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The Outcome of Laparoscopic Surgical Excision Versus Surgical Ablation of Large Ovarian Endometriomas Regarding Pain Score, Recurrence Rate and Ovarian Reserve

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Abstract: Objectives: Our objective is to determine whether laparoscopic surgical excision or ablation is the optimum surgical management of ovarian endometriomas. **Background:** Endometriosis is one of the most common gynecological disorders. Mostly present with pelvic pain, infertility, or an adnexal mass. An endometrioma is the formation of a cyst within the ovary by ectopic endometrial tissue. Several alternative laparoscopic techniques have been described for the treatment of it. Ablation of the endometrioma also involved for its management. **Patients and Methods:** This is prospective comparative study was carried out on 40 patients attended Gynecological and Infertility Clinic of Tanta University Hospital presented by ovarian endometriomas. All cases signed a well-informed written consent to declare their agreement to be enrolled in the study as agreed upon by the ethical committee. Cases we classified into two group; **Group I:** 21 cases subjected to laparoscopic ovarian cystectomy. **Group II:** 19 cases subjected to laparoscopic cyst fenestration; aspiration and endo- coagulation of cyst wall. An informed written consent before carrying the procedure was taken. **Results:** Our results showed no difference between both groups regarding age, BMI, side of affection or size of the endometrioma. Recurrence was more in group II, while there was no difference regarding pregnancy rate, operative time, estimated blood loss, and postoperative length of stay with no major intra- or post-operative complication. Also, no difference between both groups regarding day-3 FSH. While AMH and AFC significantly decreased after 6 months follow-up in group I. Pelvic pain didn't difference bin both groups preoperatively while postoperatively there was a significant improvement of pain in group I. **Conclusion:** From our study we can conclude that: laparoscopic surgery leads to decrease in ovarian reserve, AMH, AFC with stripping but pain relief is more. Cystectomy is more destructive for ovaries while the improvement of fertility/reproduction is not supported.

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Key words: AFC, Antral Folicular count, AMH, Antimullerian hormone, FSH, Follicle stimulating hormone, VAS, Visual analuge scale

1. Introduction:

Endometriosis is one of the most common gynecological disorders but also one of the greatest challenges facing gynecolical surgeons. [1]

Endometriosis affects 6-20% of women in reproductive age. these women may be asymptomatic, but the majority will present with pelvic pain, infertility, or an adnexal mass. In fact endometriosis has been reported to be as high as 35-50% in women presenting with infertility. [2]

An endometrioma is the formation of a cyst within the ovary with ectopic endometrial tissue lining. Endometriomas are found in 17-44% of patients with endometriosis. The prevalence of endometriosis is much easier to determine since the diagnosis is based on ultrasound. [3]

The sensitivity and specificity of diagnosis via ultrasound are 73% and 94%% respectively. [4] Color Doppler can help to identify vascularization of the mass and some authors have found that ovarian endometriomas in women with pelvic pain are more vascularized than in asymptomatic women. [5]

The primary indications for treatment for ovarian endometriomas are the symptoms of pelvic pain and dyspareunia [6] and may impair outcome of the fertility treatment. [7] There is also a small risk of malignant transformation. [8]

The evidence suggests that, although medical treatment will result in a reduction in size of the endometrioma of up to 57%, the most effective approach to treatment is surgical. [9] Furthermore, if they are left, as with any ovarian cyst they have a risk of rupture and torsion. Laparoscopy has become the gold standard for the treatment of ovarian endometriotic cysts. [10-13]

Several alternative laparoscopic techniques have been described for the treatment of ovarian endometriomas, cyst with evaporization (destruction by burning) preceded or not by medical therapy [11,12,14] drainage and coagulation, and stripping. [15]

Excision of the cyst involves the opening of the endometrioma either with or without the use of electrosurgical or laser energy. The wall of the endometrioma is then excised or stripped away from the underlying cortex using a combination of scissors (or monopolar hook) and grasping forceps.

Ablation of the endometrioma also involved opening of the draining of endometrioma or fenestration (making a window in the wall of the cyst), followed by the destruction of the cyst wall using either cutting or coagulating current, or using a form of laser energy. [16]

It has been suggested that the technique of ovarian endometrioma capsule excision may lead to removal of normal ovarian tissue [17] and that the procedure of capsule ablation may lead to thermal damage to the underlying ovarian cortex and a risk of incomplete destruction of the endometriotic tissue. [18]

2. Patients and Methods:

This is prospective comparative study was carried out on 40 patients attended Gynecological and Infertility Clinic of Tanta University Hospital presented by ovarian endometriomas at Tanta University Hospital. The operations were done by expert laparoscopic consultants. Patient's selection for this study based on clinical diagnosis, ultrasonographic findings and laboratory findings suggesting endometrioma.

