Cons and Pros of Interventions for Management of Ovarian Endometrioma in Infertile Women with Good Ovarian Reserve

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Abstract

Objectives : Assessment of the outcomes of surgical management of ovarian endometrioma (OMA) regarding ovarian reserve (OR), endometriosis-induced manifestations, and recurrence rate (RR).

Patients : 90 women with uniloculus OMA of >3 cm diameter in infertile women with good OR were randomly divided into three (A-C) groups according to the procedure: laparoscopic cystectomy, laparoscopic cyst evacuation and cauterization of the endocytic wall, and transvaginal aspiration and ethanol sclerotherapy. Serum anti-Müllerian hormone (AMH) and antral follicular count (AFC) were determined as baseline and 3-m and 6-m postoperative (PO). The study outcome is the impact of the applied procedures on OR, pain scores and consumption of analgesia, and the RR of OMA.

Results: The applied procedures significantly reduced pain scores and frequencies of patients according to the type of pain and analgesia consumed. At 3-m PO, serum AMH levels were decreased with non-significant differences in the percentage of decrease between the three groups. At 6-m PO, serum AMH levels were increased in Group-C patients, while progressively decreased in Group-B and did not change in Group-A patients. The decrease of AFC was maximal in group B with significantly lower counts than other groups that showed non-significant differences. Nineteen cases (21.1%) developed recurrent cysts with significantly lower RR in Group-A than in other groups.

Conclusion: No procedure was immune to disadvantages, thus proper evaluation of patients' concerns is mandatory. Transvaginal aspiration with sclerotherapy is appropriate if the pain is the main concern, while cystectomy was advocated to reduce recurrence, but for infertility management, no procedure was advantageous.

Keywords: Ovarian endometrioma, Laparoscopic cystectomy, Ethanol sclerotherapy, Ovarian reserve, recurrence

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INTRODUCTION

Endometriosis is lesions containing the endometrial glands and stroma outside the uterine cavity usually in the pelvis [1], but endometrial tissues transfer to more distant abdominal organs or spread as extra-peritoneal lesions involving the pleura or abdominal wall where recorded [2]. Endometriosis was broadly classified as either superficial peritoneal or deep infiltrating endometriosis or ovarian endometrioma (OMA) [3]. A mini-review suggested an incidence of OMAs of 17–44% among young women with endometriosis [4]. According to the recent ESHRE guideline for the management of endometriosis, the plan for OMA management depends on the main presenting manifestations and the size of the OMA [5] and may be either or a combination of multiple lines including expectant management, medical treatment, surgical treatment, in vitro fertilization in case of infertility-associated endometriosis [6]. Endometriosis has detrimental effects on fertility and this effect is multifactorial, ovarian tissue compression by the OMA may result in corrupted circulation with subsequent loss of follicles, and the increased inflammation resulting from endometriosis might alter the functions of the ovary, tubes or endometrium most probable through inflammation-induced overproduction of local ovarian and peritoneal inflammatory cytokines [7] and reactive oxygen species [8] leading to the production of poor quality oocytes [9]. Different techniques were supposed for the surgical treatment of OMAs as cystectomy, electrocoagulation, laser ablation, plasma-energy ablation, and combined techniques [10]. Laparoscopy for the management of endometriosis provided better visualization of endometriosis lesions, shorter hospitalization, and return to daily activities, so it is favored over laparotomy \ [11].

Objectives

This study tried to assess the outcomes of the management of ovarian endometrioma (OMAs) regarding ovarian reserve (OR), endometriosis-induced manifestations and recurrence rate (RR).

Design

A Prospective randomized interventional study

Setting

Department of Obstetrics and Gynecology, Faculty of Medicine, Benha University, in conjunction with multiple private gynecology centers

Ethical approvals

The study protocol was approved by the Departmental committee before the case collection in Jan 2020. The supposed therapeutic lines were discussed with patients before enrolment, and those accepted to receive any of these lines signed a written fully informed consent before inclusion in the study. After the case collection and at the end of follow-up, the study protocol with its outcomes was approved by the Ethical Committee at Benha Faculty of Medicine with RC :15-6-2023

Patients

Preliminary evaluations were performed for all patients attending the infertility clinic to select those with manifestations suggestive of endometriosis as the cause of infertility and were free of exclusion criteria. Patients' age and body mass index (BMI) were determined, and family history of endometriosis, history of medical diseases, special habits, menstrual history regarding its regularity, flow characteristics and associated manifestations were taken. Fertility status, number of living offspring, duration of infertility, the received therapeutic lines for infertility, if any, and other associated clinical manifestations were recorded. Pain history taking included the

evaluation of the presence of pain, its type, location and severity, duration, and type of analgesia received to allow pain relief. For comparative purposes, pain severity was evaluated numerically using a visual pain analogue scale of 10 points. History taking also included previous lines of medical treatment and previous aspiration or surgical interference.

