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Intraoperative hemorrhage as a complication of cesarean myomectomy: analysis of risk factors

Intraoperativno krvarenje kao komplikacija miomektomije tokom carskog reza: analiza faktora rizika

Radmila Sparić

Clinic of Gynecology and Obstetrics, Clinical Center of Serbia, Belgrade, Serbia;
Faculty of Medicine, University of Belgrade, Belgrade, Serbia

Abstract

Background/Aim. Cesarean myomectomy is a controversial issue. It was considered relatively contraindicated for many years due to increased risk of intraoperative hemorrhage. Recent studies showed that cesarean myomectomy in some women may not be associated with increased morbidity. The aim of the study was to determine the causes and risk factors for intraoperative hemorrhage in patients subjected to cesarean myomectomy. **Methods.** This retrospective study included women subjected to cesarean myomectomy, divided into the study group of 36 patients in whom intraoperative hemorrhage was registered, and the control group of 66 patients in whom it was absent. The following parameters were analyzed: age, parity, gestational age of delivery, indications, type and duration of cesarean section, surgeon's experience, type, localization, size and number of myomas, number of incisions on uterus and neonatal birth weight. **Results.** There was a significant difference between the groups in terms of the type and size of myomas ($p = 0.007$ and $p = 0.000$, respectively) and duration of the surgery ($p = 0.000$). The size of the defect resulting from myoma enucleation and speed of suturing it have significant influence on the occurrence of intraoperative hemorrhage. In our study, operation on the patients of the study group lasted 14.53 minutes longer and their myomas were 39 mm bigger compared to the controls, with no difference in surgical experience of the obstetricians ($p = 0.111$). **Conclusion.** Cesarean myomectomy is associated with an increased risk of hemorrhage. Therefore, it would be advisable to discuss the hemorrhage and transfusion risks with patients with large multiple and intramural myomas before making decision to perform cesarean myomectomy. Those who perform cesarean myomectomy should be prepared to manage intraoperative hemorrhage during surgery in cases they encounter it.

Key words:
cesarean section; uterine myomectomy; risk factors; uterine neoplasms; myoma; leiomyoma; hemorrhage; intraoperative complications.

Apstrakt

Uvod/Cilj. Miomektomija tokom carskog reza je predmet rasprava. Ona se dugo godina smatrala relativno kontraindikovanom zbog povećanog rizika od intraoperativnog krvarenja. Nedavne studije su, međutim, pokazale da miomektomija tokom carskog reza kod nekih žena ne mora biti povezana s povećanim morbiditetom. Cilj istraživanja je bio da se utvrde uzroci i faktori rizika od nastanka intraoperativnog krvarenja kod žena podvrgnutih miomektomiji tokom carskog reza. **Metode.** Ova retrospektivna studija obuhvatila je žene podvrgnute miomektomiji tokom carskog reza, koje su bile svrstane u dve grupe: studijsku, koju je činilo 36 ispitanica kod kojih je ustanovljeno intraoperativno krvarenje i kontrolnu, koju je činilo 66 žena kod kojih krvarenje nije zabeleženo. Analizirani su sledeći parametri: starost i paritet, nedelja gestacije porođaja, indikacija, vrsta i trajanje carskog reza, iskustvo hirurga, tip, lokalizacija, veličina i broj mioma, broj rezova na materici i težina deteta na rođenju. **Rezultati.** Utvrđena je statistički značajna razlika između grupa u pogledu tipa i veličine mioma ($p = 0{,}007$ odnosno $p = 0{,}000$) i trajanja operacije ($p = 0{,}000$). Veličina defekta nastalog nakon enukleacije mioma i brzina njegovog ušivanja statistički su značajno uticali na nastanak intraoperativnog krvarenja. Operacija žena studijske grupe trajala je 14,53 minuta duže nego operacija ispitanica kontrolne grupe, a njihovi miomi su bili 39 mm veći od mioma ispitanica kontrolne grupe. Nije bilo statistički značajne razlike u hirurškom iskustvu akušera koji su operisali žene obe grupe ($p = 0.111$). **Zaključak.** Miomektomija tokom carskog reza povezana je s povećanim rizikom od intraoperativnog krvarenja. Stoga, bilo bi preporučljivo obavestiti žene s velikim multiplim i intramuralnim miomima o rizicima krvarenja i transfuzije pre donošenja odluke o miomektomiji tokom carskog reza. Oni koji vrše miomektomiju tokom carskog reza trebalo bi da budu spremni da zbrinu intraoperativno krvarenje ukoliko do njega dođe tokom operacije.

