Effect of Laparoscopic Ovarian Drilling in Obese Versus Lean Polycystic Ovary Syndrome Patients

Original Article

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ABSTRACT

Objectives: To examine the menstrual cycle regularity, ovulation, hormonal profile before and after LOD, and pregnancy rate in both groups over a 3-months post-surgery period.

Study Design: Prospective cohort research.

Patients and Methods: The subjects of this prospective cohort research were ninety PCOS-positive infertile women ranging in age from 25 to 35. Each patient was randomly assigned to one of two groups: Patients who were overweight were also diagnosed with PCOS, whereas those who were slim were included in Group 1.

Results: Obese PCO (Group 2) had considerably greater pregnancy measures at 1 and 3 months compared to Lean PCO (Group 1) ($P<0.05$), and they were significantly higher after 3 months compared to 1 month in both groups ($P<0.05$). Insignificant differences were observed in right and left ovarian flow index (FI) and vascularization flow index (VFI). Both groups showed substantial decreases in right and left ovarian FI and VFI after 1 and 3 months compared to baseline ($P<0.05$).

Conclusions: PCOS is treated well by ovarian drilling. Although the mechanism of the relationship between body mass index and gonadotropins is unclear, obesity may affect luteinizing hormone and anti-mullerian hormone (AMH) levels after LOD, and LOD may improve fertility outcomes in obese PCOS patients.

Key Words: Anti-mullerian hormone, clomiphene citrate, laparoscopic ovarian drilling, obese, polycystic ovary syndrome.

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INTRODUCTION

Laparoscopic ovarian drilling (LOD) is a commonly used method to stimulate ovulation in women with polycystic ovary syndrome (PCOS) who have not responded to clomiphene citrate (CC) medication[1-5]. Some people may not have any noticeable effect from the little quantity of ovarian tissue lost during LOD is a possible reason[6,7].

This study aimed to assess the outcomes of LOD in lean and obese patients with PCOS in terms of the regularity of their menstrual cycle, ovulation, hormonal profile before and after LOD, as well as the pregnancy rate in both groups over 3 months after the surgery.

PATIENTS AND METHODS

This prospective cohort research examined a group of ninety women who had been diagnosed with PCOS using the Rotterdam criteria. Individuals suffering from infertility and ranging in age from twenty to thirty-five made up the sample. On days 2–5 of a woman's menstrual cycle, serum LH/FSH ratio become ≥2. Ultrasonographic evidence was seen, revealing ovarian stromal hypertrophy and the presence of many tiny follicles (≥10) grouped in the peripheral ovarian volume (≤10) cm^3[11]. There are four categories established for the BMI: underweight (lean) range from 15-19.9 kg/m^2, normal, overweight, and obese range from 30-35 or greater. An individual's classification as underweight (lean) is determined by their BMI, which falls between the range of 15 to 19.9. Normal weight is characterized by a BMI between 20 and 24.9. Overweight is indicated by a BMI between 25 and 29.9, while obesity is defined as a BMI of 30 to 35 or above. The formula used to compute Body Mass Index (BMI) is as follows: The BMI is calculated as the ratio of an individual's weight (kg) to their height (m^2), with kg representing weight and m^2 representing height. Failure to induce ovulation with CC. The study was carried out from April 2022 to August 2023, with the approval of the Ethical Committee of Tanta University Hospitals, situated in Tanta, Egypt (approval code: 35320/3/22). Informed written permission was obtained from the patients.

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Exclusion criteria were previous laparoscopic drilling, other causes of infertility (Uterine defects, blockage of the cervix, male factor, and tubal factor), hormonal medication during the 3 months prior to the initiation of this study and other endocrinal disorders (Thyroid disorders, D.M and Suprarenal).

Patients were divided into two equal groups: Group 1 (lean PCO group): Lean patients were diagnosed with PCOS and Group 2 (obese PCO group): Obese patients were diagnosed with PCOS.

