

Individualized Surgical Strategy for the Protection of Ovarian Reserve in Reproductive-Age Women with Ovarian Endometriosis

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Abstract

Background. Ovarian endometriosis is among the most clinically demanding subtypes of endometriotic disease in women of reproductive age and is independently associated with diminished ovarian reserve. Surgical excision remains the cornerstone of management, yet operative trauma may itself contribute to follicular loss, creating a difficult clinical trade-off between disease control and fertility protection.

Objective. To formulate and justify an individualized clinical and surgical algorithm aimed at preserving ovarian reserve in reproductive-age women undergoing surgery for ovarian endometrioma, with explicit criteria for hemostasis selection and perioperative reserve assessment.

Methods. A combined prospective-retrospective clinical observation was conducted in women of reproductive age with histologically confirmed ovarian endometriosis scheduled for surgical treatment. Preoperative ovarian reserve was evaluated by serum anti-Müllerian hormone (AMH) and transvaginal antral follicle count (AFC), together with menstrual and reproductive history. Tissue-sparing laparoscopic cystectomy was performed with patient-specific selection of hemostatic technique, prioritizing methods with minimal thermal impact. Follow-up assessments of AMH and AFC were obtained at 3, 6, and 12 months. Statistical significance was set at $p < 0.05$.

Results. A reduction in postoperative AMH was observed across the cohort, but the magnitude of decline was strongly modified by baseline reserve, cyst size, laterality, and the chosen hemostatic strategy. Tissue-sparing dissection combined with suturing or hemostatic sealants was associated with a more moderate decrease in AMH and partial late recovery, whereas extensive stripping with bipolar coagulation produced the steepest decline. Bilateral endometriomas and prior ovarian surgery emerged as the most consistent predictors of marked reserve impairment.

Conclusion. An individualized surgical strategy guided by preoperative AMH and AFC, reproductive intent, and intraoperative restraint with regard to electrocoagulation provides a clinically feasible framework for protecting ovarian reserve. Routine, uniform application of stripping cystectomy with bipolar hemostasis should be replaced by a patient-tailored approach.

Keywords: ovarian endometriosis; endometrioma; ovarian reserve; anti-Müllerian hormone; antral follicle count; laparoscopic cystectomy; hemostasis; fertility preservation; individualized management.

1. Introduction

Endometriosis is a chronic estrogen-dependent disorder affecting an estimated one in ten women during their reproductive years, and its ovarian variant — the endometrioma — represents one of the most clinically consequential phenotypes [1; 9]. The disease combines pelvic pain, infertility, and a progressive impairment of ovarian function, all of which substantially compromise quality of life and reproductive prognosis [1; 7].

Two complementary mechanisms have been described to explain the negative impact of ovarian endometriomas on the gonadal reserve. First, the cyst itself exerts a local pressure-related and inflammatory effect on the surrounding cortex, where the bulk of the primordial follicle pool resides [2; 9]. Second, surgical removal of the lesion — the standard treatment for symptomatic or progressive disease — may inadvertently excise functional ovarian tissue and inflict thermal injury during hemostasis [4; 5]. Together, these two pathways act in an additive manner and may translate into a measurable postoperative decline in anti-Müllerian hormone (AMH) and antral follicle count (AFC) [2].

Although laparoscopic cystectomy is widely regarded as an effective intervention for pain control and for reducing recurrence risk, contemporary evidence has increasingly challenged the assumption that aggressive radicality necessarily improves reproductive outcomes [1; 3]. The 2022 ESHRE guideline on endometriosis explicitly cautions against performing endometrioma surgery prior to assisted reproductive technology with the sole aim of raising live-birth rates, recommending instead a case-by-case evaluation that balances pain, malignancy concerns, and reserve status [3].

Against this background, the present article transforms and extends the authors' earlier thesis material [11] into a structured analytical review that integrates the original clinical observations with current systematic evidence on hemostatic techniques, biomarker-driven decision-making, and the role of individualized planning. The aim is to articulate a coherent surgical doctrine in which the protection of ovarian reserve is treated not as an incidental benefit but as a primary operative endpoint.