Clinical examination

All women underwent complete gynecological examination and transvaginal (TVU) and transabdominal ultrasonography to detect the lesions. Using TUV (7.5MHz vaginal probe of the General Electric Voluson E8 ultrasound unit; GE Healthcare Austria GmbH, Seoul, Korea) the OMA was described as regards laterality, its greatest diameter, locularity, and the presence of associated lesions or deposits in the tube, ligaments, vaginal wall, Douglas pouch, urinary bladder or rectum. The intra-cystic fluid was described to assure its character as the homogeneous fluid of low-level ground glass echogenicity. The baseline antral follicular count (AFC) was determined.

Exclusion criteria

Exclusion criteria included the presence of irregular menses, manifestations or evidence of premature ovarian failure as judged by AFC and serum anti-Müllerian hormone (AMH) level, bilateral, multilocular, or recurrent cysts, cysts of <3 cm in its greatest diameter, deep endometriosis, cyst suspicious to be malignant, rapidly growing or with abnormal fluid characters, diabetes mellitus, endocrinopathy with special regard to hyperprolactinemia and disturbed thyroid functions, polycystic ovary syndrome, maintenance on hormonal therapy during three months ago. Also, women who had a BMI of >30 kg/m2, associated uterine fibroid, adenomyosis, previous ovarian or pelvic surgeries or pelvic radiotherapy that resulted in pelvic adhesions were excluded as well.

Inclusion criteria

Inclusion criteria are the presence of OMA of diameter wider than 3 cm in infertile women with good OR as manifested by AFC of >4 and serum AMH of >1 ng/ml, regular menstrual cycle, free of exclusion criteria and accepted to participate in the study according to its protocol lines.

Randomization & Grouping

Women who accepted to participate in the study and signed the written informed consent were randomly allocated into three groups according to the procedure, to be provided using a software program with a sequence of 1:1:1 and irregular dropping of sequences to assure randomization. The provided sequences were translated into letters A, B, and C that were printed on cards blindly and were provided to the gynecologist in charge carrying the patient's name and the procedure to be undertaken.

The study protocol

The applied procedures were laparoscopic cystectomy (Lap C) for patients of group A, laparoscopic cyst evacuation and cauterization of (Lap E&C) the endo-cystic wall for group B and transvaginal aspiration and ethanol sclerotherapy (TV AEST) for patients of group C. All patients gave blood samples for the estimation of serum AMH using an Abcam ELISA kit (Cat No. ab267629, Abcam Co., USA), TVS for the determination of AFC before undertaking the procedure, and 3-m and 6-m after the procedure, to be used as a judge for the impact of the procedure on the OR, and this was evaluated as the percentage of change at follow-up estimated levels concerning baseline levels.

Operative procedures

Laparoscopic surgery was performed using the 4-port approach with Storz endoscopic instruments (Karl Storz) under general anesthesia with endotracheal intubation. All patients received prophylactic broad-spectrum antibiotics with induction of anesthesia. The patient was placed supine and a 1-1.5 cm just subumbilical incision is made along the skin crease, Verres needle was inserted to create pneumoperitoneum with a gradual elevation of abdominal pressure till 14 mmHg. A 10-mm trocar and telescope were inserted through the subumbilical incision, and then the other trocars were inserted and the patient was positioned in Trendelenburg position and exploratory laparoscopy and examination of the targeted cyst were performed to confirm the characteristics of the cyst.

A.Laparoscopic cystectomy (Lap C)

The cyst was dissected from any adhesions and its posterior surface is exposed and an incision is made in the outer ovarian cortical layer to expose the cyst. If the cyst was tense, a 0/4 Vicryl purse-string suture was performed and a small incision is made in the wall of the cyst to allow insertion of the suction cannula, to evaluate the cyst to allow cyst grasping, then the cannula was removed and the purse-string suture was tightened to prevent soiling with the cyst contents. Then, two atraumatic grasping forceps were used to pull the cyst, which was dissected carefully by stripping technique and hemostasis was performed using a bipolar coagulation set that was adjusted to provide 30-40W with a shot every 3-5 sec till complete cyst dissection (12). To minimize the use of electrocautery for control of oozing, a layer of Surgicel (ETHICON Surgicel Absorbable Hemostat; 2in x 4in, 10 pieces; Ethicon, Raritan, USA) that was made of oxidized regenerated cellulose and documented to be safe and effective in different surgical settings (13) was applied to the oozing surface. Then, a few simple interrupted sutures using 0/4 Vicryl absorbable suture material were applied to the edge of the cortical incision to control bleeding and reduce the resultant raw surface to minimize adhesions. The cyst was extracted and sent for pathological confirmation of the diagnosis.