Complete blood counts (CBCs), random blood sugar levels (RBSs), blood grouping, anti-mullerian hormone (AMH) testing, follicle stimulating hormone (FSH) testing, luteinizing hormone (LH) testing, and radiographic studies were all performed on all patients. Transvaginal ultrasound scanning

The imaging of pre-ovulatory follicles was conducted for all women in both groups using a 7.5MHz transducer (Mindray DC 70 exp-China). Transvaginal scanning was conducted on all patients before to the administration of LOD, as well as at 1- and 3-months post-therapy. The measurements were taken for the longitudinal, anteroposterior, and transverse diameters of the ovary. The ovarian volume was determined by using the formula for a prolate ellipsoid, which is defined as 0.523 ± length breadth thickness. Each subject's mean volume of the right and left ovary was computed[8].

Doppler flowmeter to determine flow index (FI) and vascularization flow index (VFI)

The ultrasound examinations were performed using a Voluson S 10 transvaginal 7.5-MHz power Doppler machine from the United States. The lithotomy technique involves the removal of the urine bladder from the patient. To check for uterine anomalies, a 2D transvaginal sonography (TVS) was conducted on the same days as the hormonal test. As part of this process, the endometrium and uterus were measured. The ovarian volume and stromal blood flow were measured, and PCO criteria were found in both ovaries. The resistance index (RI) and pulsatility index (PI) were computed (Figure 1).

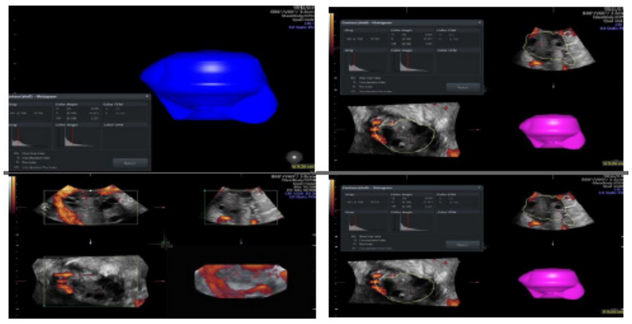

Fig. 1: Doppler flowmeter to determine flow index (FI) and vascularization flow index (VFI).

Laparoscopic Ovarian Drilling (LOD)

To eliminate individuals who have contraindications to general anaesthesia or laparoscopic surgery, pre-operative preparation was conducted. The procedure included bowel preparation, a minimum fasting period of 8 hours, a pregnancy test, and a LOD test utilizing an insulated monopolar needle. The needle's uninsulated tip had a length of 8 mm and a Caliber of 1 mm. After securely holding the ovarian ligament, the device was introduced into the antimesenteric ovarian surface at a perpendicular angle. To minimize capsular heat damage and facilitate adhesion formation, a brief duration of a cutting current of 40 W was used to facilitate the needle's entry. The needle was fully inserted into the ovary and subjected to a coagulating mode with a 40 W current for a duration of 4 seconds. Every puncture had a diameter of 4 mm and a depth ranging from 7 to 8 mm. Following the procedure, about 200 ml of Hartmann's solution was injected into the pelvis, and then methylene blue was injected intracervical to guarantee the openness of the tubules.

Follow up

The hormonal profile (AMH - FSH - LH) was assessed at one and three months following the therapy. Transvaginal ultrasound and Doppler measurements were taken at each of these time points. The regularity of the menstrual cycle (regular, irregular, amenorrhea, and oligomenorrhea) was measured at the beginning of the therapy, after 3 months, and after ovulation induction with letrozole within 1 and 3 months. The rate of pregnancy was measured at the same time points[9].

Sample Size Calculation

The sample size and power analysis were conducted using the Epi-Info software statistical tool, version 2002, which was created by the World Health Organization and the Centre for Disease Control and Prevention in Atlanta, Georgia, USA. The factors used in determining the sample size were as follows: The study has a confidence level of 95% and a power of 80%. The pregnancy rate in the most advantageous therapy group is 90%, but in the least favourable treatment group, it is 65%. Based on the established criterion, the sample size for each group was judged to be N>44. To improve the accuracy of the findings, the sample size was increased to 45.

