Intraoperative contact ultrasonography during open myomectomy for uterine fibroids

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Objective: To evaluate the benefit of intraoperative ultrasound applied directly to the uterine serosa during surgery for uterine fibroids.

Design: Prospective study.

Setting: University hospital, tertiary care.

Patient(s): Women admitted for open myomectomy due to uterine fibroids.

Intervention(s): Intraoperative ultrasound (IUS) and intraoperative palpation were performed to detect the number of residual fibroids at the end of surgery, then the number of fibroids was recorded at anatomopathology examination.

Main Outcome Measure(s): Residual fibroids detected at IUS and intraoperative palpation at the end of open myomectomy.

Result(s): The comparison between the number of residual fibroids at IUS and at intraoperative palpation was statistically significant.

Conclusion(s): Intraoperative ultrasound is more efficient than palpation in detecting residual leiomyomata at the end of open myomectomy. (Fertil Steril 2010;94:1487–90. ©2010 by American Society for Reproductive Medicine.)

Key Words: Intraoperative ultrasound, myomectomy, ultrasonography, uterine fibroids

Uterine fibroids represent the most frequent gynecologic disease in reproductive-aged women (1). Over the last decade there has been an increasing trend among women to marry and start their reproductive program later in life. This phenomenon has led to an increased number of patients with uterine leiomyomatosis who wish to preserve their fertility. The best therapeutic option for fertile women remains conservative surgery such as myomectomy. Over the last few years, numerous minimally invasive approaches such as uterine artery embolization (UAE) and magnetic resonance-guided focused ultrasound surgery (MRgFUS) have been developed. However, these procedures are not recommended in women who want to preserve fertility (2, 3). At the present time, the recurrence rate of fibroids after conservative surgery is high: 51% to 62% at 5 years (4, 5), with a cumulative probability of recurrence considerably lower in patients with a single leiomyoma compared with patients with multiple fibroids (5); this is likely to be due to undetected leiomyomata not having been removed (6) or small fibroids not having been identified at the time of surgery (7). The persistence of the pathology after surgery makes pregnancy less likely, and in one out of three cases, recurrence leads to hysterectomy (8). The accurate excision of all uterine fibroids should therefore be mandatory when aiming to both preserve fertility and avoid recurrence.

Intraoperative ultrasonographic (IUS) techniques have been used for a long time in some surgical areas; however, in gynecology these methods are not yet commonly employed (6). Our study evaluated the benefit of IUS applied directly to the uterine serosa during open myomectomy.

MATERIALS AND METHODS

All consecutive women undergoing surgery for uterine leiomyomatosis at our institutions between May 2005 and February 2006 were included in this prospective study. The different therapeutic options were always extensively discussed with the patients, and written consent was obtained. The type of surgery to be performed was based on the patient’s age, symptoms, number of myomata, and desire for future pregnancies.

This study obtained institutional review board approval.

Women who were to undergo hysterectomy, laparoscopic myomectomy, or operative hysteroscopy were excluded from this study. Preoperative diagnosis using transvaginal...
and transabdominal ultrasonographic probes was performed on the patients 1 day before surgery.

The median age of the patients who underwent myomectomy was 40 years (Table 1).

The main indications for surgery included menstrual disorders (hypermenorrhea), rapid fibroid growth, pressure symptoms, or infertility. No patients were pretreated with gonadotropin releasing-hormone (GnRH) agonists.

All surgical operations were performed by the same surgical team. Open myomectomies were performed by both laparotomy or minilaparotomy on the basis of the number and the size of diagnosed fibroids, and the personal history and general physical condition of the patient. Fibroid enucleation was performed after the injection of adrenalin diluted 1:300,000.

After the extraction of all identified fibroids and relative uterine suture, the surgeon performed an accurate examination of the uterus by palpation to detect any residual fibroids. Then, intraoperative contact ultrasound was performed directly on the uterine serosa using a General Electric Logiq Alpha 200 (General Electric Medical Systems, Milwaukee, WI) sonographic scanner equipped with a linear probe with the detection frequency set to 7.5 MHz. Ultrasonic gel was applied to the ultrasonic device covered with a sterile envelope. The surgeon guided the ultrasonic probe around the surface of the uterus while the same operator who had performed the preoperative ultrasound studied the ultrasonographic images.

After IUS and palpation additional enucleation of residual fibroids was performed, and their number was recorded (Fig. 1). In most cases, when the surgeon was unable to identify them with palpation, the enucleation of residual fibroids was performed at the site identified at ultrasonography.