B. **Laparoscopic cyst evacuation and cauterization (Lap E&C)**

Through a purse-string 0/4 vicryl stitch applied in the cystic wall, a small snip was made to allow a double-way catheter to be inserted to evacuate the cystic contents and to rinse the cyst with saline till the suction fluid returned clear. Then, the orifice is widened and the inner layer of the cystic wall is cauterized with bipolar energy provided at 40 W to deliver 640 J. Simple oozing was not cauterized and pieces of surgical were applied for control of oozing.

C.Transvaginal ultrasound-guided aspiration and ethanol sclerotherapy:

With the patient in a lithotomy position, the size and site of the cysts were identified, and under US guidance, the needle was passed through the lateral fornix to puncture the cyst and its contents were aspirated through a 16-Fr double lumen oocyte retrieval needle. Normal saline was injected to irrigate the cyst simultaneously while aspirating until a clear aspirate was obtained. Thereafter, 95% ethanol was injected according to cyst volume (García-Tejedor et al., 2015) (14).

Immediate postoperative (PO) care

- Patients of groups A and B were transferred to the post-anesthetic care unit till being able for walking independently and were home-discharged. Time to 1st ambulation and oral intake was recorded.
- PO analgesia was provided as ketorolac intravenous injection as 1:10 dilution. Patients of group C were managed as

outpatient cases and were discharged on completion of the procedure.

- PO treatment included oral antibiotics, anti-inflammatory and analgesic therapy and no hormonal therapy. Patients were asked to attend the outpatient clinic after 1 week and underwent TVU for evaluation of the presence of any pelvic collection; if any.

Follow-up

Patients were re-evaluated at 1-m PO for their preoperative symptoms and signs to evaluate the clinical outcomes. Further, Then, follow-up visits were arranged at the 3rd and 6th PO months, for estimation of serum AMH, determination of AFC and check for OMA recurrence. Pain scores were re-determined during each visit and the frequency of consumption and type of analgesia were reported.

Study outcomes

1. The primary outcome is the impact of the applied procedures on OR as judged by the changes in serum AMH and AFC.
2. The secondary outcomes included:

- The effect of the applied procedures on pain scores and consumption of analgesia.
- The recurrence rate of EO

Statistical analysis

The obtained results were analyzed using analysis of variance between each two groups to explore the differences and Chi-square test for variates' frequencies between each two groups. The cutoff point for significant was considered at P=0.05 with smaller values indicated significance. Statistical analyses were conducted using SPSS software program (IBM, USA, 2017).

Results

The evaluation process encompassed 137 infertile women suspicious to have endometriosis, 47 women were excluded and 90 women fulfilled the inclusion criteria and were randomly divided into the three interventional groups (Fig. 1). The reported inclusion criteria as shown in Table 1 showed insignificant differences between the studied groups.

Table 1: Patients' enrolment data

		Group A	Group B	Group C	P
Age (Years)		32.4±4.1	31.2±3.2	30.4v3.6	0.109
BMI (kg/m²)		29.3±2.3	30.6±2.5	30.2±2.8	0.128
Family history of endometriosis		9 (30%)	6 (20%)	7 (23.3%)	0.656
Smoking		3 (10%)	2 (6.7%)	3 (10%)	0.872
Type of infertility	Primary	11 (36.7%)	7 (23.3%)	9 (30%)	0.53
	Secondary	19 (63.3%)	23 (76.7%)	21 (70%)	
Gravidity	Nulligravida	14 (46.7%)	9 (30%)	11 (36.7%)	0.424
	Once	12 (40%)	14 (46.7%)	16 (53.3%)	
	Twice	4 (13.3%)	4 (13.3%)	2 (6.7%)	
	≥3	0	3 (10%)	1 (3.3%)	
Parity	Nulliparous	21 (70%)	14 (46.7%)	17 (56.7%)	0.161
	Once	5 (16.7%)	12 (40%)	13 (43.3%)	
	Twice	3 (10%)	3 (10%)	0	
	≥3	1 (3.3%)	1 (3.3%)	0	

