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Fertility after laparoscopic myomectomy of large intramural myomas: preliminary results

Jean-Bernard Dubuisson[1], Charles Chapron, Xavier Chavet and Stelios S.Gregorakis

Service de Chirurgie Gynecologique, Clinique Universitaire Baudelocque, CHU Cochin Port-Royal, 123 Boulevard Port-Royal, 75014 Paris, France

[1]To whom correspondence should be addressed

Fertility outcome following laparoscopic myomectomy was evaluated. A prospective clinical study was carried out between October 1990 and October 1993 in 21 infertile patients who underwent laparoscopic myomectomy for a myoma measuring ≥5 cm in diameter. The overall rate of intrauterine pregnancy was 33.3% (seven patients). Out of 12 patients with infertility factors associated with uterine myomas, three (25.0%) became pregnant, whereas four (44.4%) out of nine patients with no other associated infertility factor became pregnant. No uterine rupture was observed. Out of the seven pregnancies, four were spontaneous and began within 1 year of the operation. The other three were achieved after in-vitro fertilization in patients with associated infertility factors. In the four patients who gave birth by Caesarean section, no adhesions were found on the myomectomy scar. From these preliminary results, laparoscopic surgery for myomas seems to offer comparable results with those obtained by laparotomy.

Key words: infertility/laparoscopic myomectomy/myomas

Introduction

Treatment options for young patients with large or symptomatic myomas should be conservative, either medical therapy (Friedman *et al.*, 1994) or myomectomy. There are no set rules on how to conduct treatment for an infertile patient presenting with one or more intramural myomas. In fact, the role of uterine myomas and adenomyomas (Fedele *et al.*, 1993) as a cause of female infertility is the subject of considerable debate. Although a number of theories have been put forward to explain their role with respect to infertility (Hunt and Wallach, 1974), they are very rarely found to be the only possible aetiological factor for infertility (Buttram and Reiter, 1981; Berkeley *et al.*, 1983; Verkauf, 1992). Until now, myomectomy has been carried out by laparotomy or, far less frequently, via the vaginal route. The development of operative laparoscopy is quite definitely the biggest step forward in the field of gynaecological surgery in recent years. Laparoscopic myomectomy is a difficult technique, reserved for experienced laparoscopic surgeons who master the endoscopic suture techniques perfectly, making this operation feasible (Daniell and Guerly, 1991; Dubuisson *et al.*, 1991; Nezhat *et al.*, 1991; Hasson *et al.*, 1992). The objective of this study was to assess the fertility results and the pregnancy outcome in infertile patients who had undergone laparoscopic myomectomy. To our knowledge, this study is the first specifically to address the question of infertility after laparoscopic myomectomy.

Materials and methods

The size of the fibroids has been presented by certain authors as an important prognostic factor (Buttram and Reiter, 1981), so we have voluntarily centred our study on the analysis of fertility in infertile patients who underwent laparoscopic myomectomy for a myoma measuring ≥5 cm in diameter. This limit was chosen following a recent publication in which the fertility results after myomectomy via laparotomy were presented according to whether the myomas measured more or less than 5 cm (Rosenfeld, 1986). In addition, no studies have suggested that pedunculated myomas might bear some responsibility in terms of infertility, so these were excluded. Thus, patients included in our study were only those with one or more intramural myomas measuring ≥5 cm in diameter. This prospective study was carried out between October 1990 and October 1993. The 21 infertile patients, who were in accordance with the above criteria, underwent laparoscopic myomectomy. All the patients were operated on by the same two surgeons (J.-B.D and C.C), who worked alone or together.

As laparoscopic myomectomy requires three suprapubic access routes, it was essential to cannulate the uterus to permit the correct exposure of the myomas. A Methylene Blue test was carried out to stain the endometrium. This is a particularly useful technique for myomas embedded deeply in the myometrium. Should the uterine cavity have been breached during dissection of the myoma, this technique would have enabled the endometrium to be identified and made suturing easier. Suturing was usually made along one plane, but if myomas were embedded deeply in the myometrium, the suture could be made along two planes (only one case in this series). We carried out the uterine incision using a monopolar electrode over the convex surface of the myoma. Haemostasis during dissection was provided by bipolar coagulation.