The following patients ① Any woman with recent ultrasonography for chocolate cyst measuring ≥3 cms unilateral or bilateral; ② any gravidity and parity; ③ age (18-40 years); ④ AMH >2.0 ng /ml and ⑤ normal other infertility work up including folliculometry, HSG and semen analysis; all were included in the study.

Cases as ① abnormal pelvic ultrasound findings other than ovarian endometrioma as uterine myoma, adenomyosis, endometrial polyps; ② previous medical treatment of endometrioses; ③ previous surgical treatment of endometrioses; or ④ contra-indications for laparoscopy; all were excluded from the study.

All cases signed a well-informed written consent to declare their agreement to be enrolled in the study as agreed upon by the ethical committee.

The forty cases randomly allocated using computer program into two groups according to subsequent management. They were classified into two groups; **Group I:** Twenty one cases subjected to laparoscopic ovarian cystectomy (stripping) of endometrioma. **Group II:** nineteen cases subjected to laparoscopic cyst fenestration; aspiration and endo-coagulation of cyst wall and take biopsy from cyst wall.

After approval of local ethics committee, all patients included in the study or their relatives were informed well about the procedure and had an informed written consent before carrying the procedure.

Data were analyzed using IBM SPSS software package version 20.0 (Belmont, Calf, 2013). Data were collected in tables then analyzed in regarding to Chi square (x^2) and p value less than 0.05 were considered significant.

3. Results:

This study included 40 patients that were prospectively and randomly subjected to two surgical techniques from December 2016 to September 2018. The first 21 patients (group I) underwent laparoscopic cystectomy and the subsequent 19 cases (group II) underwent laparoscopic ablation. All patients underwent surgery in obstetrics and gynecology department in Tanta university hospital. All steps of the operations were performed by the same surgical team. All patients were followed up for at least 6 months after surgery for recurrence of endometrioma, pregnancy rate, ovarian reserve and pain relief. No patient was lost to follow-up. All studied patients attended the scheduled follow-up visits.

From table 1, there was no statistically significant difference between the patients in the studied groups regarding age, BMI, side of affection or size of the mean endometrioma diameter that was measured with trans-vaginal ultrasound.

A total of seven recurrences out of 40 patients occurred in the 6-month follow-up period. All recurrences were diagnosed at the 6-month visit, thus representing true recurrences and not persistence of the disease. The recurrence rate was significantly differed between the two techniques (1 recurrence out of 21 treated ovaries in group I (4.8%) versus 6 recurrences out of 19 treated ovaries for group II.

Thirteen patients in group I were complaining of infertility and twelve cases in group II were complaining of infertility. After a follow up period of

6 months in both groups, 30.8% pregnancy rate was found in group I while 33.3% pregnancy rate was found in group II. A statistically insignificant difference was found between both groups as regard pregnancy rate at p value of 1.000.

No difference was found between group 1 and group 2 regarding the mean operative time which was 60 minutes (range from 20–100 minutes) in group I versus 55 minutes (range from 20–90 minutes) in group II, estimated blood loss was 60 mL (range, 10–200 mL) in group I versus 50 mL (range, 10–100 mL) in group II, and postoperative length of stay was 1 day [range, 1–3 days] in group I versus 1.05 day [range, 1–2 days) in group II (Table 3). No major intra- or post-operative complication occurred. All patients were discharged within 48-72 h from surgery. Histology analysis confirmed the endometriotic nature of the treated cyst in all cases.

Among both groups, no statistically significant difference found between day-3 FSH levels pre-operative and 6 months post-operative levels (Table 4).

Preoperatively; there was a statistically insignificant difference in the levels of AMH in both groups (5.26 ± 3.26 VS 4.88 ± 2.40 at p value 0.924). 6 months-postoperatively, a statistically significant decrease was found within each group, in Group I and in Group II (1.90 ± 1.44 VS 2.87 ± 1.87 at p value0.018) respectively, a more significant decrease was found in group I than in group II (Table 5).

No statistically significant difference of preoperative AFC was observed between both groups (p 0.754 and p0. 755). At 6th month follow up, AFC in Group I were obviously lower than those in Group II, with statistical significance (p 0.013) (Table 6).

Preoperatively there was no statistically significant difference between each group regarding severity of each type of pain in the studied groups (dysmenorrhea at p Value of 0.918 inter-menstrual pains at p value of 1.000 dyspareunia at p value of 1.000 and Dyschezia at p 0.673) (Table 7).

Post operatively the extent of improvement in all types of pain in both treatment modalities result in significant improvement in absolute pain score at 6months compared with the baseline with a statistically significant decrease in VAS for dysmenorrhea in women of either group who had periods during the previous 6 months (P.13) together with inter-menstrual pain, dyspareunia and dyschezia. Comparison between the pre- and postoperative VAS for dysmenorrhea, inter-menstrual pain, dyspareunia and dyschezia in both groups showed a greater improvement in pain score in group I than in group II reaching statistical significance at 6 months for dysmenorrhea P 0.048 to dyschezia P 0.027 respectively (Table 8, Fig. 1).

