Human Reproduction vol.15 no.4 pp.869–873, 2000

Pregnancy outcome and deliveries following laparoscopic myomectomy

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Uterine rupture after myomectomy by laparotomy is not a common occurrence. Some case reports of uterine rupture after laparoscopic myomectomy (LM) raise the question of the quality of the uterine scar produced when this technique is performed. In order to assess the outcome of pregnancies and deliveries after LM and to assess the risk of uterine rupture, we performed an observational study. Questionnaires were mailed to all women who had had LM for at least one intramural or subserosal myoma of more than 20 mm diameter and who were aged <45 years. Ninety-eight patients became pregnant at least once after LM, giving a total of 145 pregnancies. Among the 100 patients who had delivery, there were three cases of spontaneous uterine rupture. Because only one of these uterine ruptures occurred on the LM scar, the risk of uterine rupture was 1.0% (95% CI 0.0–5.5%). Seventy-two patients (72.0%) had trials of labour. Of these, 58 (80.6%) were delivered vaginally. There was no uterine rupture during the trials of labour. Spontaneous uterine rupture seems to be rare after LM. This risk should not deter the use of LM if needed. When performing LM, particular care must be given to the uterine closure.

Key words: laparoscopic/myomectomy/rupture/uterine

Introduction

Laparoscopic myomectomy (LM) is a recently introduced technique which enables intramural and subserous myomas <9 cm in size and few in number to be managed by surgery (Dubuisson and Chapron, 1996). The rate of complications in the short term is low, provided that the surgeons are suitably trained (Dubuisson *et al.*, 1996). Compared with myomectomy by laparotomy, LM offers reduced postoperative pain, a shorter hospital stay, and quicker return to normal activity (Mais *et al.*, 1996). When pregnancy is desired, the technique appears particularly advantageous in that it could reduce the risk of postoperative adhesions compared with laparotomy (Bulletti *et al.*, 1996; Dubuisson *et al.*, 1998).

However, the strength of the hysterotomy scar after LM is a subject of controversy (Nezhat, 1996). Indeed, five cases of uterine rupture during pregnancy after LM have been reported within a short period of time (Table I) (Harris, 1992; Dubuisson *et al.*, 1995; Mecke *et al.*, 1995; Friedmann *et al.*, 1996; Pelosi and Pelosi, 1997). However, the true frequency of this occurrence is not clear because the cases were reported without any information concerning the total number of pregnancies obtained after LM.

Since 1989, when we first began to perform LM in our institution, we have maintained a database concerning patients operated on by this technique. The aim of this study was to assess the outcome of pregnancy and deliveries after LM, and to evaluate the risk of uterine rupture after LM.

Materials and methods

Between 31 March 1989 and 29 December 1996, 263 patients aged <45 years underwent LM in our institution. All these patients had at least one subserous or intramural myoma measuring over 20 mm in diameter. The patients were operated on using a technique described previously (Dubuisson *et al.*, 1997). With regard to the laparoscopic closure of the myoma bed, a seromuscular layer was most often used with separate stitches of Vicryl® 2/0 (Polyglactine 910; Ethicon, Neuilly, France). When the myoma was located deeply, or the uterine cavity was broached, the suturing was continued along two layers. When it was impossible to suture purely by laparoscopy, it was necessary to convert to laparoscopic-assisted myomectomy (LAM) (Nezhat *et al.*, 1994; Tulandi and Youseff, 1997). Conversions to laparotomy were defined as the use of laparotomy before the end of cleavage of all the myomas. The following data were collected prospectively for each operation: number, location, maximum diameter and type of myomas (intramural, sessile subserous, or pedunculated); the number of hysterotomies; type of suture used; opening of the uterine cavity; and associated operative procedures.

Since 1994, a postal questionnaire has been sent out annually to patients on whom we have performed this operation in order to determine whether they have become pregnant on one or more occasions since surgery, and the outcome of these pregnancies. The last questionnaire was sent during the first semester of 1998. In cases where no reply was obtained, contact was made by telephone (after first checking if there was a change of address). In the event of pregnancy, a questionnaire was sent to the obstetrician who attended the birth or who had provided care in pregnancy. One question concerned specifically the uterine scar. When a Caesarean section had taken place, a routine request was made for the operative report.

