Section: OBG

Original Research Article

EFFECT OF LAPAROSCOPIC OVARIAN CYSTECTOMY ON OVARIAN RESERVE

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ABSTRAC

Background: To assess serum Anti-mullerian hormone levels pre- and post-operatively in ovarian cysts and to compare serum Anti-mullerian hormone levels pre- and post-operatively after laparoscopic ovarian cystectomy.
Materials and Methods: This prospective, observational study was conducted over the period of 18 months in the Department of Obstetrics and Gynecology of a tertiary care institute. The study involved 26 women with ovarian cyst who underwent laparoscopic ovarian cystectomy. Measurement of serum AMH was performed prior to surgery, and 48 hours after laparoscopic cystectomy. Serum AMH levels were compared before and after the surgery and between various types of ovarian cyst.
Results: Most of the patients were in the age group of 31–40 years (46.15%). The majority of the patients were nulliparous (57%) and presented with abdominal pain (73.08%). The patients predominantly had normal body mass index (BMI, 65.38%) and CA125 levels (92%). The most prevalent type of cyst was serous cystadenoma (38.46%). AMH decreased significantly from preoperative to postoperative AMH levels ($p=0.003$). Moreover, postoperatively, the AMH levels decreased significantly in all age, BMI, and parity groups as well as cyst types ($p<0.05$). However, the mean change in postoperative AMH levels relative to preoperative levels were not significant in terms of age, BMI, and parity groups as well as cyst types ($p>0.05$).
Conclusion: Laparoscopic ovarian cystectomy leads to significant reduction in AMH levels. However, change in AMH levels was not significantly associated with age, BMI, parity, and cyst type.
Keywords: Anti - mullerian hormone, laparoscopic ovarian cystectomy.

INTRODUCTION

An ovarian cyst is a fluid containing sac that is formed in the ovaries and is common among both pre- and post menstrual women. An ovarian cysts, either asymptomatic or characterized by pelvic mass, pain, and abnormal uterine bleeding, are seen frequently in women belonging to the reproductive age group.[1] The incidence of ovarian cyst was reported between 5% and 15% of all gynecological diseases.[2] Most of the ovarian cysts are benign in nature with very low chance of malignant transformation. Benign ovarian cysts such as endometrioma, dermoid, serous, or mucinous cystadenoma are seen frequently in young or reproductive aged women. Type of surgery depends on several factors, including the size of the cyst, type of the cyst, age of the patient, and desire to conceive.[3]

Preservation of ovarian function during surgery takes precedence as the foremost consideration for fertility preservation in the context of minimally invasive surgical procedures. Benign ovarian cysts may require surgical treatment because of torsion, pain, infertility, and decreased ovarian reserve, in which laparoscopic ovarian cystectomy has been the gold standard.[4] However, as laparoscopic surgery has been demonstrated to reduce ovarian function, determining the most suitable technique is important.[5]

During cystectomy, the damage to the ovarian reserve is not only due to the inadvertent removal of healthy ovarian tissue, but also vascular compromise due to electrosurgical coagulation or postsurgical inflammation may also cause damage.[6,7] The

technique of the surgery may also affect the change in the ovarian reserve. Ovarian reserve is defined as the functional potential of the ovary, and reflects the number of the follicles left in the ovary at any given time.

Laparoscopic cystectomy is indicated in benign ovarian cysts with symptoms such as pelvic pain and dysmenorrhea or in those patients where the risk of malignant transformation is higher.[8] Studies shows AMH levels were reduced within 1 week after cystectomy but recovered after 3 months of surgery. These findings were similar to a previous study by Chang et al. which demonstrated an initial fall in the AMH values post-surgery and a recovery of AMH levels to about 65% of the baseline AMH level at 3 months after surgery.[5] Studies report that mean baseline AMH values were significantly low in the women with ovarian endometriotic cysts when compared to those with non-endometriotic cysts. These findings might be due to damage to the ovary caused by the presence of endometrioma before the surgery. When AMH levels were compared in endometriotic and non-endometriotic cysts, there was a reduction in AMH immediately after the surgery and significant recovery after 3 months of surgery.[3] Different mechanisms are proposed to explain the reduction in the ovarian reserve following laparoscopic ovarian cystectomy. Endometriotic cysts lack a true capsule around the cyst, so a greater amount of surrounding ovarian cortex is lost while stripping the cyst wall during the cystectomy procedure. This results in a greater loss of ovarian follicles leading to a greater reduction in the AMH levels post-surgery for endometriotic cyst when compared to the non-endometriotic cyst.[9] Furthermore, inflammation and edema due to the surgery in the immediate postoperative period could be another reason for the initial fall in the ovarian reserve.