2. AIM OF THE STUDY

To develop and substantiate an individualized perioperative algorithm for the preservation of ovarian reserve in reproductive-age women undergoing surgery for ovarian endometriosis, including (i) standardized preoperative biomarker assessment, (ii) intraoperative tissue-sparing principles, and (iii) explicit clinical criteria for selecting the hemostatic method.

2. Materials and Methods

3.1. Study design and population

A combined prospective-retrospective clinical observation was conducted at the Department of Obstetrics and Gynecology of Samarkand State Medical University. Eligible patients were women of reproductive age (18–42 years) with a clinical and instrumental diagnosis of ovarian endometriosis and an indication for surgical treatment. Diagnosis was confirmed by clinical examination, transvaginal pelvic ultrasonography, magnetic resonance imaging when indicated, intraoperative inspection, and histopathological verification of the excised specimen.

Exclusion criteria comprised previous bilateral oophorectomy, suspected ovarian malignancy, concurrent severe systemic disease, and the inability to attend the planned 12-month follow-up schedule.

3.2. Preoperative assessment of ovarian reserve

Baseline reserve was characterized by serum AMH measured by an automated electrochemiluminescence assay, together with AFC obtained by transvaginal ultrasonography in the early follicular phase. In addition, each patient underwent a structured evaluation of menstrual function and reproductive history, with particular attention to age, duration of endometriosis-related complaints, history of infertility, previous ovarian surgery, and prior hormonal therapy.

Patients were stratified, for analytical purposes, into low (AMH < 1.0 ng/mL), intermediate (AMH 1.0–2.5 ng/mL), and adequate (AMH > 2.5 ng/mL) reserve categories. AFC values were interpreted in parallel and used to identify discordant biomarker patterns that warranted additional counseling.

3.3. Surgical technique

All operations were performed laparoscopically by experienced surgeons under standardized general anesthesia. The intraoperative priority, declared a priori, was the maximal preservation of the healthy ovarian cortex. After mobilization of the ovary and identification of the cleavage plane, the endometriotic cyst wall was separated gently, avoiding traction that would tear adjacent functional tissue.

Hemostasis was achieved on an individualized basis. The default option in patients with low or intermediate baseline reserve and in those with bilateral lesions was intracorporeal suturing of the ovarian cortex; topical hemostatic sealants were used as an adjunct when diffuse oozing persisted. Bipolar electrocoagulation was reserved for focal, well-identified bleeders and applied in short pulses with minimal energy, in line with the principle of cortex-sparing radicality.

3.4. Follow-up and statistical analysis

Patients were re-evaluated at 3, 6, and 12 months after surgery. At each visit AMH and AFC were re-measured, menstrual function was reviewed, and reproductive plans were updated. Symptomatic recurrence was monitored clinically and by ultrasonography. Continuous variables were summarized as mean values with standard deviations or as medians with interquartile ranges, depending on distribution. Paired comparisons of preoperative and postoperative biomarker values were performed using appropriate parametric or non-parametric tests, with statistical significance accepted at $p < 0.05$.

3. Results

4.1. Baseline characteristics

The clinical profile of the cohort reflected a typical population referred for endometrioma surgery: mean age in the early thirties, frequent reports of cyclic pelvic pain, and a notable proportion of women presenting with primary or secondary infertility. Roughly one third of the patients had bilateral lesions, and a smaller but clinically important subgroup had undergone previous ovarian surgery for endometriosis or for other benign pathology.

Baseline AMH values were distributed across the predefined strata, with a meaningful share of patients already classified as having low or intermediate reserve at the time of indication for surgery. AFC values were generally concordant with AMH but, in a subset of cases, identified additional reserve compromise not fully reflected by AMH alone.

4.2. Dynamics of ovarian reserve after surgery

A decline in AMH from preoperative values was observed in essentially all patients within the first three months after surgery, in agreement with the well-recognized acute postoperative drop described in the literature [2]. However, the magnitude of this decline differed substantially between subgroups defined by baseline reserve, cyst characteristics, and the surgical technique used [11]. Women in whom tissue-sparing dissection had been combined with suturing or hemostatic sealants showed a more moderate AMH decrease at three months and a partial recovery trend by 6 and 12 months. In contrast, patients in whom more extensive stripping was performed and in whom bipolar coagulation was applied repeatedly displayed a steeper and more sustained decline. The AFC trajectory broadly followed the AMH pattern but with a smaller dynamic range, consistent with its lower sensitivity to surgical injury [2].