The number of residual fibroids identified at palpation, and the residual fibroids identified at intraoperative ultrasonographic examination at the end of surgery were compared.

The Wilcoxon test was used for statistical analysis; $P < .05$ was considered statistically significant up to the 5% level. Results were obtained using Stata 9.0 software (StataCorp LP, College Station, TX).

**RESULTS**

The study included 64 consecutive patients admitted to our institutions for open myomectomy due to uterine fibroids.

We recorded 182 myomata preoperatively at ultrasound 1 day before surgery (mean ± standard deviation [SD] 2.87 ± 1.97; median 2.00; range: 1 to 9), of which 68.2% were intramural, 2.2% submucous, 29.6% subserous, 49.5% within the anterior wall, and 50.5% within the posterior wall. We extracted 290 fibroids (mean ± SD 4.56 ± 5.78; median 2.00; range: 1 to 27) during surgery: 61% were intramural, 2% submucous, 37% subserous, 51% within the anterior wall, and 49% within the posterior wall. The comparison between data recorded at preoperative ultrasound and during surgery has been reported in another study. Our results showed that more than six fibroids statistically significantly decreased ultrasound efficiency; the undetected fibroids were mostly intramural and localized in the posterior wall.

After excising all fibroids, the surgeon palpated the uterus and counted an average number of 0.09 ± 0.30 residual

### Table 1

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Age (range: 28–51)</th>
<th>Parity (range: 0–4)</th>
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<tbody>
<tr>
<td>64</td>
<td>40</td>
<td>0.95</td>
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</table>

**Angioli. Intraoperative ultrasound and fibroids. Fertil Steril 2010.**
fibroids (median number 0.00; range: 0 to 1) for a total of six residual fibroids (Table 1): 100% of residual fibroids were intramural, 66.6% anterior, and 34.6% posterior. We then performed IUS directly on the uterus showing a total of 46 fibroids, with a mean of 0.72/C6 1.50 residual fibroids detected (median number 0.00; range: 0 to 7) and a mean maximum diameter mm 11.82/C6 6.58 (median maximum diameter 11.00 mm; range: 5 to 25 mm): 95.66% of residual fibroids were intramural, 4.34% were submucous, 24% anterior, and 76% posterior.

The comparison between palpation and IUS showed a statistically significant difference (P < .001) (Table 2). In one case, positive intraoperative palpation for residual fibroids was not confirmed by the intraoperative ultrasound, and at the following hysterotomy no fibroids were found (Fig. 2). In one case, two additional small fibroids (maximum diameter ≤ 5 mm) were found at IUS with respect to palpation, but the surgeon decided to not remove them because the uterus had been compromised by the extraction of 27 fibroids. These two residual fibroids were not considered in our statistics.

DISCUSSION
To the best of our knowledge, this is the first study designed to test the validity of IUS applied directly to the uterine serosa during open myomectomy as an aid in the identification of fibroids. In the literature, few studies on the use of IUS in gynecology have been reported. Only transabdominal, transrectal, and transvaginal ultrasound have been investigated in intrauterine surgery (9–13).

The first report on the use of contact ultrasound during myomectomy was by Letterie and Catherino (14). They reported on the application of the finger-grip probe to the uterine serosa for intraoperative guidance in three cases of transabdominal myomectomy to identify the precise location of the myomas as well as provide intraoperative guidance for dissection, demonstrating the overall usefulness of the technique (14).

Later Shimanuki et al. (15) used contact ultrasonography during laparoscopic myomectomies to detect residual fibroids. They identified 23 residual fibroids by contact ultrasound and 33 other residual fibroids with a transvaginal probe (15).

Our study not only compared IUS to intraoperative palpation during open myomectomies but also showed encouraging results in terms of better excision of uterine fibroids.

In fact, some studies suggest that the recurrence of uterine leiomyomatosis is often caused by residual disease (6, 7), but there are few and contradictory data in the literature about the possible prognosticators of disease recurrence. Hanafi (5), analyzing 145 consecutive cases of leiomyomata after myomectomy, found that the 5-year cumulative rates for leiomyoma recurrence and subsequent major surgery were 62% and 9%, respectively. At 5 years, the cumulative probability of recurrence was statistically significantly lower in patients with a single leiomyoma removed (11%) compared with patients with multiple leiomyomata (74%) (P = .011). It was also lower in patients with intraoperative uterine size of 10 menstrual weeks or less (46%), compared with more than 10 menstrual weeks (82%) (P = .032); there was a strong association of uterine size with the number of leiomyomata removed (P = .009). Childbirth after myomectomy was associated with a lower recurrence rate; the 5-year cumulative probability of recurrence was 26% in patients with subsequent parity, compared with 76% in those without subsequent parity (P = .010). Hanafi (5) concluded that solitary myomectomy and smaller intraoperative uterine size

