ULTRASONIC OVARIAN DRILLING AS A FIRST CHOICE IN INFERTILE WOMEN WITH POLYCYSTIC OVARY SYNDROME

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ABSTRACT

Objective : To evaluate the results of laparoscopic ovarian drilling using harmonic scalpel in infertility patients with PCOS as a first choice as regard to ovulation rate, pregnancy rate, hormonal profile and ultrasonographic changes which reflect the ovarian reserve and reproductive outcome.

Patients and Methods: 90 patients presented by infertility due to PCOS were randomly allocated into three equal groups. **Group (I)** were subjected to ovulation induction by clomiphene citrate (50 mg twice/day) started from the 3rd day of normal or induced cycle for 5 days for six consecutive cycles, **Group (II)** subjected to laparoscopic ovarian drilling using electrocautery and **Group (III)** was subjected to laparoscopic ovarian drilling using harmonic scalpel. all patients were assessed twice; one before the induction procedure and the 2nd was three months after if pregnancy did not occur. Patients were assessed clinically (to determine menstrual regularity, body mass index and degree of hirsutism), sonographically (to measure ovarian volume and antral follicle count at time of ovarian quiescence) and laboratory (to measure basal serum LH, FSH, LH/FSH ratio, total testosterone and estradiol). Also, 2nd look laparoscopy was performed in those patients who failed to conceive within six months of the initial laparoscopic procedure.

Results: Laparoscopic ovarian drilling using harmonic scalpel alone resolved infertility within 4-6 months in 57% of couples with significantly higher ovulation and pregnancy rates over clomiphene citrate and electrocautery groups with significantly more regular menstrual pattern and minimal incidence of post operative adhesions.

Conclusion: Laparoscopic ovarian drilling using harmonic scalpel is a minimally invasive procedure, leads to Monofollicular development which eliminates the need for cycle monitoring and risk of multiple pregnancies or ovarian hyperstimulation that may occur with medical induction of ovulation. It has significantly higher ovulation and pregnancy rates, more regular menstrual pattern and with minimal effect on ovarian reserve with minimal incidence of post operative adhesions.

INTRODUCTION

Polycystic ovary syndrome is the most common cause of anovulatory infertility affecting between 4% and 6% of women of reproductive age. Bilateral ovarian wedge resection, proposed by Stein and Leventhal in 1935[1], was the only treatment available for this syndrome. However, as ovulation inducing medical agents became available, the medical induction of ovulation became the dominant form of treatment [2]. Clomiphene citrate (cc) was used for a long time as a first Line of treatment However, 15-20% of women remain anovulatory despite receiving incremental doses of CC. Furthermore, there was a discrepancy between the ovulation and conception rates. Gonadotrophin therapy is usually the next step following failure with clomiphene [3]. However, Tracy et al., (2007) stated

that because of the peculiarly high sensitivity of polycystic ovaries to gonadotrophin stimulation it was plagued by an unacceptable rate of multiple pregnancies and ovarian hyperstimulation syndrome [4]. An alternative to the medical approach is surgical treatment. The most widely used surgical treatment today is laparoscopic ovarian drilling [4]. Laparoscopic ovarian drilling (LOD) alone can resolve infertility within 4-6 months in 50-60% of couples. So, a strategy with diagnostic laparoscopy and LOD as a first choice treatment of infertility in women with PCOS will shorten the time to pregnancy, reduce the need for medical ovulation induction and enable diagnosis of those women with anatomic infertility who can achieve pregnancy only by IVF treatment[5]. The rapid acceptance of laparoscopic surgery in gynecology has brought a reevaluation of the types of energy currently used for cutting and coagulation during these procedures. Electro-surgery has undergone significant improvements with respect to safety and delivery, but there is still considerable concern with regard to unintentional tissue damage. High frequency energy holds considerable promise as a cutting and coagulation modality[6]. The ultrasonically activated scalpel (UAS) and laparoscopic coagulation shears (LCS) use high-frequency ultrasound energy and can be tried as a substitute for electro surgery. The ultrasoically activated scalpel consists of a piezoelectric transducer that is housed in a hand piece and causes a blade tip to vibrate longitudinally at an ultrasonic level (55, 500 times per second) and excursion over a distance of 50-100 μm. The thermal spread of the ultrasonically activated scalpel is about 0.05 mm, compared with 0.35 mm for that produced by electrocautery[7].

