International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622

www.gynaecologyjournal.com
2019; 3(1): 230-237
Received: 26-11-2018
Accepted: 30-12-2018

Dr. Sujata Rawat
Senior Resident
Department of obstetrics and gynaecology Dr RML Hospital and PGIMER, New Delhi, India

Dr. KK Roy
Professor, Department of Obstetrics and Gynaecology AIIMS, New Delhi, India

Dr. Sunesh Kumar
Professor, Department of Obstetrics and Gynaecology, AIIMS, New Delhi, India

Dr. JB Sharma
Professor, Department of Obstetrics and Gynaecology, AIIMS, New Delhi, India

Dr. Neeta Singh
Professor, Department of Obstetrics and Gynaecology, AIIMS, New Delhi, India

Dr. Kunzang Chodsol
Professor, Department of Biochemistry, AIIMS, New Delhi, India

Correspondence
Dr. KK Roy
Professor, Department of Obstetrics and Gynaecology AIIMS, New Delhi, India

A randomised comparative study of ovarian reserve following two different techniques of laparoscopic cystectomy in ovarian endometrioma

Dr. Sujata Rawat, Dr. KK Roy, Dr. Sunesh Kumar, Dr. JB Sharma, Dr Neeta Singh and Dr. Kunzang Chodsol

DOI: https://doi.org/10.33545/gynae.2019.v3.i1d.40

Abstract
Objective: To compare ovarian residual volume and ovarian function i.e, the effect on ovarian reserve after stripping by two different surgical techniques of cyst removal in endometrioma & to compare the preoperative anti-mullerian hormone value with the post-operative one in terms of ovarian reserve.
Design: Prospective Randomized study. Prospective randomized clinical study, comparing two different surgical techniques of laparoscopic stripping of ovarian endometrioma.
Place of study: Department of Obstetrics and Gynaecology, AIIMS, New Delhi.
Study design: Twenty-one patients who underwent excision of endometrioma. All patients underwent Laparoscopic ovarian cystectomy, by either of the two surgical techniques i. estripping and coagulation. Bilateral ovarian volumes, antral follicle counts, and D2-5 S.AMH, FSH, LH, Inhibin B Estradiol levels were analysed in 21 patients who had undergone laparoscopic cystectomy for ovarian endometrioma.
Conclusion: The study showed that ovarian cystectomy by stripping causes significant damage to ovarian reserve. But, there was no significant difference between the two surgical approaches at hilum.

Keywords: randomised, ovarian reserve, different techniques, endometrioma

Introduction
Endometriosis is one of the most common gynaecologic disorders. It is defined as the presence of endometrial tissue (Glands and Stroma) outside the uterus. The most frequent sites of implantation are the pelvic viscera and the peritoneum [1]. Endometriosis causes Infertility and pain. About 30-40% of woman with endometriosis are infertile, Endometriomas are endometriotic deposits within the ovary. Ovarian endo metri omasoccurs in 17% to 44% of patients with this disease [2, 3, 4]. Ovarian endometriomas account for 35% of benign ovarian cysts and are associated with organic type pain such as chronic pelvic pain and dyspareunia [5]. Approximately 30-40% of women with endometriosis develop endometrioma [1].
The primary indications of treatment of ovarian endometrioma are symptoms of pelvic pain, dyspareunia and infertility [5].
Laparoscopic excision of ovarian endometriomas is a favored treatment for the improvement of fecundity in infertile women with endometriosis and in recent years, laparoscopy has become gold standard for treatment of ovarian endometriomas [6, 7, 8].
A growing body of evidence suggest that ovarian reserve is damaged after excision of ovarian endometriomas [9, 10, 11]. The damage inflicted by surgery to ovarian reserve may be due to removal of healthy tissue by laparoscopic stripping, the surgery related local inflammation or vascular compromise following electrosurgical coagulation [11].
Previously ovarian reserve was assessed by static markers (Day 2 to day5 estradiol, follicle-stimulating hormone and in hibin-B, and dynamic markers (Tests of stimulation with clomiphene citrate, gonadotropins and gonadotropin releasing hormone analogues) and ultrasonographic markers (Antral follicle count and ovarian volume). Anti mullerian hormone (AMH) is a glycoprotein molecule of the transforming growth factor beta family. It is produced by granulosa cells in the antral ovarian follicles and therefore may be representative of the quantity and quality of the ovarian follicle pool.

This study will be done with the aim of comparing two different surgical techniques of stripping in ovarian endometrioma and to determine to what extent different techniques of laparoscopic stripping of ovarian endometrioma affect ovarian reserve. Also findings may indicate the importance of measuring preoperative and postoperative serum AMH levels as a marker of ovarian reserve to evaluate the efficacy of the surgical procedure in terms of fertility preservation.

Materials and Methods

Study Design

Prospective randomized clinical study, comparing two different surgical techniques of laparoscopic stripping of ovarian endometrioma.

Place of Study

Department of Obstetrics and Gynaecology, AIIMS, New Delhi.

Total Number of Patients:

A total of 24 patients of endometrioma were recruited for the study, one patient was lost to follow up and 2 excluded as histopathology of specimen showed Hemorrhagic cyst. Therefore, final analysis was done on 21 patients.
The randomization was done by computerised generated table:

Group 1 - 10 patients for cystectomy done by stripping

Group 2 - 11 patients for cystectomy done by cutting and coagulation

Inclusion Criteria

1. Women in age group of 21-35 years with a clinical and ultrasound diagnosis of endometriosis.
2. Women with one or more endometrioma (diameter 3-8 cm) who require laparoscopic cystectomy.