In terms of ovarian function preservation, several studies have consistently suggested that ovarian cystectomy had a negative impact on ovarian reserve. This damage is secondary to an inadvertent removal of healthy ovarian tissue during cystectomy and thermal destruction of ovarian follicles during surgery. Patients undergoing ovarian cystectomy using the laparoscopic approach with 30W bipolar electrocoagulation had better postoperative ovarian preservation. Laparoscopic unilateral ovarian cystectomy does have an advantage in terms of ovarian preservation as determined by serum AMH level.[10]

Preoperative serum AMH levels have significant positive correlations with normal ovarian volumes, and serum AMH levels at 1 week and 1 month after ovarian cystectomy were positively associated with the preoperative AMH levels and normal ovarian volumes. At last, laparoscopic ovarian cystectomy is associated with a decreased ovarian reserve, measured by serum AMH levels, in the immediate postoperative period; the decreased reserve was restored thereafter until 3 months postoperative. This suggest that serum AMH level could be a marker of ovarian reserve after ovarian surgery.[5]

Though surgical excision of the ovarian cyst is reported to have a negative impact on ovarian reserve, there is limited data about the effect of laparoscopic cystectomy on ovarian reserve in ovarian cysts. Hence, the present study was undertaken to investigate whether ovarian reserve is affected by laparoscopic cystectomy for ovarian cysts and to evaluate serum AMH levels pre- and post-operatively.

MATERIALS AND METHODS

This prospective, observational study was conducted over the period of 18 months from August 2022 to March 2024 in the Department of Obstetrics and Gynecology of a tertiary care institute. The study involved 26 women with ovarian cyst who underwent laparoscopic ovarian cystectomy. Measurement of serum AMH was performed prior to surgery, and 48 hours after laparoscopic cystectomy. Serum AMH levels were compared before and after the surgery and between various types of ovarian cyst.

Inclusion Criteria included Women between ages 20– 40 years, Women with ovarian cysts measuring 5-15 cms, Women undergoing elective and emergency laparoscopic ovarian cystectomy. Patient willing to participate in the study and sign written informed consent form.

Exclusion Criteria

Pregnant women, Women with active pelvic inflammatory disease,

Women with suspected or proven genital or extra genital malignancy, Women with history of previous adnexal surgery and Women refusing to sign informed consent form.

Study Procedure

During the study period, a total of 26 patients fulfilling the eligibility criteria were enrolled in the study. Preoperatively, serum CA125 and AMH levels were assessed. Subsequently, all patients underwent elective laparoscopic ovarian cystectomy under general anesthesia. Pneumoperitoneum was created by inserting a Veres needle. Just below the umbilicus, a 10 mm trocar was inserted, and the abdominal cavity was inspected by a laparoscope. Under the guidance of the laparoscope, additional ports were introduced in the right/left hypochondrium. The cyst wall was separated from the ovarian cortex to perform cystectomy. Hemostasis was achieved with the use of electrosurgical bipolar cauterization at the lowest possible settings to prevent possible damage to the ovarian follicles. The specimens obtained were assessed by visual examination for any evidence of malignancy and it was sent for histopathological examination. Patients were monitored for 48hrs after surgery and discharged if not associated with any postoperative complication. The blood samples were collected for the estimation of serum AMH levels by peripheral venipuncture 48hrs post-operatively.

Serum Anti Mullerian Hormone were estimated by ELISA using reagent kits.

Sample Size Calculation

Based on research article Sireesha et al.[1]

The sample size (n) is calculated according to the formula.

$$N = \frac{(\alpha + Z_b)^2 \sigma^2}{(X_{pre} - X_{post})^2}$$

Where: α = 1.96 for a confidence level (α) of 95%, Zb = 1.821 at 90% power

Xpre ± σ = 4.77 ± 1.32 Xpost ± σ = 3.21 ± 1.54 n = population size

The sample size is equal to 26 x 2 (Pre-op and Post op)

The data of enrolled patients was analyzed and is presented in the Results section.