Uterine rupture was defined as a complete separation of the wall of the pregnant uterus with or without expulsion of the fetus, endangering the life of the mother or fetus (Farmer *et al.*, 1991; Cowan *et al.*, 1994). The scars checked during the Caesarean section were also classed as: invisible, thick (visible but with no distinct depression in the myometrium); thin (when the myometrium was thinner at the scar site without discontinuity); and dehiscent (discontinuity of the scar, without symptoms).

Table I. Published cases of uterine rupture after laparoscopic myomectomy

Reference	Myoma			Hysterotomy sutured	Uterine cavity opened	Gestational age (weeks)	Labour	Infant outcome
	Type	Size (mm)	Location					
Pelosi and Pelosi (1997)	Subserous	50	Fundal	No	No	33	No	Perinatal death
Friedmann *et al.* (1996)	Intramural	50	Fundal	NR	Yes	28	No	Good
Mecke *et al.* (1995)	Intramural	NR	NR	NR	Yes	30	No	Good
Dubuisson *et al.* (1995)	Intramural	30	Posterior	Yes	No	32	No	Good
Harris (1992)	NR	30	Posterior	Yes[a]	NR	34	No	Good

[a]Suture performed only for the superficial layer.
NR = not reported.

Table II. Main characteristics of the 98 patients who became pregnant after laparoscopic myomectomy

	n	Mean ± SD	%
Age (years)		33.2 ± 4.0	
Parity			
Nullipara	78		79.0
Primipara	9		9.0
Multipara	11		12.0
Previous uterine scar[a]	9		9.2
Number of myomas		1.8 ± 1.9	
=1	60		61.0
=2	18		18.0
⩾3	20		21.0
Size of largest myoma (mm)		47.8 ± 20.6	
Type of largest myoma			
Intramural	32		32.6
Subserous	41		41.8
Pedunculated	25		25.6
No. of patients with sutured hysterotomy[b]	54		55.0
Cavity opened	6		6.1
Conversion to LAM	8		8.0
Conversion to laparotomy	1		1.0

[a]Including three Caesarean section, four myomectomy by laparotomy, and two hysteroscopic myomectomy.
[b]44 patients had superficial myomectomy defects that were not sutured.
LAM = laparoscopic assisted myomectomy.

Statistical analysis was carried out using the StatView 5.0 software program (SAS Institute Inc., Cary, North Carolina, USA). Statistical analysis included the following tests: chi-squared test and Student's *t*-test. The confidence interval (CI) for the rate of rupture after LM was calculated at 95% according to the exact binomial law (Bouyer, 1996).

Results

Among the 263 operated patients, 37 (14.1%) were lost to follow-up. In addition, 128 patients (48.7%) had no pregnancy at the time of the 1998 questionnaire, and 98 patients (37.2%) had a total of 145 pregnancies after LM. The median duration of follow-up was 40 months in patients who did not conceive after LM. The median time lapse before conception was 16 months.

The characteristics of the 98 patients who became pregnant after LM are listed in Table II. One patient was 14 weeks pregnant at the time of LM (acute pelvic pain complicating a pedunculated myoma). The indications for myomectomy (sometimes more than one for the same patient) for the 98 patients were: infertility or recurrent spontaneous abortion in 53 cases (54.0%), pain or pressure in 29 cases (29.6%), abnormal bleeding in 16 cases (16.3%), and rapidly growing or enlarging myoma alone in 14 cases (14.3%).

Table III. Outcome of the 145 pregnancies after laparoscopic myomectomy

	n	%
Spontaneous abortion	38	26.2
Legal abortion	4	2.8
Ectopic pregnancy	2	1.3
Lost to follow-up	1	0.7
Delivery	100	69.0

Table IV. Delivery characteristics, maternal, and perinatal morbidity for the 100 deliveries after laparoscopic myomectomy (LM)

	n	Mean ± SD	%
Mode of delivery (n = 100)			
Spontaneous vaginal delivery	36		36.0
Forceps delivery	22		22.0
Caesarean section during labour	14		14.0
Caesarean section before labour	28		28.0
Perinatal outcome (n = 101)[a]			
Gestational age (weeks)		36.5 ± 2.7	
Birth weight (kg)		3.2 ± 0.6	
1-min APGAR score		8.9 ± 2.0	
Premature delivery	14		14.0
1-min APGAR score <7	7		6.9
Perinatal death[b]	1		1.0
Obstetric complications (n = 100)			
Uterine rupture	3		3.0
Uterine rupture related to LM	1		1.0
Uterine rupture during labour	0		0.0
Post-partum haemorrhage	3		3.0
Hysterectomy	0		0.0

[a]One patient delivered twins.
[b]One patient had unexplained intrauterine death at 27 weeks gestation.