AIM OF THE STUDY

This study was conducted to evaluate the role of laparoscopic ovarian drilling using Harmonic scalpel as regard to ovulation rate, pregnancy rate, hormonal profile and ultarsonographic changes and to compare the results with that of clomiphene citrate and laparoscopic ovarian drilling by electrocautery and to compare the post operative adhesion formation of harmonic scalpel and electrocautery.

PATIENT & METHODS

Ninety patients presented by PCOS were selected from those patients attending our infertility clinic, department of Obstetrics and Gynecology, al-Azhar University hospitals in Assiut during the period from 2005 to 2007, They were randomly allocated into three equal groups. For each group one method of ovulation induction procedure was applied namely clomiphene citrate, LOD using electrocautery and LOD using harmonic scalpel. The diagnosis of patients depended on the Rotterdam European Society of Human Reproduction / American Society for Reproductive Medicine Sponsored PCOS Consensus Workshop Group that convened in 2003[8], and required the existence of two of the following three criteria to make the diagnosis of PCOS: oligo-ovulation / anovulation, Clinical or biochemical signs of hyperandrogenism and Polycystic ovaries by ultrasound.

All patients were assessed clinically (to determine menstrual regularity, body mass index and degree of hirsutism), sonographically (to measure ovarian volume and antral follicle count at the time of ovarian quiescence) and laboratory (to measure serum LH, FSH, LH/FSH ratio, total testosterone and estradiol). Blood samples (10 ml) were obtained between 8 and 9 AM, under basal conditions, in the early follicular phase (day 3 to 5 of the menstrual cycle) in oligomenorrheic patients and at random in amenorrheic ones as long as pregnancy was ruled out by pregnancy test and/or ultrasonography. Blood samples were left to clot then centrifuged (4000 r/minute) to allow serum separation. Collected sera

were capped in bottles and labeled, then stored at -20°C until assayed. The patients were assessed twice one before the induction procedure and the other three months after, if pregnancy did not occur.

Induction procedure :

Group (I) were subjected to ovulation induction by clomiphene citrate (50 mg twice/day) started from the 2rd day of normal or induced cycle for 5 days for six consecutive cycles.

Group (II) subjected to laparoscopic ovarian drilling using electrocautery.

Group (III) was subjected to laparoscopic ovarian drilling using harmonic scalpel.

The laparoscopic procedure was performed in the follicular phase of natural or induced cycle. Laparoscopy was performed via three ports of entry after insufflation of the peritoneal cavity by electronic high-flow pneumoperitoneal insufflator with CO2 gas (Wisap, Germany). A 10-mm laparoscope (Olympus Laparoscope OTV-SP1, Germnay) was inserted in the primary submbilical trocar with two additional 5-mm trocars in the lower abdomen. A grasping forceps was used to hold the ovarian ligament for manipulation of the ovary.

In group II: the drilling was performed using an insulated unipolar electrocautery needle electrode (Surgistate II, USA), on both ovaries. The uninsulated part of the needle was 8 mm long and its diameter was < 1 mm. The needle was inserted into the ovarian surface as close to perpendicularly as possible. A short duration of a cutting current of 100 Watt was used to aid the entry of the needle. The whole length of the needle was inserted into the ovary and was activated for 2-3 Seconds with 4- Watt of coagulating current at each point.

In group III: harmonic scalpel (Ethicon Ultracission, Germany) was used as a substitute for electro surgery. We used the only active (vibrating) blade of laparoscopic coagulation shear (LCS) which has a tip of about 1 mm and a length of about 1 cm. After activation of the balde, the ovaries were drilled using the whole length of the active balde. A total of 6 punctures per ovary were created, depending upon the size of the ovary.

Before drilling, tubal patency and mobility were confirmed by flushing of the tubes with Methylene blue. Women with a blocked tube or tubes were excluded from this study.

After drilling of the cysts, the ovary was allowed to cool in a pole of saline to prevent excessive heat trauma. The abdominal cavity was then rinsed with 500 -1000 cc of sterile saline to remove blood and coagulated tissue and to minimize post operative adhesions.