Statistical analysis

The SPSS v26 statistical program, created by IBM Inc. of Chicago, IL, USA, was used to do the research. Using histograms and the Shapiro-Wilks test, we checked whether the data distribution was normal. No longer linked the study used Student's t-test to compare the two groups' means and standard deviations (SD) of quantitative parametric variables. In this research, the Mann Whitney test was employed to analyse quantitative non-parametric data, namely the median and interquartile range (IQR). For qualitative variables, we reported and analysed the frequency and percentage (%) using either Fisher's exact test or the Chi-square test, depending on what we thought was suitable. A two-tailed *P value* below 0.05 was used to determine if a result was statistically significant.

RESULTS

In this study, 90 patients were recruited, 21 patients were missed that divided into group 1 (9 patients) and group 2 (12 patients). The remaining patients (69 patients) were divided into group 1 (lean PCO) (36 patients) and group 2 (obese PCO) (33 patients). Regarding pregnancy rate, 12 (33.33%) of patients in group 1 and 15 (49.50%) of patients in group 2 got pregnant (Figure 2).

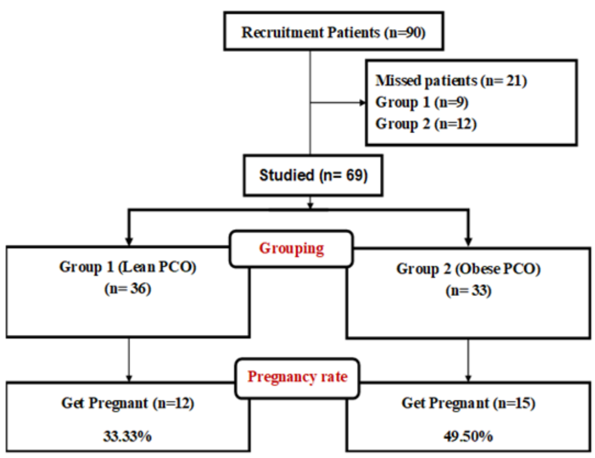

Fig. 2: Flowchart of the studied groups

Age, menstrual pattern measurements and duration of infertility were insignificantly different between both groups. Weight and BMI were significantly higher in Obese PCO (Group 2) than Lean PCO (Group 1) (P <0.001). Height was significantly lower in Obese PCO (Group 2) than Lean PCO (Group 1) (P<0.001). Menstrual pattern was significantly different between post LOD and baseline in both groups (P<0.05) (Table 1).

RBS, FSH, LH and AMH measurements were insignificantly different between both groups. FSH and LH measurements after 1month and 3months were significantly higher in Obese PCO (Group 2) than Lean PCO (Group 1) (P <0.05). FSH measurements were insignificantly different after 1month while was significantly lower after 3months compared to baseline in group1 while were significantly higher after 1month and 3 months compared to baseline in Obese PCO (Group 2) (P <0.001). LH and AMH measurements after 1 month and 3months were significantly lower compared to baseline in both groups (P<0.05). AMH measurements after 1 month and 3 months were significantly lower in Obese PCO (Group 2) than Lean PCO (Group 1) (P= 0.036 and 0.040 respectively) (Table 2).

Right and left ovarian FI and VFI measurements were insignificantly different between both groups. Right and left ovarian FI and VFI measurements were significantly lower after 1 month and 3 months compared to baseline in both groups (P<0.05) (Table 3).

Pregnancy measurements at 1 month and 3 months were significantly higher in Obese PCO (Group 2) than Lean PCO (Group 1) (P<0.05) and were significantly higher after 3 months compared to 1 month in both groups (P <0.05) (Table 4).

Case 1: Ovarian volume 10 cm^3, AMH 7.8, number of punctures 4, BMI 18 (Figure 3).

Case 2: Ovarian volume 11 cm^3, AMH 8.5, number of punctures 4 in each ovary, BMI 19 (Figure 3).

Case 3: Ovarian volume 13 cm^3, AMH 8.4, number of punctures 4 in each ovary, BMI 35 (Figure 3).

