Effects of laparoscopic tubal ligation on ovarian blood flow and steroidogenesis

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Summary

Changes in serum ovarian hormone and gonadotrophine levels and ovarian artery blood flow rate by Doppler ultrasonography following laparoscopic tubal sterilization were evaluated. Forty-seven cases of laparoscopic tubal sterilization by electrocoagulation were included in the study. Forty-two women who used nonhormonal contraceptive methods were randomized as a control group. Serum concentrations of estradiol, FSH, LH, progesterone and bilateral ovarian artery pulsatility indexes were measured at baseline and at three, six and 12 months. In the study group, the mean value of midluteal progesterone was significantly decreased three months postoperatively. The bilateral ovarian artery pulsatility indexes were increased three and six months postoperatively, compared to their preoperative values. However, there was no statistical difference between bilateral ovarian PI values calculated preoperatively and at 12 months. Laparoscopic tubal ligation by electrocoagulation may temporarily cause reduced bilateral ovarian artery flow and corpus luteum dysfunction proven by low mid-luteal progesterone levels.

Key words: Post-tubal ligation syndrome; Pulsatility index; Electrocoagulation.

Introduction

The increased usage and reliability of laparoscopy has resulted in more tubal sterilizations to be performed laparoscopically. A relationship between tubal sterilization and subsequent development of menstrual disorders has been described in the literature [1, 2] but the scientific mechanism explaining such an association has not been demonstrated. It has been postulated that destruction of the fallopian tube and, in some cases, a portion of the mesosalpinx, alters the blood supply to the ovary, with consequent impairment of follicular growth and corpus luteum function [3]. Post-tubal ligation syndrome has been described, variously, as encompassing symptoms such as abnormal bleeding and/or pain, changes in sexual behavior and emotional health, exacerbation of premenstrual symptoms, and menstrual symptoms necessitating hysterectomy or tubal reanastomosis [4].

In this study we investigated the changes in serum ovarian hormone and gonadotropin levels, and ovarian arterial blood flow rate by Doppler ultrasonography following laparoscopic tubal sterilization performed by electrocoagulation.

Materials and Methods

This investigation was performed at the Obstetrics and Gynecology Department of Izmir Ataturk Education and Research Hospital in Turkey between January 2001 and July 2003. Forty-seven women (mean age 31.38 ± 4.89) who underwent laparoscopic tubal sterilization by electrocoagulation were included in the study. Forty-two reproductive women who used a nonhormonal contraceptive method (mean age 31.72 ± 2.74) were randomly selected as a control group. Each patient was asked for reproductive history and underwent physical examination. Patients with systemic or psychological disorders were not included in the study. Also patients who had previously used contraceptive pills and hormonal medications for any other reasons were excluded. Tubal sterilization was performed laparoscopically using bipolar electrosurgical forceps in all cases. The tubal ampulla was cut with a cutting forceps following coagulation. Surgical procedures were performed by second- or third-year gynecology residents under the supervision of an experienced gynecologist. The women with unexpected or extraordinary bleeding during the procedure were excluded from the results. In the control group the cases were given no hormonal or any other medication during the study. Serum concentrations of estradiol, FSH, LH and progesterone were measured preoperatively (baseline), postoperatively at three, six and 12 months on the 3rd day (for estradiol, FSH and LH) and on the 21st day (for progesterone) of the menstrual cycle. Bilateral ovarian artery pulsatility indexes were measured by Doppler ultrasonography preoperatively (baseline), postoperatively at three, six and 12 months on the 3rd day of the menstrual cycle. FSH, LH, estradiol and progesterone values were measured in the Biochemistry Department of Ataturk Training and Research Hospital by immulite (BIODDC) apparatus by the "chemiluminecs" method.

The differences in baseline values of parameters between the two groups were assessed by an independent samples t-test. The values of the consecutive visits (3, 6 and 12 months) were compared with baseline values for each group by the paired samples t-test. A statistical software package (SPSS 11.0 for Windows) was used for statistical analysis, with a 95% confidence interval. All data are expressed as a mean ± 1 SD; p < 0.05 was considered significant.

