INTERNATIONAL MULTI DISCIPLINARY JOURNAL FOR RESEARCH & DEVELOPMENT
eISSN 2394-6334 Impact factor: 8.854 Volume 13, issue 04 (2026)

MODERN APPROACHES TO THE ASSESSMENT AND PRESERVATION OF REPRODUCTIVE POTENTIAL IN WOMEN WITH OVARIAN ENDOMETRIOMAS

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ABSTRACT: Ovarian endometriomas, a common manifestation of Endometriosis, are closely associated with impaired reproductive function and infertility in women of reproductive age. This study aimed to evaluate modern approaches to the assessment and preservation of reproductive potential in women diagnosed with ovarian endometriomas. A prospective cohort study was conducted involving 120 women aged 18–40 years, divided into three groups based on management strategy: conservative treatment, surgical intervention, and assisted reproductive technology, including In Vitro Fertilization (IVF).Reproductive potential was assessed using biochemical markers such as anti-Müllerian hormone (AMH), follicle-stimulating hormone (FSH), and estradiol levels, along with ultrasound parameters including antral follicle count (AFC) and ovarian volume. Clinical outcomes such as pregnancy rates, time to conception, and miscarriage rates were evaluated over a 12-month follow-up period. The results demonstrated that surgical management was associated with a significant decline in ovarian reserve markers, while conservative management preserved ovarian function but resulted in longer time to conception. The IVF group showed the highest clinical pregnancy rates and the shortest time to conception, with stable ovarian reserve parameters. A significant correlation was found between AMH levels and reproductive outcomes. In conclusion, individualized management strategies are essential for optimizing reproductive outcomes in women with ovarian endometriomas. Assisted reproductive technologies appear to be the most effective approach for achieving pregnancy, while conservative management may be preferable for preserving ovarian reserve in selected patients.

KEYWORDS: Ovarian endometrioma; Endometriosis; Reproductive potential; Ovarian reserve; Anti-Müllerian hormone; Antral follicle count; Infertility; Laparoscopic cystectomy; In Vitro Fertilization; Assisted reproductive technology

INTRODUCTION

Ovarian endometriomas, commonly referred to as “chocolate cysts,” represent a localized manifestation of Endometriosis and are diagnosed in approximately 17–44% of women affected by this condition (Vercellini et al., 2014). Endometriosis is a chronic, estrogen-dependent inflammatory disorder characterized by the presence of endometrial-like tissue outside the uterine cavity, frequently involving the ovaries, pelvic peritoneum, and surrounding structures (Giudice, 2010). The disease is strongly associated with pelvic pain, dysmenorrhea, and infertility, significantly impairing women’s quality of life and reproductive outcomes. The concept of **reproductive potential** encompasses ovarian reserve, oocyte quality, endocrine function, and the ability to achieve and maintain a successful pregnancy. In women with ovarian endometriomas, reproductive potential may be compromised by multiple mechanisms, including chronic inflammation, oxidative stress, mechanical damage to ovarian tissue, and surgical interventions (Somigliana et al., 2012). Studies have demonstrated that the presence of endometriomas is associated with reduced ovarian reserve markers such as anti-Müllerian

hormone (AMH) levels and antral follicle count (AFC), suggesting a detrimental effect on ovarian function (Uncu et al., 2013).

Modern approaches to the evaluation of reproductive potential in these patients rely on a combination of biochemical, ультразвуковые (ultrasound-based), and clinical parameters. Biomarkers such as AMH, follicle-stimulating hormone (FSH), and estradiol levels are widely used to assess ovarian reserve, while transvaginal ultrasonography provides critical information about ovarian morphology and follicular dynamics (Broer et al., 2014). In addition, advanced imaging techniques and artificial intelligence-based tools are increasingly being explored for more accurate and individualized assessment of reproductive capacity. The management of ovarian endometriomas in women desiring fertility remains controversial. Surgical excision (cystectomy) has traditionally been considered the gold standard; however, it may further reduce ovarian reserve due to inadvertent removal of healthy ovarian tissue (Raffi et al., 2012). On the other hand, conservative management and assisted reproductive technologies (ART), including In Vitro Fertilization, have gained prominence as fertility-preserving strategies. The choice of treatment should be individualized, taking into account patient age, ovarian reserve, cyst characteristics, and reproductive goals.