Statistical Analysis

Data was collected and graphics were designed by Microsoft Office Excel 2019. The data was analyzed with SPSS (IBM, Armonk, NY, USA) version 23.0 for Windows. The categorical and continuous variables are represented as frequency (percentage) and mean ± standard deviation, respectively. Chi-square test and independent sample t-test were used to assess the association between categorical and continuous variables, respectively. A paired t-test was used to compare postoperative AMH levels with preoperative levels. A two-tailed probability value of < 0.05 was considered as statistically significant.

RESULTS

Table 1: Distribution of patients according to age

Age (years)	N = 26	%
11-20	3	11.54
21-30	11	42.31
31-40	12	46.15

Table 1 depict the distribution of patients according to age. Majority of the patients were in the age group of 31 – 40 years (46.15%) followed by 21 – 30 years (42.31%). While the least number of patients were in the age group of 11 – 20 years (11.54%). The age of the study population ranged from 20 to 39 years with a mean age of 29.04 ± 6.88 years.

Table 2: Distribution of patients according to BMI

BMI (kg/m^2)	N = 26	%
< 18.5	3	11.54
18.5 – 24.9	17	65.38
25 – 29.9	4	15.38
≥ 30	2	7.69

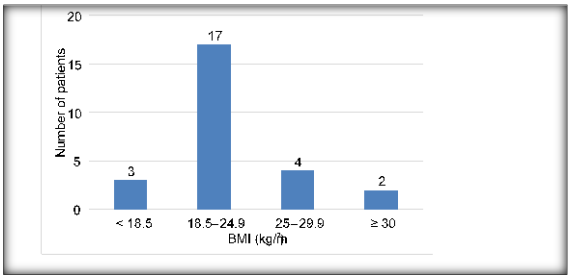

Figure 1: Distribution of patients according to BMI

Table 2 and Figure depict the distribution of patients according to BMI. Majority of the patients were in the BMI group of 18.5 – 24.9 kg/m2 (65.38%) followed by 25 – 29.9 kg/m2 (15.38%). While the least number of patients were in the BMI group of <18.5 kg/m2 (11.54%) and ≥ 30 kg/m2 (7.69%). The BMI of the study population ranged from 17 to 30.92 kg/m2 with a mean BMI of 23.04 ± 3.79 kg/m2.

Table 3: Distribution of patients according to parity

Parity	N = 26	%
P0	15	57.69
P1	1	3.85
≥ P2	10	38.46

Table 3 depict the distribution of patients according to parity. Majority of patients had parity P0 (57.69%) followed by ≥ P2 (38.46%). While only one (3.85%) patient had a parity of P1.

Table 4: Distribution of patients according to clinical symptoms

Clinical symptoms	N = 26	%
Pain abdomen	19	73.08
Dysmenorrhea	3	11.54
Anxious to conceive	1	3.85
Irregular cycles	1	3.85

No symptoms	1	3.85
White discharge PV	1	3.85

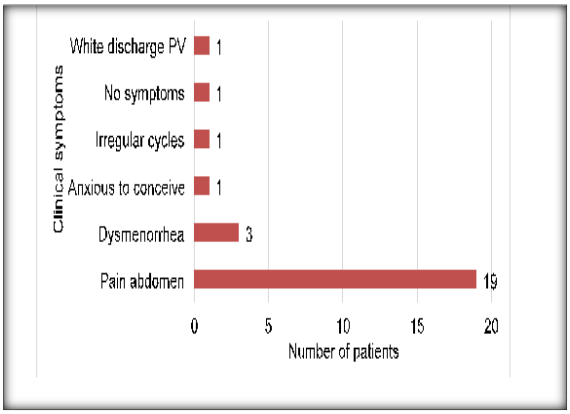

Figure 2: Distribution of patients according to clinical symptoms

Table 4 and Figure illustrate the distribution of patients based on clinical symptoms. The majority of patients reported abdominal pain (73.08%), followed by dysmenorrhea (11.54%). Conversely, the least commonly reported symptoms were anxious to conceive, irregular cycles, no symptoms, and white discharge PV (3.85% each).