Exclusion Criteria:

1. Patients with non endometriotic ovarian cyst
2. Patients with malignant ovarian cyst, or dermoid cyst
3. Patients with adenexal masses e.g.: tuberculosis
4. Patients with endometriosis of other sites e.g.: bladder, bowel,
5. Patients treated with hormonal supplements, oral contraceptives, GnRH analogues (< 3 months of use).

This study was conducted from November 2009 to October 2010 in the Department of Obstetrics and Gynaecology of AIIMS, New Delhi. The study was approved by Departmental committee of All India Institute of Medical sciences, and informed consent was obtained from all patients.

Workup of the Patient

Once the patients were included in the study, a complete workup was done in all the cases involving complete history and examination, routine investigations as per performa taking inclusion criteria into consideration. Preoperatively Venous blood sample was drawn from patient on day 2 to day 5 of menstrual cycle to measure serum FSH, LH, Estradiol and Inhibin B. About 2ml of same venous sample was centrifuged for AMH. The serum was taken and stored at -70 degree celceius. Serum anti-mullerian hormone, Follicle stimulating hormone and Inhibin B was measured using Beckmann Coulter (M/S Immunotech France) ELISA kits and samples were analyzed. In the same sitting 3D Trans vagina lultra souno graphy was performed to measure the summed ovarian volume and assess antral follicle count. The ovarian volume was calculated according to the prolate ellipsoid formula: 4/3p (1/2 diameter) 3 and the endometrioma volumes were calculated by the formula: height _ length _ width _ 0.5233 and expressed in cm3. Informed consent explaining the patient the benefits and risk of laparoscopic ovarian cystectomy was taken.

Operative procedure

Technique of Laparoscopic Ovarian Cystectomy (Stripping Vs Cutting and Electrocoagulation): All Patients underwent laparoscopic surgery under General Anaesthesia, after induction of anaesthesia, pneumo peritoneum was created using CO2 maintained at pressure of 10mm Hg, via verres needle inserted subumblically. A laparoscope was inserted via main subumblical entry through a 10 mm port. An atraumatic forceps was inserted through one of the two ipsilateral lower abdominal 5mm port in spinoumblical line under direct vision to grasp utero-ovarian ligament and to lift the ovary away from bowel. The endometriosis grading was done, and feasibility of laparoscopic procedure was assessed. Complete adhesiolysis and mobilisation of ovaries was done if necessary. The uterus, bilateral tubes, ovaries and POD was inspected to get an overview of pelvis. Bilateral chromotubation was done in infertile patients, by injecting methylene blue dye via Foleys catheter in cervix to check free spill of dye from both tubes. Uterine elevator was inserted inside the uterus to manipulate uterus. The ovary with the endometrioma was mobilised from its adhesion to ovarian fossa, cyst was ruptured and contents rinsed. Rupture site was completely exposed. The wall of the cysts was stripped from the healthy surrounding normal ovarian tissue with the use of two atraumatic 5mm grasping forceps by traction and counter-traction after identification of the cleavage plane. Dissection in the cleavage plane was continued till the area of ovarian hilum is reached.
After approaching ovarian hilum randomization was done, into two groups for two different techniques of cystectomy
Group1: Stripping of the ovarian hilus: Completion of stripping procedure upto complete removal of the cyst wall
Group 2:Coagulation and cutting at the ovarian hilus: Bipolar coagulation of final cyst wall pedicle and subsequent cutting with scissors.
Each ovary was cooled by irrigating with normal saline solution before releasing the ligament. At the end of procedure 500ml of normal saline was left in pelvis to create artificial ascites to prevent future adhesions. The ports were withdrawn and the skin incision was closed by 3-0 nylon sutures. Patient was extubated and shifted to observation room. Patients were discharged on the same day, or the next day. After surgery all endometriomas were confirmed by histological examination. In all the cases surgery was performed by same surgeon experienced in laparoscopic surgery.

Follow Up Monitoring

The patients were followed up 1 month after laparoscopic surgery, During followup visit followings were done:-
Serum FSH, LH, estradiol, inhibin B, and anti-mullerian hormone were measured between day 2 and day 5 of menstrual cycle. The sample for AMH was separated from whole blood by centrifugation, transferred to sterile polypropylene tubes and stored at -70^{0}C until assayed. The serum AMH concentrations were measured by the same enzyme immunoassay kit according to the manufacturer's instructions (EIA AMH/MIS,

IMMUNOTECH, and Marseille, France). All assays were assessed in duplicates. Post-operatively, ovarian volume was measured by 3D transvaginal ultrasonography between day 2 to day 5 of menstrual cycle. Antral follicle count was done by 3D transvaginal ultrasonography between day 2 and day 5 of menstrual cycle. All the observations were made by a single observer to avoid inter observer variation.

Ovarian reserve was assessed as follows:

- the difference between ovarian volume and antralfollicule count before and after cystectomy,
- Hormonal levels (Day2 to Day5 FSH, LH, Estradiol, inhibin B and anti-mullerian hormone) measured before and after cystectomy.

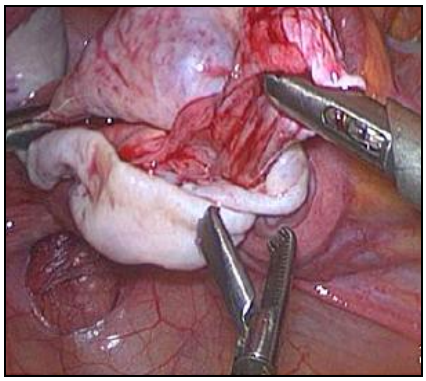
All these patients were followed up subsequently to see their ovulation and conception for 1 yr after surgery.

