



Should we perform myomectomy during cesarean section? — Tips & tricks

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A myoma is a non-cancerous tumor that involves muscle cells. There are two main types of myomas: leiomyomas, which occur in smooth muscle, the most commonly occur as uterine fibroids, and rhabdomyoma, which occurs in striated muscle. There could be no symptoms (asymptomatic), especially when the size of fibroids is less than 4–5 cm if it is not located in the uterine cavity and not multiple. Clinical findings dramatically change if the fibroids are large in size, are multiple and multi-located, and are associated with the uterine cavity. They can occur on different parts of the uterine wall: subserosal, intramural and submucosal. The site of myomas plays a speculative role in the manifestation of symptoms. The most common symptoms of fibroids are menstrual irregularities, pelvic pain, pressure complaints, low back pain, constipation, dyspareunia, and low urinary tract symptoms—moreover, pregnancy-related complications require definitive treatment.

There are observation, medical and surgical options for the management of leiomyomas. Wallach *et al.* (1) described limited treatment options such as observation, hysterectomy, and, less commonly, abdominal myomectomy. Another study indicated that little innovation had been found in treatments for fibroids, nominally because women with myomas are asymptomatic, benign, and have very low mortality (2). Lately, William H. Parker, in his review of 198 articles on uterine fibroids, describes in detail all possible treatment regimens (3). These are expectant management, medical therapy, surgical intervention, uterine

artery embolization, and ablative techniques for uterine fibroids treatment. The traditional surgical approach is fibroid excision (myomectomy) and hysterectomy, which are long-term solutions to prevent relapse. Medical treatment is essential to relieve and control symptoms, but the effect is often not permanent. The main risk factors for fibroid formation are age and race. Obesity, early menarche, and pregnancies are conditions that increase the woman's exposure to estrogen and are known risk factors for the development of uterine fibroids.

Generally, fibroids occur in approximately 3–12% of pregnant women. The most observed fibroids are intramural; they constitute 33–35% of all fibroids (4). Age is a significant risk factor for the development of fibroids. Since many women delay childbearing, myomas are more likely to be found during pregnancy. In pregnant women with fibroids, is an increased risk of spontaneous abortion, malpresentation, placenta previa, preterm birth, cesarean section (C/S), and peripartum and postpartum bleeding (5).

Bonney made the first published material in the literature on C/S myomectomy at the beginning of the 20th century (6). The author emphasized that the contractile activity of the postpartum uterus plays a positive role in the excision of fibroids, which reduces bleeding during surgery. Later, more researchers advocate routine myomectomy during C/S (7). On the other hand, current literature has shown that coagulopathy disorders or fibroid localization close to the large pelvic vessels may cause massive peri- and

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postoperative hemorrhage. These conditions can be considered a contraindication to C/S-myomectomy (8). It is known that the location of fibroids in the lower uterine segment that can obstruct the safe delivery of the fetus or interfere with suturing should be enucleated during C/S surgery (9). While there are conditions under which a C/S myomectomy should be performed, there are no clear guidelines for this procedure, so obstetricians follow their intuition and rely on their personal experience. This may explain why obstetricians worldwide are skeptical about this procedure.

Known indications for removal of uterine fibroids during C/S are the unusual intraoperative appearance of the fibroids, difficulty accessing the baby in patients whose fibroids obstruct the lower uterine segment, and pedunculated or anterior fibroids, when the fibroids cause difficulty closing the uterine wound, which leads to significant blood loss. Most articles do not specify the indications or surgical techniques for myomectomy during cesarean section and generally focus on different hemostatic techniques (uterine artery ligation, tourniquet method, etc.) to avoid a massive perioperative-postoperative hemorrhage (10-12). The safest CS myomectomy surgeries do not require an additional hysterotomy. The absence of an additional scar in the uterine wall reduces the likelihood of perioperative bleeding. Often, these fibroids are located on the anterior wall, subserosal, or pedunculated (9). In a study with a control group for subserosal and intramural fibroids, a dose of dilute oxytocin was injected into the pseudocapsule of fibroids to minimize perioperative hemorrhage. According to a study result, there was no difference between groups according to blood loss (13). Another study described the purse-string suture (PSS) for C/S myomectomy surgery (11). This study advocated that PSS tightening suture technique is relevant for preventing perioperative bleeding and not associated with significant uterine wall defects.