Ključne reči:
carski rez; materica, miomektomija; faktori rizika; materica, neoplazme; miom; leiomiom; krvarenje; intraoperativne komplikacije.

Correspondence to: Radmila Sparić, Clinic of Gynecology and Obstetrics, Clinical Center of Serbia, Višegradska 26, 11 000 Belgrade, Serbia. E-mail: radmila@rcub.bg.ac.rs

Introduction

A high percentage of cesarean sections (CS) in women with fibroids was noticed at the first half of the 20th century [1]. Cesarean myomectomy (CM) is still a controversial issue [2]. It was considered relatively contraindicated for many years due to increased risk of intraoperative hemorrhage which may even require postpartum hysterectomy [3, 4]. Recent studies showed that CM in some women may not be associated with increased morbidity [5, 6]. The reasons for reviewing the attitudes of CM are relatively rare, but very serious myoma complications during puerperium, which might require surgical treatment and even postpartum hysterectomy [1]. CM enables performing two operations in one laparotomy, as well as preservation of the uterus, while avoiding risks of relaparotomy and repeated anesthesia, complications of myomas during puerperium and subsequent pregnancies [7, 8].

The aim of the present study was to determine the incidence and causes of intraoperative hemorrhage in patients subjected to CM, as well as to define risk factors for intraoperative hemorrhage in these patients.

Methods

This retrospective case control study included women who had undergone CM during a 5-year period in a single teaching hospital. Criteria for exclusion from the study were: placenta *previa* or placental abruption, congenital or acquired coagulopathy, multiple pregnancy, and additional surgery during CM (other than myomectomy). The study was approved by institutional Ethics Committee. All the 102 patients included gave the informed consent for the operation. CM indications included: patients' wish, symptomatic or degenerative myoma and tumor *previa*. Myomectomy was always performed by sharp dissection of myoma (Figure 1). No tourniquet and electrosurgery were used. The study group consisted of the patients in whom intraoperative hemorrhage was registered, 36 of them (group I). The controls (group II) included 66 patients with no intraoperative hemorrhage. The following parameters were analyzed: age, parity, gestational age at delivery, indications for CS, type of CS (emergency or elective), duration of CS, surgeon experience, type, localization, size and number of myomas, number of incisions on uterus and neonatal birth weight. The indications for CS were defined based on the primary indication for surgery. The duration of surgery was calculated in minutes from skin incision to skin closure. Type, localization and the number of myomas were assessed from the operative reports. Myoma size was determined by the largest diameter of the myoma measured by the pathologist. In cases of multiple myomas, the diameter of the largest fibroid was taken into account. Intraoperative hemorrhage was defined by the results from the surgical operative note, the need to administer carboprost during surgery, intraoperative transfusion of heterologous or autologous blood, and based on the reduction of hemoglobin levels greater than 40 g/L and/or reduction of hematocrit values greater than 10%.

