years. With medical therapy, recurrence decreases to approximately **10–30%** over the same period. The highest risk of recurrence occurs within the first 2 years after surgery, accounting for up to 60–70% of all recurrences.

Factor	Relative risk (RR)	Comment
Young age (<30 years)	OP 2,5–3,5	High hormonal activity
Severe adhesions	OP 2,0–2,8	Makes complete removal of lesions difficult
Deep infiltrating endometriosis	OP 1,8–2,5	Multifocal involvement

Positive family history	OP 1,5–2,0	Genetic predisposition
Lack of postoperative hormone therapy	OP 2,5–3,5	Need for estrogen suppression

Pathogenetic Mechanisms of Recurrence

Incomplete removal of endometriotic epithelium — microscopic remnants in the cyst wall or on the peritoneum.

Multifocal nature of the disease — activation of latent lesions.

Retrograde menstruation — continuous reflux of endometrial cells. Metaplastic theory — transformation of coelomic epithelium under the influence of hormones and inflammation.Lymphatic/hematogenous spread — a rare but possible mechanism. Immunological dysfunction — impaired clearance of endometriotic cells.Optimal approach: laparoscopy (preferred over laparotomy).Fewer adhesions — reduction of recurrence risk by 20–30%.Better visualization — allows detection of small lesions.More precise removal — preservation of healthy ovarian tissue.Main Techniques Cystectomy with complete capsule removal — the "gold standard."Fenestration + ablation of the cyst wall — an alternative in cases with a high risk of ovarian damage.Laser vaporization — for superficial and small lesions.Technical Aspects Reducing Recurrence Risk.Identification of the cleavage plane — between the cyst capsule and ovarian stroma.Minimal use of bipolar coagulation — to preserve follicular reserve.Careful hemostasis — prevention of adhesion formation. Use of anti-adhesion barriers (Interceed, Seprafilm).

Peritoneal irrigation — removal of cyst contents and inflammatory mediators.Intraoperative Visualization.Fluorescence angiography with indocyanine green (ICG) — assessment of ovarian tissue perfusion.Narrative laparoscopy — detailed documentation of all identified lesions.Ultrasound navigation — for deep infiltrative forms.Postoperative Medical Prevention Hormonal Therapy — the Basis of Prevention.Combined Oral Contraceptives (COCs)

Regimen: extended (84/7) or continuous use is preferred.Effectiveness: reduces recurrence risk by 50–70%.Duration: at least 18–24 months.

Features: low-dose estrogen formulations combined with third-generation progestins.Progestins

Dienogest (2 mg/day): the most studied, effectiveness up to 80%.Levonorgestrel-releasing intrauterine system (LNG-IUS, Mirena): local action with minimal systemic effects. Medroxyprogesterone acetate: an alternative in case of intolerance to other progestins.Gonadotropin-Releasing Hormone Agonists (GnRH-a)Regimen: 3–6 months after surgery.Add-back therapy: to prevent side effects (tibolone, hormone replacement therapy). Limitations: hypoestrogenic symptoms, decreased bone mineral density.Non-Hormonal Approaches.Aromatase Inhibitors Indications: recurrent forms resistant to hormonal therapy. Mechanism: suppression of local estrogen synthesis in endometriotic lesions.Combination: with progestins or COCs.Immunomodulators and Anti-Inflammatory Agents Pentosan polysulfate — inhibition of angiogenesis.Selective COX-2 inhibitors (celecoxib) — reduction of inflammation.

Statins (simvastatin) — anti-inflammatory and antiangiogenic effects.Endometriosis is a systemic, estrogen-dependent, chronic, and frequently recurrent disease characterized by the presence of endometrium-like tissue outside the uterine cavity. Among all localizations of external genital endometriosis, ovarian endometriotic cysts (endometriomas) occupy a special place and are traditionally referred to as “chocolate cysts” due to their thick, dark-brown content.

Relevance of the Problem of Ovarian Endometriosis

The relevance of ovarian endometriosis is determined by several key factors:

1.High prevalence: Ovarian endometriomas are diagnosed in 17–44% of patients with endometriosis, with bilateral involvement observed in 28% of cases.

