Comparative Evaluation of Ovarian Reserve After Laparoscopic Surgery for Endometriotic and Non-Endometriotic Ovarian Cysts.

Introduction:

Laparoscopic surgery is widely accepted for the management of benign ovarian masses, offering reduced morbidity, shorter hospital stay, and faster recovery compared to laparotomy. However, growing evidence suggests that ovarian surgery may compromise ovarian reserve, raising concerns regarding future fertility outcomes, particularly in reproductive-age women undergoing ovarian cystectomy.

Anti-Müllerian hormone (AMH) has emerged as one of the most reliable biomarkers for assessing ovarian reserve because it is secreted by granulosa cells of preantral and small antral follicles and remains relatively stable throughout the menstrual cycle. Unlike follicle-stimulating hormone (FSH), AMH directly reflects the remaining follicular pool and has been increasingly used to evaluate ovarian function after surgical intervention.

Several studies have demonstrated a significant decline in AMH levels following laparoscopic ovarian cystectomy. Chang et al. reported serial postoperative reductions in serum AMH after laparoscopic cystectomy, suggesting a detrimental effect on ovarian reserve [1]. Similarly, Salihoğlu et al. observed a short-term decline in ovarian reserve markers in both endometriotic and non-endometriotic cysts following laparoscopic surgery [2]. Vignali et al. further demonstrated that the decline in AMH was more pronounced and prolonged in patients undergoing surgery for endometriomas compared with other histological subtypes [3].

Recent systematic reviews have strengthened this evidence. Moreno-Sepulveda et al. found that laparoscopic endometrioma surgery was consistently associated with a significant reduction in AMH levels [4]. Likewise, Pais et al. and Anh et al. reported persistent postoperative decline in ovarian reserve, particularly among women with endometriotic cysts [5,6]. Additionally, Ata et al. and Deckers et al. highlighted that surgical hemostatic techniques such as bipolar coagulation may further contribute to ovarian tissue damage and postoperative decline in ovarian reserve [7,8].

Despite these findings, most available literature primarily focuses on endometriotic cysts, and limited comparative data exist regarding the impact of different benign ovarian cyst types on ovarian reserve. Understanding whether various cyst histologies have differential effects on postoperative ovarian reserve is essential for optimizing surgical planning and improving preoperative fertility counseling.

Therefore, this study aimed to compare changes in AMH levels following laparoscopic management of different benign ovarian masses and evaluate whether endometriotic cysts result in greater ovarian reserve compromise than other benign ovarian pathologies.

Materials & Methods

Study design and setting

This prospective observational study was conducted at the Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur, from March 2023 to January 2024 after approval from the Institutional Ethics Committee of Sawai Man Singh Medical College, Jaipur. The study adhered to the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants.

Participants

Women aged 18-38 years with benign ovarian masses requiring laparoscopic surgery were recruited from the gynecology outpatient department.

Inclusion Criteria: Women diagnosed with benign ovarian masses (ovarian cysts, endometriotic cysts, paraovarian cysts, and dermoid cysts) who provided informed consent.

Exclusion Criteria: Polycystic ovarian syndrome, malignant ovarian masses, prior ovarian surgery, ovarian ectopic pregnancy, and infective ovarian pathology (e.g., tuberculosis or pyogenic infections).

Surgical procedure

All laparoscopic procedures were performed by experienced gynecologic surgeons using a standardized three-port technique. After induction of general anesthesia and bladder catheterization, pneumoperitoneum was established using a Veress needle through the umbilical port. Cyst enucleation was performed using sharp and blunt dissection, and hemostasis was achieved with bipolar electrocoagulation. As excessive use of bipolar coagulation has been associated with reduced ovarian reserve, minimal energy application was emphasized during surgery [7,8]. Tissue specimens were retrieved using endobags and sent for histopathological examination.

Outcome measures

The primary outcome was the change in serum anti-Müllerian hormone (AMH) levels from baseline to postoperative day 30. Secondary outcomes included AMH levels on postoperative day 7 and postoperative changes in follicle-stimulating hormone (FSH) levels. AMH was selected as the primary biomarker due to its reliability as an indicator of ovarian reserve and its widespread use in studies evaluating ovarian function following surgery [1-3].