Once the myoma had been enucleated, haemostasis of the uterine bed was completed. The uterus was then repaired, most often along a sero-muscular plane, using separate stitches of vicryl 3/0 or 4/0 (Polyglactine 910; Ethicon, Neuilly, France). In all cases the myoma was extracted from the abdominal cavity. Whereas at the beginning of our study we extracted the myoma after fragmentation via one of the laparoscopic ports, we subsequently preferred to use a posterior colpotomy. The last phase of the operation was copious abdomino-pelvic lavage using warm normal saline. No other kind of peri- or post-operative treatment was used to prevent adhesions (Dubuisson *et al.*, 1993).

Myomectomy was indicated in all of our cases because of a recent enlargement of the uterine size (Smith and Uhlir, 1990). In nine cases

Table I. Pregnancies after laparoscopic myomectomy

Case no.	Sterility	Mode of conception	Duration of sterility (months)	No. of myomas removed	Size[a] of myomas (mm)	Type of delivery
1	Primary	IVF	54	10	60	VD (IUD)
2	Secondary	IVF	36	1	50	CS
3	Secondary	SP	12	1	90	CS
4	Secondary	SP	12	3	50	CS
5	Primary	SP	30	1	100	CS
6	Primary	IVF	24	4	70	VD
7	Secondary	SP	15	1	100	VD (STM)

CS = Caesarean section; IUD = intrauterine death; IVF = in-vitro fertilization; SP = spontaneous pregnancy; STM = second trimester miscarriage; VD = vaginal delivery.
[a]Size measured by diameter.

Table II. Patient characteristics according to associated infertility factors

Patient characteristics	Associated infertility factors		Statistical result
	Yes (n = 12)	No (n = 9)	
Age (years)	36.75 ± 2.89	38.33 ± 3.87	NS
Percentage with sterility			
Primary (n)	41.7 (5)	33.3 (3)	NS
Secondary (n)	58.3 (7)	66.7 (6)	NS
Duration of infertility (months)	44.5 ± 26.4	37.66 ± 52.20	NS
No. of myomas removed	2.58 ± 2.60	1.78 ± 0.97	NS
Percentage with distorted cavity (n)	41.7 (5)	44.4 (4)	NS

NS = not significant.

Table III. Reproductive outcome according to associated infertility factors

Intrauterine pregnancy	*Associated infertility factors*					*Statistical result*
		Yes (n = 12)		No (n = 9)		
	n	*n*	*%*	*n*	*%*	
Yes	7	3	25.0	4	44.4	NS
No	14	9	75.0	5	55.6	NS

NS = not significant.

Table IV. Published results of reproductive outcome in infertile patients after myomectomy

Authors	Infertile patients[a]	Intrauterine pregnancy	
	n	*n*	*%*
Brown *et al.* (1956)	21	11	52.4
Babaknia *et al.* (1978)	46	22	47.8
Ranney and Frederick (1979)	9	8	88.9
Berkeley *et al.* (1983)	6	6	16.7
Rosenfeld (1986)	23	15	65.2
Gatti *et al.* (1989)	20	10	50.0
Verkauf (1992)	3	2	66.7
Total	128	69	53.9
Present study	9	4	44.4

[a]Patients without associated infertility factors.

(42.9%) the uterine cavity was distorted. The mean age of patients was 37.42 ± 3.35 years (range 32–44). The mean duration of infertility was 41.57 ± 38.5 months (range 12–174). The infertility was primary in eight cases (38.1%) and secondary in 13 cases (61.9%). For all women, the other associated infertility factors were evaluated by a complete work-up including ovulation studies, spermocytogram, hysterosalpingography and a post-coital test. For each patient, the pre-operative work-up for the myoma systematically included diagnostic hysteroscopy, carried out on an outpatient basis during consultation, and both abdominal and transvaginal ultrasound investigations.

Fertility results and pregnancy outcome were analysed, taking into account whether or not there were any associated infertility factors. The minimum amount of time elapsed since the operation for each patient was 1 year. None of the 21 patients was lost to follow-up.