4.3. Predictors of marked reserve loss

Three clinical factors were consistently associated with a more pronounced postoperative reduction in AMH: bilateral disease, previous ovarian surgery, and large cyst diameter. These observations match the predictors of postoperative reserve impairment reported in international literature [2; 6] and support the use of these variables as decision triggers when planning the operative strategy.

Patients with a baseline AMH below 1.0 ng/mL who underwent extensive bilateral resection represented the most vulnerable subgroup, both numerically and clinically. In several of these women, the postoperative reserve approached the threshold associated with markedly reduced spontaneous conception probability, underlining the importance of preoperative fertility counseling and, where appropriate, of fertility preservation before surgery.

4. Discussion

5.1. From radical surgery to function-preserving radicality

The findings presented here, together with the recent international literature, reinforce the view that the modern goal of endometrioma surgery cannot be defined by the completeness of cyst excision alone. Although thorough removal of endometriotic tissue may improve pain outcomes and reduce short-term recurrence risk, it inevitably entails some degree of damage to the cortical reserve, which represents the only non-renewable component of the female gonad [1; 2]. The clinical task is therefore not to choose between adequacy and conservatism, but to integrate them into what may be termed function-preserving radicality — a strategy that achieves disease control without sacrificing reproductive potential beyond what is strictly necessary [6].

5.2. The role of biomarkers in perioperative decision-making

AMH has emerged as the most informative single biomarker of ovarian reserve in the context of endometrioma surgery, owing to its relatively low intracycle variability and its demonstrated sensitivity to the impact of cystectomy [2]. In our practice, the systematic use of AMH and AFC before surgery did not merely document the starting condition of the ovary but also actively shaped the surgical plan, by identifying patients in whom a more conservative approach or a preoperative fertility preservation step was warranted.

Several scenarios deserve particular emphasis: patients with bilateral endometriomas, those with prior ovarian surgery, those with a measured AMH below 1.0 ng/mL, and those with urgent reproductive plans. In each of these settings the threshold for extensive excision should be raised, and the option of preoperative oocyte or embryo cryopreservation should be openly discussed before the operation [3; 6].

5.3. Hemostasis as an independent determinant of reserve

A recurring theme in the contemporary literature — and one strongly supported by the present observations — is that the surgical insult to the ovary is not limited to the excision of the cyst wall but extends to the hemostatic phase of the operation [4; 5]. Bipolar coagulation, although technically convenient and effective, transmits heat to the adjacent cortex and may thereby destroy follicles that the surgeon intended to preserve [4]. Meta-analytic evidence indicates that suturing and hemostatic sealants are associated with better postoperative AMH values than bipolar desiccation, particularly in patients undergoing bilateral procedures [4; 5].

From a practical standpoint, this means that the choice of hemostatic technique should be regarded as a clinical decision of comparable weight to the choice of excision technique, rather than as a purely technical preference of the operating team. In our protocol, suturing was used as the default modality in higher-risk patients, with bipolar coagulation reserved for focal bleeders and applied in carefully limited doses.

5.4. Timing of surgery relative to fertility treatment

The timing of intervention with respect to assisted reproductive technology constitutes a further axis of individualization. The 2022 ESHRE guideline explicitly recommends against routine endometrioma surgery before in vitro fertilization purely to improve live-birth rates, and instead lists the specific situations — severe pain, mechanical obstruction of follicular access, suspicion of malignancy, and rapidly progressive lesions — in which operative treatment retains a clear indication [3]. This position is in full agreement with the broader argument advanced here, namely that no single operative strategy can be considered optimal for all women with ovarian endometriomas [3; 11].

5.5. Limitations

Several limitations should be acknowledged. The observational nature of the study restricts inferential strength relative to a randomized comparison of hemostatic techniques. Single-center recruitment may limit external validity, and follow-up of twelve months, although adequate for capturing the acute and subacute reserve trajectory, does not allow conclusions about long-term reproductive outcomes such as live birth. Larger multicenter cohorts and standardized reporting frameworks will be required to refine the proposed algorithm and to quantify the differential benefit of each component.

5. Conclusion

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