Living offspring	No	21 (70%)	18 (60%)	22 (73.3%)	0.077
	One	5 (16.7%)	12 (40%)	8 (26.7%)	
	Two	4 (13.3%)	0	0	
Other complaints	No	10 (33.3%)	7 (23.3%)	11 (36.7%)	0.406
	Pelvic tenderness	16 (53.4%)	14 (46.7%)	15 (50%)	
	Abdominal tenderness	4 (13.3%)	9 (30%)	4 (13.3%)	
Duration of pain (years)		6.7±2	5.7±1.7	5.6±2.4	0.073
Cyst diameter (mm)		52.4±8.3	50. 7±9.5	52.6±8.8	0.662

Operative time for patients of group C was significantly (P<0.001) shorter than that for patients of groups A and B with non-significantly (P=0.254) longer operative time for patients of group A. PO durations till 1st ambulation and oral intake and hospital stay were insignificantly longer for group A (Table 2)

Table 2: Operative and immediate PO data of patients of the studied groups

		Group A	Group B	Group C	P1	P2	P3
Operative time (min)		52±7.5	49±6.6	39.5±8	0.106	<0.001	<0.001
Duration till 1st (min)	Ambulation	30.5±8.8	28±6.6	-	0.254	-	-
	Oral intake	62.5±13.8	56.5±12.3	-	0.079	-	-
Duration of hospital stay (h)		5±0.9	5.3±1.4	-	0.327	-	-

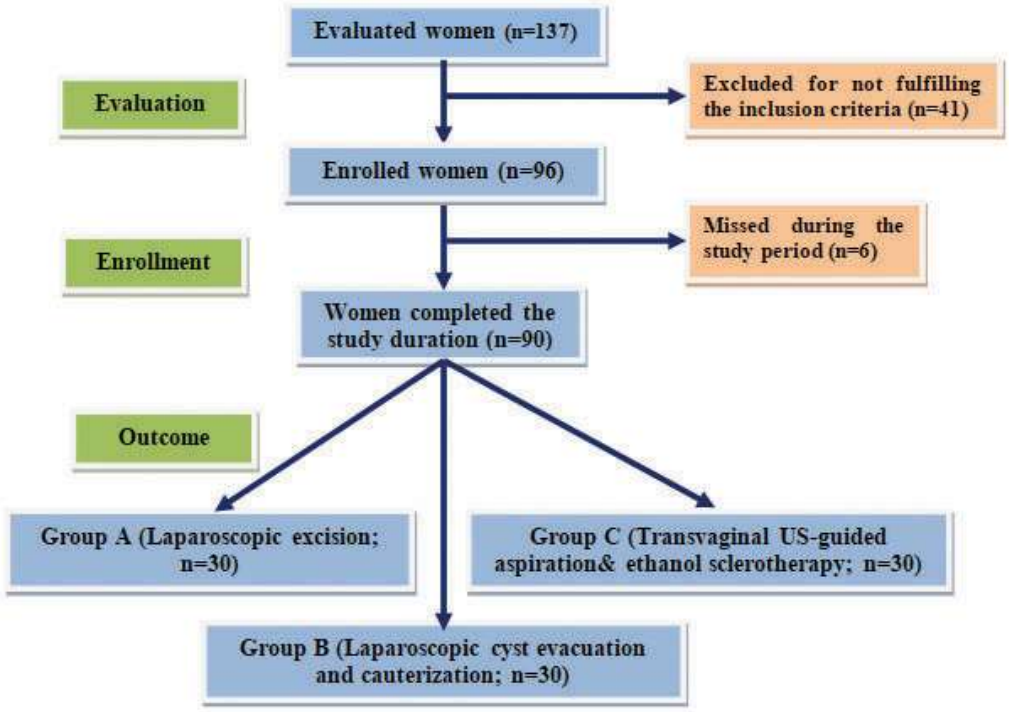

Figure 1: Study Flow Chart

Mean values of total pain scores of the studied patients decreased progressively during follow-up with significant differences in comparison to preoperative scores but with non-significant differences between the three groups. Patients' frequency according to the type of pain showed a progressive decrease at 3-m and 6-m PO and showed non-significant differences between the three groups. The frequency of patients who had dysmenorrhea was decreased at 3-m PO significantly in group A (P=0.038), but insignificantly in other groups, but at 6-m PO the decrease was significant in all groups in comparison to the preoperative frequencies. However, the differences between the reported frequencies of patients who had dysmenorrhea at 3-m and 6-m PO showed non-significant differences in groups B and C, but were significant in group A (P=0.044). The applied procedures significantly decreased the reported frequencies of patients who had dyspareunia at 3-m and 6-m PO in comparison to preoperative frequencies with insignificant differences between the frequencies reported at 3-m and 6-m PO. On the contrary, NMPP at 3-m and 6-m decreased non-significantly in all patients compared to the preoperative frequencies. The frequencies of patients receiving analgesia significantly decreased in all patients at 3-m and 6-m PO in comparison to the preoperative frequencies but with non-significantly lower frequency at 3-m PO compared to 6-m PO (Table 3).