All patients were followed up for 6 months to evaluate the changes in menstrual pattern, hormonal profile, ultrasonographic findings, ovulation rate and pregnancy rate as well as assessment of post laparoscopic adhesions in the electrocoutery and harmonic scalpel groups by 2nd look laparoscopy if pregnancy did not occur within six months of the initial procedure.

The statistical analysis was performed with the use of commercial software programs (SPSS for Windows, version 9.0, and Minitab Statistical Software for Windows, Release 13.1). The Student's t-test for independent samples was used to compare baseline differences. Chi-square or Fisher exact tests were used as appropriate for categorical variables. A p value of less than 0.05 was considered statistically significant.

RESULTS

The base line clinical hormonal and ultrasonographic characteristics of each study group are shown in Table (I). Comparison of the preoperative hormonal characteristics of PCOS patients among the three groups showed no

significant statistical difference.

Associated Findings :

There were 2 cases of hypertension (2.2%) in this study, one in group I and the other in group II. Insulin dependent diabetes mellitus (IDDM) was diagnosed in 3 cases (3.3%), one in group II and two in group III. These findings indicate the presence of inulin resistance in PCOS patients.

Complications of the Induction Procedure :

One case (3.3%) in the clomiphene citrate group developed ovaian hyperstimulation syndrome (OHSS) which was mild and conservatively treated.. In the electrocautery group, injury to the mesovarian ligament occurred during the attempt to manipulate the ovary in one case (3.3%). In the harmonic scalpel group, one case (3.3%) developed mild subcutaneous emphysema which resolved spontaneously few hours after the procedure.

Fllow up and Outcomes :

85 patients were follwed up for six months, five patients were lost to follow up, one from group I and two from each of groups II and III; they were excluded from the statistics of follow up.

A) Post induction menstrual pattern:

The percentage of cases with regular cycles became significantly more in both groups II and III (92.85% for each) compared to group I (86.2%) ($P<0.05$). On the other hand, there was no significant difference between group II and group III as regard to menstrual regularity ($P<0.05$) (Table II).

B) Post induction Hormonal profile:

There was a significant reduction in the mean levels of LH, LH/FSH ratio and Testosterone in the three groups ($p <0.05$). On the other hand, there were no significant changes of the mean levels of FSH and E2 in any of the three groups ($p > 0.05$) (Table III).

C) Post-induction ultrasonographic characteristics:

There was a reduction in both ovarian volume and antral follicle count (AFC) after each method of induction; however the reduction was statistically insignificant in C.C group and harmonic scalpel group, ($P> 0.05$). On the other hand the reduction in both ovarian volume and antral follicle count in electrocautery group was statistically significant ($P<0.001$) Table IV.

D) Ovulation and pregnancy rates:

There were significant differences in ovulation and pregnancy rates between medical ovulation induction group (group I) and surgical ovulation induction group (groups II and III), ($P < 0.05$). On the other hand there was no significant difference in ovulation or pregnancy rates between the electrocautery group and the harmonic scalpel group ($P > 0.05$) (Tabel V).

E) Postoperative adhesion Formation:

Second look laparoscopy was carried out for those patients who failed to conceive after six months of the initial laparoscopic induction procedure. The total number of cases who didn't get pregnanct in group II and III was 26 patients. Six cases failed to undergo second look laparoscopy due to drop out and were excluded from the statistical analysis. The number of patients who underwent 2nd look laparoscopy was twenty patients (eleven patients from group II and nine patients from group III). Also there was an opportunity to evaluate pelvic adhesions in four patients who delivered by cesarean section in our department (two patients from each group). Assessment of post LOD adhesion formation, According to American Fertility Society (AFS) classification of adnexal adhesions 1988, showed that the incidence and type of post LOD adhesion of the harmonic scalpel group was significantly less than that produced by electrocautery (Table VI).

Table I : Pre induction clinical, hormonal and ultrasonographic characteristics of the three groups of PCOS patients (n=90).