Results

A total of 87 reproductive healthy women were included in the study; 47 women as the “study group” and 42 women as the “control group”. There were no signif-
significant differences in the baseline values of variables between the two groups (Table 1). The differences in the mean value of FSH, LH and E2 levels between baseline and at three, six and 12 months, respectively, were not statistically significant for either group. Table 2 shows the mean values of FSH, LH and E2 at baseline and at three, six and 12 months and the p values in the study group. The mean value of midluteal progesterone in the study group was significantly decreased at three months postoperatively compared to the preoperative midluteal progesterone mean value (preoperative progesterone = 13.113 ± 1.643 ng/ml; 3rd month progesterone = 8.187 ± 0.863 ng/ml, p < 0.001). However, the differences of mean midluteal progesterone values between preoperative and at six and 12 months were not statistically significant. Also controls showed no difference for midluteal progesterone levels obtained at three, six and 12 months (Table 3).

Bilateral ovarian artery pulsatility indexes were increased postoperatively at three and six months, compared to their preoperative values. However, there was no statistically significant difference between bilateral ovarian PI values calculated at baseline and at 12 month. Also controls showed no difference in bilateral ovarian artery PI values measured at baseline and at three, six and 12 months (Table 4).

<table>
<thead>
<tr>
<th>Preoperative value of</th>
<th>Control Group</th>
<th>Study Group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSH (mU/ml)</td>
<td>6.230 ± 0.754</td>
<td>6.562 ± 1.08</td>
<td>0.100</td>
</tr>
<tr>
<td>LH (mU/ml)</td>
<td>3.784 ± 0.509</td>
<td>3.853 ± 0.808</td>
<td>0.213</td>
</tr>
<tr>
<td>E2 (pg/ml)</td>
<td>45.31 ± 16.58</td>
<td>43.085 ± 6.293</td>
<td>0.417</td>
</tr>
<tr>
<td>Midluteal pregnancy (ng/ml)</td>
<td>12.667 ± 1.125</td>
<td>13.113 ± 1.643</td>
<td>0.136</td>
</tr>
<tr>
<td>Left Ovarian Artery PI</td>
<td>1.991 ± 0.597</td>
<td>2.219 ± 0.559</td>
<td>0.072</td>
</tr>
<tr>
<td>Right Ovarian Artery PI</td>
<td>2.307 ± 0.675</td>
<td>2.292 ± 0.553</td>
<td>0.422</td>
</tr>
</tbody>
</table>

Table 2. — The mean values of FSH, LH and E2 obtained preoperatively (marked as “0”) and at 3, 6 and 12 months in the study group.

<table>
<thead>
<tr>
<th>Study group</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSH (mU/ml)</td>
<td>6.562 ± 1.08</td>
<td>6.578 ± 0.766</td>
<td>6.389 ± 1.05</td>
<td>6.441 ± 0.786</td>
</tr>
<tr>
<td>LH (mU/ml)</td>
<td>3.853 ± 0.808</td>
<td>3.759 ± 0.569</td>
<td>3.772 ± 0.49</td>
<td>3.608 ± 0.436</td>
</tr>
<tr>
<td>E2 (pg/ml)</td>
<td>43.085 ± 6.293</td>
<td>41.383 ± 7.714</td>
<td>41.638 ± 7.1</td>
<td>43.149 ± 8.559</td>
</tr>
<tr>
<td>p value</td>
<td>FSH</td>
<td>LH</td>
<td>E2</td>
<td></td>
</tr>
<tr>
<td>p (0-3)</td>
<td>0.941</td>
<td>0.512</td>
<td>0.265</td>
<td></td>
</tr>
<tr>
<td>p (0-6)</td>
<td>0.450</td>
<td>0.530</td>
<td>0.299</td>
<td></td>
</tr>
<tr>
<td>p (0-12)</td>
<td>0.570</td>
<td>0.071</td>
<td>0.972</td>
<td></td>
</tr>
</tbody>
</table>

Data presented as mean ± SD; p value indicates statistical significance.

Table 3. — The mean values of midluteal progesterone levels obtained preoperatively (marked as “0”) and at 3, 6 and 12 months with comparison of the measurements.

<table>
<thead>
<tr>
<th>Midluteal progesterone (ng/ml)</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.113 ± 1.643</td>
<td>8.187 ± 0.863</td>
<td>13.042 ± 1.666</td>
<td>12.443 ± 0.992</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>&lt; 0.001</td>
<td>0.388</td>
<td>0.113</td>
<td></td>
</tr>
</tbody>
</table>

Data presented as mean ± SD; p value indicates statistical significance.