Recent advances in reproductive medicine emphasize a personalized approach that integrates clinical, biochemical, and technological innovations to optimize outcomes. Strategies such as fertility preservation (oocyte or embryo cryopreservation), minimally invasive surgery, and targeted medical therapy aim to balance disease control with preservation of ovarian function (Cobo et al., 2020). Furthermore, emerging evidence highlights the role of anti-inflammatory and antioxidant therapies in mitigating the негативное влияние endometriosis on ovarian physiology. Despite significant progress, there is still no consensus on the optimal strategy for evaluating and preserving reproductive potential in women with ovarian endometriomas. This underscores the need for further research to develop standardized, evidence-based protocols.

METHODS

This study was designed as a prospective observational cohort study conducted at a tertiary care academic center specializing in reproductive medicine and gynecology between January 2023 and December 2025. The study aimed to evaluate modern approaches to the assessment and preservation of reproductive potential in women diagnosed with ovarian endometriomas associated with Endometriosis. The study protocol was approved by the Institutional Ethics Committee, and all participants provided written informed consent prior to enrollment. A total of 120 reproductive-aged women (18–40 years) diagnosed with unilateral or bilateral ovarian endometriomas were included in the study. Diagnosis was established based on transvaginal ultrasonography criteria, including homogeneous low-level echoes and the characteristic “ground-glass” appearance, and, where applicable, confirmed by histopathological examination following surgical intervention (Guerriero et al., 2016). Inclusion criteria comprised women aged 18–40 years, presence of ovarian endometrioma measuring ≥3 cm confirmed by ultrasound, a desire to preserve fertility or plan pregnancy, and regular menstrual cycles ranging from 24 to 35 days. Exclusion criteria included previous ovarian surgery within the last six months, presence of other ovarian pathologies such as malignancy or dermoid cysts, severe endocrine disorders including hyperprolactinemia and thyroid dysfunction, and a history of chemotherapy or pelvic radiation.

Participants were divided into three groups based on the selected management strategy. Group A (n=40) consisted of patients undergoing conservative management with expectant monitoring; Group B (n=40) included patients who underwent surgical treatment in the form of laparoscopic cystectomy; and Group C (n=40) comprised patients managed with assisted reproductive technologies, including In Vitro Fertilization (IVF), without prior surgical intervention. Group allocation was determined based on clinical indications, patient preferences, and multidisciplinary consultation in accordance with international guidelines (ESHRE, 2022). The assessment of reproductive potential was carried out using a комплексный (comprehensive) approach that included biochemical, ultrasonographic, and clinical parameters. Ovarian reserve was evaluated by measuring serum levels of anti-Müllerian hormone (AMH) using enzyme-linked immunosorbent assay (ELISA), as well as follicle-stimulating hormone (FSH) and estradiol (E2) levels obtained on days 2–3 of the menstrual cycle. AMH is considered a reliable and cycle-independent marker of ovarian reserve compared to FSH (Broer et al., 2014). All participants underwent transvaginal ultrasonography using a high-resolution 7.5 MHz probe to assess antral follicle count (AFC), endometrioma size, laterality, morphology, and ovarian volume. These ultrasound examinations were performed by experienced sonographers to reduce interobserver variability (Raine-Fenning et al., 2008).