Laboratory analysis

Venous blood samples (5 mL) were collected preoperatively, on postoperative day 7, and postoperative day 30 for AMH measurement. Additional samples for FSH and LH estimation were collected preoperatively (day 1 of the previous menstrual cycle) and postoperatively (day 2 of the subsequent cycle). Samples were processed within two hours and analyzed using standardized automated immunoassays. AMH levels were reported in ng/mL, and FSH and LH levels in mIU/mL.

Sample size and statistical analysis

A sample size of 30 patients was calculated to achieve 80% power at a 95% confidence level to detect a minimum difference of 0.9 ng/mL in AMH levels between preoperative and postoperative measurements based on previously published data. Descriptive statistics were used to summarize baseline characteristics. Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test where appropriate. Continuous variables were expressed as mean ± standard deviation or median with interquartile range according to data distribution. Normality was assessed using the Shapiro-Wilk test. Paired sample t-tests were used for normally distributed data, while Wilcoxon signed-rank tests were used for non-parametric comparisons. A p-value <0.05 was considered statistically significant. Statistical analysis was performed using IBM SPSS Statistics version 25.0.

Results

A total of 30 women with benign ovarian masses who underwent laparoscopic cystectomy were included in the study. The mean age of participants was 26.43 ± 4.48 years (range: 18-38 years), with most patients belonging to the 18-27-year age group (63.3%).

Clinical presentation

The most common presenting symptoms were infertility (96.7%, n=29), irregular menses (73.3%, n=22), and abdominal pain (66.7%, n=20). Among infertile patients, 50.0% had primary infertility, 46.7% had secondary infertility, and 3.3% had no infertility issues.

Cyst characteristics and distribution

Cyst Location: The right ovary was most commonly affected (70.0%, n=21), followed by bilateral involvement (16.7%, n=5) and left ovary (13.3%, n=4).

Histopathological Types(Table 1): Endometriotic cysts were the most common (33.3%, n=10), followed by dermoid cysts (16.7%, n=5), hemorrhagic cysts (13.3%, n=4), follicular cysts (10.0%, n=3), mucinous cystadenomas (10.0%, n=3), serous cystadenomas (6.7%, n=2), and mixed bilateral cysts (10.0%, n=3).

Types of Cyst	Frequency	Percentage
Dermoid	5	16.7
Endometriotic cyst	10	33.3
Follicular cyst	3	10.0
Hemorrhagic cyst	4	13.3
Mucinous cystadenoma	3	10.0
R-follicular cyst, L-haemorrhagic cyst	1	3.3
R-haemorrhagic cyst, L-simple ovarian cyst	1	3.3

R-hemorrhagic cyst, L-follicular cyst	1	3.3
Serous cystadenoma	2	6.7
Total	30	100.0

Table 1: Distribution of study subjects according to type of Ovarian Cyst

R-Right

L-Left

Baseline AMH levels

The majority of patients (66.7%, n=20) had baseline AMH levels between 2.01-4.00 ng/ml, while 26.7% (n=8) had levels ≤2.00 ng/ml. Only 6.6% had AMH levels >4.00 ng/ml. A significant correlation was found between infertility status and preoperative AMH levels (p=0.0001), with both primary and secondary infertility patients having significantly lower baseline AMH levels.

Surgical outcomes

All procedures were completed laparoscopically without conversion to open surgery using standardized three-port technique. Ovarian cyst enucleation was performed by the same surgeon using minimal or no energy source to preserve ovarian tissue. No major intraoperative complications occurred, and all patients were discharged within 24 hours postoperatively.

AMH changes over time

Postoperative Day 7 Analysis(Table 2): No cyst type showed statistically significant AMH decline at day 7 post-surgery. Mean changes included: dermoid cysts (3.81±3.66 to 3.24±3.09 ng/mL, p=0.80), endometriotic cysts (2.53±1.35 to 2.45±0.96 ng/mL, p=0.88), follicular cysts (2.23±0.72 to 2.05±0.88 ng/mL, p=0.76), hemorrhagic cysts (2.41±0.66 to 2.30±0.64 ng/mL, p=0.77), mucinous cystadenomas (1.95±0.73 to 1.89±0.25 ng/mL, p=0.71), and serous cystadenomas (2.76±0.93 to 2.46±0.66 ng/mL, p=0.745).