Table 1: Demographic data, menstrual pattern measurements and duration of infertility of the studied groups

		Group 1 (Lean PCO) (n=45)	Group 2 (Obese PCO) (n=45)	*P*
Age (years)		28.87 ± 7.57	30.42 ± 7.21	0.321
Weight (kg)		53.4 ± 7.47	87.2 ± 8.35	<0.001*
Height (m)		1.67 ± 0.07	1.61 ± 0.05	<0.001*
BMI (kg/m²)		19.43 ± 4	33.76 ± 2.47	<0.001*
Baseline	Regular	18(40%)	15(33.33%)	0.735
	Irregular	12(26.67%)	12(26.67%)	
	Amenorrhea	3(6.67%)	6(13.33%)	
	Oligomenorrhea	12(26.67%)	12(26.67%)	
Post LOD	Regular	15(33.33%)	12(26.67%)	0.249
	Irregular	9(20%)	3(6.67%)	
	Amenorrhea	0(0%)	0(0%)	
	Oligomenorrhea	0(0%)	0(0%)	
P value compared to baseline		0.016*	0.008*	
Duration of infertility (years)		3.17 ± 1.77	2.84 ± 1.96	0.411

Data are presented as mean±SD or frequency (%), SD: stander deviation, * significance *p value* <0.05, PCO: polycystic ovary syndrome.

Table 2: Random blood sugar and hormonal profile (FSH, LH and AMH) measurements of the studied groups

		Group 1 (Lean PCO) (n=45)	Group 2 (Obese PCO) (n=45)	*P*
RBS (mg/dL)		90.53 ± 9.17	92.87 ± 27.46	0.590
FSH (IU/L)	Baseline	6.61 ± 1.99	6.52 ± 1.89	0.818
	After one month	5.9 ± 1.73	6.84 ± 1.61	0.04*
	After three months	5.11 ± 0.88	6.67 ± 1.5	0.003*
P value between one month and baseline		0.763	<0.001*	
P value between three months and baseline		<0.001*	0.001*	
LH (IU/L)	Baseline	9.89 ± 4.11	8.65 ± 3.61	0.132
	After one month	5.84 ± 2.59	7.44 ± 3.2	0.036*
	After three months	4.07 ± 2.37	6.72 ± 3.41	0.033*
P value between one month and baseline		<0.001*	0.001*	
P value between three months and baseline		<0.001*	0.008*	
AMH (IU/L)	Baseline	7.45 ± 3.76	6.69 ± 3.09	0.299
	After one month	6.62 ± 3.72	4.83 ± 2.03	0.036*
	After three months	5.85 ± 3.02	3.15 ± 0.27	0.04*
P value between 1month and baseline		<0.001*	0.001*	
P value between three months and baseline		<0.001*	0.046*	

Data are presented as mean±SD, SD: stander deviation, * significance *p value* <0.05, PCO: polycystic ovary syndrome, FSH: Follicle-Stimulating Hormone, LH: luteinizing hormone, AMH: anti-mullerian hormone.

Table 3: Right and left ovarian FI and VFI measurements of the studied groups

		Group 1 (Lean PCO)	Group 2 (Obese PCO)	*P*
Right ovarian FI	Baseline	53.31 ± 5.4	52.13 ± 3.84	0.238
	After 1 month	50.32 ± 5.83	49.42 ± 4.82	0.519
	After 3 months	51.61 ± 3.95	50.1 ± 2.87	0.247
P value between 1month and baseline		<0.001*	<0.001*	
P value between 3months and baseline		<0.001*	<0.001*	
Left ovarian FI	Baseline	39.16 ± 10.49	41.69 ± 7.33	0.188
	After 1 month	36.37 ± 10.57	39.34 ± 7.54	0.146
	After 3 months	34.36 ± 10.59	37.64 ± 7.78	0.139
P value between 1month and baseline		<0.001*	<0.001*	
P value between 3months and baseline		<0.001*	<0.001*	
Right VFI	Baseline	2.54 ± 1.74	3.07 ± 0.58	0.059
	After 1 month	2.13 ± 1.65	2.7 ± 0.68	0.095
	After 3 months	1.95 ± 1.36	2.58 ± 0.47	0.134
P value between 1month and baseline		<0.001*	<0.001*	
P value between 3months and baseline		<0.001*	<0.001*	
Left VFI	Baseline	2.89 ± 1.23	3.07 ± 0.58	0.395
	After 1 month	2 ± 1.45	2.46 ± 0.71	0.137
	After 3 months	2.05 ± 1.28	2.48 ± 0.58	0.23
P value between 1month and baseline		<0.001*	<0.001*	
P value between 3months and baseline		<0.001*	<0.001*	