Table 1: Comparison between the two studied groups according to demographic data

	Group I (n = 21)		Group II (n = 19)		P
Age:					
Min–Max	20.0-35.0		20.0-37.0		0.698 (NS)
Mean±SD	25.67±4.16		26.16±3.73		
BMI:					
Min-Max	21.0-35.0		22.5-34.0		0.323 (NS)
Mean±SD	27.38±3.03		28.39±3.35		
Cyst volume (cm):					
Min-Max	3.60-4.50		3.20-5.10		0.395 (NS)
Mean±SD	3.96±0.30		4.10±0.64		
Bilaterality	**No.**	**%**	**No.**	**%**	P
Bilateral	1	4.8	1	5.3	1.00 (NS)
Unilateral	20	95.2	18	94.7	

*: Statistically significant at p ≤ 0.05

Table 2: Comparison between the two studied groups according to recurrence of endometrioma

Recurrence of endometrioma	Group I (n = 21)		Group II (n = 19)		P
	No.	**%**	**No.**	**%**	
No	20	95.2	13	68.4	0.040*
Yes	1	4.8	6	31.6	

*: Statistically significant at p ≤ 0.05

Table 3: Operative results in the studied patients in both groups

	Group I (n = 21)	Group II (n = 19)	p
Operative time (min)			
Min-Max	20.0 – 100.0	20.0 – 90.0	0.466 (NS)
Mean±SD	60.43 ± 20.23	55.84 ± 19.07	
Intraoperative blood loss (ml)			
Min-Max	10.0-200.0	10.0 – 100.0	0.796 (NS)
Mean±SD	60.62±57.76	50.53 ± 36.45	
Hospital stay (days)			
Min-Max	1.0-3.0	1.0-2.0	0.593 (NS)
Mean±SD	1.14±0.48	1.05±0.23	

NS: not significant >0.05

Table 4: Comparison between the two studied groups according to day 3 FSH

FSH	Group I (n = 21)	Group II (n = 19)	P
Pre-operative			
Min-Max	4.61-9.90	4.61-8.71	0.154 (NS)
Mean±SD	7.02±1.88	6.27±1.32	
After 6 months:			
Min-Max	3.54-11.20	3.34-10.20	0.708 (NS)
Mean±SD	7.14±2.42	6.85±2.42	

NS: not significant >0.05, *: Statistically significant at $p \leq 0.05$

Table 5: Comparison between the two studied groups according to AMH (ng/ml)

AMH (ng/ml)	Group I (n = 21)	Group II (n = 19)	P
Pre-operative			
Min-Max	2.10 – 13.60	2.01-11.60	0.946
Mean±SD	5.26 ± 3.26	4.88±2.40	
After 6 months:			
Min-Max	0.78-6.0	0.50-8.20	0.018*
Mean±SD	1.90±1.44	2.87±1.87	

NS: not significant >0.05, *: Statistically significant at $p \leq 0.05$

Table 6: Comparison between the two studied groups according to AFC

AFC	Group I (n = 21)	Group II (n = 19)	p
Pre-operative			
Min-Max	2.0-8	2-10	0.487 (NS)
Mean±SD	4±2	4±2	
Post-operative:			
Min-Max	2.0-4	2.0-7.0	0.013*
Mean±SD	2±0	4±2	

NS: not significant >0.05, *: Statistically significant at $p \leq 0.05$

Table 7: Pain severity (preoperatively) among patients in both groups:

Type of pain	Group I (n = 21)		Group II (n = 19)		P
	No.	%	No.	%	
Dysmenorrhea					
Mild	3	14.3	4	21.1	0.918 (NS)
Moderate	8	38.1	7	36.8	
Severe	10	47.6	8	42.1	
Intermenstrual pain					
Mild	4	19.0	3	15.8	1.000 (NS)
Moderate	8	38.1	7	36.8	
Severe	9	42.9	9	47.4	
Dyparoneania					
Mild	3	14.3	2	10.5	1.000 (NS)
Moderate	4	19.0	4	21.1	
Severe	14	66.7	13	68.4	
Dyschasia					
Mild	3	14.3	2	10.5	0.673 (NS)
Moderate	9	42.9	6	31.6	
Severe	9	42.9	11	57.9	

NS: not significant >0.05

Table 8: Comparison of pre-operative (baseline score) and post-operative visual analogue scores (VAS) in both groups (excision N = 21) vs. (ablation N = 19)

