Doppler colour flow analysis of uterine and ovarian arteries prior to and after surgery for tubal sterilization: a prospective study

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Female sterilization by tubal ligation is a very common method of birth control. A relationship between tubal sterilization and subsequent development of menstrual disorders has been described in the literature but a biological mechanism explaining such an association has not yet been demonstrated. The aim of this study was to evaluate the influence of tubal ligation by the Pomeroy technique on ovarian and uterine artery blood flow using pre- and post-surgical Doppler assessments. We studied prospectively 20 patients undergoing laparotomy for tubal ligation. All patients had a Doppler blood flow assessment before and after surgery, conducted in the mid-follicular phase of their cycle. The pulsatility index (PI) of the right uterine artery ranged from 1.44 to 3.86 (mean 2.23) when measured prior to surgery and from 1.36 to 2.85 (mean 2.13) when measured after surgery. In the left uterine artery, the PI ranged from 1.67 to 3.17 (mean 2.17) and from 1.69 to 2.88 (mean 2.22) before and after surgery respectively. The difference was not statistically significant. The PI of the right ovarian artery ranged from 1.38 to 3.48 (mean 2.41) prior to surgery and from 1.48 to 3.23 (mean 2.29) after surgery. In the left ovarian artery, the PI ranged from 1.36 to 3.62 (mean 2.54) and from 1.85 to 4.00 (mean 2.61) before and after surgery respectively. Again, the difference was not statistically significant. Our results suggest that tubal sterilization performed by Pomeroy's technique does not induce immediate alterations in the vascular flow of either ovarian or uterine arteries.

Key words: Doppler blood flow/menstrual disorders/tubal sterilization

Introduction

Female sterilization by tubal ligation is a common method of birth control which is used worldwide. Despite its popularity, there is still concern as to whether it could have adverse effects. A relationship between tubal sterilization and subsequent development of menstrual disorders has been described in the literature since 1951 (Williams et al., 1951). Although >40 years of research have elapsed, the various studies described (Neil et al., 1975; Rioux, 1977; Stock, 1978; Riedel et al., 1981; DeStefano et al., 1983, 1985; Rulin et al., 1985, 1989, 1993; Stergachis et al., 1990; Shy et al., 1992; Thranov et al., 1992) have not defined an actual association between tubal sterilization and menstrual changes because the majority of these studies have methodological limitations, and variable and controversial outcomes.

The menstrual disorders described as associated with 'post-tubal ligation syndrome' include irregular cycles, more frequent menstrual periods, prolonged menstrual bleeding, increased menstrual bleeding, intermenstrual bleeding or spotting, oligomenorrhoea and dysmenorrhoea (Rioux, 1977; Hargrove and Abraham, 1981; DeStefano et al., 1983). However, it has not been confirmed whether or not these alterations were present before the surgery.

These menstrual alterations could occur as a result of anatomical or hormonal modifications caused by the method (Donnez et al., 1981; El-Minawie et al., 1983; Verco et al., 1983; Huggins and Sondheimer, 1984; Thranov et al., 1992). Nevertheless, a biological mechanism which might explain such an association has not yet been demonstrated. Sterilization techniques which involve large amounts of tissue destruction may lead to greater menstrual alterations because they could cause a significant alteration in ovarian blood flow (Riedel et al., 1981; DeStefano et al., 1985). However, these findings have not yet been confirmed. Endocrine alterations relating to changes in the oestradiol and progesterone concentrations after tubal sterilization are controversial (Hargrove and Abraham, 1981; Helm and Sjoberg, 1983; Cattanach, 1985; Alvarez et al., 1989; Thranov et al., 1992).

The development of transvaginal probes associating colour pulsatile Doppler images gave rise to a new refinement of gynaecological ultrasound (De Ziegler and Cedars, 1992) and an improved capacity to study and analyse pelvic blood flow. By studying uterine and ovarian vascular resistance, we were able to evaluate the possibility of an anatomical alteration determining endocrinological consequences, or vice versa, as demonstrated previously (Anderson et al., 1977; Goswamy and Steptoe, 1988; De Ziegler et al., 1991).