Data are presented as mean±SD, SD: stander deviation, * significance *p value* <0.05, PCO: polycystic ovary syndrome, FI: flow index, VFI: vascularization flow index.

Table 4: Pregnancy of the studied groups

		Group 1 (Lean PCO) (n=36)	Group 2 (Obese PCO) (n=33)	*P*
After 1 month	Positive	0(0%)	3(9.09%)	<0.001*
	Negative	36(80%)	21(69.3%)	
After 3 months	Positive	12(33.3%)	12(39.6%)	0.001*
	Negative	24(66.7%)	9(29.7%)	
P value compared to one month		<0.001*	<0.001*	

Data are presented as frequency (%), SD: stander deviation, * significance *p value* <0.05, PCO: polycystic ovary syndrome.

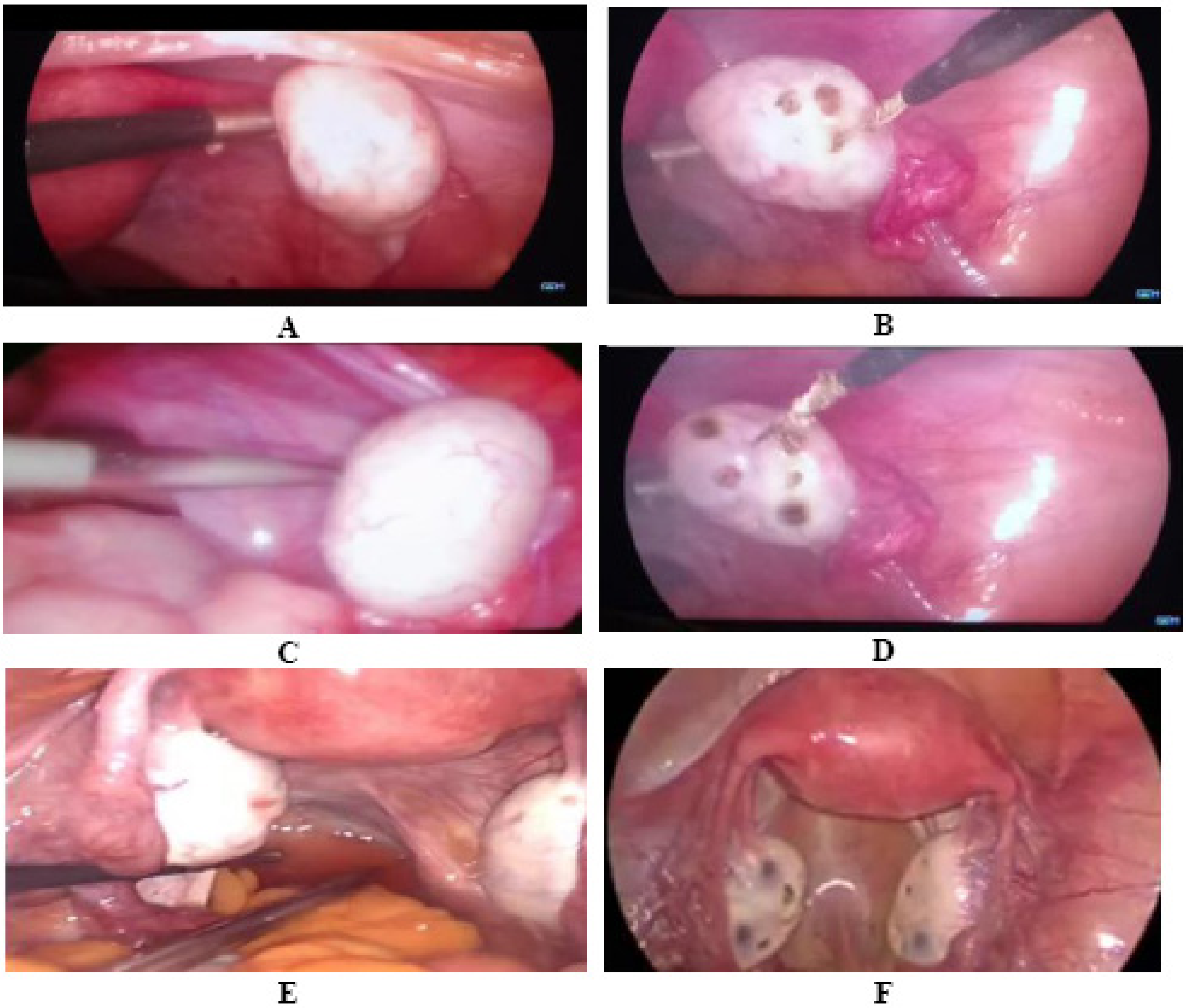

Fig. 3: A, B) Bilateral laparoscopic ovarian drilling, C, D) Bilateral laparoscopic ovarian drilling, and E, F) Bilateral laparoscopic ovarian drilling.

DISCUSSION

PCOS is the most common cause of anovulatory infertility in women of reproductive age. It is a heterogenous group of conditions characterized by the combination of hyperandrogenism and ovulatory dysfunction, in the absence of overt pituitary, thyroid, or adrenal disease[10]. Patients may have hirsutism, acne, obesity, hyperinsulinism or increased insulin resistance, typical ultrasonographic appearances of bilateral polycystic ovaries, and an elevated LH: FSH ratio[11].

In our study, baseline measurements of FSH, LH, and AMH showed no significant differences between the groups. However, over time, distinct changes were observed. After 1 and 3 months, FSH levels were significantly higher in Obese PCO (Group 2) compared to Lean PCO (Group 1), with Obese PCO (Group 2) also showing a significant increase from baseline, whereas Lean PCO (Group 1) had an insignificant difference after 1 month but a significant decrease after 3 months. LH levels, on the other hand, were significantly higher in Obese PCO (Group 2) than in Lean PCO (Group 1) at both 1 and 3 months, with both groups showing a significant reduction from baseline at these time points. AMH levels followed a similar pattern to LH, being significantly lower in Obese PCO (Group 2) than Lean PCO (Group 1) after 1 and 3 months, and both groups experienced a significant decrease from baseline at these intervals.

This corresponds to the findings of Mohamed *et al.*[12]. The study found that the average AMH level was 8.07±1.49, 6.1±1.4, and 5.2±1.1 (ng/ml) before the surgery, 3. months after the surgery, and 6 months after the surgery, respectively. The average LH/FSH Ratio values were 2.8±0.7, 1.8±0.6, and 1.4±0.5 before the surgical procedure, as well as at 3 and 6 months following the procedure, respectively. All the studied measures of OR

(AMH, LH/FSH ratio) saw a substantial decrease after LOD at 3 and 6 months.

According to Zhao *et al*.[13] reported that, obese individuals had reduced levels of AMH, LH/FSH, and LH compared to non-obese people.

Both ovarian wedge resection and ovarian cautery have been shown to result in a decrease in blood levels of androgens and LH, as well as an increase in follicle stimulating hormone (FSH) levels[14]. Mohamed *et al*.[15] observed a significant reduction in blood AMH levels after ovarian cystectomy. This finding suggests that ovarian surgical stress is linked to the loss of follicles and subsequent reduction in the manufacture of anti-tumour hormone (AMH).

