Ultrasound evaluation of uterine wound healing following laparoscopic myomectomy: preliminary results

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The purpose of our work was to study the evolution of the uterine scar following laparoscopic myomectomy, as imaged by ultrasonography and Doppler velocimetry of the uterine arteries. We prospectively studied 30 patients. In the first phase, 15 patients were submitted to two-dimensional (2D) endovaginal ultrasound on day –1, 1, 7, 30 and 60 (surgery = day 0). In the second phase an additional 15 patients were studied by both 2D ultrasound and by Doppler velocimetry. The resistance index (RI) was calculated from the flow velocity waveform of the uterine arteries, at the origin of their ascending branch. Only one ultrasonic pattern was found, which was a dense echogenic area having an ill-defined, heterogeneous texture. In one case a small anechoic area (1 cm) was detected in the scar, possibly due to a haematoma. The evolution of uterine healing showed a progressive reduction in the size of the scar. On day 1 its mean diameter was 37.04% less than the myoma diameter and on day 30 71.7% less. The difference was significant at $P < 0.001$. A further significant ($P < 0.001$) reduction was found at day 60 in the 15 patients studied in phase I. On both day 1 and day 30 following surgery, there was no correlation between the sizes of the myoma and the scar. There was a statistically significant increase ($P < 0.01$) in the RI value of the ipsilateral uterine artery from 0.64 on day –1 to 0.79 on day 1. On day 30, 12/15 (80%) cases had RI values ranging between 0.80 and 0.98, while in three cases there was absence of end diastolic flow. The RI values of the contralateral uterine artery were high (0.90) before surgery and did not change afterwards. There was no correlation between the size of the myoma and the increase in the uterine artery RI value following surgery. Considering the velocimetric findings, 30 days are a reference point for assessing the healing process. Ultrasound imaging and Doppler velocimetry can be used for studying the evolution of the uterine scar following myomectomy.

Key words: Doppler investigation /laparoscopic myomectomy/ ultrasound/uterine repair

Introduction

Myomas develop during the reproductive years, often in women desiring pregnancy or affected by infertility. A growing myoma is an accepted indication for myomectomy, which is now made possible by laparoscopy when performed by skilled surgeons. The rate of adhesions following laparoscopic myomectomy does not represent a real concern (Dubuisson et al., 1998). The suture is the main problem of the operation. Five reported cases of uterine rupture during pregnancy following laparoscopic myomectomy (Harris, 1992; Dubuisson et al., 1995; Mecke et al., 1995; Friedmann et al. 1996; Pelosi and Pelosi, 1997) have made surgeons alert. Moreover, the promising results of this technique and the presence of very little patient discomfort could lead to a poorly controlled overuse of this surgical option.

There are no published reports evaluating the uterine scar following laparoscopic myomectomy. However, it has been suggested that ultrasound could be a useful means of assessing the uterine scar following laparotomy (Pun et al., 1998).

The purpose of our work was to study the evolution of the uterine scar following laparoscopic myomectomy, as imaged by ultrasonography and Doppler velocimetry of the uterine arteries.

This report describes the preliminary results of our study.

Materials and methods

In the first part of our study (November 1996–December 1997) we prospectively evaluated 15 women who underwent laparoscopic myomectomy. In order to describe the evolution of the sonographic findings (phase I), ultrasound examinations were performed on day –1, 1, 7, 30 and 60 (surgery = day 0). All the patients were scanned with a Bruel and Kjaer scanner (Type 1846, Naerum, Denmark) equipped with a 7-MHz transducer.

After this period of training, we began phase II, during which time we also studied the vascular Doppler velocimetric patterns of the uterine arteries. Following laparoscopic myomectomy, 15 patients underwent sonographic evaluations at the Department of Gynecology and Obstetrics of the University of Turin (S.Anna Hospital) between December 1997 and January 1999. Informed consent was obtained from patients in both phases of the study.

The patients studied in phases I and II were similar both in terms of their age and the size of the removed myomas. Only the patients with a single myoma were included in the study in order to avoid mixed ultrasound findings from different scars. The mean age was 35.1 years (25–43). There was no febrile morbidity (fever higher than 38°C). All patients were discharged the day after surgery. Seven patients were unipara and 23 nulligravid. There were no intra-operative complications. Two out of 14 infertile patients conceived: one had a vaginal delivery at 39 weeks and the other a Cesarean section at 38 weeks.
Uterine wound healing after myomectomy

Figure 1. Sonographic findings on day before surgery. 
e: endometrium; m: myoma; +, ×: myoma diameters.

Figure 2. Flow velocity waveforms from the uterine artery on day 1 after surgery.