A statistical analysis was performed using the following tests: the χ^2 test with a threshold of significance set at $P < 0.05$ ($\chi^2 > 3.84$), Fisher's exact test and Student's t-test.

Results

For the 21 infertile patients who underwent a laparoscopic myomectomy, the mean duration of the operation was 133 ± 64 min (range 60–270). No transfusion either peri- or post-operatively was required. The average drop in haemoglobin concentration was 1.4 ± 1.1 g/100 ml (range 0.0–3.8). All the operations were carried out exclusively by laparoscopic surgery, and in this series we never had to convert to laparotomy. We observed no complications justifying a re-operation whether by laparotomy or laparoscopy. We observed only one patient with a transient high fever (38.5°C after 24 h). The mean duration of the hospital stay was 2.60 ± 0.57 days (range 2–4). The mean number of myomas removed was 2.23 ± 2.09 (range 1–10). The average size of the largest intramural myoma removed was 61.90 ± 16.00 mm (range 50–100).

The rate of intrauterine pregnancy was 33.3% (seven patients). Of these, three pregnancies were obtained after in-vitro fertilization (IVF). In these three cases, the patients presented other infertility factors associated with the uterine myomas. No ectopic pregnancies occurred. The four patients who conceived spontaneously did so within 1 year of the laparoscopic myomectomy. The outcome of these pregnancies is reported in Table I. No cases of uterine rupture during either the pregnancy or labour were observed. The four Caesarean sections, carried out between 38 and 39 weeks of amenorrhoea before labour commenced, were decided upon because of the patient history of a uterine scar. One normal vaginal delivery occurred without labour being induced. One late miscarriage occurred at 22 weeks of amenorrhoea without any aetiology being found. One unexplained fetal death *in utero* happened at 29 weeks of amenorrhoea. Labour was induced according to the procedures we recommend in cases of presence of a uterine scar (MacKenzie *et al.*, 1984). As for the four patients who underwent a Caesarean section, exploration of the abdominal cavity revealed in all four cases a uterine scar with no dehiscence and no adhesions (six myomectomy sites). In the three other cases, a manual examination of the uterus after delivery was normal and no uterine rupture was detected.

These overall results were analysed according to whether or not there were other infertility factors associated with the myomas. Of the 21 patients, nine (42.9%) presented no other infertility factor. For the 12 other patients (57.1%), the associated infertility factors were: anovulation (n = 3), male factor spermatozoa (n = 4), tubal factors (n = 5), adenomyosis (n = 1) and endometriosis (n = 1). Two patients presented two associated infertility factors (adenomyosis and anovulation; anovulation and tubal pathology). The patient characteristics with respect to the presence or absence of associated infertility factors are reported in Table II. Concerning these, the two groups established according to the presence of associated infertility factors were comparable with respect to age, the type and duration of infertility, the number of myomas removed and the existence of a distorted uterine cavity. The intrauterine pregnancy rate in patients without other associated infertility factors was 44.4% (n = 4) compared with 25.0% (n = 3) in patients presenting additional infertility factors (Table III). All three pregnancies achieved following IVF occurred in patients with associated infertility factors, whereas the four pregnancies achieved in patients with no other infertility factors started spontaneously without any treatment.

The results were also analysed according to whether the uterine cavity had been distorted by the myomas. After the laparoscopic myomectomy, the intrauterine pregnancy rate was 16.7% (n = 2) for the 12 patients with a normal uterine cavity, as observed during the pre-operative hysteroscopy, and 55.6% (n = 5) for the nine patients who had a distorted uterine cavity prior to the operation.

Discussion

Laparoscopic myomectomy is still a new technique. As an operation, it poses three specific technical difficulties: the location of the uterine incision, the type of incision and uterine repair. The choice of uterine incision is very important because it affects the whole of the rest of the operation. It is easier to decide this matter when the subserous part of the intramural myoma is of considerable size. When myomas are embedded deeply in the myometrium, or are purely interstitial, it is essential to refer the patient for a pre-operative ultrasound scan. An ultrasound scan locates the myoma very accurately, so the uterine incision can then be made with precision on the uterine wall immediately superior to the myoma. For the abdominal and transvaginal ultrasound examinations to provide the maximum amount of information, they should be carried out during the luteal phase. It is during this period of the menstrual cycle that the endometrium, which is the essential landmark for locating the myomas, can best be seen as a fine echogenic line. Ultrasound also enables the measurement of the distance between the myoma and the uterine serosa, as well as the distance between the myoma and the myometrium.