Statistical analysis

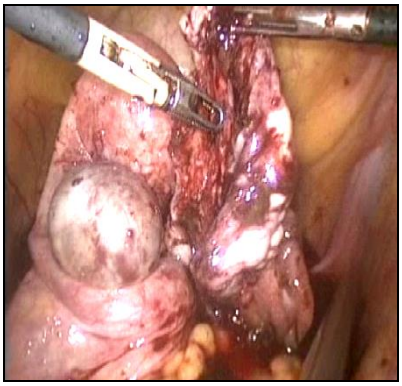
Data were analyzed using the Sigma Plot 11 software program. Simple linear regression analyses and the Pearson correlation were applied where appropriate. Multiple linear regression analysis were applied using the significant factors in the simple linear regression analyses. Student's t-test and the Fisher exact test were used for comparing the patient characteristics and variables between unilateral and bilateral groups. The Wilcoxon signed-rank test for comparing the serum AMH levels before and after surgery. The Mann–Whitney U-test was applied instead of the Student's t-test when the variables did not pass the normality test. p-value of <0.05 was considered to be statistically significant.

Observations and Results

A total of 22 patients with suspected ovarian endometrioma diagnosed on the basis of clinical examination and ultrasound, and confirmed by laparoscopy were recruited in the study carried out at AIIMS, from November 2009 to october 2010. All patients underwent Laparoscopic ovarian cystectomy, by either of the two surgical techniquesi.e stripping (picture1) and coagulation. (Picture 2) One patient was lost to follow up after surgery. Therefore final analysis was done in 21 patients of endometriosis.



Picture 1: Stripping



Picture 2: coagulation.

Age distribution

The mean age of patients studied was 25.3 years, in the range from 17-32 years. There were 3 patients in age group of 15- 20 yrs age. Seven patients were in age group of 21-25 years, 8 patients were between 26-30 years and 3 patients between 31-35 years. No significant difference was found regarding the mean ages of patients between the two groups. i,e both the groups were comparable on the basis of age distribution as shown in table 1

Table 1: Age distribution comparison in two groups

Variable	Group 1 n=10	Group 2 N=11	p value
Mean ± SD	23.5± 4.47	26.18± 4.02	0.174 (NS)

*NS – not significant

Serum FSH value

All patients had normal FSH values pro-operatively. There was no significant difference in the mean s.FSH of patients between the two groups. The range of baseline s.FSH in group 1 was 2.1-3.6 IU/L and in group 2 it was ranging from 2.1-4.2 IU/L

In both the groups (Stripping or coagulation), a statistically significant difference of the mean FSH value was seen post-operatively. (p=0.02 in group 1, p= 0.021 in group 2). Shown in table 2.

Table 2: preoperative and postoperative s.FSH in both groups

Variable	Study group	Pre-operative (mean±SD)	Post-operative (mean±SD)	p value
s. FSH	Group 1 (stripping at hilum)	2.7± 0.49	3.6±0.87	0.020 (S)
	Group 2 (Coagulation at hilum)	3.2± 0.67	3.9± 1	0.022 (S)

*S- significant

Since both surgical procedures causes significant rise in postoperative s.FSH levels, so it is important to know which of the two causes more rise. This was calculated as follows:

Percentage rise in FSH in Group 1 = mean of (post-operative FSH- preoperative FSH)/ preoperative FSH

i,e % Rise in FSH in Group 1 = 100 × 0.9/2.7 = 33.3%

Similarly, % Rise in FSH in group 2 = 100 × 0.7/3.9 = 17.9%

Therefore, postoperatively there is more rise in s.FSH in group 1 than in group 2. (as shown in figure 1)

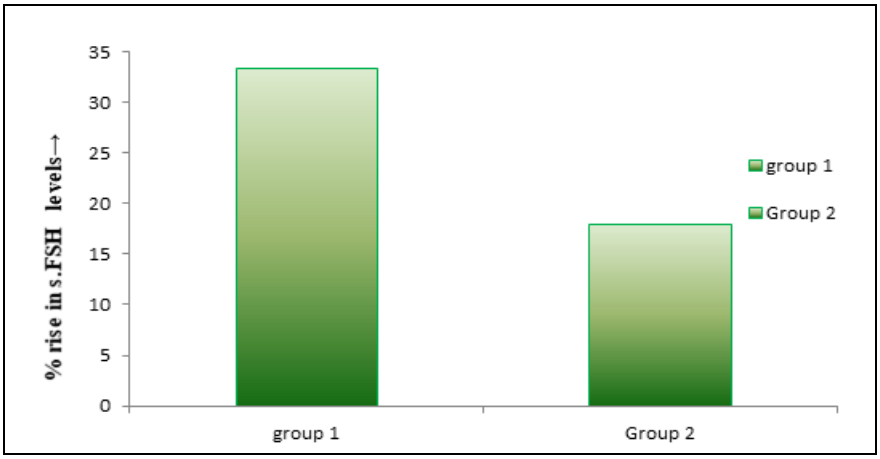


Fig 1: percentage rise of s. FSH in two groups

Serum AMH

There was no statistically significant difference in baseline preoperative AMH levels between two groups. Postoperatively, the serum AMH levels in both groups was significantly lower than the preoperative values, as shown in table 3.