2.Peak incidence occurs in young reproductive age, which underscores the importance of fertility preservation.

3.Negative impact on ovarian reserve — both due to the disease itself and as a consequence of surgical treatment.

4.Potential risk of malignant transformation — in recent years, the role of atypical endometriosis as a precursor of endometriosis-associated ovarian cancer has been actively studied.

5.Lack of a unified management algorithm in complex clinical situations such as recurrences, bilateral cysts, and infertility in older patients.

This review aims to systematize current concepts of ovarian endometriosis, with a focus on controversial issues in diagnosis and treatment, as well as emerging scientific directions. Implantation Theory (J. Sampson, 1921)

The most widely accepted concept, according to which viable endometrial cells entering the peritoneal cavity via retrograde menstruation implant on the surface of the ovaries and peritoneum, proliferate, and invade tissues. A limitation of this theory is that retrograde menstruation occurs in up to 90% of women, whereas endometriosis develops in only about 10%, indicating the role of additional factors such as immunological, genetic, and microenvironmental influences.Theory of Embryonic Müllerian Remnants.This theory suggests that residual Müllerian-derived cells retain the ability to differentiate into endometrioid tissue under the influence of estrogens beginning from puberty. Epidemiological studies demonstrate a twofold increased risk of endometriosis in women exposed in utero to diethylstilbestrol.Genetic and Epigenetic Theory:Alterations in genetic regulatory networks have been identified in stromal cells of eutopic endometrium in patients with endometriosis. A key role is played by epigenetic alterations, including aberrant DNA methylation of genes such as HOXA10, HOXC6, ALDH1A2, as well as estrogen and progesterone receptors and the aromatase gene.

HOXA10 is an important regulator of stromal cell proliferation and local immunosuppression during implantation.Coelomic Metaplasia:A hypothesis suggesting that undifferentiated mesothelial cells of the peritoneum undergo metaplastic transformation into endometrium-like tissue.Theory of Hematogenous and Lymphogenous Spread Explains the presence of extrapelvic endometriosis lesions. Microvascular studies demonstrate lymphatic pathways from the uterus to the ovary, which may play a role in the pathogenesis of ovarian endometriomas.Neuroangiogenesis:Ectopic implants recruit a neurovascular network through neuroangiogenesis. Newly formed nerve fibers within endometriotic lesions influence

dorsal neurons of the central nervous system, enhancing pain perception.Stem Cell Theory: Suggests the involvement of endometrial progenitor cells and multipotent bone marrow–derived cells in the formation of lesions.Hormonal Pathophysiological Cascade In normal endometrium, the expression of receptors for estrogens, androgens, progestins, and glucocorticoids is cell-specific and cyclical. In endometriotic lesions, estradiol stimulates the synthesis of prostaglandin E2, which in turn increases aromatase activity — a key enzyme in estrogen biosynthesis.

More than 20 years ago, it was discovered that stromal cells of endometriotic heterotopias express aromatase, confirming their ability for local estradiol synthesis and supporting therapeutic strategies aimed at creating a hypoestrogenic microenvironment.Future Perspectives mTOR inhibitors (everolimus) — suppression of cell proliferation. Monoclonal antibodies against VEGF (bevacizumab) — antiangiogenic effect. Antifibrotic therapy — prevention of adhesion formation.

Integrated and Personalized Approach

Assessment of Individual Risk Factors:

1.Reproductive plans (desire for pregnancy)
2.Age and ovarian reserve (AMH, AFC)
3.Stage and extent of endometriosis (rASRM)
4.Presence of chronic pelvic pain
5.Tolerance to hormonal therapy

Treatment Strategy Selection:

► **Young women planning pregnancy:**
• Short course of GnRH agonists (3 months) → attempt natural conception
• If unsuccessful → assisted reproductive technologies (ART) with progestin support
► **Women postponing pregnancy (1–3 years):**
• Continuous COCs or dienogest
• Regular monitoring of ovarian reserve
► **Women not planning pregnancy:**
• LNG-IUS or long-term dienogest therapy
• Alternative: COCs until perimenopause
► **Patients with recurrent forms:**
• Combined therapy (hormonal + non-hormonal)
• Consider repeat surgery with expert laparoscopy