The second difficulty lies in the choice of the incision. The standard option is a vertical incision into the uterus (Verkauf, 1992). However, given the fact that the arteries and arterioles of the myometrium run almost transversely and not vertically (Farrer-Brown *et al.*, 1970; Igarashi, 1993), it seems more logical to make a transverse incision. This type of incision enables blood loss to be reduced, especially when the intramural myoma is deep and richly vascularized, which can be seen during the pre-operative Doppler ultrasound examination.

The third difficulty with this operation is uterine repair. The technical procedures used for this are varied. Continuous or interruptured sutures can be used. As for the knots, these can be tied either intra- or extracorporeally. In the latter case, they are taken down the pelvis with a knot-pusher. The choice of technique depends mainly on the surgeon's experience and preference. There is no gold standard for this, and we ourselves use interrupted stitches, just as we do at laparotomy. As stated above, if the myomas are embedded deeply in the myometrium then the suture can be made along two planes (Dubuisson *et al.*, 1995a). The results of this series, as of other publications (Daniell and Guerly, 1991; Nezhat *et al.*, 1991; Hasson *et al.*, 1992), confirm that it is perfectly possible to carry out myomectomies for large intramural myomas via laparoscopy, provided that the technique used is absolutely precise. In this series we observed no pre- or post-operative complications, and never needed to convert to laparotomy.

The degree of involvement of the myomas in the infertility of certain patients is the subject of considerable debate, and a number of theories have been put forward. Fibroids may affect sperm migration by reducing uterine contractility and increasing the distance the spermatozoa have to travel (Hunt and Wallach, 1974). They might be responsible for vascular changes (Farrer-Brown *et al.*, 1970) which have repercussions on the endometrium and may hinder implantation (Hunt and Wallach, 1974). The fertility results after myomectomy presented in Table IV vary widely from one series to the next. In a review of the literature, Buttram and Reiter (1981) collected 1202 cases of myomectomy via laparotomy, reporting an intrauterine pregnancy rate of 40.0% (480 patients). The results we obtained in this preliminary series are comparable with this because 33.3% of the patients who underwent

laparoscopic myomectomy in a context of infertility managed to conceive. The pregnancy rates are affected by the presence of other infertility factors associated with the uterine myomas. Whereas the intrauterine pregnancy rate in the analysis by Buttram and Reiter (1981) was 39.0% (439 cases) for the 1126 patients presenting associated infertility factors, it rose to 54.0% (n =41) for the 76 patients in the group who had no other infertility factor associated with the uterine myomas.

In Table IV we present an overview of results from seven published studies with patients having no other infertility factor associated with their uterine fibroids. For these patients the mean intrauterine pregnancy rate after myomectomy via laparotomy was 53.9% (Table IV). This is slightly higher than the 44.4% rate we obtained after laparoscopic myomectomy for the same type of patient. However, the fertility results as a function of the surgical method are not really comparable. This is because the surgical series via laparotomy includes patients presenting voluminous and multiple fibroids which in any case cannot be operated on by laparoscopy. Despite this, for this series we selected those patients for whom the operation was difficult via laparoscopy. We deliberately excluded pedunculated myomas and all patients with intramural myomas measuring <5 cm in diameter.