Table 3: Preoperative and postoperative s. AMH levels in two groups

Variables		Pre-operative	Post-operative	p value
s. AMH	Group 1 (10)	4.7 ±0.94	4.27±1.02	0.002 (s*)
	Group 2 (11)	4.4±0.72	4.2±0.76	0.004 (s*)

*s- significant

Since both groups have statistically significant difference between their preoperative and postoperative values, we need to know which of the group has more fall relative to other. To know this, we have calculated the rate of decline of serum AMH levels:

Rate of decline (%) = 100 × [preoperative AMH level – post-operative AMH level]/preoperative AMH level.
Percentage fall in s.AMH in group 1 = 100× mean of (post-operative AMH – preoperative AMH) / preoperative AMH
i,e 100 ×0.43/4.7 = 9.1%
Similarly% fall in s. AMH in group 2 = 100 ×0.2/4.4 = 4.5%
Thus the postoperative fall in s. AMH concentration after surgery is more in group1compared to that in group 2(9.1% Vs 4.5%). Therefore coagulation and cutting at hilum may be preferred surgical approach in terms of compromising ovarian reserve.

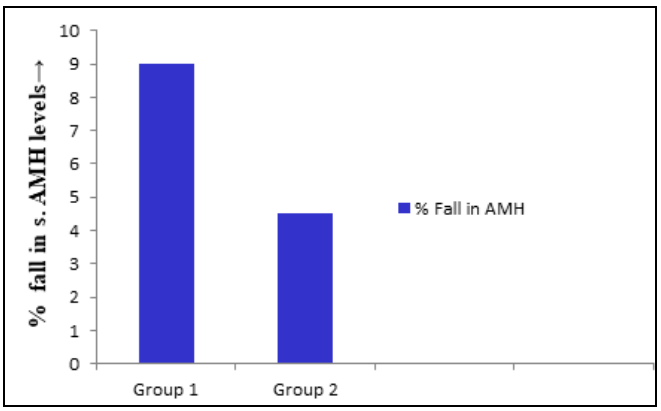


Fig 2: Postoperative Fall in s. AMH levels in both groups

Inhibin B, Estradiol& S.LH

The baseline values were comparable between the two groups. There was no statistically significant difference between preoperative and Postoperative values.

Antral follicle count

The baseline antral follicle counts were comparable between the two groups. When postoperative antral follicle counts were compared with the preoperative values, statistically significant difference was seen in both the groups. As shown in table 4.

Table 4: Comparison of preoperative and postoperative AFC in both groups

Variables		Pre-operative	Post-operative	P value
Antral follicle count	Group 1	8.3± 1.16	6.6 ± 2.06	0.001 (S)
	Group 2	8 ±1.14	6.5 ± 1.17	0.001 (S)

*S- significant

Ovarian Volume

The baseline sonographic findings were comparable between the two groups. The mean size of endometriomas was 84.7 mm^3 in Group 1 and 102.95 mm^3in Group 2.

Pregnancy outcome

One patient in group 1 and one patient in group 2 concieved spontaneously**.** There is no difference in pregnancy outcome among two groups. As shown in table 5,

Table 5: Pregnancy outcome in patients

Variable	Pregnancy outcome	P value
Group 1	1(10%)	0.916
Group 2	1(9%)	NS

*NS- not significant

Discussion

Laparoscopic excision of all forms of endometriosis is effective and today can be considered as the gold standard surgical technique for women with endometriosis related to pelvic pain or infertility [7]. The ideal conservative laparoscopic approach for management of endometriomas is still controversial [12, 13, 14, 15, 16]. Various techniques of endometrioma excision have been described, but the two most common laparoscopic techniques, excision and coagulation, have been compared to each other in various studies [13, 17, 18, 19] but it remains a matter of controversy that which surgical technique is favoured approach for endometrioma.

During cystectomy, it is sometimes difficult to identify and separate the cleavage plane between the cyst wall and adjacent ovarian cortex tissue due to endometriosis induced fibrosis. Also serious bleeding at the ovarian hilus requiring extensive application of bipolar electrocoagulation and causes, adverse changes in ovarian blood supply [20, 21] as well as a functional loss in the ovarian reserve [22, 23, 24]. Thus technically how dissection is carried out at hilum area determines the subsequent ovarian function and determines efficacy of surgical approach.

Beretta *et al* [17]. conducted a randomized trial in which these two different approaches (stripping and coagulation) have been compared, showed statistically no significant difference in the rate of disease recurrence between the two groups (6.2% vs 18.8%), but a higher pregnancy rate at 24-month follow-up in the group treated with complete cyst excision. Another study by brosen *et al*. [25]. retrospectively compared these two different surgical techniques and concluded that laparoscopic excision of ovarian endometriomas at 42- month follow-up is associated with a lower reoperation rate than that of fenestration and ablation (23.6% vs 57.8%).

Muzii *et al* [26] in 2005 conducted another study on 48 patients with ovarian endo metrioma. Two different techniques were analysed at the ovarian hilus (stripping versus coagulation and cutting). Operative time and technical difficulties were prospectively evaluated. At the initial part of the stripping procedure, the technique of circular excision and subsequent stripping appeared to be more easily performed than the technique of direct stripping ($P < 0.01$), although operative times were comparable between the two techniques. At the hilus, the two techniques utilized appeared to be comparable both for easiness of procedure and operating times. Thus, they concluded that different techniques used during the stripping procedure appeared to be comparable in terms of operative times and complications.

Few prospective randomized trials have established laparoscopic excision with stripping as the optimal method of treatment of endo metriomas from the aspects of recurrence, reoperation rate, pain relief and postoperative conception rate [17, 27]. Cochrane 2011 includes 2 trials and concluded that excisional surgery for endo metrioma provides a more favourable outcome than drainage and ablation with regard to the recurrence of the endo metrioma, recurrence of pain symptoms, and subsequent spontaneous pregnancy in women who were previously subfertile.

In the present study, we found that technically coagulation and cutting at hilum is more easier to perform as it causes less bleeding, whereas stripping at hilum was associated with more bleeding, possibly because of tearing of vessels at hilum.