Type of pain	Group I (n = 21)	Group II (n = 19)	P
	Mean ± SD.	Mean ± SD.	
Dysmenorrhea			
Pre	6.0±3.0	6.1±1.7	0.899 (NS)
Post	2.5±1.0	4.0±3.2	0.048*
p_1	<0.001*	0.016*	
Inter-menstrual pain			
Pre	6.4±2.8	6.7±2.6	0.728 (NS)
Post	3.8±3.3	4.6±2.0	0.366 (NS)
p_1	0.009*	0.008*	
Dyspareunia			
Pre	2.8±3.4	3.0±2.4	0.832 (NS)
Post	1.2±2.4	1.5±1.1	0.621 (NS)
p_1	0.020*	0.018*	
Dyschezia			
Pre	5.3±3.1	5.6±2.7	0.747 (NS)
Post	2.3±2.88	4.0±1.5	0.027*
p_1	0.002*	0.030*	

NS: not significant >0.05, *: Statistically significant at $p \leq 0.05$

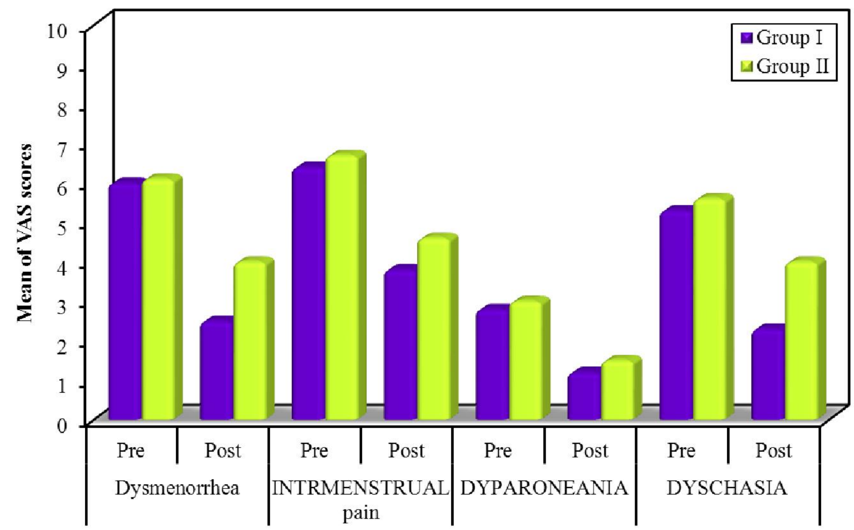

Fig. 1: Comparison of pre-operative (baseline score) and post-operative visual analogue scores in both groups (excision N = 21) vs. (ablation N = 19)

4. Discussion

Laparoscopy has become the gold standard for the treatment of ovarian endometriotic cysts [19,20]. When compared to traditional surgery; operative laparoscopy is associated with shorter hospital stay, faster patient recovery, decreased costs and lower incidence of de novo-adhesion formation. [21]

Laparoscopic surgery for endometrioma does carry a risk of conversion to laparotomy, and this is associated with the experience of the surgeon, the complexity of the surgery. [22]

Several alternative laparoscopic techniques have been described for the treatment of ovarian endometrioma: cyst wall laser vaporization (destruction by burning) proceeded or not by medical therapy, drainage and coagulation, and stripping. [23]

The two most common surgical techniques used in the management of endometriomas include laparoscopic ovarian cystectomy which is a conservative surgical procedure, a controversial treatment for endometriomas due to the invasive nature of the surgery via the stripping technique (in which the drained endometrioma and ovarian cortex are pulled apart by atraumatic grasping forceps, and hemostasis applied to the ovarian cyst bed) and ablation (in which the endometrioma is fenestrated, drained, washed out, and the cyst wall then destroyed with an energy source).

In the current study, the recurrence rate of ovarian endometriomaas assessed by pelvic ultrasonography in group I was present in 4.8% of the studied patients had occurred after six months and in group II, the recurrence rate was 31.6 within the same period. Comparing our results to Cochrane review published in 2005, the recurrence rate of the endometriomata as assessed by pelvic ultrasonography was analyzed in two studies that met the inclusion criteria. [24,25] These studies both followed the patients for up to 2 years. In Alborzi et al study, the recurrence rate in excisional surgery was 17.3%, and in Ablative surgery was 31%. In Beretta et al., study, the recurrence rate in excisional surgery was 6.25% and in Ablative surgery was 18%. There was a significantly reduced rate of recurrence in the patients who underwent excisional surgery and one study demonstrated a significantly reduced requirement for further surgery in the excisional group. [25]

Fayez and Vogel, (1991), evaluated four different methods for the treatment of endometriomas: complete excision of the cyst, stripping of the lining, CO_2 laser ablation of the lining, and drainage of the cyst. It was not explained in their study whether there was any difference between the complete removal and excision of the cyst and the stripping of the lining. They also used danazol in their patients for 8 months after the operation, which would interfere with the result. They concluded that there was no statistically significant difference in the recurrence of endometriosis in the four studied groups. [26]