In addition to these encouraging results in terms of fertility after laparoscopic myomectomy, this preliminary series permits four concluding comments to be made. Firstly, the essential problem with regard to fertility after myomectomy, regardless of the operation (laparoscopy or laparotomy), remains the selection of infertile patients who need the surgery. Unlike Babaknia *et al.* (1978) and Rosenfeld (1986), who believe there is no relationship between the existence of a distorted uterine cavity and the fertility results after myomectomy, we have observed that the results were better when the cavity was distorted prior to the operation. Similarly, the size of the uterus is a factor that gives rise to differing opinions. Whereas Buttram and Reiter (1981) feel that this is a major factor for the prognosis (no conception following myomectomy in patients with uteri >10–12 weeks gestational size), Smith and Uhlir (1990) and Rosenfeld (1986) do not agree. However, despite the absence of specific criteria and even if the benefit of myomectomy among women with so-called 'unexplained' infertility and uterine myomas has not been established (Paulson, 1993), we share Rosenfeld's (1986) opinion that myomectomy should be considered in the patient with otherwise unexplained infertility of >2 years duration.

The second comment is that intrauterine pregnancy after laparoscopic myomectomy seems to occur within a short period of time. The four intrauterine pregnancies achieved by patients who had no associated infertility factor all began within 1 year of the laparoscopic surgery. Rapid conception following myomectomy has also been reported when the operation is carried out via laparotomy (Berkeley *et al.*, 1983; Rosenfeld, 1986; Gatti *et al.*, 1989; Verkauf, 1992).

Thirdly, laparoscopic myomectomy does not seem to give rise to many adhesions. In the four patients who gave birth by Caesarean section, no adhesions were found on the myomectomy scar during exploration of the pelvic cavity. These results might be directly related to the operative technique used and to the fact that patients who conceived and subsequently underwent a Caesarean section may be a selected group of patients with no or minimal adhesions. Myomectomy as a reproductive procedure should be performed with the same principles of atraumatic technique used in other fertility operations. This implies meticulous haemostasis, accurate closure and re-approximation of the uterine incisions, the use of fine suture material, atraumatic forceps and constant irrigation. The fact that these principles were adhered to, and also the low risk of adhesion formation which usually accompanies laparoscopic procedures, were the reasons for the very low rate of post-operative adhesions observed compared with those reported after laparotomy (Starks, 1988; Tulandi *et al.*, 1993). This point is of the utmost importance, because post-myomectomy adhesions can be responsible for secondary infertility (Berkeley *et al.*, 1983).

Finally, the quality of the uterine repair after laparoscopic myomectomy would appear to be satisfactory. Indeed, no case of uterine rupture was observed, during pregnancy or during labour, for the three patients who gave birth vaginally. However, these results must be interpreted with considerable caution before claiming that the uterine suture via laparoscopy is as sturdy as that made via laparotomy. Whereas the risk of uterine rupture after myomectomy by laparotomy is low (Davids, 1952; Brown *et al.*, 1956), two cases of uterine rupture after laparoscopic myomectomy have already been reported (Harris, 1992; Dubuisson *et al.*, 1995b). These two cases were in fact comparable, in that the uterine rupture occurred during pregnancy (34th week of amenorrhoea) and not during labour, after a small intramural myoma had been removed and the uterus repaired via laparoscopy.

It is now established that laparoscopic myomectomy is feasible. The technique requires experienced laparoscopic surgeons who are able to master perfectly the endoscopic suturing techniques. Laparoscopic myomectomy is a safe and reproducible technique, and several teams have already reported their experiences. These preliminary results are encouraging in terms of fertility. Larger series are necessary to confirm these initial results and also to assess the adhesiogenic risk of the operation and the quality of the uterine repair via laparoscopy.

References

Babaknia, A., Rock, J.A. and Jones, H.W. (1978) Pregnancy success following abdominal myomectomy for infertility. *Fertil. Steril.*, **30**, 644–647.

Berkeley, A.S., De Cherney, A.H. and Polan, M.L. (1983) Abdominal myomectomy and subsequent fertility. *Surg. Gynecol. Obstet.*, **156**, 319–322.

Brown, A.B., Chamberlain, R. and Telinde, R.W. (1956) Myomectomy. *Am. J. Obstet. Gynecol.*, **71**, 759–763.

Buttram, V.C. and Reiter, R.C. (1981) Uterine leiomyomata: etiology, symptomatology, and management. *Fertil. Steril.*, **36**, 433–445.

Daniell, J.F. and Guerly, L.D. (1991) Laparoscopic treatment of clinically significant symptomatic uterine fibroids. *J. Gynecol. Surg.*, **7**, 37–40.