Table 3: The PO pain data of patients of the studied groups

		Group A	Group B	Group C	P
Pain score	Preoperative	6±1.5	6±1.8	6.2±1.9	0.814
	1-m PO	4.6±1.6	4.4±1.8	4.6±1.7	0.716
	P1	0.002	0.001	0.0003	
	3-m PO	3.4±2.1	3.1±2	3.2±1.5	0.768
	P1	<0.001	<0.001	<0.001	
	6-m PO	1.4±1.4	1.7±1.3	1.8±1.5	0.457
	P1	<0.001	<0.001	<0.001	
Dysmenorrhea	Preoperative	20 (66.7%)	17 (56.7%)	22 (73.3%)	0.393
	3-m PO	12 (40%)	10 (33.3%)	17 (56.7%)	0.171
	P1 value	0.038	0.069	0.175	
	6-m PO	5 (16.7%)	7 (23.3%)	11 (36.7%)	0.195
	P1 value	0.0001	0.0084	0.0043	
	P2 value	0.045	0.391	0.121	
Dyspareunia	Preoperative	22 (73.3%)	20 (66.7%)	23 (76.7%)	0.679
	3-m PO	13 (43.3%)	12 (40%)	15 (50%)	0.729
	P1 value	0.018	0.038	0.032	
	6-m PO	6 (20%)	9 (30%)	10 (33.3%)	0.487
	P1 value	<0.001	0.0045	0.0007	
	P2 value	0.052	0.417	0.190	
NMPP	Preoperative	5 (16.7%)	8 (26.7%)	4 (13.3%)	0.389
	3-m PO	3 (10%)	5 (16.7%)	2 (6.7%)	0.455
	P1 value	0.448	0.347	0.389	
	6-m PO	1 (3.3%)	2 (6.7%)	1 (3.3%)	0.227
	P1 value	0.085	0.095	0.161	
	P2 value	0.301	0.447	0.554	

Analgesia	Preoperative	Oral NSAID	15 (50%)	14 (46.7%)	13 (43.3%)	0.442
		Injectable NSAID	13 (43.3%)	16 (53.3%)	12 (40%)	
		Others	2 (6.7%)	0	5 (16.7%)	
	3-m PO	No	6 (20%)	5 (16.7%)	7 (23.3%)	0.429
		Oral NSAID	19 (63.3%)	15 (50%)	12 (40%)	
		Injectable NSAID	5 (16.7%)	10 (33.3%)	10 (33.3%)	
		Others	0	0	1 (3.4%)	
		P1	0.0073	0.04	0.02	
	6-m PO	No	13 (43.3%)	7 (23.3%)	9 (30%)	0.088
		Oral NSAID	15 (50%)	16 (53.4%)	11 (36.7%)	
		Injectable NSAID	2 (6.7%)	7 (23.3%)	10 (33.3%)	
		P1	<0.001	0.005	0.0025	
		P2	0.114	0.639	0.731	

The preoperative serum AMH levels and US-detected AFC showed non-significant differences between patients of the three groups. Unfortunately, all of the applied procedures induced a decrease of serum AMH levels estimated at 3-m PO with non-significant differences in the percentage concerning preoperative levels between the three groups. The extent of decrease in serum AMH was the least in group C and the estimated levels were higher than the levels estimated in samples of patients of group A (P=0.064) and B (P=0.006). Interestingly, serum AMH levels estimated at 6-m PO were increased in samples of patients of group C, while showed a progressive decrease in samples of patients group B and did not change in group A. Estimated serum levels of AMH were significantly lower in samples of group B in comparison to that of patients of groups A (P=0.0008) and C (P<0.001), while were significantly higher in samples of group C (P=0.0003) than in group A. Further, the percentages of decrease of serum AMH estimated at 6-m PO concerning preoperative levels were significantly lower in samples of group C than in samples of group A (P=0.028) and B (P=0.0042) as shown in Table 4 and Figure 2.