Statistical comparisons were made between the control and study groups of patients. Data were analyzed using the statistical software SPSS version 20.0. Parametric data, after controlling normal distribution were compared by using the Student's *t*-test. For comparisons of a difference in terms of

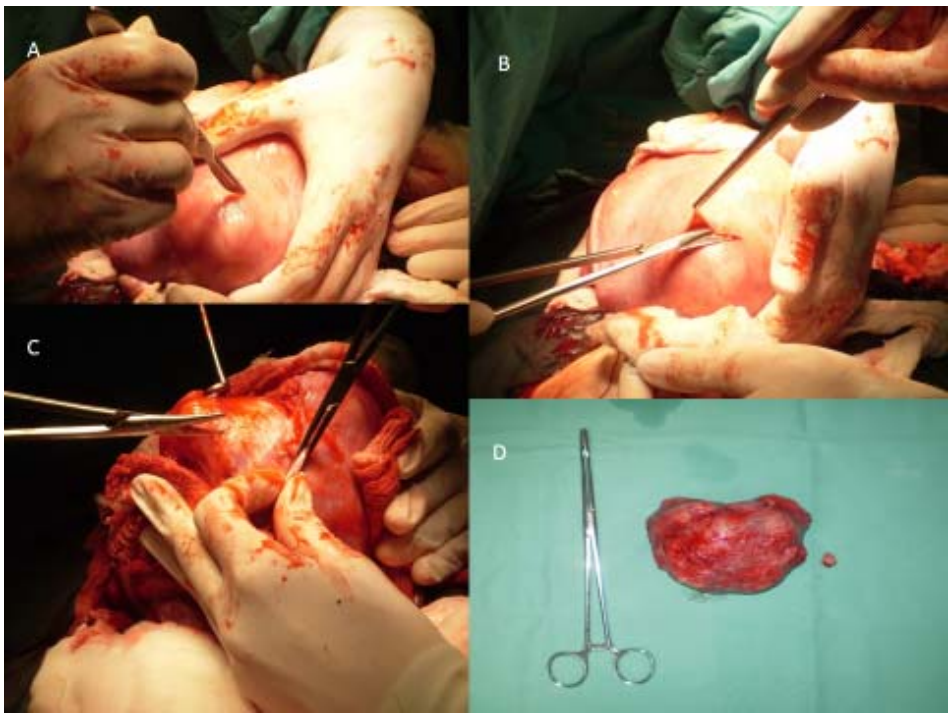

Fig. 1 – Myoma enucleation during cesarean myomectomy: A) Linear incision over the uterine serosa by scalpel; B) Myoma dissection using sharp Metzenbaum scissors; C) Myoma hooked and extracted from its capsule; D) Enucleated myoma.

myoma size and localization among groups we used Likelihood Ratio. In order to evaluate the predictive accuracy of myoma size in the occurrence of intraoperative hemorrhage we used receiving operating characteristics (ROC). The unique level of significance throughout the study was 0.05.

Results

The incidence of intraoperative hemorrhage in our study was 35.29%.

The groups did not differ by age, parity, gestational week of delivery and neonatal body weight, as shown in Table 1. None of the newborns had birth weight greater than 4,000 g. The largest number of patients in both groups were primiparas in term gestations.

Features of myomas are shown in Table 2. There was a highly significant difference between the groups in terms of the type and size of myomas, without difference in myoma number and localization. The most common myoma type was multiple in the study group (47.2%), and subserous (51.5%) in the control group. Anterior myomas were the most common in both groups, accounting for 50.0% of myomas in the study and 65.2% in the control group, respectively. The study group patients had on average 39.11 mm bigger myomas. Impact of myoma size on the occurrence of intraoperative hemorrhage was further analyzed by ROC. The area under ROC (AUROC) curve for the intraoperative hemorrhage was 0.825 (Figure 2, Table 3).

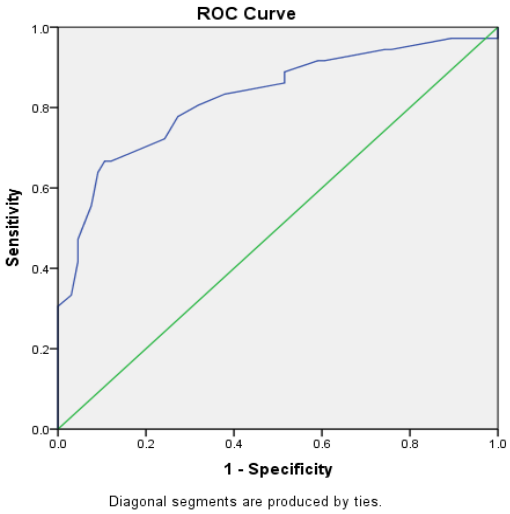

Fig. 2 – Receiving operating characteristic (ROC) curve for the sensitivity of myoma size in the occurrence of intraoperative hemorrhage.