Variable	Group (I) (n = 30)	Group (II) (n = 30)	Group (III) (n = 30)
Age (years) Mean ± SD	25.1 ± 4	24.95 ± 2.4	24.8 ± 3.1
Duration of infertility (years) Mean ± SD	4.3 ± 3	5.4 ± 2.4	6.2 ± 2.4
Menstrual pattern [No. (%)]			
• Oligomenorrhea	22 (73.3%)	20 (66.7%)	21 (70.0 %)
• 2ry amenorrhea	7 (23.3%)	9 (30%)	8 (26.6 %)
• Polymenorrhea	1 (3.4%)	1 (3.6%)	1 (3.4 %)
BMI (Kg/m^2) Mean ± SD	29.8 ± 5.97	28.7 ± 3.86	29.1 ± 4.7
Classification [No.(%)]			
• Normal	6 (20%)	8 (26.7%)	5 (16.7 %)
• Overweight	12 (40%)	12 (40%)	14 (46.6 %)
• Obese	12 (40%)	10 (33.7%)	11 (36.7 %)
Hirsutism [No.(%)]			
• Non	6 (20%)	7 (23.3%)	6 (20 %)
• Mild	13 (43.3%)	12 (40%)	12 (40 %)
• Moderate	7 (23.3%)	6 (20%)	6 (20 %)
• Severe	4 (13.4%)	5 (16.7 %)	6 (20 %)
Hormonal profile (Mean ± SD)			
• LH (IU/L)	12.87 ± 2.28	13.1 ± 2.11	12.8 ± 1.88
• FSH (IU/L)	5.9 ± 1.2	5.69 ± 0.93	5.3 ± 0.93
• LH: FSH ratio	2.25 ± 0.56	2.36 ± 0.54	2.49 ± 0.57
• Total testost. (ng/ml)	0.95 ±0.15	0.96 ±0.16	0.96 ±0.14
• Serum E2 (pg/mL	75.3 ± 4.87	75.77 ± 6.13	77.9 ± 5.24
Ultrasonographic characteristics (Mean ± SD)			
• Ovarian volume (cm3)	11.68 ± 2.4	11.66 ± 2.17	12.5 ± 1.66
• Antral follicle count (AFC)	16 ± 1.9	16.1 ± 2	16 ± 2.3

There were no significant differences among the three groups ($P > 0.05$).

Table II : Menstrual pattern before and after different methods of ovulation induction during the period of follow up .

Menstrual pattern	Pre induction	Post induction	P value
Group (I) : Clomiphene citrate			
• Normal cycle	0 (0 %)	25 (86.2 %)	< 0.01
• Oligomenorrhea	22 (73.3 %)	4 (13.8 %)	
• 2ry amenorrhea	7 (23.3 %)	0 (0 %)	
• Polymenorrhea	1 (3.4 %)	0 (0 %)	
• Total	30 (100 %)	29 (100 %)	
Group (II) : Electrocautery			
• Normal cycle	0 (0 %)	26 (92.85 %)	< 0.01
• Oligomenorrhea	20 (66.7 %)	2 (7.15 %)	
• 2ry amenorrhea	9 (30 %)	0 (0 %)	
• Polymenorrhea	1 (3.6 %)	0 (0 %)	
• Total	30 (100 %)	28 (100 %)	
Group (III) : Harmonic scalpet			
• Normal cycle	0 (0 %)	26 (92.85 %)	< 0.01
• Oligomenorrhea	21 (70.0 %)	2 (7.15 %)	
• 2ry amenorrhea	8 (26.6 %)	0 (0 %)	
• Polymenorrhea	1 (3.4 %)	0 (0 %)	
• Total	30 (100 %)	28 (100 %)	

Values are given as [No. (%)].

Post induction menstrual pattern:

Group I and group III; $p < 0.05$.

Group I and group II; $p < 0.05$.

Group II and group III; $p < 0.05$.

Table III : Pre induction and post induction hormonal levels in the three groups .