The purpose of this study was to evaluate prospectively the influence of tubal sterilization by the Pomeroy technique on blood flow in the ovarian and uterine arteries in a selected group of women, using pre-surgical Doppler assessment of the same patients as a control. The influence of this technique of female sterilization on blood flow in the uterine and ovarian arteries has not as yet been described.

Materials and methods

We prospectively studied 20 patients undergoing laparotomy for tubal sterilization from January to July 1994. All patients agreed to have
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Figure 1. Doppler colour blood flow of right ovarian artery before tubal sterilization.

Figure 2. Doppler colour blood flow of left ovarian artery after tubal sterilization.

Table I. Pulsatility index (PI) of the uterine arteries before and after surgery

<table>
<thead>
<tr>
<th>Uterine artery</th>
<th>Pre-surgery PI</th>
<th>Post-surgery PI</th>
<th>Mean difference*</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>2.23 (1.44-3.86)</td>
<td>2.13 (1.36-2.85)</td>
<td>0.10 ± 0.67</td>
<td>0.59</td>
</tr>
<tr>
<td>Left</td>
<td>2.17 (1.67-3.17)</td>
<td>2.22 (1.69-2.88)</td>
<td>-0.05 ± 0.60</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Values are means. Values in parentheses are ranges. *Mean of each pair difference (pre—post-surgery).

Table II. Pulsatility index (PI) of the ovarian arteries before and after surgery

<table>
<thead>
<tr>
<th>Ovarian artery</th>
<th>Pre-surgery PI</th>
<th>Post-surgery PI</th>
<th>Mean difference*</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>2.41 (1.36-3.48)</td>
<td>2.29 (1.48-3.23)</td>
<td>0.12 ± 0.73</td>
<td>0.69</td>
</tr>
<tr>
<td>Left</td>
<td>2.54 (1.36-3.62)</td>
<td>2.61 (1.85-4.00)</td>
<td>-0.07 ± 0.66</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Values are means. Values in parentheses are ranges. *Mean of each pair difference (pre—post-surgery).

a Doppler blood flow assessment before surgery and to repeat it 1 month following surgery. Five patients were excluded because they withdrew permission for the post-operative Doppler examination.

Only patients with regular menstrual cycles (28–30 days), without any adnexal or uterine pathology, with at least three live births from only vaginal deliveries and aged ≥29 years were included in the study. None of the patients was using intrauterine devices or oral contraceptives.

All operations were performed by the same surgeon using Pomeroy's technique (Lull and Mitchell, 1950). All patients were
discharged 24 h after surgery, and there were no complications during the operation or afterwards.

Real-time imaging and pulsed transvaginal colour Doppler assessment of the blood flow using a 5.0 MHz probe (SSA-270A; Toshiba, Tokyo, Japan) were used to measure the blood flow indexes in the uterine and ovarian arteries. The Doppler index we utilized was equivalent to the pulsatility index (PI = (A – B)/mean), in which A was the maximum (systolic) Doppler frequency shift, B was the minimum (diastolic) Doppler frequency shift and ‘mean’ represented the average Doppler frequency shift. All studies were performed in the longitudinal plane.

The uterine artery could be identified on a transverse scan at the level of the internal os of the cervix. The ovary was found lateral to the uterus, lying on the great pelvic vessels, together with the internal iliac artery, the internal iliac vein and the external iliac vein in the fossa of Waldeyer. The ovary has a dual blood supply, one from the adnexal branch of the uterine artery and the other directly from the abdominal aorta, but the main blood supply comes from the ovarian artery passing within the infundibulopelvic ligament. This entrance point of the ovarian artery in the ovary was the Doppler measurement area (Kurjak et al., 1989; De Ziegler and Cedars, 1992) in this study.