### TABLE 2
Comparison between the number of residual fibroids (64 patients).

<table>
<thead>
<tr>
<th></th>
<th>Intraoperative palpation</th>
<th>Intraoperative ultrasound</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>6</td>
<td>46</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Mean ± standard deviation</td>
<td>0.09 ± 0.30</td>
<td>0.72 ± 1.50</td>
<td></td>
</tr>
<tr>
<td>Median number (range)</td>
<td>0.00 (0–1)</td>
<td>0.00 (0–7)</td>
<td></td>
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### FIGURE 2
Presence (+) or absence (−) of residual fibroids detected by intraoperative ultrasound (IUS) or intraoperative palpation (IP) in our study of 64 patients.
are associated with lower rates of leiomyoma recurrence after myomectomy; the significance of uterine size may be affected by its correlation with the number of leiomyomata removed. Subsequent parity is associated with a lower probability of recurrence, but the cause and effect relationship between these two variables is unclear. In contrast, it has been found that women with a uterine size of less than 12 menstrual weeks at the time of abdominal myomectomy might be at increased risk of second surgery (7).

The only study evaluating the effectiveness of IUS in reducing recurrent fibroids during myomectomy was performed by Shimanuki et al. (15). These investigators evaluated a total of 42 patients who underwent laparoscopic myomectomy. All patients underwent contact ultrasonography and transvaginal ultrasonography to detect residual fibroids. After laparoscopic myomectomy, additional enucleation guided by contact ultrasonography was performed; then, the final residual fibroids were detected using transvaginal ultrasonography. The frequency of postoperative residual fibroids and their characteristics were evaluated. All cases were evaluated for >6 months postoperatively to assess recurrence. The total number of fibroids enucleated in the initial enucleation was 201, or 4.8 per patient. Median diameter of the largest fibroids for each patient was 60 mm. There were 25 additional fibroids enucleated with contact ultrasonographic guidance, and their median diameter was 12.1 mm. After the additional enucleation, 33 final residual fibroids were identified by transvaginal ultrasonography. Their median diameter was 9.0 mm, which was statistically significantly smaller than those of the additionally enucleated fibroids (P= .002). The frequency of patients with residual fibroids was calculated in relation to the number of enucleated fibroids, and the results showed that the frequency tended to increase as the number of fibroids increased and that almost all the patients (seven of eight cases, 87.5%) with ≥10 fibroids had residual ones. The median follow-up period was 31 months (range: 6 to 37 months), and eight cases (19.0%) had recurrent fibroids. The recurrence rate in patients with ≥10 fibroids was 50%. Intraoperative contact ultrasonography was useful in detecting and enucleating residual fibroids. As the number of enucleated fibroids increased, the risk of residual fibroids and recurrence tended to increase as well.

Our results confirmed the findings of Shimanuki et al. (15) during laparoscopic myomectomy, showing that IUS clearly outperforms intraoperative palpation in detecting residual fibroids after open myomectomy. Some fibroids are impossible to palpate because of their consistency or their small size, or because of the presence of the uterine suture. In such cases, IUS proves to be an effective technique that can easily identify residual fibroids within the uterine walls.

We extended the follow-up period of our patients to evaluate their recurrence rate at 5 years as well as the clinical significance of the technique in terms of pregnancy rate and excision of all the detectable fibroids, including small leiomyomata of <10 mm of maximum diameter. The study period is near its conclusion.

A limitation of our study was the impossibility of verifying the exact number of fibroids within the uterine walls after the enucleation of those detected by IUS. Being unsure of the true number of fibroids, we were unable to confirm whether IUS had identified all of the residual ones. We did not perform a transvaginal ultrasound after additional enucleation of the fibroids because the patients were in an inadequate position, because the presence of the urinary catheter, because of the edema from the uterine sutures, and because of the presence of intra-abdominal fluid. Its usefulness might be evaluated in future studies, however.

We believe that IUS applied directly to the uterine serosa may be a valid aid to the surgeon for identifying the number of residual leiomyomata during open myomectomy. The final decision as to when to stop the surgical procedure for the patient’s benefit belongs to the surgeon. When numerous fibroids have been enucleated and the uterus is in danger of being functionally compromised, there is no place for further excision, regardless of the number of residual fibroids.

REFERENCES