There are significant concerns about the potential deleterious effects of surgical treatment of endometrioma on ovarian reserve & future fertility [7, 28, 29, 30, 31, 32]. Certain degree of inadvertent loss of ovarian tissue is related to removing of the pseudocapsule of endometriomas that is actually the ovarian tissue [26, 28]. This inadvertent loss of ovarian tissue [28, 33] surrounding the cyst wall results in compromise to ovarian reserve. Also serious bleeding at the ovarian hilus requiring extensive application of bipolar electrocoagulation and hence, adverse changes in ovarian blood supply [20, 21] as well as a functional loss in the ovarian reserve [23, 24, 33].

Tsolakidis D *et al* (2010) [34] conducted a study comparing cystectomy with ablation procedure, used s.FSH, s. AMH, s. Inhibin B, s. Estradiol, AFC, Ovarian volume to determine ovarian reserve preoperatively and postoperatively. Ovarian reserve as determined by AMH was less diminished after the ablation procedure compared with cystectomy of endometriomas. They also found a nonsignificant rise in s. FSH. The results were similar to our present study.

Biacchiardi[35]*et al* 2011conducted a study to estimate the impact of laparoscopic stripping of endometriomas on the ovarian follicular reserve, on 43 normo-ovulatory women using endocrine (anti-Müllerian hormone (AMH), FSH, LH, inhibin B, oestradiol) and ultrasonographic (antral follicle count (AFC)) methods before surgery, and 3 and 9months after surgery. Serum AMH concentrations significantly decreased after the operation whereas basal FSH, LH, oestradiol and inhibin B concentrations remained unchanged.The volume of the operated ovary significantly diminished after surgery ($P<0.0001$), whereas the AFC was not significantly altered.

In our study stripping at hilus or coagulation and cutting at hilus both causes decrease in ovarian reserve as assessed 1 month postoperatively. However, out of the two approaches, coagulation of the endometrioma stump near hilum and cutting causes less ovarian reserve damage. This can be explained by the following: As dissection generally becomes difficult close to ovarian hilus (due to endometriosis induced fibrosis), an inadequate stripping technique may tear ovarian vessels and induce significant bleeding, which was controlled by electrocautery. Use of bipolar electro-coagulation was done close to hilum which might have caused irreversible damage to hilar vessels leading to decrease in ovarian reserve. Also stripping at hilum cause inadvertent removal of healthy ovarian tissue even by experienced laparoscopist, due to endometriosis induced fibrosis and consequent absence of cleavage plane. Stripping also might lead to tear of ovarian vessels and damage to ovarian reserve. This shud be avoided by using careful technique. If dissection near hilum appears too difficult then it's better to stop procedure. The surgeon should avoid coagulation of the remaining ovarian stroma and the ovarian hilus [36].

Preservation of the vascular blood supply to the ovary is of importance as it is vital for the preservation of ovarian function. So, gentle and careful bipolar coagulation of the bleeders after stripping the pseudocapsule is important.

Many studies have been done using only s. FSH to assess ovarian [37]. The clinical value of testing for basal FSH value is limited in view of its intercycle and intracycle variability [37].

. It is well known fact that plasma AMH measurements are a far more sensitive marker of diminished ovarian reserve than traditional markers such as early follicular phase FSH [38, 39, 40]. Ultrasonographic markers, such as antral follicle count and ovarian volume, can be used as indicators of ovarian reserve. However, it is difficult to assess the exact number of antral follicles and ovarian volume of the cystic ovary before cystectomy [41]. As it is difficult to determine AFC of endometriotic ovary, particularly if size of cyst is large.

Previously various studies have evaluated the ovarian reserve damage using serum AMH levels in women undergoing endometrioma cystectomy [42, 43]. Tsolakidis *et al*. reported that the mean serum AMH level was significantly reduced 6 months after surgery.[34]However a study conducted by ercan CM [44] *et al* showed results different from above mentioned authors. They conducted a prospective controlled trial in 47 women with endometrioma. They showed a decrease in mean level of post-operative serum AMH but this reduction was not statistically significant. ($P > 0.05$). They concluded that Laparoscopic endometrial striping surgery do not appear to cause a damage in the AMH secreting healthy ovarian tissue. Also, the results of our study are in contrast to those by Alper *et al*. [45], who suggested that laparoscopic removal of an ovarian cyst did not

affect the AMH or AFC levels. These authors attributed their finding to the relatively small number of patients in their study.

In the present study, significant decreases in serum AMH levels was detected after surgery in both groups. This could be explained by possible thermal damage to ovarian stromal blood vessels at hilum after bipolar electrocoagulation during laparoscopy. Another factor could be the increase in the amount of ovarian tissue removed during laparoscopic stripping of an ovarian cyst, with resultant decreases in AFC and AMH levels. Stripping causes inadvertent loss of ovarian stroma adjoining cyst wall, which results in removal of primordial follicles along with. There by resulting in decreased ovarian reserve after cystectomy. Even by experienced laparoscopist, stripping at hilum can be difficult (due to endometriosis induced fibrosis).[63] and such difficulties may provoke severe bleeding and excessive use of bipolar coagulation, so inducing irreversible severe damage of ovarian reserve.

The real amount of surgery-mediated ovarian reserve damage cannot be measured directly. In the previous reports, ovarian responsiveness to gonadotropin hyperstimulation, ovarian volume, and antral follicle count (AFC) have been used as the marker for assessing ovarian reserve damage [7, 36]. AFC is thought to be the most reliable indicator factor of primordial follicle pool [46]. Sonographic assessment of the AFC has been used as a reliable sonographic indicator of ovarian reserve [46, 47] and spontaneous pregnancy.[48]Similar result was seen by Ercan CM *et al*. [44]. Ercan CM *et al* conducted a study on 36 patients where they found that mean antral follicle counts (AFC) of the operated side ovaries were significantly lower on the second postoperative day and in the third month.