Recent reviews (14-16) on this topic do not show dramatic differences in obstetric, perinatal & postpartum outcomes in patients undergoing C/S myomectomy and C/S-only procedures. According to current reviews, C/S myomectomy surgery seems to be a safe procedure for obstetricians with previous experience. Another author emphasized the need to reevaluate scientific findings related to C/S myomectomy through large multicenter prospective studies (17). Primary, we aimed to inspect the recent works on “myomectomy during cesarean section” topic and objectively convey information about C/S myomectomy to readers. Our motto

in this article was “when & where, and which patient.” In line with our slogan, we have reviewed the latest articles and tried to update the current messages for obstetric surgeons regarding the C/S myomectomy procedure.

We summarized the current studies from this article related to C/S myomectomy in *Table 1*. In Shakespeare’s play *Hamlet*, the question “To be, or not to be” remains unanswered. The answer to the question “Perform or not perform myomectomy during C/S” is still controversial. Myomectomy during cesarean section is not a preferred surgical procedure for many obstetricians because of the risk of uncontrollable perioperative hemorrhage. These concerns are not unfounded, since the increased blood supply to the uterine artery during pregnancy increases the likelihood of acute perioperative bleeding during C/S myomectomy. There are studies designed to prevent massive bleeding during the C/S myomectomy procedure. In one randomized, prospective study by Sapmaz E., patients were divided into two equal groups. The first group, bilateral uterine artery ligation (BUAL), and myomectomy were performed after lower uterine segment transverse cesarean section, and the second control group, myomectomy, was performed with a tourniquet (12). This study showed that the tourniquet method is ineffective in the postoperative period for blood loss, as the tourniquet is removed at the end of the operation. However, bilateral ligation of the ascending uterine artery may be preferable for C/S myomectomy. Another author found similar results in subsequent prospective clinical studies. A study conducted by Liu *et al.* suggests that uterine artery ligation is a promising method for treating pregnant women with uterine leiomyomas who undergo cesarean section because it can reduce postpartum blood loss and minimize the necessity of future surgery (10).

Kaymak *et al.* (18) compared the postpartum results of 40 pregnant women who underwent myomectomy during C/S and 80 pregnant women with myomas who underwent cesarean delivery alone. The researchers found no difference in postoperative fever and blood transfusion rates between the myomectomy and control group. The authors also noted that myomectomy during cesarean section is not always a hazardous procedure, and it can be performed without significant complications by experienced obstetricians. Gürsoy *et al.* (19) reported similar results in their study. They also suggest that myomectomy during C/S allows a patient to avoid a second operation. A retrospective and multicenter study of 39 hospitals where pregnant women with uterine fibroids underwent cesarean