The outcome of the 145 pregnancies after LM is shown in Table III. One pregnancy was lost to follow-up during the first trimester. One hundred patients (69.0%) delivered 101 viable term neonates; for these patients, delivery characteristics, maternal and perinatal morbidity are shown in Table IV. One patient (1.0%) had unexplained fetal death *in utero* at 27 weeks of gestation without any connection to the history of LM.

During follow-up of these pregnancies, there were three

cases of uterine rupture. Case no. 1 was a 31-year-old woman who had LM for an intramural posterior wall myoma 30 mm in size. The uterine cavity was not opened during surgery. The hysterotomy was sutured laparoscopically along one layer using four stitches of Vicryl® 3/0 (Ethicon). The patient's postoperative recovery was uneventful, but during second-look laparoscopy 7 weeks later a fistula on the myomectomy scar was identified using the methylene blue test. The dehiscence was sutured using a figure-of-eight stitch with Vicryl® 3/0 (Ethicon). Fourteen months after LM a single uterine pregnancy was obtained by in-vitro fertilization (IVF) and embryo transfer. At 32 weeks gestation, the patient had an emergency laparotomy for acute abdominal pain and fetal distress. There was a large rupture of the uterine scar. Both mother and baby had a favourable outcome. This case has been reported previously (Dubuisson *et al.*, 1995).

Case no. 2 was a woman aged 34 years who underwent LM for the ablation of two myomas, one of which was a sessile subserous posterofundal myoma, measuring 50 mm in diameter (not infiltrating the myometrium); the other was an intramural isthmic posterior myoma 25 mm in diameter. The uterine cavity was not entered. The two myomectomy sites were sutured along one layer using separate stitches of Vicryl® 3/0 (Ethicon). A third intramural anterior myoma that was probably small was not recognized during the laparoscopy. The patient's postoperative history was uncomplicated. Two years later, in another institution, she underwent LAM for the anterior intramural myoma which by then measured 80 mm. A traditional uterine suture was made, in two layers by minilaparotomy. The operative report did not mention the scars from the first myomectomy. Three years after the second myomectomy, the woman became pregnant spontaneously. At 25 weeks gestation she underwent emergency laparotomy for haemoperitoneum. The placenta was inserted on the anterior wall over the scar from the second operation. This scar appeared thin, and at the upper end there was uterine rupture with placenta percreta. The living child was transferred to the intensive care unit; both mother and baby had a favourable outcome.

The third case was a 32-year-old woman who had laparoscopy as a work-up for tubal infertility. During this operation a small 20 mm posterior, subserous sessile myoma was resected. The myomectomy site was not sutured. One month later, the patient had a bilateral tubocornual anastomosis by laparotomy; the myomectomy scar was invisible on the occasion of this operation. Eighteen months after the second operation, the patient became pregnant spontaneously, and at 34 weeks gestation underwent emergency laparotomy for acute abdominal pain and fetal distress. Uterine rupture was revealed at the right cornual anastomosis, whereas the myomectomy scar was intact. Both mother and baby had a favourable outcome.

Given that in case nos 2 and 3 the uterine rupture did not occur on the LM site, the risk of uterine rupture related to the LM scar was 1.0% (95% CI 0.0–5.5%) for the follow-up period.

Seventy-two patients (72.0%) had trials of labour. Of these patients, 58 (80.6%) were delivered vaginally, 12/57 (21.1%) had induced labour, 28/69 (40.6%) received oxytocin augmentation of labour, and 38/71 (53.5%) received epidural anaesthesia. There was no uterine rupture during the trials of labour. The patients who were allowed a trial of labour had fewer intramural myomas (23.6 versus 50.0%; $P < 0.001$) and were less likely to have a sutured hysterotomy (44.0 versus 78.0%; $P < 0.01$) compared with patients who underwent elective Caesarean section. The fact that a trial of labour was accepted was not connected with either the size of the largest myoma (47 ± 24 mm versus 48 ± 19 mm; not significant), or the number of myomas removed (1.8 ± 1.2 versus 2.1 ± 2.5; not significant).

Table V. Main indications for Caesarean section after laparoscopic myomectomy

Indication	*n*	%
Elective Caesarean section for uterine scar	16	38.1
Failed trial of labour	14	33.3
Maternal or fetal pathology[a]	6	14.3
Breech presentation	3	7.1
Suspected uterine rupture[b]	3	7.1
Total	42	100.0

[a]Including hypertensive disorders, placenta praevia, fetal distress before labour, severe ophthalmic pathology, myoma praevia.
[b]Including acute abdominal pain and fetal distress.