AFC showed its better predictive power than pulsatility and resistance indexes in comparison with two laparoscopic management of endometriomas in the study of Pados *et al*. [43]. Pados *et al* 2010 conducted a study on 20 patients with endometrioma to evaluate the impact of two different laparoscopic methods (cystectomy Vs ablation) on sonographic indicators of ovarian reserve in the treated ovary. All patients underwent ultrasound examination preoperatively and 6 months and 12 months after laparoscopy. They investigated the alterations in the residual ovarian volume, ovarian vascular supply and antral follicle count (AFC) on the ovary with the endometriotic cyst by transvaginalcolor Doppler ultrasonography. The residual ovarian volume and the lowest pulsatility and resistance indexes were found to be similar between the two groups before and 6 months after laparoscopic intervention. The AFC of the operated ovary was increased significantly (P = 0.002) in Group 2 compared with Group 1 after 6 months.

Our study also showed significant decrease of AFC, confirms that part of the healthy ovarian pericapsular tissue, containing primordial and preantral follicles, is removed or damaged despite all the surgical efforts to be atraumatic.

Ovarian volume has also been reported as a reliable indicator of ovarian reserve [56, 213, 218] which can be used as a surrogate measurement of the remaining primordial follicle pool [41, 42]. It has been reported that diminished ovarian volume results in poor response to ovulation induction, low clinical pregnancy rate [48] and early menopause. Some authors have suggested that ovarian stripping of endometriomas was associated with significant decrease in residual ovarian volume [42].

Exacoustos *et al*. [42]. (2004) have found that ovarian stripping of endometriomas is associated with a significant decrease in residual ovarian volume. In our study, post-surgical ovarian volume was influenced to the same degree irrelevant of the technique used. Ovarian volume has been reported to be a reliable indicator of ovarian reserve by several authors [32]. Contrary to above views, this study does not show significant change in ovarian volume. It might be attributed to short follow up period. It might be a result of the gentle surgical technique, meticulous haemostasis using excessive bipolar forceps electro coagulation. Also the surgery being done by skilled surgeon and finding the right cleavage plane may also protect the ovary from severe damage and may have a positive effect on its future volume.

This study has several strengths, it is a prospective randomised controlled trial, and two different surgical techniques were attempted, by the same surgeon (without inter observer variability). This study has used biochemical markers like s. AMH, s.FSH, and ultrasound markers like antral follicle count, which are very accurate measure of ovarian reserve. In this prospective study of ours, the ovarian reserve was evaluated in an unselected population with endometriomas suffering mainly from pelvic pain and less from infertility, without using any type of ovarian hyperstimulation. The advantage of this study is that the ovarian reserve was assessed in our unselected population without postoperative stimulation of ovaries for determination of follicular response. In the majority of studies [129, 176] the ovarian reserve was assessed by measuring the early follicular phase serum AMH level, the follicular response of ovaries, and the number of retrieved oocytes, after controlled ovarian hyperstimulation (COH) with clomiphene (CC) or gonadotropins. These studies have many biases and definite conclusions cannot be drawn.

The present study has several limitations: The relative small size of the sample, short postoperative follow-up (only 1 month), the absence of pathological confirmation of normal functioning ovarian tissue in our cyst specimens and non-use of Doppler studies. Another disadvantage was the inability to determine the thermaldamage of ovarian reserve by histological examination and correlateit to any sonographic marker. Also in the study, a single sample of FSH was obtained preoperatively, so we cannot demonstrate that FSH levels were uniform and unchanging before the surgery. FSH per say has high biological variability. Thus, one could argue that the change of FSH merely represents variability in FSH values in these women secondary to some type of ovarian dysfunction or is because of surgery mediated injury.

In conclusion, the results of our study show that laparoscopic stripping of ovarian endometrioma is associated with a statistically significant reduction in ovarian reserve as seen after one month postoperative follow up. The postoperative values of s. FSH, s.AMH changed significantly from their respective preoperative values. But the change was well with in normal range. The damage cannot be ascribed merely to the amount of ovarian tissue removed during surgery; but there may be damage to the ovarian vascular system by electrocoagulation as depicted by significant differences in s.AMH in both groups. Thus use of electro-coagulation for hemostasis causes additional adverse effect on ovarian reserve. This adverse effect could be less if the hemostasis is achieved by suturing rest of the ovarian tissue.[13] or vaporisation [49, 50] or manage endometrioma by 3 stage technique [7, 51]. However, further studies in a larger number of patients are required to make certain judgments whether the injury is related to other factors and to ascertain which is the less harmful alternative therapeutic approach.

Conclusion

In present study of 21 cases of endometrioma, the effect on

ovarian reserve after stripping by two different surgical techniques of cyst removal was compared, using biochemical (s. AMH, s.FSH, s. LH, s. Estradiol, s. Inhibin) and ultrasono graphic markers (AFC and Ovarian volume) of ovarian reserve. The result of the study showed that ovarian cystectomy by stripping causes significant damage to ovarian reserve. But, there was no significant difference between the two surgical approaches at hilum. However, In view of small number of cases no definite conclusion can be drawn. Prospective studies on larger number of patients are needed.

