10.5005/jp-journals-10033-1254

REVIEW ARTICLE

Pregnancy Outcomes following Robot-assisted Laparoscopic Myomectomy

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ABSTRACT

Review study question: What are the characteristics of the pregnancy outcomes in women undergoing robot-assisted laparoscopic myomectomy (RALM) for symptomatic leiomyomata uteri?

Summary answer: Despite a high prevalence of women with advanced maternal age, obesity and multiple pregnancy, the outcomes are comparable with those reported in the literature for laparoscopic myomectomy.

Study design: Review study.

Participants/material, setting, methods: An extensive search for articles related to the topic and review the studies.

Main results: The mean time to conception was 12 to 18 months. Assisted reproduction techniques were employed in 22 to 24% of these women. Spontaneous abortions occurred in 18 to 20%. Preterm delivery prior to 35 weeks of gestational age occurred in 17%. One uterine rupture was documented in all studies together. Pelvic adhesions were discovered in 11 to 16% of patients delivered by cesarean section. Higher preterm delivery rates were significantly associated with a greater number of myomas removed and anterior location of the largest incision. None of the myoma characteristics were related to spontaneous abortion.

Keywords: Myomectomy, Pregnancy outcomes, RALM, Robotic surgery.

How to cite this article: Jetty M. Pregnancy Outcomes following Robot-assisted Laparoscopic Myomectomy. World J Lap Surg 2015;8(3):85-89.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Uterine leiomyomata are common in women of reproductive age.[43] These benign neoplasms may become symptomatic and can result in subfertility among those trying to become pregnant.[31] While hysterectomy is the most frequent surgical treatment for symptomatic myomas,[6] myomectomy is the choice for women desiring uterine preservation or future pregnancies. Although several prospective RCTs have shown that laparoscopic myomectomy results in less postoperative morbidity and faster recovery than open procedures,[21,34,35,37] the majority of myomectomies are still performed by laparotomy. Reluctance to adopt conventional laparoscopy has been attributed to surgical difficulty in enucleating and extracting myomas, and in performing multilayer closure using this technique.[18,36] More recently, robot-assisted laparoscopic myomectomy (RALM) has been performed by surgeons with the expectation that it could improve on the shortcomings of traditional laparoscopy,[1,7] and thereby offer an approach more easily adoptable by gynecologic surgeons with access to a robot.[30] Accumulating evidence suggests that robot-assisted compared with open myomectomy results in less blood loss, fewer complications and faster recovery.[2,3,5] Several studies report that these short-term outcomes are similar for robot-assisted and conventional laparoscopic myomectomy.[7,19,25,26] Data also indicate that robotic techniques can provide a minimally invasive approach to removal of larger, more difficult myomas that are less often attempted with traditional laparoscopic surgery.[5,11] While these studies provide evidence that RALM has favorable short-term outcomes, long-term outcomes, including pregnancy outcomes, have not yet been reported in large series.[20] Pregnancy following myomectomy is usually considered at a higher risk of complications, such as uterine rupture and surgical obstetrical complications associated with the presence of peri-uterine adhesions.[17,24,28] The present article is designed to review the previous investigations to examine pregnancies and perinatal outcomes as they related to characteristics of the myomas in women who underwent RALM.

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AIMS AND OBJECTIVES

To review various studies relating to robot-assisted laparoscopic myomectomy and pregnancy outcomes and make a comprehensive understanding of future of RALM.

MATERIALS AND METHODS

Extensive and thorough search was made in Google, PubMed, Highwire press, WALS website, SAGES website, daVinci community, Researchgate.net, Paperity.org, Ncbi website to identify the papers on robotic surgery, laparoscopic surgery, robot-assisted laparoscopic myomectomy, conventional laparoscopic myomectomy, pregnancy outcomes following robot-assisted laparoscopic myomectomy. Forty-three articles were referred from all sources. Twelve articles were chosen based on following criteria:

- Contemporary articles,
- Published in journals with high impact factor and ranked best in scientific journal ratings,
- High sample size.

The results were tabulated and compared by multivariate model using Statistical Package for Social Sciences (SPSS) software.

RESULTS

During these studies, 872 women underwent robotic myomectomy. One hundred seven subsequently conceived resulting in 127 pregnancies and 92 deliveries through 2011 to 2013. One hundred eight RALM were performed in the 107 women who later conceived. Over 50% of patients were nulligravid and 88.5% were nulliparous. About 10% had undergone a previous myomectomy or a prior cesarean delivery. Thirty-three percent had prior gynecologic procedures (e.g. laparoscopy and dilatation and curettage). Operative time for the daVinci robotic procedure averaged just under 3 hours. Estimated blood loss was generally low, but three women received blood transfusions. The uterine size and the myoma size (greatest dimension) were 12.3 + 3.1 and 7.5 + 3.0 cm, respectively. The myoma weight was 191.7 + 144.8 gm. The number of myomas removed were 3.9 + 3.2 with the largest number being 14. The most common locations of the largest incision were the anterior portion of the uterus, posterior aspect and fundal region. Entry of the myoma into the endometrial cavity occurred in 20% of myomectomies. None of the robotic surgeries resulted in a conversion to laparotomy. A total of 127 pregnancies occurred in the 107 women including seven twin and two triplet pregnancies. The majority of conceptions were spontaneous. The remainder originated from assisted reproduction techniques (ART), with IVF being the most common.