Table VI. Appearance of uterine scars at second-look laparoscopy and during Caesarean section ($n = 7$)

		Caesarean section		
		Thick/ invisible	Thinned	Dehiscence/ rupture
Second-look laparoscopy	Thick/invisible	3	1	0
	Thinned	0	2	0
	Dehiscence/rupture	0	0	1

Forty-two patients (42.0%) underwent Caesarean section, the indications for which are listed in Table V. The appearance of the hysterotomy scars was as follows: no scar visible in 23 cases (54.8%); thick scar in seven cases (16.7%); thin scar in four cases (9.5%); not specified in five cases (11.9%); uterine rupture on the LM scar in one case (2.4%); and in two cases (4.8%) uterine rupture away from the LM scar (rupture on a previous repeated myomectomy scar, see case no. 2, and rupture on a tuboplasty scar, see case no. 3). Among the patients who gave birth by Caesarean section, seven had previously had a second-look laparoscopy with methylene blue test after LM. For six patients the appearance of the LM scars assessed at second-look laparoscopy matched the description in the Caesarean operative report (Table VI); in particular concerning the case of uterine rupture on the LM scar, the second-look laparoscopy had shown dehiscence on the LM scar.

Discussion

The rate of uterine rupture which can be attributed to LM was 1.0% (95% CI 0.0–5.5) for the period covered by the study.

Our study covers the largest series of pregnancies after LM to date. The low proportion of cases lost to follow-up (14.1%), and the fact that uterine rupture took place in a different institution to ours (Dubuisson *et al.*, 1995), means it is unlikely that we missed another uterine rupture. One important point meriting discussion is to what cause the rupture in case no. 2 should be attributed. In this observation, although several elements strongly suggest that the second myomectomy (carried out by LAM) was responsible, it is impossible to say if the posterior fundal scar made during LM may have had an adverse influence.

Until now, in addition to our study, eight teams have reported 111 births after LM and none of them has witnessed any uterine rupture (Hasson *et al.*, 1992; Reich, 1995; Miller *et al.*, 1996; Stringer and Strassner, 1996; Daraï *et al.*, 1997; Seinera *et al.*, 1997; Nezhat *et al.*, 1999; Ribeiro *et al.*, 1999).

It is difficult to say whether there is a greater risk of uterine rupture than after myomectomy by laparotomy. The good reputation of myomectomy scars by laparotomy for obstetrics is based on the fact that a great number of pregnancies have been reported after this operation without any cases of rupture at all (Mussey *et al.*, 1945; Finn and Muller, 1950; Davids, 1952; Brown *et al.*, 1956; Brown *et al.*, 1967; Loeffler and Noble, 1970; Berkeley *et al.*, 1983; Egwuatu, 1989; Smith and Uhlir, 1990; Sirjusingh *et al.*, 1994; Acien and Quereda, 1996; Sudik *et al.*, 1996). However, the most important series in terms of births date back many years, and the proportions of patients lost to follow-up is not reported in any of them. In addition, observations of uterine rupture after laparotomy have been reported regularly in the literature (Garnet, 1964; Palerme and Friedman, 1966; Quakernack *et al.*, 1980; Georgakopoulos and Bersis, 1981; Golan *et al.*, 1990; Ozeren *et al.*, 1997). Finally, in a retrospective study carried out at the Trinidad Maternity Hospital, the rate of rupture observed at birth after myomectomy by laparotomy was 5.3% (95% CI 0.5–14.8%) (Roopnarinesingh *et al.*, 1985). In this study all the pregnancies were followed up at the same centre, but the myomectomies were carried out at different centres. All these elements tend to suggest that the risk of rupture after myomectomy by laparotomy is underestimated.