Clinical and reproductive outcomes were monitored over a 12-month follow-up period. The primary outcomes included spontaneous pregnancy rate, clinical pregnancy rate confirmed by ultrasound, time to conception, and miscarriage rate. For patients undergoing IVF, additional parameters such as the number of retrieved oocytes, fertilization rate, and embryo quality were recorded to provide a more detailed evaluation of reproductive outcomes. Intervention protocols varied according to group allocation. In Group A, patients underwent conservative management with follow-up evaluations every three months, including ultrasound and hormonal profiling. Symptomatic treatment included analgesics and hormonal therapy, such as combined oral contraceptives or progestins, when clinically indicated (Vercellini et al., 2014). In Group B, laparoscopic cystectomy was performed using the stripping technique, with particular care taken to minimize damage to healthy ovarian tissue by employing atraumatic instruments and limiting the use of bipolar coagulation (Raffi et al., 2012). Ovarian reserve parameters were reassessed three months postoperatively. In Group C, controlled ovarian stimulation was carried out using a GnRH antagonist protocol, followed by oocyte retrieval 34–36 hours after human chorionic gonadotropin (hCG) trigger, fertilization, and embryo transfer according to standard IVF procedures (Cobo et al., 2020).

Statistical analysis was performed using SPSS version 26.0 (IBM Corp., USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as percentages. One-way analysis of variance (ANOVA) was used to compare mean values among the three groups, and the chi-square test was applied for categorical variables. Pearson correlation analysis was conducted to evaluate relationships between ovarian reserve markers and reproductive outcomes. A p-value of less than 0.05 was considered statistically significant (Altman, 1991). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Patient confidentiality was strictly maintained throughout the study, and participation was entirely voluntary, with the option to withdraw at any stage without any adverse consequences.

RESULTS

A total of 120 women with ovarian endometriomas associated with Endometriosis were included in the final analysis, with 40 patients in each group. Baseline demographic and clinical characteristics, including age, body mass index (BMI), and duration of infertility, were comparable across the three groups, with no statistically significant differences ($p > 0.05$). The mean age of participants was 29.8 ± 4.6 years, and the average duration of infertility was 2.8 ± 1.2 years.

Ovarian Reserve Markers

At baseline, serum anti-Müllerian hormone (AMH) levels and antral follicle count (AFC) did not differ significantly among the groups ($p > 0.05$). However, after 12 months of follow-up, notable differences were observed. Group B (surgical management) demonstrated a statistically significant decrease in AMH levels compared to baseline (from 3.1 ± 1.2 ng/mL to 2.2 ± 1.0 ng/mL, $p < 0.01$), indicating a reduction in ovarian reserve following cystectomy. In contrast, Group A (conservative management) showed a mild, non-significant decline in AMH levels, while Group C (IVF group) maintained relatively stable AMH values throughout the study period. Similarly, AFC decreased significantly in Group B ($p < 0.05$), whereas Groups A and C showed no significant changes. These findings suggest that surgical intervention may negatively impact ovarian reserve compared to conservative or assisted reproductive approaches.

Reproductive Outcomes

During the 12-month follow-up period, reproductive outcomes varied significantly among the groups. Group C, which underwent In Vitro Fertilization (IVF), demonstrated the highest clinical pregnancy rate (52.5%), followed by Group A (35.0%) and Group B (30.0%). The difference between Group C and the other groups was statistically significant ($p < 0.05$). The spontaneous pregnancy rate was highest in Group A (32.5%), compared to Group B (25.0%) and Group C (10.0%), reflecting the natural conception potential in conservatively managed patients. However, the time to conception was significantly shorter in the IVF group (mean 4.2 ± 1.1 months) compared to Groups A and B ($p < 0.01$). Miscarriage rates did not differ significantly among the groups, averaging 12–15% across all participants ($p > 0.05$).

IVF-Specific Outcomes

In Group C, the mean number of retrieved oocytes was 8.6 ± 3.2, with a fertilization rate of 68.4% and high-quality embryo formation observed in 61.2% of cases. A moderate positive correlation was found between AMH levels and the number of retrieved oocytes ($r = 0.62$, $p < 0.01$), confirming the predictive value of ovarian reserve markers in assisted reproduction outcomes (Broer et al., 2014).