Davids, A. (1952) Myomectomy: surgical technique and results in aseries of 1150 cases. *Am. J. Obstet. Gynecol.*, **63**, 592–604.

Dubuisson, J.B., Lecuru, F., Foulot, H., Mandelbrot, L. *et al.* (1991) Myomectomy by laparoscopy: a preliminary report of 43 cases. *Fertil. Steril.*, **56**, 827–830.

Dubuisson, J.B., Chapron, C., Mouly, M. *et al.* (1993) Laparoscopic myomectomy. *Gynaecol. Endosc.*, **2**, 171–173.

Dubuisson, J.B., Chapron, C., Chavet, X. *et al.* (1995a) Laparoscopic myomectomy: where do we stand? *Gynaecol. Endosc.*, **4**, 83–86.

Dubuisson, J.B., Chavet, X., Chapron, C. and Morice P. (1995b) Uterine rupture during pregnancy after laparoscopic myomectomy. *Hum. Reprod.*, **10**, 1475–1477.

Farrer-Brown, G., Beilby, J.O.W. and Tarbit, M.H. (1970) The vascular patterns in myomatous uteri. *J. Obstet. Gynaecol. Br. Commonw.*, **77**, 967–970.

Fedele, L., Bianchi, S., Zanotti, F. *et al.* (1993) Fertility after conservative surgery for adenomyomas. *Hum. Reprod.*, **8**, 1708–1710.

Friedman, A.J., Daly, M., Juneau-Norcross, M. *et al.* (1994) Long-term medical therapy for leiomyomata uteri: a prospective, randomized study of leuprolide acetate depot plus either oestrogen–progestin or progestin 'add-back' for 2 years. *Hum. Reprod.*, **9**, 1618–1625.

Gatti, D., Falsetti, L., Viani, A. and Gastaldi, A. (1989) Uterine fibromyoma and sterility: role of myomectomy. *Acta Eur. Fertil.*, **20**, 11–13.

Harris, W.J. (1992) Uterine dehiscence following laparoscopic myomectomy. *Obstet. Gynecol.*, **80**, 545–546.

Hasson, H.M., Rotman, C., Rana, N., Sistos, F. and Dmowski, W.P. (1992) Laparoscopic myomectomy. *Obstet. Gynecol.*, **80**, 884–888.

Hunt, J.E. and Wallach, E.E. (1974) Uterine factors in infertility — an overview. *Clin. Obstet. Gynecol.*, **17**, 44–64.

Igarashi, M. (1993) Value of myomectomy in the treatment of infertility. *Fertil. Steril.*, **59**, 1331–1332.

MacKenzie, I.Z., Bradley, S. and Embrey, M.P. (1984) Vaginal prostaglandins and labor induction for patients previously delivered by Caesarean section. *Br. J. Obstet. Gynaecol.*, **91**, 7–10.

Nezhat, C., Nezhat, F., Silfen, S.L. *et al.* (1991) Laparoscopic myomectomy. *Int. J. Fertil.*, **36**, 275–280.

Paulson, R.J. (1993) Value of myomectomy in the treatment of infertility. *Fertil. Steril.*, **59**, 1332.

Ranney, B. and Frederick, I. (1979) The occasional need for myomectomy. *Obstet. Gynecol.*, **53**, 437–441.

Rosenfeld, D.L. (1986) Abdominal myomectomy for otherwise unexplained infertility. *Fertil. Steril.*, **46**, 328–330.

Smith, D.C. and Uhlir, J.K. (1990) Myomectomy as a reproductive procedure. *Am. J. Obstet. Gynecol.*, **162**, 1476–1482.

Starks, G.C. (1988) CO_2 laser myomectomy in an infertile population. *J. Reprod. Med.*, **33**, 184–186.

Tulandi, T., Murray, C. and Guralnick, M. (1993) Adhesion formation and reproductive outcome after myomectomy and second-look laparoscopy. *Obstet. Gynecol.*, **82**, 213–215.

Verkauf, B.S. (1992) Myomectomy for fertility enhancement and preservation. *Fertil. Steril.*, **58**, 1–15.

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