Some authors consider that laparoscopic surgery is not suitable for making the uterine repair after myomectomy (Harris, 1992; Nezhat, 1996). It is true that it is more difficult to make an adequate suture by laparoscopy than by laparotomy (Dubuisson and Chapron, 1996). On the other hand, the fact that the cases of uterine rupture after LM (Table I) (Harris, 1992; Dubuisson *et al.*, 1995; Mecke *et al.*, 1995; Friedmann *et al.*, 1996; Pelosi and Pelosi, 1997) occurred when the teams first started using LM means they were probably due to technical errors connected with the surgeons' lack of experience. For example, the lack of suture, or suturing only the superficial layers of the myometrium, resulted in thin or dehiscent scars (Nezhat *et al.*, 1991; Harris, 1992; Hasson, 1996). In our series, during the early stages of our experience, we left unsutured the superficial myomectomy defect created by removal of some subserosal myomas (Table II). We acted in this way because the defects created by removal of such myomas were shallow. Uterine rupture can occur even after removal of superficial subserosal myomas (Table I) (Pelosi and Pelosi, 1997). Inappropriate use of electrocautery may sometimes have induced in-depth necrosis of the myometrium with an adverse effect on healing (Harris, 1992; Dubuisson *et al.*, 1995; Pelosi and Pelosi, 1997). Several cases of uterine rupture reported after myolysis confirm this negative effect of electrocoagulation (Arcangeli and Pasquarette, 1997; Vilos *et al.*, 1998). However, the proposal by one author (Nezhat, 1996) that LM should be avoided for cases of intramural myoma is excessive in our opinion, for several reasons: (i) the risk of uterine rupture after LM observed in our study is similar to that observed after Caesarean section, and varies between 0.4 and 2.2% (Phelan *et al.*, 1987; Nielsen *et al.*, 1989; Farmer *et al.*, 1991; Flamm *et al.*, 1994); (ii) the only uterine rupture which could be attributed to LM caused (in that case) no detrimental maternal (except the uterine rupture itself) or fetal effects apart from premature birth; (iii) the use of LAM as recommended in order to ensure that the hysterotomy scars are good (Nezhat *et al.*, 1994) is not the panacea that it appears, because case no. 2 involved uterine rupture precisely on a scar obtained using this technique. The hysterotomy can be repaired satisfactorily by the laparoscopic approach alone (Dubuisson and Chapron, 1996; Hasson, 1996; Miller *et al.*, 1996; Ostrzenski, 1997), provided that the same principles are applied as for laparotomy. The correct repair of the uterine incision is fundamental. The suture must take up the whole depth of the edges of the hysterotomy in order to ensure that the whole of the myomectomy bed is brought into contact, so that secondary formation of a haematoma in the myometrium is avoided (Bonney, 1931; Hasson, 1996; Miller *et al.*, 1996). When the myomectomy bed is deep or the uterine cavity opened, two layers may be necessary to close the myometrium. This type of suture can be carried out by laparoscopy (Dubuisson and Chapron, 1996; Miller *et al.*, 1996; Ostrzenski, 1997). We now recommend that even superficial myomectomy should be sutured.

Systematic recourse to Caesarean after LM, as recommended by some authors for cases of intramural or deep subserous myoma (Friedmann *et al.*, 1996; Stringer and Strassner, 1996; Seinera *et al.*, 1997; Nezhat *et al.*, 1999), does not appear justified in our opinion. In our study, a trial of labour was accepted for 72% of patients, because similarly to other teams (Daraï *et al.*, 1997; Ribeiro *et al.*, 1999) we made no particular recommendations concerning the type of birth after LM. A large number of these patients had intramural or deep subserous myomas. The trials of labour resulted in no complications and, in particular, no cases of uterine rupture. It may be an advantage to assess the quality of the scars postoperatively in order to decide on the type of birth. Hysterography would not seem to be a satisfactory method because in a case of uterine rupture reported previously (Pelosi and Pelosi, 1997), this investigation showed no anomaly. At our institution we frequently carry out a second-look laparoscopy when pregnancy is desired, in order to reduce the adhesions after myomectomy (Tulandi *et al.*, 1993; Ugur *et al.*, 1996; Dubuisson *et al.*, 1998). During this second-look laparoscopy the thickness and quality of the hysterotomy scars are easily assessed by carrying out a methylene blue test. We consider that the findings during the second-look laparoscopy may offer important information for the management during future pregnancy. However, we still do not have enough evidence to support this statement. Postoperative magnetic resonance imaging (MRI)—or even better, MRI during pregnancy—could be very

useful (Ito *et al.*, 1998). More studies would be useful, however, to check if these procedures are reliable for diagnosing a uterus that is too fragile to consider vaginal delivery.

In conclusion, spontaneous uterine rupture seems to be rare after LM, but further studies are still needed to determine whether this risk is more important than when the myomectomy is performed by laparotomy. This risk should not result in laparoscopic myomectomy being avoided if needed, even for intramural myomas. When performing LM, particular care must be taken with the uterine closure.

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Received on September 16, 1999; accepted on January 12, 2000