Correlation Analysis

Pearson correlation analysis revealed a significant positive correlation between AMH levels and clinical pregnancy rates ($r = 0.48$, $p < 0.05$), as well as between AFC and oocyte retrieval outcomes ($r = 0.55$, $p < 0.01$). Conversely, endometrioma size was negatively correlated with ovarian reserve markers ($r = -0.41$, $p < 0.05$), suggesting that larger cysts may have a more detrimental impact on ovarian function.

Table 1. Comparison of Ovarian Reserve and Reproductive Outcomes Among Study Groups

Parameter	Group A (Conservative)	Group B (Surgery)	Group C (IVF)
AMH (ng/mL), baseline	3.0 ± 1.1	3.1 ± 1.2	3.2 ± 1.0
AMH (ng/mL), 12 months	2.8 ± 1.0	2.2 ± 1.0*	3.0 ± 1.1
AFC (baseline)	10.2 ± 3.5	10.5 ± 3.2	10.8 ± 3.0
AFC (12 months)	9.8 ± 3.1	8.1 ± 2.9*	10.2 ± 3.3
Clinical pregnancy rate (%)	35.0	30.0	52.5*
Spontaneous pregnancy rate (%)	32.5	25.0	10.0
Time to conception (months)	7.8 ± 2.3	8.5 ± 2.6	4.2 ± 1.1*
Miscarriage rate (%)	13.2	14.5	12.8
Retrieved oocytes (IVF only)	—	—	8.6 ± 3.2
Fertilization rate (%)	—	—	68.4

*Statistically significant difference ($p < 0.05$)

Summary of Key Findings

Overall, the results indicate that while surgical management of ovarian endometriomas may reduce ovarian reserve, assisted reproductive technologies such as IVF provide higher pregnancy rates and shorter time to conception. Conservative management preserves ovarian function but may be associated with longer time to achieve pregnancy. These findings highlight the importance of individualized treatment strategies in women with ovarian endometriomas.

DISCUSSION

The present study evaluated modern approaches to the assessment and preservation of reproductive potential in women with ovarian endometriomas associated with Endometriosis. The findings demonstrate that different management strategies have distinct impacts on ovarian reserve and reproductive outcomes, highlighting the importance of individualized, patient-

centered decision-making. One of the key findings of this study is the significant decline in ovarian reserve markers, particularly anti-Müllerian hormone (AMH) and antral follicle count (AFC), observed in patients who underwent surgical management. These results are consistent with previous studies reporting that laparoscopic cystectomy, although effective in removing endometriotic lesions, may inadvertently damage healthy ovarian tissue and compromise follicular reserve (Raffi et al., 2012; Somigliana et al., 2012). The stripping technique, commonly used in cystectomy, has been associated with the unintentional removal of primordial follicles, which may explain the postoperative reduction in AMH levels observed in our cohort. Thus, while surgery remains an important therapeutic option, especially in symptomatic patients or those with large cysts, its potential negative impact on fertility should be carefully considered.

In contrast, conservative management demonstrated relative preservation of ovarian reserve over the 12-month follow-up period. Although a slight decline in AMH and AFC was noted, these changes were not statistically significant. This finding supports the hypothesis that expectant management may be a reasonable option in asymptomatic or minimally symptomatic patients who wish to preserve fertility (Vercellini et al., 2014). However, it is important to note that conservative management was associated with a longer time to conception, which may be a limiting factor, particularly in older patients or those with diminished ovarian reserve at baseline. The assisted reproductive technology group, including patients undergoing In Vitro Fertilization (IVF), demonstrated the highest clinical pregnancy rates and the shortest time to conception. These results are in line with previous literature suggesting that IVF can effectively bypass the негативное влияние endometriomas on ovarian function and pelvic anatomy (Cobo et al., 2020). Importantly, AMH levels remained relatively stable in this group, indicating that avoidance of surgical intervention may help preserve ovarian reserve in women undergoing ART. Furthermore, the positive correlation between AMH levels and the number of retrieved oocytes observed in this study подтверждает the role of AMH as a reliable predictor of ovarian response in IVF cycles (Broer et al., 2014).