Types of ovarian cyst	Count	Pre Operative AMH		Post Operative Day 7 AMH		P-Value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Dermoid	5	3.81	3.66	3.24	3.09	0.80	NS
Endometriotic cyst	10	2.53	1.35	2.45	0.96	0.88	NS
Follicular cyst	4	2.23	0.72	2.05	0.88	0.76	NS

Hemorrhagic cyst	6	2.41	0.66	2.30	0.64	0.77	NS
Mucinous cystadenoma	3	1.95	0.73	1.89	0.25	0.71	NS
Serous cystadenoma	2	2.76	0.93	2.46	0.66	0.745	NS

Table 2: Comparison of mean preoperative and postoperative day 7 AMH levels by ovarian cyst type

AMH- Anti mullerian hormone

S-Significant

NS-Non significant

Postoperative Day 30 Analysis(Table 3): Only endometriotic cysts demonstrated a statistically significant AMH decline from 2.53±1.35 ng/mL preoperatively to 1.48±0.62 ng/mL at day 30 (p=0.038), representing a 41.5% reduction. Other cyst types showed no significant changes: dermoid cysts (3.81±3.66 to 3.16±2.39 ng/mL, p=0.748), follicular cysts (2.23±0.72 to 1.92±0.80 ng/mL, p=0.585), hemorrhagic cysts (2.41±0.66 to 2.05±0.54 ng/mL, p=0.325), mucinous cystadenomas (1.95±0.73 to 1.85±0.11 ng/mL, p=0.826), and serous cystadenomas (2.76±0.93 to 2.59±0.81 ng/mL, p=0.863).

Types of ovarian cyst	Count	Pre Operative AMH		Post Operative Day 30 AMH		P-Value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Dermoid	5	3.81	3.66	3.16	2.39	0.7481	NS
Endometriotic cyst	10	2.53	1.35	1.48	0.62	0.038	S
Follicular cyst	4	2.23	0.72	1.92	0.80	0.585	NS
Haemorrhagic cyst	6	2.41	0.66	2.05	0.54	0.325	NS
Mucinous cystadenoma	3	1.95	0.73	1.85	0.11	0.826	NS
Serous cystadenoma	2	2.76	0.93	2.59	0.81	0.863	NS

Table 3: Comparison of mean preoperative and postoperative day 30 AMH levels by ovarian cyst type

AMH- Anti mullerian hormone

S-Significant

NS-Non significant

FSH and LH changes

FSH Analysis(Table 4): Only mucinous cystadenomas showed significant FSH decrease from 8.12±1.61 mIU/mL preoperatively to 4.15±0.91 mIU/mL postoperatively (p=0.02). Other cyst types showed no significant FSH changes: dermoid cysts (8.51±1.72 to 6.49±1.99 mIU/mL, p=0.124), endometriotic cysts (8.94±0.88 to 7.95±1.63 mIU/mL, p=0.108), follicular cysts (8.77±0.22 to 6.00±2.82 mIU/mL, p=0.097), hemorrhagic cysts (8.56±0.94 to 6.52±2.74 mIU/mL, p=0.115), and serous cystadenomas (7.73±0.57 to 5.13±0.92 mIU/mL, p=0.076).

Types Of Ovarian Cyst	Count	Pre Operative FSH		Post Operative Day 2 FSH		P-Value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Dermoid	5	8.51	1.72	6.49	1.99	0.124	NS
Endometriotic cyst	10	8.94	0.88	7.95	1.63	0.108	NS
Follicular cyst	4	8.77	0.22	6.00	2.82	0.097	NS
Haemorrhagic cyst	6	8.56	0.94	6.52	2.74	0.115	NS
Mucinous cystadenoma	3	8.12	1.61	4.15	0.91	0.02	S
Serous cystadenoma	2	7.73	0.57	5.13	0.92	0.076	NS

Table 4: Comparison of preoperative and postoperative day 2 FSH levels by cyst type

FSH- Follicle-Stimulating Hormone

S-Significant

NS-Non significant

LH Analysis(Table [5](#)): No cyst type demonstrated statistically significant changes in LH levels postoperatively. Changes included: dermoid cysts (6.19±1.89 to 7.55±4.15 mIU/mL, p=0.523), endometriotic cysts (6.66±2.63 to 7.15±3.14 mIU/mL, p=0.709), follicular cysts (8.71±2.85 to 7.90±2.77 mIU/mL, p=0.697), hemorrhagic cysts (9.03±2.30 to 6.07±2.72 mIU/mL, p=0.207), mucinous cystadenomas (6.95±1.46 to 5.99±4.66 mIU/mL, p=0.75), and serous cystadenomas (4.50±2.04 to 4.09±1.02 mIU/mL, p=0.823).