Table 1 The summarization of references related to C/S myomectomy

Study number	Reference	Reference details	Type of study	Aim of study	Study group (n)	Control group (n)	Surgical technique	Results	Conclusions
11	Mu <i>et al.</i> (7), 2011	China, May 2004 to March 2008	Retrospective	To evaluate the impact of uterine leiomyomas on pregnancy outcome and to determine the effectiveness of myomectomy at the time of cesarean delivery	Total: 9,259; 50 pregnant women (0.54%) with uterine leiomyoma	Not included	Not specified	41 patients (89.1%) underwent C/S myomectomy Two patient mid-trimester myomectomies were performed The mean blood loss from myomectomy at the time of caesarean section was 260 (200 to 700) mL, and 5% of patients who underwent myomectomy were transfused	Myomectomy can be performed at the time of cesarean section routinely without significant complications
22	Sparić <i>et al.</i> (8), 2015	Data collected within 5 years period	Retrospective	To determine factors influencing the intraoperative decision to perform CM	Total of 185 patients with uterine myomas, 102 C/S myomectomy	–	Not specified	The mean number of years of practice for the surgeon who operated on the women from the study group was significantly higher Mostly performed in women with pedunculated fibroids (9 patients, 81.82%); subserosal myomas (41 patients, 71.93%); least frequently performed for intramural myomas (26.83%) Myomectomy is more often performed in younger women and by experienced obstetricians	C/S myomectomy is still a controversial issue. Requires prospective randomized studies to define the criteria for indications and contraindications accurately
3	Hassiakos <i>et al.</i> (9), 2006	Greece, January 1995 to December 2004	Retrospective case-control study	To evaluate the safety and efficacy of myomectomy during cesarean section	47 C/S myomectomy	94 those without removal of the fibroids	Not specified	The length of hospitalization was compared between the two groups Myomectomy added a mean time of 15 min to the operative time of C/S None of the patients received a blood transfusion	Suggest that myomectomy during cesarean section could be generally recommended. Depending on the size and location of myomas, the associated risks are similar to those of isolated cesarean section
4	Brown <i>et al.</i> (13), 1999	Jamaica	Retrospective	To evaluate the safety of this procedure; the need for blood transfusion, postoperative febrile morbidity; length of hospital stay	16 C/S myomectomy	16 C/S women without uterine fibroids	An umbrella-type incision was made at the fibroid end to remove the fibroid mass. Infiltrate of oxytocin diluted with an equal volume of normal saline injected into the capsule overlying the fibroid for hemostasis	C/S myomectomy mean blood loss of 495 (range, 200–1,000) mL; control group 355 (range, 150–900) mL The C/S myomectomy group had a mean fall in hemoglobin level of 1.7 g/dL compared to 1.4 g/dL in the control group. There were no significant differences between the groups in the need for blood transfusion, post-operative febrile morbidity, or length of hospital stay No significant differences between the groups in need of blood transfusion, postoperative febrile morbidity, or length of hospital stay	C/S myomectomy is safe and offers no significant increased risk to the patient over cesarean section alone. Beneficial to the health sector by the avoidance of an interval myomectomy
5	Lee <i>et al.</i> (11), 2011	South Korea, January 2003 to February 2005	Prospective	To evaluate the safety of MUPS during C/S	31 pregnant with uterine myoma	Not included	MUPS was tightened and tied immediately after complete resection Stitches of another MUPS suture were placed alternately with each previous stitch on the inner side of the first suture	3 years of MUPS use shows no failures and severe complications (late hemorrhage); uterine rupture during a subsequent pregnancy	Myomectomy using a purse-string suture during C/S is a safe, useful, and convenient technique
6	Goyal <i>et al.</i> (14), 2021	17 studies, 6,545 women, prospective cohort or retrospective case-control studies that address C/S myomectomy were reviewed	Review and meta-analysis	To assess the safety and feasibility of myomectomy during a cesarean section	4,702 pregnant (71.85%) C/S myomectomy	1,843 (28.15%) CS-only group	–	There was a statistically significant but clinically insignificant decrease in hemoglobin (very low quality) and; a significantly higher need for blood transfusion (high quality) in the C/S myomectomy group The mean operative time (minutes; moderate quality) and mean hospital stay (days; high quality) was significantly less in the study group, though of not have any clinical significance. No difference in the incidence of hemorrhage (moderate quality evidence) and fever (moderate quality) in the two groups	C/S myomectomy is associated with a clinically insignificant increase in operative time, blood loss, and hospital stay, especially with multiple and large-size myomas. It should be preferred over CS alone, especially by experienced surgeons with appropriate hemostatic techniques and tertiary care centers
7	Pergialiotis <i>et al.</i> (15), 2017	19 studies, 3,900 women, all observational studies were selected that reported outcomes on patients undergoing myomectomy at the time of C/S	Review and meta-analysis	To assess the association of myomectomy during cesarean delivery with intraoperative and perioperative maternal morbidity	2,301 C/S myomectomy	1,599 C/S only	–	A mild decline in hemoglobin in the study group C/S myomectomy is associated with longer surgical time Blood transfusion and postoperative fever rates did not differ between the two groups	Demonstrated an association with increased operative time and hemoglobin drop in C/S myomectomy patients. No increased rate of major hemorrhage or need for transfusion was identified C/S myomectomy may be considered in cases of isolated myomas, although randomized trials are needed

Table 1 (continued)