All examinations were performed in the same range of hours, i.e. from 18:00 to 20:00 h. In all cases, Doppler assessments of blood flow were conducted in the mid-follicular phase (day 6 or 7 of the menstrual cycle). No dominant follicles were observed during the examination.

A statistical analysis was performed using the paired t-test. Differences were considered significant when P was <0.05.

Results
A total of 15 patients underwent tubal ligation by Pomeroy’s technique, preceded and followed by a Doppler assessment of blood flow. The age ranged from 29 to 44 years (mean 33.5). The number of deliveries ranged from three to nine (mean 4.1).

The mean PI of the right uterine artery was 2.23 when measured prior to surgery and 2.13 when measured after surgery. The left uterine artery presented mean PI values of 2.17 and 2.22 when measured prior to and after surgery respectively (Table I). The differences between sides were not statistically significant.

The mean PI of the right ovarian artery was 2.41 prior to surgery and 2.29 after surgery. In the left ovarian artery, the mean PI values were 2.54 and 2.61 when analysed prior to and after surgery respectively (Table II; Figures 1 and 2). Again, the difference was not statistically significant.

Discussion
Transvaginal colour Doppler has been shown to give reproducible and reliable results (Steer et al., 1995). Zaidi et al. (1995), studying a total of six patients, concluded that circadian cycle changes in the uterine artery blood flow during the periovulatory period are dissociated from the mid-cycle hormonal changes. However, as our study was performed in an early follicular phase and all examinations were carried out during the same range of hours, we assume that there was no influence of the circadian rhythm on the study results.

The authors are not aware of another study in the literature analysing the interference of female sterilization methods with menstrual features from an anatomical point of view. Our results indicate a lack of association between tubal sterilization using Pomeroy’s technique and further vascular alteration, as demonstrated by a Doppler assessment of the blood flow. In fact, we found no alterations in the vascular flow PI after the tubal sterilization surgery in all areas analysed, i.e. uterine and ovarian arteries.

Neil et al. (1975), in a retrospective study, showed that menstrual alterations were higher in patients submitted to laparoscopic tubal sterilization than in those submitted to sterilization by Pomeroy’s technique, suggesting a probable interference of the technique.

In a study of 719 women submitted to tubal sterilization and subsequently interviewed, DeStefano et al. (1985) found that some tubal sterilization methods could carry an increased risk of menstrual disturbances, and that it may take >2 years to become apparent. However, this study does not suggest any mechanism by which tubal sterilization could determine the appearance of such menstrual disturbances.

In a prospective study of 389 women submitted to laparoscopic tubal sterilization and interviewed afterwards, Rulin et al. (1989) found that tubal sterilization does not adversely affect most menstrual parameters, and that increasing dysmenorrhea following surgery occurred only in patients who had stopped making use of oral contraceptives or intrauterine devices.

A study by Stergachis et al. (1990) of 7414 patients who had undergone tubal sterilization showed that the association between tubal sterilization and the risk of a subsequent hysterectomy would depend on the age and marital status of the patient, and not on a biological consequence of the method.

Our results demonstrate that tubal sterilization by Pomeroy’s technique does not interfere with uterine and ovarian circulation up to 1 month after surgery. However, we cannot state whether a later vascular alteration may arise. In our opinion, this possibility is very remote because we believe that if a vascular alteration arising from surgery does not occur immediately afterwards, the risk of a later alteration would be very small. This opinion, however, needs supporting evidence from further studies for confirmation.

Whether or not there is an association between tubal sterilization and subsequent menstrual alterations cannot yet be determined. Nevertheless, the supposed mechanism of vascular alteration in the ovarian arteries, followed by hormonal alteration and menstrual irregularity, was not confirmed in our study. In addition, vascular alterations in the uterine arteries could not be confirmed in our study.

In conclusion, our results suggest that tubal sterilization performed by Pomeroy’s technique does not induce immediate alterations in the vascular flow, to either ovarian or uterine arteries.

References


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