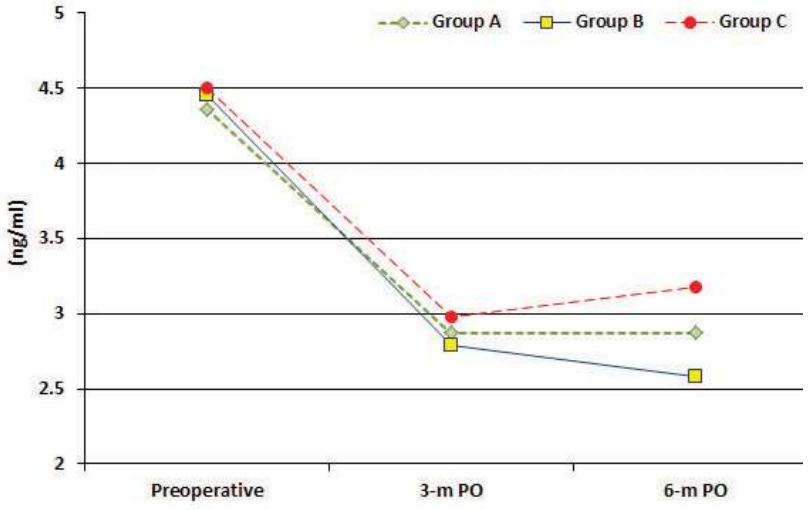

Fig. (2): Mean serum AMH levels estimated at 3-m & 6-m PO in comparison to preoperative levels estimated in studied women

Regarding the AFC, it was decreased in all patients concerning the preoperative count, however, at 3-m PO, the decrease was maximal in group B and the detected count was significantly (P<0.001) lower and the percentage of decrease was significantly (P<0.001) higher than that of other groups with significantly (P=0.0006) lower percentage of decrease in group C than group A. At 6-m PO, the detected AFC increased in all patients, despite being still lower than the preoperative count. The detected AFC in patients of group B was significantly lower compared to patients of groups A (P=0.0094) and C (P=0.0024) with a non-significant difference between groups A and B. Concerning preoperative AFC, the percentage of decrease was significantly (P<0.001) higher in patients of group B than in other groups with significantly (P=0.0256) lower percentage of decrease in patients of group C than patients of group A (Table 4, Fig. 3).

Table 4: The PO serum AMH levels and AFC data of patients of the studied groups

Variants	Time		Group A	Group B	Group C	P1	P2	P3
Serum AMH	Preoperative		4.36±0.8	4.45±1.33	4.5±1.4	0.757	0.642	0.887
	3-m	Level	2.87±0.2	2.79±±0.27	2.98±0.24	0.205	0.064	0.006
		% of change	32.4±10.2	33.3±15.6	28.7±18.2	0.788	0.335	0.295
	6-m	Level	2.87±0.32	2.58±0.29	3.18±0.3	0.0008	0.0003	<0.001
		% of change	32.9±10.4	37.7±16.9	24.7±16.9	0.190	0.028	0.0042
AFC	Preoperative		9.9±1.5	10.1±1.3	9.5±1.5	0.582	0.302	0.100
	3-m	Count	8.5±1.4	6±0.9	8.7±1.5	<0.001	0.589	<0.001
		% of change	14.1±6.6	40.2±8.5	8.5±5.4	<0.001	<0.001	0.0006
	6-m	Count	8.8±1.5	7.9±1	9±1.6	0.0094	0.616	0.0024
		% of change	10.8±10.1	21.4±8	5.2±8.9	<0.001	<0.001	0.0256