Hormone	Pre induction	Post induction	P value
Group (I) : Clomiphene citrate			
LH (IU/L)	12.87 ± 2.28	9.67 ± 1.6	< 0.05
FSH (IU/L)	5.9 ± 1.2	6.0 ± 1.1	> 0.05
LH/FSH ratio	2.25 ± 0.56	1.64 ± 0.4	< 0.05
Testosterone (ng/mL)	0.95 ± 0.15	0.66 ± 0.129	< 0.05
Estradiol (pg/mL)	75.3 ± 4.87	74.8 ± 5.5	> 0.05
Group (II) : Electrocautery			
LH (IU/L)	13.1 ± 2.1	8.23 ± 1.1	< 0.05
FSH (IU/L)	5.69 ± 0.93	6.0 ± 1.0	> 0.05
LH/FSH ratio	2.36 ± 0.54	1.4 ± 0.3	< 0.05
Testosterone (ng/mL)	13.1 ± 2.1	8.23 ± 1.1	< 0.05
Estradiol (pg/mL)	5.69 ± 0.93	6.0 ± 1.0	> 0.05
Group (III) : Harmonic scalpet			
LH (IU/L)	13.1 ± 2.1	8.23 ± 1.1	< 0.05
FSH (IU/L)	5.69 ± 0.93	6.0 ± 1.0	> 0.05
LH/FSH ratio	2.36 ± 0.54	1.4 ± 0.3	< 0.05
Testosterone (ng/mL)	13.1 ± 2.1	8.23 ± 1.1	< 0.05
Estradiol (pg/mL)	5.69 ± 0.93	6.0 ± 1.0	> 0.05

Values are given as mean ± SD.

Between groups ($p > 0.05$

Table IV : Pre and pot induction ultrasonographic characteristics of the three groups.

Variable	Pre induction	Post induction	P value
Group (I) : Clomiphene citrate			
Ovarian volume (cm^3)	11.68 ± 2.4	11.2 ± 1.7	> 0.05
Antral follicle count (AFC)	16.0 ± 1.9	15.4 ± 1.8	> 0.05
Group (II) : Electrocautery			
Ovarian volume (cm^3)	11.66 ± 2.17	10 ± 1.9	< 0.05
Antral follicle count (AFC)	16.1 ± 2.02	14.14 ± 1.76	< 0.05
Group (III) : Harmonic scalpet			
Ovarian volume (cm^3)	12.5 ± 1.66	11.3 ± 1.1	> 0.05
Antral follicle count (AFC)	16 ± 2.3	115.46 ± 1.89	> 0.05

Values are given as Mean ± SD.
Post induction Ultrasonographic Characteristics of the three groups:
Group I and group III; $p > 0.05$.
Group I and group II; $p < 0.05$.
Group II and group III; $p > 0.05$.

Table V : Post induction ovulation and pregnancy rates among the three groups.

Variable	Group(I) (n = 29)	Group(II) (n = 28)	Group(III) (n = 28)
Ovulation	24 (82.8 %)	25 (89 %)	26 (92.9 %)
Pregnancy	12 (41.4 %)	14 (50 %)	16 (57 %)

Values are given as No. (%).
Group I and group III; $p < 0.05$.
Group I and group II; $p < 0.05$.
Group II and group III; $p > 0.05$.

Table VI : Incidence and type of post LOD adnexal adhesions

Type of adhesion	Electrocautery (n = 13)	Harmonic Scalpel (n = 11)	P value
None	10 (76.9 %)	10 (90.0 %)	< 0.01
Minimal	12 (15.4 %)	1 (9.1 %)	
Mild	1 (7.9 %)	0 (0 %)	
Total adhesion	3 (23.1 %)	1 (9.1 %)	

Values are given as [No. (%)] .

DISCUSSION

The main goal of infertile women with PCOS is to create ovulation. Bilateral ovarian wedge resection (BOWR) was proposed by stein and Leventhal (1935) [1]. For a long period it was the only treatment available for this syndrome but that technique was completely abandoned because of high incidence of periadnexal adhesions (100%) in patients who failed to get pregnant after that procedure[2].

When treatment using anti-estrogens commenced and when the good results obtained with these treatments become well known, the surgical technique was discontinued. Clomiphene citrate was used for a long time as a first Line of treatment; the ovulation rate with this drug is about 80-85%.

However, 15-20% of women remain anovulatory despite receiving incremental doses of CC. Furthermore, there was a discrepancy between the ovulation and conception rates which was 40-50%[3].

Consequently, surgical treatment of PCOS was renewed by adoption of minimally invasive laparoscopic surgery. Various laparoscopic techniques have been described with the use of different energy modalities aiming to improve the success rate and decrease the post opeative adhesions.