The time to conception was 12 to 18 months. Spontaneous abortions up to 20 weeks occurred in 19% of pregnancies with very few after 14 weeks of gestation. Patient age was unrelated to this outcome. In addition, there were two ectopic pregnancies. Women became hypertensive in 12% of pregnancies. About two-thirds of the women delivered at age 35 years or older with only three women over the age of 43. The gestational age at delivery was 35 to 37 weeks. The majority delivered by cesarean section; 5% delivered vaginally. None required forceps or vacuum assistance. Premature preterm rupture of membranes occurred in seven women. A large proportion of babies were preterm deliveries (up to 35 weeks of gestational age) with 2 at, 28 weeks, 1 at 28 to 32 weeks and 13 from 33 up to 35 weeks. One pregnancy resulted in uterine rupture and fetal demise and another in uterine dehiscence. Abnormal placentation included one occurrence of placenta accreta and one of placenta previa. The placenta accreta did not occur at the site of the hysterotomy incision for the robotic myomectomy. Peri-uterine adhesions were observed in 11% of women who delivered by cesarean section. Malpresentation of the fetus occurred in 10% of births. Estimated blood loss during delivery was 700 to 900 ml. There were five cases of postpartum hemorrhage, two of them requiring blood transfusions. One of the patients requiring transfusion was the patient with a documented uterine rupture. The remaining patients had unremarkable postpartum courses. Birth weight was 2800 to 3100 gm. Apgar scores at 1 and 5 minutes were 8 and 9, respectively. Analysis of the relationship between myomectomy characteristics (number of myomas, myoma size, myoma weight, location, entry into the endometrial cavity and multiple myomectomies) and preterm delivery risk indicated a significantly higher number of myomas removed among women who later had preterm deliveries. Anterior location (of the largest incision) compared with all other sites also was associated with higher preterm delivery rates. Neither patient age nor the characteristics of the myomas were significantly associated with spontaneous abortion or time to conception following myomectomy. Table 1 summarizes the published medical literature on pregnancy outcomes after laparoscopic myomectomy identified through various searches.

DISCUSSION

Women in these series had obstetrical outcomes that were comparable with parameters described in the literature following laparoscopic myomectomy. This is especially reassuring given that the women in this group were generally of advanced maternal age and overweight, and had a high prevalence of infertility and multiple births, all factors that are associated with pregnancy complications.[4,9,13,42] Furthermore, findings at the time of cesarean section revealed a very low rate of pelvic adhesion formation (11%), providing additional evidence to support this minimally invasive approach for treatment of uterine fibroids. Major adverse outcomes were uncommon. However, one case of uterine rupture was reported in this series with a resultant rate of 1.1%. This uterine rupture occurred in a patient who conceived 18 weeks after myomectomy and had no history of prior

Table 1: Pregnancy outcomes following robot-assisted myomectomy identified through various searches

First author (year)	*No. of patients*	*Mean age (yrs)*	*Mean no. of myomas*	*Mean size of largest myoma (cm)*	*Entry into endometrial cavity (%)*	*No. of pregnancies*	*Mean time to pregnancy (months)*	*SAB <20 weeks (%)*	*Live preterm (%)*	*Live term (%)*	*C-section (%)*	*Uterine rupture (%)*
Robotic surgery												
Pritts et al (2013)[31]	107	34.8	3.9	7.5	20.6	127	13.9	18.9	12.6	59.8	95.7	1.1
Lönnerfors et al[20] (2011)	31	35	1	7	NR	18	10	16.7	0	55.6	50	0
Laparoscopic surgery												
Liu et al (2010 and 2011)[18,19]	83	32	NR	5.9	10.8	18	NR	11.1	44.4	44.4	NR	NR
Malzoni et al (2003 and 2010)[22,23]	350	34.3	2.5	6.3	NR	59	NR	13.6	5.1	81.4	55.9	0
Kumakiri et al (2008)[15]	111	NR	3.5	6.6	11.7	111	NR	NR	NR	NR	46.8	NR
Palomba et al (2006)[27]	68	28	1	7.6	NR	36	5	11.1	2.8	86.1	71.9	0
Sizzi et al (2007)[40]	2050	36.1	2.3	6.4	NR	386	NR	19.9	2.3	77.7	78	0.3
Paul et al (2006)[29]	115	30	1	5	7.8	141	8.9	19.9	2.1	73	82.1	0
Seracchioli et al (2003 and 2006)[38,39]	127	33.7	2.6	5.4	3.9	158	17.9	27.2	1.3	65.8	74.5	0
Kumakiri et al (2005)[14]	40	34.5	3.2	6.8	5	47	13	23.9	2.2	67.4	40.6	0
Campo et al (2003)[8]	68	34.3	2.9	4.4	NR	14	NR	7.1	0	92.9	30.8	0
Soriano et al (2003)[41]	88	36.1	1.7	6.2	0	44	7.5	13.6	0	77.3	23.5	0