Table 5: Distribution of patients according to types of cysts

Types of cysts	N = 26	%
Serous cystadenoma	10	38.46
Endometriotic	4	15.38
Dermoid	4	15.38
Hemorrhagic	3	11.54
Mucinous cystadenoma	2	7.69
Seromucinous cystadenoma	1	3.85
Corpus luteal	1	3.85
Endometroid adenofibroma	1	3.85

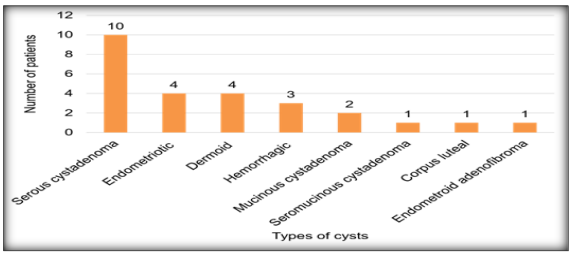

Figure 3: Distribution of patients according to types of cysts

Table 5 and Figure present the distribution of patients according to types of cysts. The most prevalent type was serous cystadenoma (38.46%), followed by endometriotic cysts and dermoid cysts (15.38% each), hemorrhagic cysts (11.54%), and mucinous cystadenomas (7.69%). Conversely, the least frequently observed cyst types included seromucinous cystadenoma, corpus luteal, and endometroid adenofibroma (3.85% each).

Table 6: Distribution of patients according to CA 125 level

CA 125 (U/ml)	N = 26	%
Normal	24	92.31
Raised	2	7.69

Table 6 present the distribution of patients according to CA 125 level. Out of 26 patients, 24 (92.31%) patients had normal and 2 (7.69%) patients had raised CA 125 (U/ml) level. The CA 125 ranged from 5.5 to 71.3 (U/ml) with mean CA 125 level was 17.27 ± 14.83 (U/ml).

Table 7: Comparison of patients according to anti-Mullerian hormone level

AMH (ng/ml)	Pre AMH	Post AMH	p
Mean ± SD	1.14 ± 0.91	0.78 ± 0.75	0.003

Table 7 present the comparison of patients according to anti-Mullerian hormone level. Analysis by paired sample t test revealed significant decrease in postoperative AMH levels compared to preoperative AMH levels (p = 0.003).

Table 8: Association of age with AMH levels during the study period

Age (years)	Pre AMH	Post AMH	p	Mean change	p
20 – 30 (N=14)	1.33 ± 0.80	0.84 ± 0.61	0.019	0.50 ± 0.70	0.187
31 – 40 (N=12)	0.91 ± 1.00	0.71 ± 0.90	0.034	0.20 ± 0.29	

Table 8 illustrate the relationship between age and AMH levels throughout the study period. Analysis by paired sample t test revealed significant decrease in postoperative AMH levels compared to preoperative

AMH levels in the age group of 20 - 30 years (p = 0.019) and 31 - 40 years (p = 0.034). An independent samples t-test was conducted to compare the mean changes in AMH levels between the age groups of 20-30 years and 3140 years. The analysis revealed no significant difference between these two groups (p = 0.187).

Table 9: Association of BMI with AMH levels during the study period

BMI (kg/m^2)	Pre AMH	Post AMH	p	Mean change	p
17 – 24.9 (N=20)	1.05 ± 0.82	0.68 ± 0.58	0.014	0.37 ± 0.61	0.903
≥ 25 (N=6)	1.44 ± 1.19	1.11 ± 1.17	0.077	0.34 ± 0.37	

Table 9 present the association of BMI with AMH levels during the study period. Analysis by paired sample t test revealed significant decrease in postoperative AMH levels compared to preoperative AMH levels in the BMI group of 17 – 24.9 kg/m2 (p = 0.014), while there was no significant decrease in the BMI group of ≥ 25 kg/m2 (p = 0.077). An independent samples t-test was conducted to compare the mean changes in AMH levels between the BMI groups of 17 – 24.9 kg/m2 and ≥ 25 kg/m2. The analysis revealed no significant difference between these two groups (p = 0.903).

Table 10: Association of cyst type with AMH levels during the study period

Cyst type	Pre AMH	Post AMH	p	Mean change	p
Serous cystadenoma (N=10)	0.90 ± 0.57	0.66 ±0.35	0.022	0.24 ± 0.28	0.456
Non-serous cystadenoma (N=16)	1.29 ± 1.05	0.85 ±0.92	0.020	0.44 ± 0.68	