In the present investigation, there was no significant difference observed in the right and left FI measures between the two groups. The measures of right and left femoral index (FI) shown a substantial decrease after 1 month and 3 months, as compared to the initial measurements, in both groups. In the present investigation, there was no statistically significant difference seen in the right and left VFI measures between the two groups. The measures of the right and left VFI were considerably reduced after 1 month and 3 months compared to the initial measurements in both groups. In their study, Izzo and Halbe[16] observed a decrease in ovarian volume after LD, accompanied by a reduction in blood levels of testosterone and androstenedione. However, they did not see any significant impact on the levels of gonadotropins. The pregnancy rate after LD treatment exhibited a similar trend to that seen following ovulation induction cycles with recombinant follicle stimulating hormone.

In our study, menstrual pattern measurements were insignificantly different between both groups. Menstrual pattern was significantly different between post LOD and baseline in both groups. Hemeida *et al*.[17] reported that, A total of 30 patients (75%) exhibited monthly abnormalities characterized by oligo-hypo- or oligo-hypomenorrhea, whereas 10 patients (25%) reported a regular cycle pattern. There was no occurrence of amenorrhea in any of the patients. Amer *et al*.[18] reported that, According to this research, 8% of women with PCOS had menstrual cycles that were seemingly regular before their last menstrual cycle.

While persistent anovulation in women with PCOS is often linked to monthly abnormalities[22], a number of authors have shown that around 16-24% of these women do exhibit menstrual cycles that seem to be "regular"[19,20].

Women who undergo ovulation induction surgery are reporting the restoration of menstrual periods[21], which includes improved blood flow inside the ovarian stroma[22].

In our study, pregnancy measurements at 1 month and 3 months were significantly higher in Obese PCO (Group 2) than Lean PCO (Group 1) and were significantly higher after 3months compared to 1month in both groups. This finding aligns with the research conducted by Al-Ojaimi *et al*.[23], which revealed a robust favourable association between surgical results and obesity. The pregnancy rate among obese women (BMI $\leq$30 kg/m^2) was 93.5%, while it was 75% among non-obese women (P=0.002). Based on this positive outcome, the authors propose that obesity should not be seen as a reason to avoid LOD. However, obese women are at a higher risk of experiencing antiasthma-related complications, and there may be additional challenges in establishing a pneumoperitoneum during laparoscopic operations. Moreover, Amer *et al*.[18] found that Once ovulation occurred, the body mass index (BMI) did not have any influence on the rate of pregnancy. Conversely, Abu Hashim *et al*.[24] found that obesity was a significant factor in predicting worse outcomes of LOD in PCOS. Turgut *et al*.[25] recently documented a pregnancy rate of 54.1% and 34.2% with unilateral and bilateral LOD respectively, following a one-year follow-up period.

The results were observed between the findings pertaining to pregnancy in the research conducted by Rezk *et al*.[26] and our results about the pregnancy rate in relation to the features of the patients. Younger patients (under 25 years), those with a lower BMI (under 25 years), and those with a shorter term of infertility (under 3 years) had greater rates (p<0.05). While the bilateral ovarian drilling (BLOD) group exhibited increased ovulation and pregnancy rates at 3-month intervals, the difference was not statistically significant (p>0.05). The significance of the 6-month period was seen (p<0.05). Nevertheless, our results align with the observation that lower preoperative AMH levels (less than 5 ng/ml) were associated with increased chances of pregnancy (p <0.05).

One of the limitations of this research was to the relatively small sample size, consisting of 45 patients in each group. The research was carried out only in a singular facility, perhaps constraining the applicability of the findings to other contexts or demographic groups. Limited Follow-up Period: The follow-up period was restricted to a duration of 3 months after the LOD. The patients were assigned to the lean and obese groups based on their BMI, which could introduce bias. The study did not account for other potential factors that could influence the outcomes, such as lifestyle and dietary habits or additional treatments received by the patients.

CONCLUSIONS

PCOS is treated well by ovarian drilling. Although the mechanism of the relationship between body mass index and gonadotropins is unclear, obesity may affect luteinizing hormone and anti-mullerian hormone (AMH) levels after

LOD, and LOD may improve fertility outcomes in obese PCOS patients.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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