Types of Ovarian Cyst	Count	Pre Operative LH		Post Operative Day 2 LH		P-Value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Dermoid	5	6.19	1.89	7.55	4.15	0.523	NS
Endometriotic cyst	10	6.66	2.63	7.15	3.14	0.709	NS
Follicular cyst	4	8.71	2.85	7.90	2.77	0.697	NS
Hemorrhagic cyst	6	9.03	2.30	6.07	2.72	0.207	NS
Mucinous cystadenoma	3	6.95	1.46	5.99	4.66	0.75	NS
Serous cystadenoma	2	4.50	2.04	4.09	1.02	0.823	NS

Table 5: Comparison of preoperative and postoperative day 2 LH levels by ovarian cyst type

LH- Luteinizing Hormone

S-Significant

NS-Non significant

Women undergoing laparoscopic surgery for endometriotic cysts experienced a significant short-term decline in ovarian reserve, whereas patients with non-endometriotic benign ovarian cysts did not demonstrate statistically significant ovarian reserve reduction.

Discussion

The present prospective study evaluated the short-term impact of laparoscopic management of benign ovarian masses on ovarian reserve using serum anti-Müllerian hormone (AMH) as the primary marker. The key finding was that only endometriotic cysts demonstrated a significant postoperative decline in AMH levels, with a 41.5% reduction at postoperative day 30 (2.53 ± 1.35 ng/mL vs. 1.48 ± 0.62 ng/mL; p=0.038), while non-endometriotic cysts showed no statistically significant decline. These findings suggest that ovarian reserve compromise following laparoscopic surgery is largely influenced by cyst pathology rather than surgery alone.

Our findings are consistent with existing literature demonstrating that endometriomas have a disproportionately harmful effect on ovarian reserve. A recent meta-analysis by Moreno-Sepulveda et al. reported postoperative AMH reductions ranging from 35% to 65% following laparoscopic endometrioma surgery [4]. Similarly, Younis and Taylor highlighted that both the presence of endometrioma and surgical excision contribute to diminished ovarian reserve [9].

Prospective studies have reported findings similar to ours. Chang et al. observed significant serial declines in AMH following laparoscopic cystectomy [1], while Vignali et al. demonstrated persistent long-term ovarian reserve reduction after endometrioma excision [3]. Anh et al. also reported incomplete AMH recovery during long-term follow-up after laparoscopic endometrioma surgery [6]. Together, these studies support our observation that endometriotic cysts pose a greater threat to ovarian reserve compared with other benign ovarian masses.

The mechanism of ovarian reserve decline is likely multifactorial. Inadvertent removal of normal ovarian cortex during cyst stripping, thermal damage from electrocautery, and pre-existing inflammatory damage caused by endometriosis may all contribute to follicular loss [6,9,10]. Although minimal energy sources were used in our study, a significant AMH decline was still observed in endometrioma patients, suggesting that disease-related ovarian damage may play an important role.

Notably, no significant AMH decline was observed on postoperative day 7, indicating that early postoperative measurements may underestimate ovarian reserve loss. Similar delayed declines have been reported in previous studies evaluating AMH at later postoperative intervals [1,6]. FSH and LH were less reliable indicators in our cohort, with no consistent postoperative changes observed. This supports previous evidence that AMH remains the most sensitive marker for evaluating ovarian reserve after ovarian surgery [2].

The strengths of this study include its prospective design, standardized surgical technique, and evaluation of multiple cyst types. However, limitations include small sample size, short follow-up duration, and absence of long-term fertility outcomes.

Conclusions

Laparoscopic management of benign ovarian masses appeared to preserve ovarian reserve in most non-endometriotic cysts. However, patients with endometriotic cysts demonstrated a significant short-term decline in serum AMH levels, suggesting increased vulnerability of ovarian reserve in this subgroup.

These findings emphasize the importance of cyst type-specific preoperative counseling, particularly in reproductive-age women desiring future fertility. Baseline ovarian reserve assessment and fertility-preserving surgical techniques should be considered in patients undergoing laparoscopic surgery for endometriomas.

Further large-scale prospective studies with longer follow-up are required to evaluate long-term recovery of ovarian reserve and reproductive outcomes following laparoscopic cystectomy.

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