All ultrasound examinations were carried out by one of the authors (P.G.) on days –1, 1 and 30, using an Aloka SSD 1700 scanner (Aloka Co. Ltd, Tokyo, Japan) and 5 MHz transvaginal probe. On day –1 the uterus and the myoma were measured on two planes (sagittal and coronal) (Figure 1). The resistance index (RI) was calculated from the flow velocity waveforms of both uterine arteries at the origin of their ascending branch (Figure 2). The scar was measured on day 1 (Figure 3) and day 30 and the RI of the uterine arteries was obtained on days –1, 1 and 30. After this, scar reduction was calculated as a percentage of the myoma diameter.

The day of the cycle was not considered when carrying out the ultrasound examination.

A growing myoma (>2 cm/3 months), as revealed in at least two sonographic examinations, was considered an indication for operative laparoscopy. Other indications were infertility and menorrhagia.

No preoperative hormonal treatment was prescribed in order to reduce the diameter of the myoma.

Student's t-test for paired samples was used to compare the data, with a P value < 0.01 being considered significant.

Surgical technique

Patients were treated using the previously reported laparoscopic technique (Seinera et al., 1997). The only important difference was in regard to the technique of uterine suture. The uterine wound was always repaired in one or two layers depending on its depth. Separate stitches were made using only curved needles rather than straight ones. This makes the reapproximation of the uterine edges more accurate (Dubuisson, 1998). Polyglyconate (Maxon 2/0®; Davis and Geck, Gosport, UK) or polyglactin V318 (Vicryl 0®; Ethicon, Roma, Italy) were used to reconstruct both the perimetrium and myometrium. Myocamycin (Miocamen®; Menarini, Firenze, Italy) 600 mg, twice a day for 5 days, was administered post-operatively to all patients.

Results

The results concerning the size of the myomas, their echogenic characteristics and the reduction of the scar at days 1 and 30 were similar for patients in both phases I and II. Therefore, the data were pooled. The size of the myomas was 3–4 cm in 9/30 cases (30%), 5–6 cm in 18 cases (60%) and >7 cm in three cases (10%). The location of the myoma was intramural in 24/30 cases (80%) and submucosal in six. All the myomas were completely or mainly in one side of the uterus.

Regarding the echogenic characteristics of the uterine scar, only one ultrasonic pattern was found: a highly echogenic area having an ill-defined, heterogeneous myometrial texture. No important fluid-filled areas were seen. A similar pattern was also observed on day 7 (phase I) and on day 30. A few, small (<5 mm) anechoic areas were detected in the site of the myomectomy wound in all patients on day 1. In only one case did the scar present an anechoic area of about 1 cm, possibly due to a haematoma. No important differences in the ultrasonic appearance of the scar were observed between day 30 and day 60 (phase I).

The evolution of uterine healing studied by two-dimensional (2D) ultrasound showed a progressive reduction in the size of the scar. This was measured as the percentage difference between the mean myoma diameter and the mean scar diameter; on day 1 it was 37.04% (range 20–58), on day 30 it was 71.7% (range 50–80) and on day 60 (in 15 patients in phase I) it was 87.5%. In both cases, the reduction was significant (P < 0.001). There was no correlation between the size of the myoma and the size of the scar on both day 1 and day 30.
There was a statistically significant increase \((P < 0.01)\) in the RI value of the ipsilateral uterine artery from 0.64 (range 0.47–0.78) on day –1 to 0.79 (range 0.59–0.98) on day 1. At day 30 12/15 (80%) cases had RI values ranging between 0.80 and 0.98, while in three cases there was absence of end diastolic flow. The further increase in RI values from day 1 to day 30 was significant \((P < 0.001)\). The RI values of the contralateral uterine artery were high (0.90; range 0.80–1.00 on day –1) and did not change following surgery. There was no correlation between the size of the myoma and the degree of increased uterine RI value following surgery. In one case, not included in our study, a low RI value was found on both day 1 and day 30. After further examination, the patient was found to be pregnant at 5 weeks.

In all cases a small \(<20 \text{ ml}\) amount of blood was detected in the pouch of Douglas.

**Discussion**

Laparoscopic myomectomy is a rather recent technique. The main concern is the uterine rupture during subsequent pregnancies that has been reported. The reason for the uterine rupture is uncertain. A haematoma located deep in the myometrium is considered a risk factor as it is believed to weaken the uterine wall as a result of fibrous healing (Dubuisson *et al.*, 1995). Poor vascularization and tissue necrosis due to widespread use of electrosurgery could negatively affect the scar strength (Elkins *et al.*, 1987; Nezhat *et al.*, 1996). Healing by secondary repair as a consequence of an incorrect reapproximation of the edges of incision is another possibility. Moreover, in order to avoid any tissue trauma, some authors (Lyon and Richardson, 1987) have emphasized the use of polyglycolic acid sutures, using small needles. Since synthetic absorbable sutures break down in the tissues by hydrolysis rather than by phagocytosis, they cause much less tissue reaction than do those made of catgut.