Algorithm for Selecting a Preventive Strategy

Assessment of Individual Risk Factors:

1.Reproductive plans (desire for pregnancy)
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► **Patients with recurrent forms:**
• Combined therapy (hormonal + non-hormonal)
• Consideration of repeat surgery with expert-level laparoscopy

Duration of Preventive Therapy
• **Minimum:** 18–24 months after surgery
• **Optimal:** until planned pregnancy or until perimenopause
• **In recurrent cases:** long-term, potentially lifelong therapy

Monitoring the Effectiveness of Prevention

Clinical:
• Pain assessment (Visual Analog Scale, VAS)
• Quality of life (EHP-30 questionnaire)

Ultrasound:
• Transvaginal ultrasound every 6–12 months

Laboratory:
• CA-125, HE4 markers (limited clinical value)

MRI:
• Indicated in suspected deep infiltrating endometriosis

NEW TECHNOLOGIES AND FUTURE DIRECTIONS

Targeted Therapy
• Kinase inhibitors (sunitinib, pazopanib) — targeting angiogenesis and cell proliferation
• Estrogen receptor blockers (selective modulators)
• Growth factor inhibitors (IGF-1, TGF-β)

Immunotherapy
• Modulation of macrophages — key cells in endometriosis pathogenesis
• Vaccination against endometrioid antigens
• CAR-T cell therapy — an experimental approach

Epigenetic Approaches
• DNA methyltransferase inhibitors — modulation of gene expression
• microRNA-based therapy — correction of regulatory networks
• Histone modification — influence on inflammatory response

Nanotechnology in Drug Delivery
• Liposomal formulations — increased bioavailability
• Targeted nanoparticles — reduction of systemic side effects
• Stimuli-responsive systems — drug release in response to inflammation

Hormonal Basis of Endometriosis and Treatment Approaches

Endometriosis is a benign uterine disease characterized by menstrual pain and infertility, significantly affecting women's health. It is a chronic condition requiring long-term treatment.

Hormonal therapy is currently the most widely used medical treatment and is based on endocrine pathogenetic mechanisms. Estrogen dependence and progesterone resistance are key factors contributing to ectopic implantation of endometrial cells, decreased apoptosis, and increased oxidative stress, inflammation, and neuroangiogenesis.

Endometriotic cells express anti-Müllerian hormone (AMH), transforming growth factor (TGF)-related growth factors (inhibin, activin, follistatin), corticotropin-releasing hormone (CRH), and stress-related peptides.

Endocrine and inflammatory alterations explain pain and infertility, as well as systemic comorbidities observed in these patients, including autoimmune disorders (thyroiditis, arthritis, allergies), inflammatory diseases (gastrointestinal and urinary tract disorders), and psychiatric conditions.

Hormonal treatment of endometriosis aims to suppress menstruation either by inhibiting the hypothalamic–pituitary–ovarian axis or by inducing pseudodecidualization followed by amenorrhea, thereby preventing progression of endometriotic lesions.

Gonadotropin-releasing hormone (GnRH) agonists and antagonists are effective by acting on pituitary and ovarian function. Progestins are mainly used for long-term treatment (dienogest, norethisterone acetate [NETA], medroxyprogesterone acetate [MPA]) and exert effects at multiple targets. Combined oral contraceptives are also used to reduce symptoms by suppressing ovarian function.

Currently, clinical trials are investigating selective progesterone receptor modulators, selective estrogen receptor modulators, and aromatase inhibitors.

To date, all these hormonal agents are considered first-line therapy for women with endometriosis, aimed at improving symptoms, delaying surgery, or preventing recurrence after surgical treatment.

This review provides a comprehensive analysis of current and future hormonal treatment strategies for endometriosis, taking into account the endocrine background of the disease.