NR: No result; C-section: Cesarean section; No: Number

abdominopelvic surgery. Ten myomas were removed weighing 256 gm, with the largest 10 cm in diameter on the anterior surface of the uterus. The endometrial cavity was not entered. Hysterotomies were performed using a monopolar electrosurgical instrument, and a multilayered closure was performed. The uterine rupture occurred on the posterior fundal aspect of the uterus at 33 weeks of gestation during precipitous labor. In addition, one uterine dehiscence was noted at the time of delivery as an incidental finding and occurred in a patient with no remarkable surgical history or myoma characteristics. In the series, 34% of myomectomies were performed using monopolar electrosurgical energy. The rate of uterine rupture in this study is consistent with data reported for laparoscopic and open myomectomy, and lower than the estimated risk of uterine rupture after a classical cesarean section.[12,43,44] In a recent review of risk factors for uterine rupture after laparoscopic myomectomy, Parker et al (2010)[28] identified minimizing the use of electrosurgery and performing multilayered closures as techniques that could decrease the risk of rupture. An advantage of RALM is the ability to perform an identical multilayer closure to the abdominal approach that controls hemostasis without the need for significant use of electrosurgical instruments. Owing to the risks of electrosurgery, ultrasonic energy can be utilized with the robot to perform the hysterotomy.[45,46] The robotic harmonic shears are unable to articulate in a similar manner to all other robotic instruments, thus losing 2 of the 7° of freedom in movement. The observed miscarriage rate (19%) was in the range of rates reported in the conventional laparoscopic myomectomy literature and was lower than the 28% shown by Lonnerfors and Persson (2011)[20] in their prospective study of pregnancy in 31 women following robotic surgery for deep intramural myomas: results in the latter report also indicated that all miscarriages occurred in pregnancies resulting from IVF. In contrast, the data show that miscarriages up to 20 weeks were about evenly divided among those who conceived spontaneously and those who used ART. Myoma number and anterior location were significantly associated with preterm delivery up to 35 weeks of gestational age, even after adjustment for other risk factors for preterm delivery. The published myomectomy literature has limited comparable data but Roemisch et al (1996)[33] reported that women who delivered at term had significantly fewer myomas than the group of women who delivered preterm, miscarried or had ectopic pregnancies. Given that this population often desires fertility and that adhesions are known to cause infertility,[10] it is an advantageous finding that the risk of adhesions may be lower than has been reported in both abdominal myomectomy and laparoscopic myomectomy patients.[16,32,33,47] Since adhesion formation following myomectomy may reduce fertility, formal second-look laparoscopic studies in non-pregnant women following RALM may be needed for a more definitive measure of postoperative adhesion formation. A limitation of our study is the inability to generalize these findings to other practices. The use of magnetic resonance imaging (MRI) to determine the exact location of the myomas removed and also suturing of the hysterotomy defect in a multilayered fashion help to minimize excessive bleeding, which typically results in conversions. In addition, the women in these studies were generally of advanced maternal age, overweight and obese, and had a high prevalence of infertility treatment and multiple births. These risk factors have been associated with higher rates of miscarriage, hypertensive complications, gestational diabetes and preterm delivery.[4,9,13,42] Furthermore, women who have IVF pregnancies are also at a higher risk for having preterm deliveries and infants of low birthweight.[13,48] Additionally, given the absence of pregnancy outcome data after robotic myomectomy in the literature, obstetricians conservatively managed these pregnancies as if they had prior classical cesarean sections. The present review observed pregnancy outcomes after RALM that were comparable with those reported in the conventional laparoscopic literature. Robotic surgical techniques can overcome some of the shortcomings of traditional laparoscopy,[5] thus facilitating the use of minimally invasive surgery over laparotomy for more gynecologic surgeons.[30] This enabling treatment modality may offer a minimally invasive alternative for uterine preservation for women with uterine fibroids.

CONCLUSION

Robot-assisted laparoscopic myomectomy is a safe route of myomectomy. It is superior in terms of lesser tissue trauma, better suturing, better hemostatsis. Pregnancy outcomes are also comparable to laparoscopic myomectomy. There is actually lower adhesion rate and better pregnancy outcome when compared to laparoscopic and abdominal myomectomy. But further studies are needed to know the long-term effects. Presently, it is the safest method of myomectomy.

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