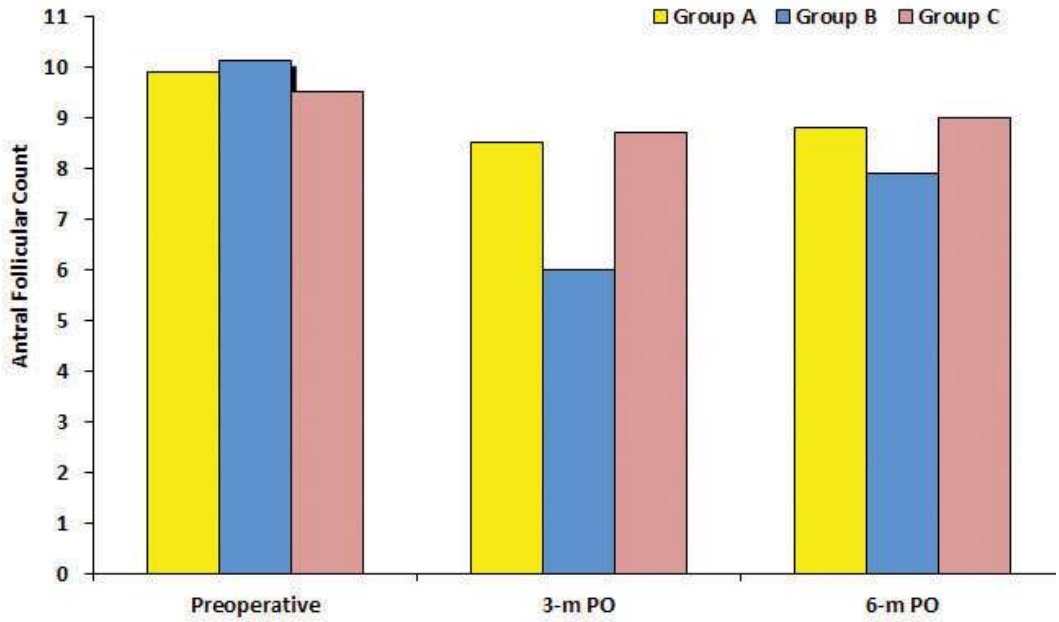

Fig. (3): Mean AFC detected on TVU of the studied women at 3-m & 6-m PO in comparison to preoperative count

During the follow-up period, 19 cases (21.1%) developed recurrent cysts; 9 in group C and 8 in group B with a non-significant (P=0.775) difference between both groups. Only two women in group A had recurrent cysts with a significantly lower incidence of recurrence in comparison to that reported in group B (P=0.037) and C (P=0.019) as shown in Figure 4.

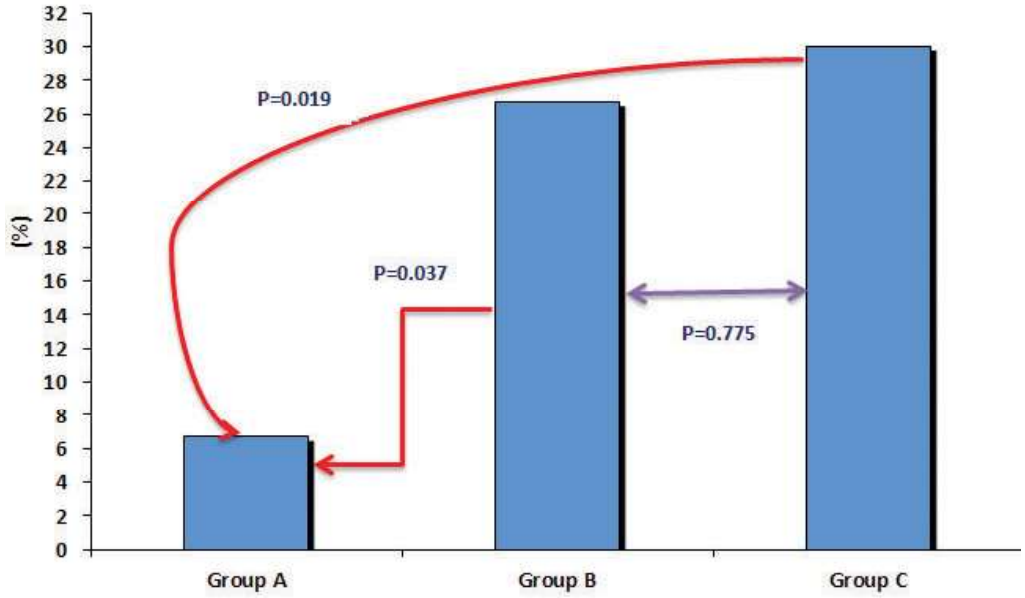

Fig. (4): Cyst recurrence rate at 6-m PO as detected by TVU for women of the studied groups

Discussion

Management of OMAs showed discrepant outcomes, despite the improved constitutional manifestations, management using any of the applied procedures negatively impacted the ovarian reserve as appraised by serum AMH and AFC. This outcome coincided with Mansouri et al. [15] who prospectively reported reduced AMH levels after laparoscopic cystectomy of OMA and found its levels negatively related to the number of cauterizations and type and location of the cyst. Further, Zhang et al. [16] in a meta-analysis of the effect of cystectomy versus ablation on OR of women undergoing treatment of OMAs found both procedures have significant detrimental impacts on OR as judged by PO serum AMH but are dependent on AFC, the ablation causes relatively less damage. Also, Crestani et al., [17] reported a significant decrease in serum AMH after laparoscopic sclerotherapy for OMA during surgery for deep infiltrative endometriosis. Considering pregnancy rate after surgical treatment of OMAs as a judge for OR, Puscasiu et al. [18] reported pregnancy rate after cystectomy, ablation, and drainage of 27%, 32%, and 16% at 12 months, but the probability of conception after simple drainage was increased with the use of assisted reproductive technology. The obtained results and literature spotlight the deleterious effects of ovarian manipulations for the management of any lesion on the OR of the affected women. In support of this assumption, Liang et al. [19] detected significantly lower serum AMH levels at 3-m and 12-m after excision of ovarian mature cystic teratoma and dead-space closure using either conventional or barbed sutures.