On the other hand; Hemmings et al., (1998), showed that there was no statistically significant difference in recurrence rate among the three groups who underwent fenestration and coagulation, laparoscopic cystectomy, and cystectomy by laparotomy. [27]

Donnez et al., (1996), suggest that the potential cause of recurrence after excision of endometrioma or vaporization is due to the invagination of endometriotic tissue into the ovary [28]; thus, Donnez et al., (2012), recommend vaporization of the cyst wall. [29]

The current surgical conservative management of ovarian endometriomas uses the laparoscopic approach of stripping the cyst wall away from the ovarian cortex and/or stroma or aspirating and coagulating the cyst wall. Various studies have demonstrated that treating endometriomas by stripping the cyst wall is associated with a significantly lower risk of cyst recurrence than fenestration, drainage, and coagulation or laser vaporization of the pseudo-capsule. Therefore, cystectomy is the preferable procedure for the laparoscopic management of ovarian endometriomas. [30-32]

After resection of endometriomas, recurrence rates are quite variable, ranging from 6% through 30%. The great difference in recurrence rates may be explained by the fact that some authors consider recurrence of symptoms as recurrence of the disease, whereas others assess recurrence by ultrasound detection of ovarian lesions [31-33] while yet others base recurrence on surgical findings and pathological diagnosis. [26,34]

The American College of Obstetricians and Gynecologists practice bulletin suggests that the real recurrence or persistence rate has to be considered higher than that generally reported in the literature because most publications report only symptomatic recurrence and not asymptomatic cysts such as those found by ultrasound. [35] In an ultrasound follow-up study after laparoscopic stripping of endometriomas, they recently observed a recurrence rate in the treated ovary of 26.4%. The management of such recurrences, as detected by transvaginal sonography (TVS), is subjective and unclear. [33]

We observed in our study during short period of follow up (6 months) spontaneous pregnancy rate was 30% patients in group I (excision group) and 33% patients in group II (ablative group) it shows statistically no significant difference, we suggest that this low rate attributed to short period of follow up and that not all patients was initially presented by delayed fertility.

Somigliana et al., (2008), found that ovarian endometriomas can be further complicated by the formation of adhesions that can fixate the pelvic organs. Fixation of the pelvic organs may distort the anatomical locations and reduce natural fertility. [29]

Spontaneous pregnancy was one of the important items as it may be the main concerning complaint of patient presenting with ovarian endometrioma, Cochrane review published in 2005, spontaneous pregnancy was significantly greater in the excision group. Pregnancy in the laparoscopic excision was (59.37%) and among ablative group pregnancy was (23.33%) in follow up after surgery for 1year. [24]

Recently the practice committee opinion for ASRM about endometriosis and infertility in this point recommends that for women who are found to have an asymptomatic endometrioma and who are planning to undergo IVF/ICSI, there is insufficient evidence to suggest that removal of the endometrioma will improve IVF success rates. However, if the endometrioma is large (>4 cm), surgery should be considered to confirm the diagnosis histologically, to improve access to follicles during oocyte retrieval, and possibly to improve ovarian response. The patient should be made aware that extensive ovarian surgery could compromise ovarian function and diminish the response to ovarian stimulation; the committee concluded that surgical management of an endometrioma should include resection or ablation, rather than drainage, with resection preferred. [36]

Hull, (1992), reported a spontaneous conception rate of <20% in patients with stage III and IV endometriosis after 24 months of follow up, he concluded that the surgical technique consisting of fenestration and coagulation with bipolar cautery of ovarian endometriomas was associated with faster conception and did not have a higher recurrence rate compared with other surgical techniques over a 3-year follow-up period. [37]

Hart, (2008), compared fertility outcomes between excisional and ablative surgery in women with ovarian endometrioma. In that review, excision of the cyst wall was associated with a higher spontaneous pregnancy rate compared to women who underwent laparoscopic ablation. However, there was insufficient evidence supporting excisional surgery over ablative surgery in terms of pregnancy chance after ovarian stimulation and intra-uterine insemination. [23]

Cranney, (2017), found that ovarian response to stimulation appears to be a better predictor of clinical pregnancy rate than the presence of endometrioma per se. [38] Coehlo et al., (2015), performed a retrospective study of 517 women undergoing IVF/ICSI. Poor ovarian response (POR), defined as three or fewer oocytes retrieved, was significantly higher in women with endometrioma (38.5 vs. 17.2%, $p = 0.002$). However, reasonable pregnancy rates (37.5%) were observed in women with endometriomas when four or more oocytes were retrieved. The authors concluded that although endometrioma is associated with POR, endometrioma alone is not an independent predictor of pregnancy. [39]