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8	Song <i>et al.</i> (16), 2013	9 studies, 1,082 pregnant, a case-control study comparing myomectomy with C/S only	Review and meta-analysis	To assess the safety of myomectomy performed during cesarean delivery	443 (41.0%) C/S myomectomy	639 (59.1%) C/S alone	–	The drop in hemoglobin was 0.30 g/dL greater, and operative time was 4.94 minutes longer in C/S myomectomy, but the differences were insignificant The overall incidence of fever was comparable in the two groups No hysterectomies were performed in any of the included studies	C/S myomectomy may be a reasonable option for some women with leiomyoma. No definite conclusion can be drawn because the data included in the meta-analysis were low quality
99	Sparić <i>et al.</i> (17), 2017	Scientific databases were revised to investigate the indications and contraindications for CM, the operational techniques, benefits, and complications	Review	To provide the latest data on this topic regarding the techniques and complications of C/S myomectomy	–	–	–	C/S myomectomy provides the benefits of two surgeries in one laparotomy, avoiding the risks of repeated anesthesia and relaparotomy Myomas compromising fetal extraction and uterine incision or suturing should preferably be enucleated during CS C/S myomectomy is generally considered relatively safe in anterior wall myomas, subserous and pedunculated myomas Multiple myomas, deep intramural, fundal, and corneal myomas, and posterior uterine wall myomas are more complicated during C/S myomectomy	The risk/benefit ratio of C/S myomectomy should continue to be assessed using randomized controlled trials to gain more data on C/S myomectomy
110	Sapmaz <i>et al.</i> (12), 2003	Turkey	Prospective	To investigate the effects of using bilateral ascending uterine artery ligation and tourniquet use on intraoperative and postoperative blood loss during C/S myomectomy	52 patients C/S myomectomy, 1 group BUAL	2-group (the control group) myomectomy was performed with a tourniquet	Randomly divided into two equal groups. In the group 1 BUAL and myomectomy were performed after lower uterine segment transverse C/S	Intraoperative blood loss, total operation duration, number of enucleated myomas, and febrile morbidity were similar	The tourniquet method is ineffective in the postoperative period since the tourniquet is removed at the end of the operation. BUAL may be preferable in C/S myomectomy
111	Kaymak <i>et al.</i> (18), 2005	Turkey (January 2000 to April 2003)	Retrospective case-control	To evaluate the outcome of myomectomy during a cesarean section	40 C/S myomectomy	80 C/S alone	A linear incision was made over the myoma, and electro-cautery was used to remove the myomas with minimal blood loss	The incidence of hemorrhage in the study group was 12.5%, 11,3% in the control group There are no significant differences in the incidence of postoperative fever and frequency of blood transfusion	Myomectomy during C/S is a hazardous procedure, and it can be performed without significant complications by experienced obstetricians
112	Gürsoy <i>et al.</i> (19), 2021	Turkey (2017–2020)	Retrospective	To evaluate the safety and effectiveness of myomectomy during C/S	54 C/S myomectomy	26 patients with myomas C/S alone	Not specified	No significant difference in postoperative fever, preoperative hemoglobin (g/dL), change in hemoglobin (g/dL), preoperative hematocrit (%), change in hematocrit (%), or length of hospital stay between the two groups	This study shows that C/S myomectomy is a safe procedure. It also offers the advantage of avoiding a second operation in patients
113	Zhao <i>et al.</i> (20), 2019	39 hospitals, China, January 2011 to December 2011	Retrospective, multicentered, cross-sectional	To evaluate the safety and feasibility of C/S myomectomy among pregnant women with uterine fibroids	In total, 2,565 women, 2,344 (91.4%) C/S myomectomy	221 (8.6%) C/S only	Not specified	The comparison of postpartum hemorrhage, neonatal weight, fetal distress, and neonatal asphyxia showed no statistical significance Multivariate logistic regression analysis demonstrated that birth weight $\geq 4,000$ and diameter > 5 cm fibroids were high-risk factors for PPH $\geq 1,000$ mL	C/S myomectomy—safe and feasible based on the estimation by experienced obstetricians. During the procedure, special attention should be paid to a large-sized leiomyoma ≥ 5 cm and birth weight $\geq 4,000$ g
114	Doğan <i>et al.</i> (21), 2016	Turkey January 2002 to December 2009, 267 pregnant with fibroids	Retrospective study	To evaluate the effect of fibroids on pregnancy and the safety of myomectomy during C/S	267 pregnant women with fibroids, 124 C/S myomectomy	267 age- and parity-matched controls	Not specified	Higher rate of pain-related hospitalization in the large fibroid group The C/S myomectomy group had lower postoperative hemoglobin levels and a higher need for transfusion	C/S myomectomy increases the need for transfusion without an increase in the risk of hysterectomy
115	Ramya <i>et al.</i> (22), 2019	India, January 2008 to December 2017	Retrospective study	To share the experience of cesarean myomectomy in the last decade	20 C/S myomectomy	Not included	Experienced gynecologists performed the surgery. Preoperatively Tranexamic acid 1 gm in 100 mL isotonic saline was infused over 20 min. When myomas were located at the lower uterine segment, myomectomy was performed before the delivery of the fetus	The majority of patients got discharged on the fifth day of surgery. There were no incidences of postpartum pyrexia or surgical site infections	C/S myomectomy is a safe and feasible procedure in experienced hands. It is an advantage to avoid a second surgery in selected patients