Discussion

Widespread usage of tubal sterilization has brought about some questions currently at issue: Some women who have undergone tubal sterilization have had complaints which they attributed to tubal ligation. First in 1976, Chamberlain and Foulkes reported that menstrual symptoms may occur after tubal sterilization as well as possible increased menstrual bleeding and pain [5]. Catnach and Milne classified the major problems experienced subsequent to tubal sterilization into three categories; some women had problems in more than one category: a) Abnormal uterine bleeding and/or menorrhagia, b) physical problems c) psychological and/or psychiatric problems [6]. The mechanism of post-tubal sterilization syndrome has not yet been clarified. It was reported that damage in the fallopian tubes and mesosalpinx could change the ovarian blood supply [3]. This change causes a decrease in gonadotropin signals in the ovaries and finally follicular growth and corpus luteum function and steroidogenesis are impaired.

In the literature, ovarian function abnormalities such as reduced mid-luteal estrogen ecretion [6], disturbed estrogen/progesterone ratio during luteal phase [7], and low follicular LH values [9-11] have been suspected of contributing to development of post-tubal sterilization syndrome. In contrast to these reports, Timonen et al. reported high mid-luteal serum estrogen, while Radwanska et al. reported high luteal progesterone levels [8, 13].

However, most recent studies have revealed no hormonal changes underlying post-tubal ligation syndrome [14-16]. These studies evaluated hormonal changes a few days or weeks after tubal ligation except for the 5-year follow-up study of Carmona et al. [16]. In our study we evaluated serum hormones at onset and at three consecutive visits during the first year. We found no significant differences in FSH, LH and estradiol levels in post-tubal ligation patients compared to controls. However mid-luteal serum progesterone levels of patients who underwent laparoscopic tubal ligation were significantly low at the third month compared to baseline levels. Most likely this decrease was related to corpus luteum dysfunction which occurs after tubal ligation.

Recently, Doppler ultrasound studies showed increased levels of PI and RI which means reduced ovarian blood flow [14, 17, 19]. We demonstrated increased PI values at the third and sixth months, correlated with these data.
In our opinion these changes are the main causes of all underlying disturbances related to post-tubal sterilization syndrome. Localized hypertension in the vessels of the utero-ovarian plexus and tissue damage during tubal ligation may cause this decreased blood flow rate.

Women who were using hormonal contraceptives and already having hormonal medication were excluded from this study. Thus, impairments in steroidogenesis and ovarian blood supply which may occur after stopping hormonal medications were eliminated [4].

There is a dilemma in the literature as to which method more likely causes post tubal ligation syndrome. Tubal ligation with electrocoagulation may be more likely since it is thought to destroy a larger amount of tissue than the other procedure. An international study of 8,464 women with post-tubal ligation syndrome found that those who underwent electrocoagulation were significantly more likely to experience menstrual changes than those who underwent other procedures [18]. However Revel and co-workers reported that patients undergoing post-bilateral ligation by the Pomeroy technique might acquire an ovarian polycystic appearance and increased ovarian PI, which may be associated with a tendency to develop post-tubal ligation symptoms [19]. In fact, there is no report in the literature which compares different types of tubal ligation methods in regard to development of post-tubal ligation syndrome. In our opinion, electrocoagulation can cause more damage than other methods in unskilled hands. Thus our operations were performed by second- or third-year gynecology residents under the supervision of an experienced gynecologist and women with unexpected or extraordinary bleeding during the procedure were excluded from the study. In this way, we tried to constitute standard manipulation. However, more broad, controlled studies which compare different procedures in the same study are needed to shed light on this subject.

In summary, laparoscopic tubal ligation by electrocoagulation may temporarily cause reduced bilateral ovarian artery flow rates, especially in the first three to six months. Meanwhile, this disturbance causes corpus luteum dysfunction which reveals itself by low mid-luteal progesterone levels. However progesterone levels returned to baseline levels at the sixth and 12th month. There was no change in FSH, LH, or estradiol levels after laparoscopic tubal ligation by electrocoagulation. Moreover we concluded that laparoscopic tubal sterilization by electrocoagulation did not cause any additional risks for ovarian dysfunction than other methods when compared to the literature.

References


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