Dienogest is effective compared with placebo in the short term (NP2) and long term (NP4) for the treatment of painful endometriosis. Compared with GnRH agonists, dienogest is also effective in terms of pain reduction and improvement of quality of life in non-operated patients (NP2), as well as in reducing recurrence of lesions and symptoms after surgery (NP2). Data on GnRH antagonists, selective progesterone receptor modulators, and selective inhibitors (anti-TNF-α, matrix metalloproteinase inhibitors, angiogenesis growth factor inhibitors) are insufficient to support their clinical relevance for the treatment of painful endometriosis (NP3). Dienogest is recommended as second-line therapy for the treatment of painful endometriosis (Grade B). Due to the lack of evidence, aromatase inhibitors, elagolix, SERMs, SPRMs, and anti-TNF-α agents are not recommended for the treatment of painful endometriosis (Grade C).

This work is based on a literature review covering the period from January 2006 to December 2017. The Medline (PubMed) and Cochrane databases were searched for meta-analyses, randomized trials, literature reviews, controlled, uncontrolled, and retrospective studies published on this topic. Studies concerning dysmenorrhea in adolescents without endometriosis were excluded. The quality of evidence was heterogeneous. Dienogest and GnRH agonists (GnRHa) are the only treatments specifically evaluated for adolescent endometriosis. They reduce endometriosis-associated pain. Combined oral contraceptives have not been studied in the context of endometriosis but are effective for dysmenorrhea. Add-back therapy

containing estrogens should be considered to improve bone mineral density and quality of life in young women receiving GnRHa. Medical treatment of endometriosis in adolescents is associated with risks related to young age. Therapeutic strategies should take into account the side effects of each treatment.

In this study, we summarize the role of the shared and independent (epi)genetic background between endometrioid carcinoma (EC) and clear cell carcinoma (CCC), two histological subtypes of endometriosis-associated ovarian cancer (EAOC). Using the PubMed database, we conducted a literature review of various studies related to the malignant transformation of endometriosis. Both endometriosis and EAOC face potential environmental hazards, including hemoglobin (Hb), heme, and free iron, which induce DNA damage and mutations. Although EC differs from CCC due to distinct morphology, both share common environmental profiles and support similar (epi)genomic aberrations with multiple overlaps and analogous molecular signatures. Conversely, EAOC also has disease-specific gene signatures corresponding to each histological subtype: estrogen receptor promotes proliferation in EC, and hepatocyte nuclear factor-1β (HNF-1β) induces cell cycle arrest in CCC under oxidative stress conditions. This model emphasizes a subtype-dependent "go or stop" dichotomy, possibly due to differential adaptability to the changing environment.

It was found that cyst fluid concentrations of Hb and iron were significantly lower in EAOC compared to benign ovarian endometriomas (BOE), supporting the hypothesis that redox imbalance plays a key role in EAOC pathogenesis. There are at least two phases of iron-driven carcinogenesis and tumor progression: the first wave of iron-induced oxidative stress and DNA mutations is followed by a second large wave of subsequent antioxidant synthesis, which reduces cellular susceptibility to oxidative stress, increases apoptosis resistance, and promotes tumor initiation and progression. Particular attention is paid to new pathophysiological concepts of malignant transformation of endometriosis.

It is known that endometriotic cysts can transform into ovarian cancer, such as clear cell and endometrioid carcinoma. We hypothesized that the iron-rich environment resulting from recurrent hemorrhages into endometriotic cysts during the reproductive period may play a key role in cyst carcinogenesis through iron-induced persistent oxidative stress.

Contents of human ovarian cysts, including 21 endometriotic cysts, 4 clear cell carcinomas, and 11 non-endometriotic cysts, were analyzed for free "catalytic" iron concentration, lactate dehydrogenase, potential antioxidants, lipid peroxides, and 8-hydroxy-2'-deoxyguanosine (8-OHdG). Histological evaluation of iron deposits and 8-OHdG levels was also performed. Reactive oxygen species and mutagenicity of endometriotic cyst contents were determined in vitro. The concentration of free iron in endometriotic cysts (100.9 mmol/L) was significantly higher than in non-endometriotic cysts (0.075 mmol/L; $P < 0.01$). Mean concentrations of lactate dehydrogenase, potential antioxidants, lipid peroxides, and 8-OHdG were also significantly higher in endometriotic cysts ($P < 0.01$). A correlation was observed between free iron concentration and 8-OHdG levels ($P < 0.01$). Histologically, iron deposits were more abundant in endometriotic cysts compared to non-endometriotic cysts ($P < 0.01$). The level of 8-OHdG in endometriosis-associated carcinoma was higher than in carcinoma without endometriosis ($P < 0.05$). In vitro analyses showed that endometriotic cyst contents produced more reactive oxygen species and induced gene mutations more frequently than other cyst contents. High levels of free iron in endometriotic cysts were closely associated with