In the present study, regular menstruation after ovarian drilling was established in 92.8% of patients in both electrocautery and harmonic scalpel groups. Comparison of the menstrual pattern before and after surgery showed that, oligomenorrhea dropped from 66.7% and 70% to 7.2% for both groups, and 2^{ry} amenorrhea dropped from 30% and 26.6% to 0% in electrocautery and harmonic scalpel groups respectively. These results are comparable with that of Takeuchi et al. (2002)[4], where regular menstrual pattern was established in 94% and 88% and oligomenorrhea dropped to 6% and 12% in electrocautery and harmonic scalpel groups respectively. The present study is also comparable to that of Mural et al. (2005) where regualr menstrual pattern was established in 93.3% [10].

However, Afaf et al. (2000) reported regular menstrual pattern of 80.4% and oligomenorrhea of 19.6% after electrocautery. This difference may be attributed to different criteria used for diagnosis of PCOS or different study size.

In the present study, regular menstrual pattern in the CC group that was established after induction was 86.2% whereas oligomenorrhea was 13.8% and this result is comparable with that of Kovacs et al. (2003)[11].

In the present study, the comparison of post induction menstrual pattern between medial induction of ovulation (group I) and surgical induction of ovulation (groups II and III) was statistically significant and in favor of laparoscopic groups.

In the present study the reduction in the mean levels of serum LH, LH/FSH ratio and total testosterone in each of the three groups was found to be statistically significant. On the other hand, comparison of hormonal levels of the three groups after induction was statistically insignificant. These results are in agreement with that of Afaf et al. (2000), Takeuchi et al. (2002); Kovacs et al. (2003); Gleeman et al. (2004); Murat et al. (2005); Mustafa and Tulay (2005) and Mohamed and Maha (2005) [3,5,11-14].

In the present study we could not find any significant change in the mean levels of estradiol and FSH after induction in any of the three groups. These results are in agreement with Afaf et al. (2000); Takeuchi et al. (2002) and Mustafa and Tulay (2005) [3,9,13].

Contrary to our findings, Murat et al. (2005) reported a significant rise of FSH level after laparoscopic ovarian drilling with electrocautery[10]. However, we could not find any significant difference in FSH levels after any method of ovulation induction procedure used in this study.

The present study showed no significant reduction in ovarian volume or antral follicle count in CC group or harmonic scalpel groups. On the other hand, the reduction in ovarian volume and antral follicle count was statistically significant in electrocautery group where ovarian volume decreased from 11.6±2.17 to 10±1.9 ($p < 0.001$) and the antral follicle count decreased from 16.1±2 to 14.1±1.7 ($P<0.001$). These findings are comparable to the results obtained by Mohamed and Selim (2005)[14] who concluded that diminished ovarian reserve might occur after bilateral ovarian drilling but not after CC

induction of ovulation. Mohamed and Selim (2005)[14] attributed this reduction of ovarian reserve to the surrounding thermal damage of ovarian tissue that occurred by electrocautery where single drilling resulted in 0.4 ml destruction of ovarian tissue; so an average of 3.2 ml of ovarian volume were destroyed when 8 drillings in both ovaries were done. In the present study, we didn't find any significant reduction in ovarian volume or antral follicle count after ovarian drilling using harmonic scalpel. This can be attributed to the minimal lateral thermal damage to ovarian tissue (0.05 ml) which is approximately 1/8th of the damage that results by electrocautery. However, the only available study evaluating the use of harmonic scalpel in LOD, done by Takeuchi et al. (2002)[12] didn't evaluate the ultrasonographic changes after LOD but evaluated hormonal changes, ovulation an pregnancy rates, so further studies are needed to evaluate this issue.

In the present study ovulation rate was 92.9% and 89% in harmonic scalpel and electrocautery groups respectively. There was no statistically significant differences between the two groups. This result is .