Studies have reported a wide range in spontaneous pregnancy rates ranging from 14-54% after laparoscopic cystectomy. [40,41] Kitajima et al., (2011), suggested that the increase in spontaneous pregnancy following cystectomy might be due to decreased ovarian inflammation, which can lower follicular density. Women who are 35 years of age or younger are encouraged to wait 1 year before considering IVF. Women who are older than 35 years of age are encouraged to wait 6 months before attempting IVF. [42]

Repeated or extensive ovarian surgery has a detrimental impact on ovarian reserve and this should be considered when deciding on treatment and specifically, further surgery. The theoretical benefit of performing surgery to improve pelvic anatomy and accessibility is plausible, but has not been supported with substantive scientific evidence. Until robust evidence from large RCTs incorporating modern treatment modalities is available, many uncertainties will remain on the optimal treatment of an endometrioma (Royal College of Obstetricians and Gynecologists, 2017). [43] Meanwhile, management decisions should be based on individual circumstances, such as patient choice, age, and ovarian reserve and associated symptoms after the operation.

Some investigators showed that cystectomy can cause reduced follicular response in controlled ovarian hyper-stimulation cycles however; others could not find follicles in the histologic specimens of excised tissue after cystectomy and suggested that post-cystectomy ovarian response to gonadotropins was comparable to the contralateral ovary. [44] More data are needed to definitely prove this issue.

The level of expertise in endometriosis surgery was inversely correlated with the amount of ovarian tissue inadvertently removed with the endometrioma wall. Surgeons trained in laparoscopic surgery but without specific expertise in endometriosis surgery may be less proficient in surgery for endometriomas, this opinion agrees with Muzi et al., (2011), study shows that specimens obtained via surgery performed by residents have statistically significantly more ovarian tissue when compared with those obtained by experienced surgeons with years of practice in the field of reproductive and endometriosis surgery. [45] In experienced hands, laparoscopic stripping of endometriomas appears to be a technique that does not significantly damage the ovarian tissue. [46]

ESHRE guidelines (2013) recommend in infertile women with endometrioma undergoing surgery, clinicians should perform excision of endometrioma capsule instead of drainage and electrocoagulation of the wall to increase spontaneous pregnancy rate (evidence grade A). [47,48]

A statistically insignificant difference was found in either group regarding operative time, intraoperative blood loss and hospital stays. Beretta et al., (1998), addressed the effect of laparoscopic excision versus drainage and coagulation of endometriomata on operating time and post-operative stay: there were no reported differences between the two groups. [24]

The surgical technique of endometrioma excision has been previously described by many authors as being an ovarian tissue sparing procedure; Roman et al., (2009), [49] Muzii et al., (2005), [50] and Muzii et al., (2002) [51] and it takes into account the physiopathology theories of the development of endometriomas proposed by Nisolle and Donnez, (1997), that states that endometriomas originate from the metaplasia of celomic epithelium invaginated into the ovarian cortex, a theory which fits 100% of cases of ovarian endometriomas. [28] Mircea et al., (2016), stated that physio-pathologically understanding is of major importance for surgeons because excision of an endometrioma does not require antimesial incision of the ovarian parenchyma, as it can be performed through a small area of the cyst, free of ovarian tissue. In this regard the tissue-sparing approach is recommended because the absence of a cleavage plane due to endometriosis-induced fibrosis. This often leads to inadvertent removal of an amount of the adjacent ovarian cortex and serious bleeding at the ovarian hilus requiring extensive application of bipolar electrocoagulation and hence, adverse changes in ovarian blood supply, as well as a functional loss in the ovarian reserve. [52]

Ovarian reserve is one of the important issues in comparing the laparoscopic techniques in removing the ovarian endometrioma, AMH one of the most reliable tests for ovarian reserve, In the current study, there was a statistically significant decrease in the level of AMH within each group after the intervention (in group I 5.26 ± 3.26 vs.1.90 ± 1.44) and (in group II 4.88 ± 2.40 vs. 2.87 ± 1.87) with more 6 months postoperative decrease in Group I than in Group II (5.26 ± 3.26vs2.87 ± 1.87 at p = 0.018).

Recently a systematic review (meta-analysis) of changes in AMH after surgical excision of endometrioma shows 9 of 11 studies documented a statistically significant reduction of serum AMH level after surgery. [53] The two studies failing to document this decrease were published by the same study group (Ercan et al 2010, 2011) The studies evaluating serum AMH level serially after surgery and documented that this reduction occurred early, being already evident at 1 week after surgery. [54,55] Celik et al., (2012), observed a progressive reduction over time, but the loss of a consistent proportion of women at 6-month assessment (26/65, 40%) does not allow to draw definitive conclusions. [56]

de Carvalho et al., (2010), found that AMH levels were not significantly different between patients with and without endometriosis. [57] de Vet et al., (2002), found that AMH levels correlate with age, decreasing from pre-pubescent years until menopause. [58] A potential benefit of using AMH compared with other ovarian reserve measures is that AMH levels do not change throughout a woman's menstrual cycle. [59]