The reported impact on OR was procedure-dependent where TV-AEST resulted in the least effects on AMH levels and AFC, and laparoscopic cystectomy non-significantly decreased the

AFC in comparison to TV-AEST at 3-m and 6-m PO, while the outcomes of Lap E&C were worse than the other two procedure for having the highest deleterious effects on the levels of serum AMH and AFC. In support of the procedure-dependency of deteriorated OR after OMA management, Fakehi et al. (20) detected an AMH decline rate of 30% after laparoscopic cystectomy and found the decline was insignificantly related to the demographic characteristics, preoperative AMH, and the amount of CA125

Regarding PO recurrence of OMA as a target for intervention, the total 6-m RR was 21.1% and differentially was 6.7%, 26.7% and 30% after cystectomy, evacuation and sclerotherapy, respectively. The reported low recurrence rate after cystectomy could be attributed to the meticulous dissection while applying the stripping technique. Such attribution goes in hand with Becker et al. [5] who documented that the stripping technique for OMA surgical excision provided lower pain and cyst recurrence rates. In a trial to reduce the RR after OMA cystectomy, Shaltout et al. [21] compared cystectomy versus drainage with and without surgical application to the ovarian or cystic remnants and found surgical effectively reduced the RR after either drainage or cystectomy with a non-significant difference. However, during the current procedures, surgical was applied after Lap E&C and did not reduce the RR in comparison to TV-AEST. Further, the constituents of surgical, which act as hemostatic bio-absorbable material [22] could not explain its effect on recurrence, and the authors who reported such effect did not explain the mechanism through which surgical reduced the RR, especially with drainage.

The obtained results point to the fact that OMA recurrence seemed to be an unavoidable complication for the reported high recurrence rate, irrespective of the procedure, within 6-m and might allow us to consider OMA recurrence as both disease-related and procedure-related. In support of this assumption, Del Forno et al. [23] used estroprogestins or progestins continuous therapy starting immediately after cystectomy in a trial to prevent a recurrence, but reported an RR of 36% during a median follow-up duration of 3.7 years with dysmenorrhea was the first symptom to reappear and affected 43.2% of the studied population.

In a trial to investigate the pathogenesis of OMA recurrence, Xu et al. [24] experimentally and using an animal model, attributed the recurrence of OMA especially after drainage, irrespective of cauterization or sclerotherapy to the presence of living endometrial cells with high adhesion ability in OMA fluid that could leak after drainage or aspiration or rupture of the cyst.

Regarding the effects on the constitutional manifestations, the three techniques significantly reduced PO pain scores concerning preoperative scores with a significant reduction of the frequencies of patients according to the type of pain and type of analgesia consumed. The improved pain scores could be attributed to the removal of cystic fluid with its constituents of inflammatory and nociceptive cytokines and free radicals that proved to be concomitant to endometriosis disease [8, 7, 25, 26, 27].

The current study found complete cystic excision significantly improved the constitutional symptoms than other procedures that depended on the evacuation of the cyst. However, TV-AEST was advantageous for being an outpatient procedure, needing no general anesthesia or hospital admission and thus minimizes the cost, while both laparoscopic procedures share in being more invasive and consuming longer theater time and PO hospital stay and costs. These data supported previous work, wherein Huang et al. [28] documented the effectiveness of TV-AEST of OMA in preserving RR and Miquel et al. [29] found OMAs ethanol sclerotherapy is a rapid outpatient procedure that requires little equipment and low cost.

Conclusion

Each procedure had its cons and pros and this indicated the necessity for proper evaluation of patients' concerns. Thus, if pain is the main concern, transvaginal aspiration and sclerotherapy is the appropriate, if the risk of recurrence is the concern, laparoscopic cystectomy was advocated, while for infertility management, no procedure was advantageous.

Limitations

The small sample size, short duration of follow-up, and the missing evaluation of post-procedural pregnancy rates are the study limitation

Recommendations

Wider-scale studies with long-duration of follow-ups are required to provide more precise guidelines for surgical decision-making. Also, evaluation of the pregnancy rate after each procedure using assisted reproductive technology or not is mandatory.

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