References

1. berek n novaks 14th edition, Thomas M. D' Hooghe Joseph A. Hill III,p- 1143.
2. Gruppoitaliano per lo studio dell' endometriosi. Endometriosis: prevalence and anatomical distribution of endometriosis in women with selected gynecological conditions; results from a multicentric Italian study. Hum Reprod. 1994; 9:1158-1162.
3. Jenkins S, Olive DL, Haney AF. Endometriosis: pathogenetic implications of the anatomic distribution. Obstet Gynecol. 1986; 67:335-338.
4. Redwine DB. Ovarian endometriosis: a marker for more extensive pelvic and intestinal disease. FertilSteril. 1999; 72:310-315.
5. Vercellini P. Endometriosis: what pain it is. Semin Reprod Endocrinol. 1997; 15:251-256.
6. Daniel JF, Kurtz BR, Gurley LD. Laser laparoscopic management of large endometriomas. Fertility sterility, 1991: 55:692-695.
7. Donnez J, Nissole M, Gillet N, v Smets M, Bassil S, *Cassanas Roux* F. Large ovarian endometriomas. Human Reprod. 1996; 11:641-646.
8. Yuen PM, Yu KM, Yip SK, Lau WC, Rogers MS, Chang A.A randomised prospective study of laparoscopy and laparotomy in management of benign ovarian masses. Am J Obstet Gynaecol. 1997; 177:109-114.
9. Busacca M, Riparini J, Somigliana E, Oggioni G, Izzo S, Vignali M *et al*. Postsurgical ovarian failure after laparoscopic excision of bilateral endometriomas. Am J Obstet Gynaecol. 2006; 195(2):421-5.
10. Horikawa T, Nakagawa K, Ohgi S, Koj ma R, Nakashima A *et al*. The frequency of ovulation from the affected ovary decreases following laparoscopic cystectomy in infertile woman with unilateral endometrioma during a natural cycle. J Assist Reprod Genet. 2008; 25:239-244.
11. Somigliana E, Arnoldi Mbenaglia L, lemmelo R Nicolosi, Ragni G. IVF-ICSI outcome in women operated on for bilateral endometriomas. Human reprod. 2008; 23:1526-1530.
12. Vercellini P, Chapron C, De Giorgi O, Consonni D, Frontino G, Crosignani PG. Coagulation or excision of ovarian endometriomas? Am J Obstet Gynecol. 2003; 188:606-610.
13. Chapron C, Vercellini P, Barakat H, Vieira M, Dubuisson J. Management of ovarian endometriomas. Hum Reprod Update. 2002; 8:591-7.
14. Alborzi S, Zarei A, Alborzi S, Alborzi M. Management of ovarian endometrioma. Clin Obstet Gynecol. 2006; 49:480-91.
15. Retto G, Santoro G, Sturlese E, De Dominici R, Villari D, Retto A *et al*. Efficacy of laparoscopic stripping for ovarian cysts: Histological and clinical findings. J Obstet Gynaecol Res. 2011; 37(6):547-52.
16. Garcia Velasco JA, Somigliana E. Management of endometriomas in women requiring IVF: to touch or not to touch. Hum Reprod. 2009; 24:496-501.
17. Beretta P, Franchi M, Ghezzi F, Busacca M, Zupi E, Bolis P. Randomized clinical trial of two laparoscopic treatments of endometriomas: cystectomy versus drainage and coagulation. Fertil Steril. 1998; 70:1176-1180.
18. Brosens I. Endometriosis and outcome of in vitro fertilization. FertilSteril. 2004; 81:1198-1200.
19. Roy KK, Singla S, Chawla H, Baruah J, Sharma JB, Jain S. A randomized control trial comparing direct stripping and bipolar electrocoagulation for laparoscopic endometriotic cystectomy- surgical and histological aspects. IJCM, 2011, 2. doi10.4236/ijcm.2011.22013.
20. Simpson JL, Elias S, Malinak LR, *et al*. Heritable aspects of endometriosis. I. Genetic studies. Am J Obstet Gynecol. 1980; 137:327-331.
21. La Torre R, Montanino Oliva M, Marchiani E, Boninfante M, Montanino G, Cosmi EV. Ovarian blood flow before and after conservative laparoscopic treatment for endometrioma. Clin Exp Obstet Gynecol. 1998; 25:12-4.
22. Muzii L, Bellati F, Bianchi A, Palaia I, Manci N, Zullo MA, *et al*. Laparoscopic stripping of endometriomas: a randomized trial on different surgical techniques. Part II: pathological results. Hum Reprod. 2005; 20:1987-92.
23. Laura Benaglia, Edgardo Somigliana, Valentina Vighi, Guido Ragni, Paolo Vercellini, Luigi Fedele. Rate of severe ovarian damage following surgery for endometriomas Human Reprod. 2010: 25:678-682.
24. Reich H, Abrao MS. Post-surgical ovarian failure after laparoscopic excision of bilateral endometriomas: is this rare problem preventable? Am J Obstet Gynecol. 2006; 195:339-40.
25. Brosens IA, Van Ballaer P, Puttemans P, Deprest J. Reconstruction of the ovary containing large endometriomas by an extraovarian endosurgical technique. Fertil Steril. 1996; 66:517-21.
26. Muzii L, Bellati F, Palaia I, Plotti F, Manci N, Zullo MA, Angioli R *et al*. Laparoscopic stripping of endometriomas: a randomized trial on different surgical techniques. Part I: Clinical results Hum Reprod. 2005; 20(7):1981-6.
27. Saeed Alborzi, Mozhdeh Momtahan, Mohammad Ebrahim Parsanezhad, Sedigheh Dehbashi, Jaleh Zolghadri, Soroosh Alborzi. A prospective, randomized study comparing laparoscopic ovarian cystectomy versus fenestration and coagulation in patients with endometriomas Fertil Steril. 2004; 82:1633-7.
28. Hachisuga T, Kawarabayashi T. Histopathological analysis of laparoscopically treated ovarian endometriotic cysts with special reference to loss of follicles. Hum Reprod. 2002; 17:432-5.
29. Loh FH, Tan AT, Kumar J, Ng SC. Ovarian response after laparoscopic ovarian cystectomy for endometriotic cysts in 132 monitored cycles. Fertil Steril. 1999; 72:316-21.
30. Nargund G, Cheng WC, Parsons J. The impact of ovarian cystectomy on ovarian response to stimulation during in-vitro fertilization cycles. Hum Reprod. 1996; 11:81-3.
31. Ho HY, Lee RK, Hwu YM, Lin MH, Su JT, Tsai YC. Poor response of ovaries with endometrioma previously treated with cystectomy to controlled ovarian hyperstimulation. J Assist Reprod Genet. 2002; 19:507-511.
32. Somigliana E, Ragni G, Benedetti F, Borroni R, Vegetti W, Crosignani P. Does laparoscopic excision of endometriotic ovarian cysts significantly affect ovarian reserve? Insights