Celik et al., (2012), performed cystectomies for ovarian endometriomas with AMH assessments preoperatively and 3 and 6 months postoperatively, they observed a decrease in AMH level between the baseline and the 3-month postoperative value (1.78 ± 1.71 vs. 1.32 ± 1.29), with a continuing decrease over the subsequent 3 months (6-month value at 0.72 ± 0.79). When compared with the baseline value, the 6-month level showed an average 61% decrease and was starker in bilateral endometriomas (29% of patients) and in women with endometriomas measuring 5 cm in diameter (61.5% of patients). However, the loss of 40% of their patients from follow-up between the third and sixth postoperative month prevented definitive conclusions from being drawn. [56]

The explanation for each study for reduction of AMH in the systemic review represented as risk factor for postoperative decrease in AMH:

1- Bilaterality of the endometriomas was reported by Hirokawa et al., (2011), as the unique factor correlating with the rate of postoperative decline of serum AMH levels. They failed to observe an independent role of age, serum AMH level before surgery, the score of American Society for Reproductive Medicine, serum CA-125, number of follicles removed, blood loss during surgery, and cyst diameter. [60]

2- Presurgical serum AMH levels were identified by Celik et al. as the unique independent predictor of AMH decline. In their explanation, endometriomas size, age, and bilaterality did not have independent effects. [56]

3- Presence of normal ovarian tissue in the enucleated cyst was suggested by Kitajima et al (2011) as the single significant factor influencing the rate of serum AMH decline when adjusting for confounders. The magnitude of the reduction in women who underwent endometrioma excision with or without incidental normal ovarian tissue removal was (-42% ± 33%) and (-9% ± 13%), respectively (P=0.01). [61]

4- Other data obtained from univariate analyses were provided in two studies. Ercan et al., (2010), failed to document any significant association between the size of the endometriomas and decline in serum AMH level. [54] Chang et al., (2010), reported that the rate of recovery was positively correlated with pre-surgical serum AMH levels. [62]

In our study we observed significant reduction in AMH in group II (ablation) but there was more significant reduction in group I (cystectomy). In the randomized controlled trial from Tsolakidis et al., (2010), contrary to what observed for the stripping technique, AMH levels were not modified by the use of the three-step laser vaporization technique. [63] This can be explained by superficial ablation that can be reflected on the recurrence rate later.

Ovarian reserve also can be evaluated by sonographic assessment of AFC (antral follicle count) and, In our study, the number of preoperative and postoperative follicles (after 6 months) were compared; There was a significant reduction in AFC in group II with more significant reduction in group I after 6months follow up.

Among both groups the difference was statistically significant (P=0.013) after 6 months comparing the two techniques, agreeing with our results, Var et al., (2011), showed that the number of AFC in coagulated group was significantly reduced 6 months postoperatively from 5.42±0.77 to 4.75 ± 0.60 (P=0.02). in the same study in the cystectomyzied ovaries the AFC fell significantly from5.58 ± 1.13, to 3.67 ± 1.26 (P=.001) this results were very comparable to our results. [64]

In contrast to the current study Tsolakidis et al., (2010), investigated the impact on ovarian reserve after laparoscopic ovarian cystectomy versus three-stage management in patients with endometriomas as regards AFC the operated ovary increased significantly (P=0.002) in group 2 (three-step laser vaporization) (from 1.27-4.36) in relation to group 1 (ovarian cystectomy) (from 2–2.38) no explanation was present for this changes except that decompression can release same compressed follicles from physical suppression. [63]

In contrast to our study; Tsolakidis et al., (2010), found no effect on ovarian volume in three- stage management comparing it to stripping. [63] Post-cystectomy and post fenestration ablation treatment options have been compared, mostly in IVF cycles, and the response of ovaries to gonadotropins and pregnancy rates have been studied, reduction in responsiveness to gonadotropin or a higher dose of gonadotropin usage after ovarian cystectomy has been reported, although this has not affected the IVF outcomes as regards number of oocyte and cumulative pregnancy rate. [64,65]

Georgievska et al., (2015), found reversed findings with increase in AFC in both groups of patients, and more frequent increase in the group operated by cystectomy. [66] In the study of Celik et al., (2012), the AFC increased six weeks and six months postoperatively. [56]

Muzii et al., (2016), in a multicenter randomized controlled trial; ovariancystectomy was compared with the combined excision/ablation technique in women with bilateral endometrioma. The study included 51 women with endometriomas >3 cm. In each patient, one endometrioma was treated with stripping and the contralateral endometrioma with the combined excisional/ablative technique using bipolar coagulation. The AFC did not differ significantly between the two techniques at the one-, three- and six-month follow-up visits. The authors concluded that ovarian stripping should be considered the gold standard for surgical treatment of endometrioma; however, this was a small study with short follow-up duration. Larger studies with longer follow-up times that also assess AMH and spontaneous/ART pregnancy outcomes, were required to confirm these findings. [67]