C/S, Cesarean section; CM, cesarean myomectomy; MUPS, myomectomy using purse-string suture; BUAL, bilateral ascending uterine artery ligation; PPH, postpartum hemorrhage.

section was divided into the cesarean section myomectomy group and only the cesarean section group (20). The result of this study pointed out that myomectomy during cesarean section could be safe and feasible based on the estimation by experienced obstetricians. The authors emphasized that during the procedure, special attention should be paid to a large-sized leiomyoma ≥ 5 cm and birth weight $\geq 4,000$ g. A retrospective study with a large number of patients shows that performing a myomectomy during C/S increases the need for transfusions without increasing the risk of hysterectomy and other life-threatening complications (21). Another retrospective study of tertiary care institutions, in which the database was analyzed from January 2008 to December 2017, demonstrates that myomectomy cesarean section is a safe and feasible procedure in experienced hands. In addition, the authors suggested that this procedure avoids reoperation in selected patients (22).

We encountered similar results when reviewing meta-analyses over the past two decades. A meta-analysis of nine studies conducted in 2013, including 1,082 women with leiomyomas, where 443 (41.0%) women underwent cesarean myomectomy and 639 (59.1%) underwent cesarean delivery alone shows that C/S myomectomy may be a reasonable option for some women with leiomyomas (16). However, since the data included in the meta-analysis were of low quality, a definite conclusion could not be reached. A systematic review [2017] of 19 studies involving 3,900 pregnant women shows that women undergoing concomitant myomectomy had a mild decline in hemoglobin, and this group of patients had a longer surgical time than cesarean delivery alone. Blood transfusion and postoperative fever rates did not differ between the two groups (15). Two hundred forty-nine studies [2021] were assessed for eligibility, and 17 studies involving 6,545 pregnant women were included in a recent systematic review and meta-analysis (14). The present meta-analysis suggests that cesarean myomectomy is associated with a clinically insignificant increase in operative time, blood loss, and hospital stay, especially with multiple and large-size myomas. These meta-analyses (14-16) convinced that C/S myomectomy could be preferred over C/S alone, especially for experienced surgeons with appropriate hemostasis techniques and tertiary care centers.

The guidelines for C/S myomectomy indicated that pregnant women with fibroids represent a group of patients at high risk of peripartum and postpartum hemorrhage. American College of Obstetricians and Gynecologists (ACOG) guideline emphasizes that pregnant women

with fibroids are at risk for postpartum hemorrhage (23). According to National Institute for Health and Care Excellence (NICE) recommendations, pregnant women with fibroids should have an individual assessment when planning the place of birth (24). Preparation for CS myomectomy operation should be done accurately according to guidelines and recommendations. We can summarize the associations' recommendations for C/S myomectomy as "in the right place, at the right time".

These current studies and guidelines encourage obstetricians to perform myomectomy during C/S, because an experienced surgeon with adequate conditions can easily manage potential complications. Another study with the extraordinary title "Uterine Fibroids: The Elephant in the Room" also encourages surgeons to perform CS myomectomy. This study emphasized the theory that some uterine leiomyosarcomas may arise from a specific subset of leiomyomas (2). Leiomyosarcoma risk is higher in women whose fibroids are larger than 8 cm. However, there are no other specific pathognomonic parameters that can rule out sarcoma. If fibroid malignancy is suspected, liquidating tumoral tissue is the best treatment option here (25). All those opinions invite the surgeon to think twice before not removing fibroids during a cesarean section. There is no strict opinion about which myomas should be surgically removed. However, all these studies and current guidelines recommendations directed us to support myomectomy during cesarean section in the conditions of sufficient preparation of the surgical team. One of the questions in our article "which patient" in the research process remained unanswered. It is known that some fibroids spontaneously resolve due to a decrease in estrogen levels and a decrease in blood supply to the uterus in the postpartum period, so not all patients may need a myomectomy during a cesarean section. Future research should focus on selecting patients for whom a C/S myomectomy procedure is necessary. This is another essential issue that needs to be explored in a prospective study with a large sample size and with a control group.

Up-to-date articles and guideline recommendations suggest that obstetricians might perform myomectomy during cesarean section according to their personal experience and the capabilities of the facilities they work in. Myomectomy during cesarean section is a safe surgical intervention if the obstetrician has experience with this procedure. We assume that the "tricks" here are: performing the surgical procedure (C/S) in institutions with appropriate capabilities, the blood preparation for patients,

and a team with sufficient experience. However, we need more high-quality, multicenter, and prospective studies with large sample sizes for a definite conclusion.

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Footnote

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