from IVF cycles. Hum Reprod. 2003; 18:2450-3.
33. Muzii L, Bellati F, Bianchi A, Palaia I, Manci N, Zullo MA, *et al*. Laparoscopic stripping of endometriomas: a randomized trial on different surgical techniques. Part II: pathological results. Hum Reprod. 2005; 20:1987-92.
34. Tsolakidis D, Pados G, Vavilis D, Athanatos D, Tsalikis T, Giannakou A *et al*. The impact on ovarian reserve after laparoscopic ovarian cystectomy versus three-stage management in patients with endometriomas: a prospective randomized study. FertilSteril. 2010; 94:71-6.
35. Biacchiardi CP, Piane LD, Camanni M, Deltetto F, Delpiano EM, Marchino GL, Gennarelli G, Revelli A. Laparoscopic stripping of endometriomas negatively affects ovarian follicular reserve even if performed by experienced surgeons. Reprod Biomed Online, 2011.
36. Marconi G, Vilela M, Quintana R, Sueldo C. Laparoscopic ovarian cystectomy of endometriomas does not affect the ovarian response to gonadotropin stimulation. Fertil Steril. 2002; 78:876-878.
37. Maheswari A, Fowler P, Bhattacharya S. Assessment of ovarian reserve—should we perform tests of ovarian reserve routinely? Hum Reprod. 2006; 21:2729-35.
38. Fanchin R, Schonauer LM, Righini C, Guibourdenche J, Frydman R, Taieb J. Serum anti-Mullerian hormone is more strongly related to ovarian follicular status than serum inhibin B, estradiol, FSH and LH on day 3. Hum Reprod. 2003; 18:323-7.
39. De Vet A, Laven JS, de Jong, FH Themmen AP, Fauser BC. Anti-Mu¨ llerian hormone serum levels: A putative marker for ovarian aging. Fertil. Steril. 2002; 77:357-362.
40. Kelton P. Tremellen, Michele Kolo, Alan Gilmore and Dharmawijaya N. Lekamge Anti-müllerian hormone as a marker of ovarian reserve Australian and New Zealand Journal of Obstetrics and Gynaecology. 2005; 45:20-24.
41. Maheswari A, Fowler P, Bhattacharya S. Assessment of ovarian reserve—should we perform tests of ovarian reserve routinely? Hum Reprod. 2006; 21:272-35.
42. Exacoustos C, Zupi E, Amadio A, Szabolcs B, De Vivo B, Marconi D *et al*. Laparoscopic removal of endometriomas: sonographic evaluation of residual functioning ovarian tissue. Am J Obstet Gynecol. 2004; 191:68-72.
43. Pados G, Tsolakidis D, Assimakopoulos E, Athanatos D, Tarlatzis B. Sonographic changes after laparoscopic cystectomy compared with three-stage management in patients with ovarian endometriomas: a prospective randomised study. Hum Reprod. 2010; 25:672-7.
44. Ercan CM, Sakinci M, Duru NK, Alanbay I, Karasahin KE, Baser I. Anti-mullerian hormone levels after laparoscopic endometrioma stripping surgery. Gynecol Endocrinol. 2010; 26:468-72.
45. Alper E, Oktem O, Palaoglu E, Peker K, Yakin K, Urman B. The impact of laparoscopic ovarian cystectomy on ovarian reserve as assessed by antral follicle count and serum AMH levels. Fertil Steril. 2009; 92(3):S59.
46. Visser JA, Themmen AP. Anti-Mullerian hormone and follicullgenesis. Mol Cell Endocrinol. 2005; 234:81-86.
47. Mattukrishna S, Mc Garrigle H, Wakim R, Khadum I, Ranieri DM, Serhal P. Antral follicle count, anti-mullerian hormone and inhibin B: predictors of ovarian response in assisted reproductive technology? BJOG. 2005; 112:1384-1390.
48. Lass A, Brinsden P. The role of ovarian volume in reproductive medicine. Hum Reprod Update. 1999; 5(3):256-66.
49. Carmona F, Angeles M, Zamora M, Rabanal A, Sergio Mart, Balasch J. Ovarian cystectomy versus laser vaporization in the treatment of ovarian endometriomas: a randomized clinical trial with a five-year follow-up Fertil Steril. 2011; 96:251-4.
50. Roman H, Pura I, Tarta O, Mokdad C, Mathieu A, Bourdel N *et al*. Vaporization of ovarian endometrioma using plasma energy: histologic findings of a pilot study FertilSteril. 2011; 95:1853-6.
51. Luciano AA, Lowney J, Jacobs SL. Endoscopic treatment of endometriosis- associated infertility. Therapeutic, economic and social benefits. J Reprod Med. 1992; 37:573-576.