Biacchiardi et al., (2011), sit up several proposed mechanisms in which laparoscopic cystectomy may worsen ovarian reserve including accidental removal of healthy ovarian cortex, thermal damage from coagulation of bleeding vessels, and surgical-related local inflammation. [68] Several authors have shown histologic evidence of damage to the ovarian cortex after laparoscopic cystectomy and that healthy ovarian tissue with primordial follicles is often inadvertently removed during cystectomy, particularly if the tissue is approaching the hilus (Mircea-2016). [52] Matsuzaki et al., (2009), [40] demonstrated that ovarian tissue found on endometrioma cyst wall specimens was 10 times more frequent than on other benign cyst wall specimens afterusing the laparoscopic stripping method.

Romualdi et al., (2011), observed that more follicles were lost with surgery in women with smaller cysts. This correlation was only found in younger patients. The authors suggest younger women with small endometriomas should be warned that healthy ovarian tissue may be removed during surgery. Moreover, they observed that endometriomas that had a fibroblastic capsule were associated with an increased loss of follicular tissue after surgery compared to endometriomas with a fibrocystic capsule. The fibroblastic capsule was associated with more inflammation and also seemed to be less defined with respect to healthy ovarian cortex, thereby making it difficult to find a proper cleavage plane at the time of surgery. [69]

A number of other studies report pain relief following laparoscopic surgery for endometrioma Sutton et al., (1997), Montanino, (1996). Unfortunately, all these studies lack an objective measurement of pain such as a visual analogue score. Because pain is such a subjective phenomenon, it is extremely easy for the investigator to influence the outcome. The investigator can unwittingly coerce the patient into an affirmative response with regard to outcome because many patients will minimize their symptoms in order to please their surgeons. [70,71]

Previous randomized controlled studies demonstrated lower recurrences of dysmenorrhea dyspareunia and inter-menstrual pain after laparoscopic cystectomy than after ablation. [23-25]

An assessment of the effect of excision of an endometrioma versus ablation on the outcome variable relief from pelvic pain (immediately post operation) was impossible to derive as many studies suggest complete relief of pelvic pain by both surgical modalities, and this highlights the difficulty in determining when the initial assessment should be made. However, Alborzi et al., (2004), reported the outcome variable ‘recurrence of pelvic pain’ was significantly worse in the drainage and ablation treatment arms. The concern that this may be not related to the management of the endometrioma but to the background disease of endometriosis can be dismissed, as in both studies there was no difference in the disease severity between the two treatment modalities. In the analysis of the recurrence of pelvic pain, one of the studies only analyzed the recurrence of dysmenorrhea. [25]

Hart, (2008), in a recent Cochrane review evaluated the most effective technique for treating an ovarian endometrioma, either excision of the cyst capsule or drainage followed by electrocoagulation of the cyst wall, measuring the primary outcome as pain symptom improvement. Two randomized studies of the laparoscopic management of ovarian endometrioma, greater than 3 cm were included; found thatlaparoscopic excision of the cyst wall of the endometrioma was associated with a reduced recurrence rate of dysmenorrhea, dyspareunia and non-menstrual pelvic pain. For the secondary outcome measures, laparoscopic excision of the cyst wall was associated with a reduced rate of recurrence of the endometrioma and with a reduced requirement for further surgery compared with ablative surgery. [23]

Redwine, (1999), found that ovarian endometriosis is a marker for more extensive pelvic disease, which should also be treated if the patient is to benefit from the operationhas shown that only 1.06% of patients exclusively have ovarian disease. [72] Laganà, (2016), found that deeply infiltrating endometriosis often involves the utero-sacral ligamentsand endometriosis at this site is also responsible for pelvic pain andthe intensity of the pain is related to the depth of lesion penetration. [73]

Fauconnier et al., (2002), found that ovarian endometriomadid not contribute to chronic pelvic pain, but were highly associated with deep infiltrating endometriosis, which is known to cause chronic pelvic pain. [74]

Alborzi, (2004), found that the pain recurrence was lower in the cystectomy group (15.8%) than in the coagulation group (56.7%) (P.001); in addition, patients remained asymptomatic longer in the first group (192). [25] This is similar to the study of Beretta et al., (1998), in which the cystectomy group had a lower recurrence rate of deep dyspareunia, dysmenorrhea, and non-menstrual pelvic pain in 24 months than the fenestration and coagulation group. [24]

5. Conclusion:

From our study we can conclude that: laparoscopic surgery leads to decrease in ovarian reserve specially with stripping. Also, stripping leads to decrease the value of AMH and AFC but pain relief is more. Cystectomy is more destructive for ovaries while the improvement of fertility/reproduction is not supported.

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