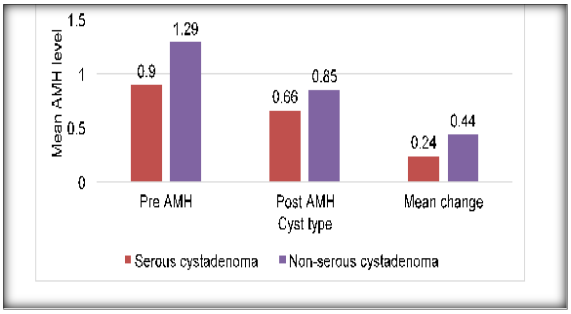

Figure 4: Association of cyst type with AMH levels during the study period

Table 10 and Figure present the association of cyst type with AMH levels during the study period. Analysis by paired sample t test revealed a significant decrease in postoperative AMH levels compared to preoperative AMH levels in the serous cystadenoma group (p = 0.022) and the non-serous cystadenoma group (p = 0.020). An independent samples t-test was conducted to compare the mean changes in AMH levels between the serous cystadenoma group and non-serous cystadenoma group. The analysis revealed no significant difference between these two groups (p = 0.456).

Table 11: Association of parity with AMH levels during the study period

Parity	Pre AMH	Post AMH	p	Mean change	p
P0 – P1 (N=16)	1.29 ± 1.00	0.87 ± 0.89	0.025	0.42 ± 0.67	0.522
≥ P2 (N=10)	0.90 ± 0.72	0.63 ± 0.46	0.023	0.27 ± 0.31	

Table 11 present the association of parity with AMH levels during the study period. Analysis by paired sample t test revealed significant decrease in postoperative AMH levels compared to preoperative AMH levels in the parity group of P0 – P1 (p = 0.025) and ≥ P2 (p = 0.023). An independent samples t-test was conducted to compare the mean changes in AMH levels between the parity group of P0 – P1 and ≥ P2. The analysis revealed no significant difference between these two groups (p = 0.522).

DISCUSSION

An ovarian cyst is a fluid containing sac that is formed in the ovaries. Most of the ovarian cysts are benign in nature with a very low chance of malignant transformation. Most common symptoms of these cysts, such as chronic pelvic pain, dyspareunia, gastrointestinal, and urinary symptoms, are resulted from the pressure they apply to the nearby structures such as the GI tract and bladder.[1] The incidence of ovarian cyst was reported between 5% and 15% of all gynecological diseases.[2] Most cases of laparoscopic cystectomy are done in patients who wants fertility. Recently, laparoscopic ovarian cystectomy has become the first-line choice and is increasingly favored by gynecologic surgeons.[11] Although surgical excision of ovarian cysts may negatively impact ovarian reserve, data on laparoscopic cystectomy's effects are limited. This study aims to assess how laparoscopic cystectomy influences ovarian reserve by evaluating serum AMH levels before and after the procedure and how the procedure is used for Fertility enhancing surgery (FES)

The findings of the present study are discussed under the following headings

In the present study, the majority of the patients were in the age group of 31 – 40 years (46.15%) and 21 – 30 years (42.31%), with the mean age of 29.04 ± 6.88 years. In agreement with the findings of the present study, Ali et al. found that most of the patients were in the age group of 23 – 38 years with mean age 30.3

± 4.9 years.[4] In another study, Sireesha et al. observed that patients were predominantly in the age group of 26 – 36 years with mean age of 31.17 ± 4.5 years.[5] Similarly, other studies Sahabuddin et al,[2] found that the majority of patients were in the age group of 20 – 40 years (94.4%) and 20 – 30 years (62.5%), respectively. Thus, the age distribution observed in the present study is consistent with the existing literature.

In the present study, the majority of the patients were in the BMI group of 18.5 – 24.9 kg/m2 (65.38%) and the mean BMI was 23.04 ± 3.79 kg/m2. In agreement with the findings of the present study, Ono et al. found that the mean BMI of the patients with cyst was 19.6 ± 3.0 kg/m2.[12] In their study, Sireesha et al. observed that patients had mean BMI of 25.97±3.7 kg/m2.[5]

In the present study, the most prevalent type was serous cystadenoma (38.46%). In agreement with the findings of the present study, Amooee et al. found that most of patients had serous cystadenoma (43.33%).[1] In their study, Ali et al. observed that most of the patients had dermoid type of cyst (41.2%), followed by serous and mucinous cyst (each 29.4%).[4] In another study, Sireesha et al. reported that most of the patients had endometriotic cysts (40%) followed by serous cystadenoma (19%).[5] This variation in the distribution of cysts according to the types can be attributed to difference in study population.