increased oxidative stress and frequent DNA mutations. Prolonged accumulation of erythrocytes in ovarian endometriotic cysts during the reproductive period induces oxidative stress, which may be responsible for malignant transformation of endometriotic cysts.

Endometriosis is defined as the presence of estrogen-dependent endometrium-like tissue outside the uterine cavity. Despite extensive research, endometriosis remains a mysterious condition that is difficult to diagnose and treat. A common clinical feature is the association of endometriosis with multiple comorbidities. To build and evaluate predictive models, we used a total of 627,566 clinically collected data points from endometriosis cases (0.82%) and controls (99.18%). We developed a machine learning platform for constructing diagnostic tools for endometriosis. The platform consists of logistic regression, decision tree, random forest, AdaBoost, and XGBoost for prediction, and uses Shapley Additive Explanation (SHAP) values for quantitative feature importance assessment.

In the model selection phase, the constructed XGBoost model outperformed other algorithms, achieving an area under the curve (AUC) of 0.725 on the test set during the evaluation phase, resulting in a specificity of 62.9% and a sensitivity of 68.6%. The model yields a relatively low positive predictive value of 1.5%, but a fairly satisfactory negative predictive value of 99.58%. Furthermore, feature importance analysis identified age, infertility, uterine fibroids, anxiety, and allergic rhinitis as the five most important features for predicting endometriosis. While these results demonstrate the feasibility of using machine learning to improve endometriosis diagnosis, further research is needed to enhance the performance of predictive models for endometriosis diagnosis. This situation is partly explained by the complex nature of circumstances and, at the same time, the administrative nature of our features. If more informative features had been used, a higher AUC for endometriosis prediction could have been achieved. As a result, we regard the constructed predictive model only as a tool for providing supportive information in clinical practice.

CONCLUSION

The prevention of ovarian endometriosis recurrence in modern gynecology has shifted from empirical approaches to evidence-based, personalized strategies, grounded in understanding disease pathogenesis and individual risk factors. Key elements of successful prevention include:

- **Optimal surgical treatment** with complete removal of lesions while preserving reproductive potential.
- **Prolonged postoperative medical therapy**, tailored to reproductive plans and treatment tolerability.
- **Regular monitoring** using modern imaging techniques.
- **An integrative approach** that considers not only gynecological but also psychosocial aspects of the disease.

The future of recurrence prevention is associated with the development of targeted therapy, immunomodulation, and personalized medicine, allowing a shift from symptomatic treatment to pathogenetic management and significantly improving the quality of life of millions of women suffering from endometriosis.

Ovarian endometriosis remains a complex multidisciplinary challenge at the intersection of gynecology, surgery, reproductive medicine, and oncology. The key clinical dilemma — fertility preservation versus radical treatment — requires a strictly personalized approach.

The modern management strategy for patients with endometriomas is based on the following principles:

- Consideration of endometriosis as a chronic disease requiring long-term planning.
- Avoidance of repeated surgical interventions due to their lack of impact on fertility improvement.
- Use of the most conservative surgical techniques when surgery is justified.
- Wide application of ART as a priority strategy in older patients and those with reduced ovarian reserve.
- Mandatory postoperative hormonal suppression to prevent recurrence.
- Oncological vigilance regarding atypical endometriosis.

A unified systemic concept of a multidisciplinary approach is needed, integrating advances in molecular biology, surgical technique, and reproductive medicine to improve quality of life and preserve reproductive potential for millions of women worldwide.

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