No diagnostic method has yet been widely accepted to assess the healing process. Some authors (Dubuisson *et al.*, 1998) proposed a laparoscopic second look after 4–8 weeks for patients desiring pregnancy. Nevertheless, its value is questionable since the examination of the scar is only external, limited to the perimetrium, and no useful information can be obtained about the integrity of the more important uterine layer, i.e. the myometrium. A biopsy of the uterine scar for histological demonstration of regular healing could be self-defeating and might also cause further tissue damage.

Echography may be an interesting technique for attempting to resolve the problem. First of all, it allows us to view all of the layers of the uterine wall, so as to detect and describe any alteration in the muscular echotexture. The second advantage is that a vascular study involving the uterus and the scar can be assessed in order to recognize the effects of poor quality uterine suture (haematoma or irregular vascular patterns).

To date, no reports exist regarding ultrasound evaluation of the uterus following laparoscopic myomectomy. In a recent prospective study (Pun *et al.*, 1998), 10 patients were examined following open myomectomy to determine the morphology and the volume of the scars. In all cases an area with heterogeneous echo was detected at the site of a prior myoma, which seemed to represent the myometrial wall surrounding the myoma that had been approximated by sutures. No information was given about vascular uterine patterns.

To the best of our knowledge, our study on the use of transvaginal ultrasonography associated with Doppler imaging to evaluate the uterine scar following myomectomy is the first of its kind. In order to reveal the sonographic changes in the healing uterus (phase I), we started by assessing uterine features at regular intervals following surgery. Only one ultrasonic pattern was found: a dense echogenic area having an ill-defined heterogeneous myometrial echotexture. It is difficult to assign this finding to a definite histological pattern. It is probably produced by the tissue healing (blood and wounded tissue), where it is always possible to distinguish a variable amount of suturing material. The same ultrasonic pattern was present in all patients on day 30. The anechoic areas <5 mm, which were present on day 1 in all patients, were probably due to focal haemorrhage in normal tissue healing and not related to haematomas. In only one case could the ultrasonic image be interpreted as haematoma, with the presence in the scar of an anechoic area of about 1 cm. This image disappeared 8 months later. The absence of any clinical symptom in the post-operative period could possibly be related to its small size. In any case, our findings suggest that haematomas in the uterine scar are rare following laparoscopic myomectomy.

The ultrasonographic image that we have described is similar to the one reported (Pun *et al.*, 1998) following laparotomic myomectomy. Their report gave results at 6 months as well, at which time they observed a short linear echogenic shadow. We found the same pattern occurring at 8 months in six patients. We speculate that our laparoscopic suturing technique is as reliable as the conventional laparotomic one.

The size of the uterine wound decreased steadily from day 1 to day 30, while the reduction was much slower after that. This fact may be related to the intense initial response of regenerating healing tissue. It is likely that oedema and the small amount of blood in the wounded tissue disappear quite rapidly, thereby giving way to a more gradual healing.

It is difficult to draw conclusions from our Doppler velocimetric findings. Certainly the increase in the RI values from day 1 reflects the success of the surgical procedure. The pre-intervention low values are most likely due to the abnormal vascularization of the myoma. In one case, in which the RI did not increase, an area of adenomyosis was observed. The normal values on day 30 most probably indicate the normal function of the uterus. However, it is unclear whether this provides any information about the characteristics of the healing process. The absence of end diastolic velocities found in three cases on day 30 could reflect an increase in peripheral resistance. This, in turn, could be due to an abnormal healing process (fibrosis) which is undetectable by 2D imaging. We only studied patients with a single myoma. It is likely that the echographic and Doppler findings would be the same when multiple tumours are present.
In conclusion, we have described the evolution of the uterine scar following laparoscopic myomectomy. The ‘normal’ healing pattern is an echogenic, heterogeneous, ill-defined area. Echography is a simple and non-invasive diagnostic tool for repeated assessment of uterine morphology after intervention. We do not feel it is justified to propose further surgery in order to assess the condition of the uterine wall since, given its poor value, such a procedure is too invasive. The velocimetric findings seem to indicate that day 30 is the reference point for assessing the healing process. Further studies are warranted to relate possible abnormalities of the healing process and long-term adverse reproductive outcomes. We stress that our technique uses only vasoconstrictive agents and suturing to achieve haemostasis, rather than radio frequencies. Nevertheless, it would be interesting to compare our echographic and velocimetric findings with those of laparoscopic myomectomy in which radio frequencies are widely used.

References

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