In the present study the incidence of adhesion formation after LOD was 9.1% and 23% in harmonic scalpel and electrocautery groups respectively. There was a statistically significant difference between the two groups in favor of harmonic scalpel. Also the type of adhesion was different in the harmonic scalpel group comparable to that of Takeuchi et al. (2002)[12] where ovulation rate was 94% in both groups. On the other hand ovulation rate after CC was 82.8%. There was a statistically significant difference as regard to ovulation rate between medical induction of ovulation group (CC group) and surgical induction of ovulation groups (electrocautery and harmonic scalpel groups). These results are in accordance with that of Kovacs et al. (2003)[11] where ovulation rate was 80% after CC induction. In the present study the pregnancy rates were 57% and 50% for harmonic scalpel and electrocautery groups respectively. The difference between the two groups was statistically insignificant. Other studies reported different ovulation and pregnancy rates after using different laparoscopic techniques and are shown in (Table VII). The difference among these variable studies may be attributed to different laparoscopic techniques, different periods of follow up or the use of medical ovulation induction agents as CC after electrocautery. Takeuchi et al. (2002)[12] reported pregnancy rates of 53% and 50% after harmonic scalpel and electrocautery ovarian drilling respectively which is in accordance with the present study. On the other hand pregnancy rate following medical induction of ovulation by CC was 40%. The differenc between medical induction of ovulation group and the other two groups was statistically significant. Also, the difference between ovulation rate and pregnancy rate in this group was marked. These differences can be attributed to the antifecundity effect of CC on cervical mucous and endometrium. The above results are comparable to that of Kovacs et al. (2003) [11] where ovulation rate was 80% and pregnancy rate was 42%. Adhesions According to the American Fertility Society Classification (1988) was minimal and confined to the ovarian surface. On the other hand, in electrocautery group minimal and mild adhesions were present. Many studies assessed adhesion formation following LOD by electrocautery or laser but very few studies assed the incidence of pelvic adhesions following the use of harmonic scalpel in gynecological surgery, so further studies should be directed to evaluate this issue (Table VIII).

CONCLUSION

Laparoscopic ovarian drilling using harmonic scalpel is a minimally invasive procedure, leads to monofollicular development which eliminates the need for cycle monitoring and risk of multiple pregnancies or ovarian hyper-stimulation that

Table VII : Ovulation and pregnancy rates obtained from different laparoscopic treatments of PCOS.

Reference	Technique	% ovulation	% pregnancies
Cohen et al. (1972 a,b) [15]	Biopsy	85	41
Gjoannaess (1984) [16]	Cauterization	92	84
Greenblatt and Casper (1987) [17]	Cauterization	71	56
Cohen and Audebert (1989) [18]	Cauterization	80	31.8
Huber et al. (1988) [19]	Laser	41.7	23
Daniell and Miller (1989) [20]	Laser	83.8	66.7
Utsunomiyat et al. (1990) [21]	Biopsy	93.8	50
Gadir et al. (1990) [22]	Cauterization	26.5	43.8
Tasaka et al. (1990) [23]	Cauterization	91	36
Gurgan et al. (1991) [24]	Cauterization	71	57
Kovacs etl al. (1991) [25]	Cauterization	70	20
Pellicer and Remohi (1992) [26]	Cauterization	67	52.6
Ostrzenski (1992) [27]	Laser	92	92
Armar and Lachelln (1993) [28]	Cauterization	86	66
Campo et al. (1993) [29]	Resection coelio	56	56
Gjoannaess (1994) [30]	Cauterization	92	84
Takeuchi et al. (2002) [12]	Harmonic scalpel	94	53
	cauterization	94	50

Takeuchi et al. (2002) [12]

Table VIII : Periadnexal adhesion formation as assessed by 2nd look laparoscopy following surgical treatment of PCOS.

Reference	Technique	% of adhesion
Portuondo et al. (1984) [31]	Ovarian biopsy	0
Grochmal (1988) [32]	ND: YAG laser	3
Lyles et al. (1989) [33]	Cauterization/ND: YAG laser	100
Daniell andMiller (1989) [20]	CO2 KTP laser	0
Keckstein (1989) [34]	CO2 laser	43
	ND: YAG laser	0
Gurgan et al. (1991) [24]	Cauterization	86
	ND: YAG laser	80
Naether et al. (1994) [35]	Cauterization	35
Gurgan et al. (1992) [36-37]	ND: YAG laser	85
Naether & Fischer (1993) [38]	Cauterization	19
Dabirashraft et al. (1991) [39]	Cauterization	0

Naether et al. (1994) [4]

associates medical induction of ovulation. It has significantly higher ovulation and pregnancy rates, more regular menstrual pattern and with minimal effect on ovarian reserve with minimal incidence of post operative adhesions. So a strategy with diagnostic laparoscopy followed by LOD as a first choice treatment for PCOS is to be performed to shorten the time to pregnancy for many women, reduce the need for medical ovulation induction and enable diagnosis of those women with anatomic infertility, who can achieve pregnancy only by in vitro fertilizaion.

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