In the present study, predominantly patients had normal CA125 levels (92.31%) with a mean level of 17.27 ± 14.83 U/ml. In consensus with the findings of the present study, Sahabuddin et al. found that the most of patients had normal CA125 (70%).[2]

In the present study, postoperative AMH levels were significantly lower than preoperative levels (p = 0.003). In agreement with the findings of the present study, Ali et al. found that there is significant decrease in postoperative AMH levels compared to preoperative AMH levels (p < 0.01).[4] In other studies, Sahabuddin et al,[2] and Sireesha et al,[5] observed that AMH levels decreased significantly in postoperative period than preoperative period (both p <0.05). We concluded that, Laparoscopic ovarian cystectomy results in significant reduction in Serum AMH levels.

Association of Age with AMH Levels

In the present study, postoperative AMH levels were significantly lower than preoperative AMH levels in age groups of 20 - 30 years (p = 0.019) and 31 - 40 years (p = 0.034). In agreement with the findings of the present study, Elsemary et al. reported a significant decrease in postoperative AMH levels compared to preoperative AMH levels in both age group of <38 years and >38 years (p < 0.001).[13] In the present study, there was no significant difference in the mean changes in AMH levels between the age groups of 20-30 years and 31-40 years (p = 0.187).

Association of BMI with AMH Levels

In the present study, postoperative AMH levels were significantly lower than preoperative AMH levels in the BMI group of 17 – 24.9 kg/m2 (p = 0.014), and not in BMI group of ≥ 25 kg/m2 (p = 0.077). However, there was no significant difference in the mean changes in AMH levels between the BMI groups of 17 – 24.9 kg/m2 and ≥ 25 kg/m2 (p = 0.903). In agreement with the findings of the present study, Mansouri et al. found that there was no significant decrease in postoperative AMH levels compared to preoperative AMH levels in BMI groups ≥25 kg/m2 and <25 kg/m2 (p = 0.38).[14] Similarly, Cho et al. reported no significant association of decrease in postoperative AMH levels compared to preoperative AMH levels in BMI groups ≥20 kg/m2 and <20 kg/m2 (p > 0.05).[14]

Association of Parity with AMH Levels

In the present study, postoperative AMH levels were significantly lower than preoperative AMH levels in the parity group of P0 – P1 (p = 0.025) and ≥ P2 (p = 0.023). However, there was no significant difference in the mean changes in AMH levels between the parity group of P0 – P1 and ≥ P2 (p = 0.522). However, Shi et al. reported that percentage change in AMH level ≥ 30% was significant association of parity (p < 0.012).[15]

Association of Cyst Type with AMH Levels

In the present study, postoperative AMH levels were significantly lower than preoperative AMH levels in the patients with serous cystadenoma group (p = 0.022) and the non-serous cystadenoma group (p = 0.020).

In the present study, there was no significant difference in the mean changes in AMH levels between the serous cystadenoma and non-serous cystadenoma (p = 0.456). Contrary to the findings of the present study, Ali et al. found that there was significant decrease in postoperative AMH levels compared to preoperative AMH levels in the dermoid cyst group (p < 0.001)[4] In another study, Amooee et al. discovered that percentage decrease in postoperative AMH levels was significant greater in dermoid cyst compared to mucinous (p <0.001) and serous cystadenoma (p <0.001), while postoperative AMH levels did not significantly between mucinous and serous cystadenoma (p = 0.446).[1]

In our study we noticed cystectomy results in a significant decrease in AMH levels; however, the amount of decrease depends on the type of cyst excised.

CONCLUSION

The majority of the patients were in the age group of 31 – 40 years (46.15%) with a mean age of 29.04 ± 6.88 years. Most of the patients were in the BMI group of 18.5 – 24.9 kg/m2 (65.38%) with a mean BMI of 23.04 ± 3.79 kg/m2. The majority of patients were nulliparous (57.69%) and predominantly came with abdominal pain (73.08%).

The most prevalent type of cyst was serous cystadenoma (38.46%). patient and had normal CA125 levels (92%) with mean 17.27 ± 14.83 U/ml.

AMH decreased significantly from preoperative to postoperative AMH levels ($p = 0.003$).

Postoperatively, the AMH levels decreased significantly in all age, BMI, and parity groups as well as cyst types ($p < 0.05$).

The mean change in postoperative AMH levels relative to preoperative levels were not significant in terms of age, BMI, and parity groups as well as cyst types ($p > 0.05$).

These findings highlight the need for careful preoperative evaluation and consideration of fertility preservation options in women undergoing this procedure.

Further research is warranted to explore strategies to mitigate the impact on ovarian reserve and improve fertility outcomes for affected women.

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