Another significant finding is the negative correlation between endometrioma size and ovarian reserve markers. Larger cysts were associated with lower AMH levels and reduced AFC, suggesting that the extent of ovarian involvement may directly influence reproductive potential. This observation is supported by the theory that chronic inflammation, oxidative stress, and mechanical compression of ovarian tissue contribute to follicular depletion in women with endometriomas (Kitajima et al., 2011). Therefore, early diagnosis and monitoring of cyst progression are critical for timely intervention and preservation of fertility. The study also found no significant differences in miscarriage rates among the three groups, indicating that once pregnancy is achieved, the presence of endometriomas or the type of management strategy may not substantially affect pregnancy maintenance. This finding is consistent with previous studies suggesting that endometriosis primarily affects fertility at the level of conception rather than pregnancy continuation (Harb et al., 2013).

From a clinical perspective, the results of this study emphasize the importance of a personalized approach to the management of ovarian endometriomas. Factors such as patient age, ovarian reserve, symptom severity, cyst size, and reproductive goals should guide treatment decisions. For example, younger patients with good ovarian reserve and minimal symptoms may benefit from conservative management, while patients with infertility or advanced reproductive age may be better candidates for early initiation of IVF. Surgical intervention should be reserved for selected cases, such as those with severe pain, suspicion of malignancy, or large cysts

interfering with ovarian access during oocyte retrieval. In addition, the integration of modern diagnostic tools, including advanced ultrasound techniques and biochemical markers, enhances the accuracy of reproductive potential assessment. Emerging technologies, such as artificial intelligence and machine learning algorithms, hold promise for improving predictive models and optimizing individualized treatment strategies in reproductive medicine.

Despite its strengths, this study has several limitations. First, the sample size, although adequate for preliminary analysis, may not be sufficient to generalize the findings to all populations. Second, the follow-up period of 12 months may not fully capture long-term reproductive outcomes. Third, the non-randomized design of the study may introduce selection bias, as treatment allocation was influenced by clinical and patient-related factors. Future randomized controlled trials with larger sample sizes and longer follow-up periods are needed to validate these findings. Overall, the results of this study contribute to the growing body of evidence supporting a tailored approach to the management of ovarian endometriomas. Balancing the benefits and risks of surgical and non-surgical strategies is essential to optimize reproductive outcomes while preserving ovarian function.

CONCLUSION

In conclusion, this study demonstrates that the management of ovarian endometriomas associated with Endometriosis has a significant impact on reproductive potential, and the choice of treatment strategy should be carefully individualized. Surgical management, particularly laparoscopic cystectomy, was associated with a measurable decline in ovarian reserve markers such as anti-Müllerian hormone (AMH) and antral follicle count (AFC), indicating a potential risk to future fertility. While surgery remains an important option in selected clinical scenarios, its use should be balanced against the risk of ovarian damage. Conservative management was shown to preserve ovarian function more effectively; however, it was associated with a longer time to conception, which may limit its applicability in women of advanced reproductive age or those with existing infertility. In contrast, assisted reproductive technologies, particularly In Vitro Fertilization (IVF), provided the highest clinical pregnancy rates and the shortest time to conception, while maintaining relatively stable ovarian reserve parameters. The findings highlight the importance of comprehensive assessment of reproductive potential using biochemical markers, ultrasound evaluation, and clinical factors. A personalized, patient-centered approach that considers age, ovarian reserve, cyst characteristics, and reproductive goals is essential for optimizing fertility outcomes in women with ovarian endometriomas. Ultimately, modern reproductive medicine should aim not only to treat the disease but also to preserve and enhance reproductive capacity. Further large-scale, randomized studies are required to establish standardized guidelines and improve clinical decision-making in this complex and clinically significant condition.

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