Table 1

Patients' characteristics

Characteristics	Study group ($\bar{x} \pm SD$)	Control group ($\bar{x} \pm SD$)	*p*
Age (years)	34.19 ± 5.24	34.68 ± 4.17	0.608
Parity (n)	1.17 ± 0.45	1.17 ± 0.41	1.000
Gestational age (weeks of gestation)	39.08 ± 1.95	38.94 ± 1.85	0.713
Neonatal birth weight (gr)	3179.17 ± 535.77	3231.82 ± 566.61	0.649

Study group – patients with intraoperative hemorrhage;
Control group – patients without intraoperative hemorrhage.

Table 2

Myoma characteristics

Characteristics	Study group	Control group	*p*
Number of myoma, $\bar{x} \pm SD$	1.69 ± 0.92	1.88 ± 1.47	0.497
Myoma size (mm), $\bar{x} \pm SD$	80.92 ± 40.85	41.80 ± 18.24	0.000**
Myoma type, n (%)			
pedunculated	5 (13.9)	4 (6.1)	0.006**
subserous	7 (19.4)	34 (51.5)	
intramural	7 (19.4)	4 (6.1)	
multiple	17 (47.2)	24 (36.4)	
Myoma localization, n (%)			
fundal	4 (11.1)	4 (6.1)	0. 384
anterior wall	18 (50.0)	43 (65.2)	
posterior wall	8 (22.2)	15 (22.7)	
isthmicocervical	3 (8.3)	2 (3.0)	
cornual	3 (8.3)	2 (3.0)	
Total, n (%)	36 (100.0)	66 (100.0)	

Study group – patients with intraoperative hemorrhage;
Control group – patients without intraoperative hemorrhage.
***** $p < 0.05$; ****** $p < 0.01$.**

Table 3

Area under receivig operating characteristic (AUROC) curve: test results for myoma size

AUROC	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			lower bound	upper bound
0.825	0.046	0.000	0.734	0.916

The cut-off point for the size of myomas in terms of the occurrence of intraoperative hemorrhage was 61.5 mm; the sensitivity was 66.7% and specificity of 87.9% (Table 4).

Table 4

Coordinates of the receiving operating characteristic (ROC) curve

Test result variable(s): myoma size

Positive if greater than or equal to[a]	Sensitivity	1 - Specificity
9.0000	1.000	1.000
12.5000	0.972	1.000
16.5000	0.972	0.985
19.0000	0.972	0.970
21.5000	0.972	0.909
24.0000	0.972	0.894
26.5000	0.944	0.758
29.0000	0.944	0.742
31.0000	0.917	0.606
33.5000	0.917	0.591
36.5000	0.889	0.515
39.0000	0.861	0.515
42.5000	0.833	0.379
47.5000	0.806	0.318
52.5000	0.778	0.273
57.5000	0.722	0.242
61.5000	0.667	0.121
64.0000	0.667	0.106
67.5000	0.639	0.091
72.5000	0.556	0.076
77.5000	0.472	0.045
82.5000	0.417	0.045
87.5000	0.333	0.030
92.5000	0.306	0.000
97.5000	0.222	0.000
105.0000	0.194	0.000
115.0000	0.167	0.000
125.0000	0.139	0.000
140.0000	0.111	0.000
180.0000	0.028	0.000
211.0000	0.000	0.000

Intraoperative hemorrhage was registered in 75% of the patients with myomas bigger than 60 mm.

The indications for CS in the studied groups are listed in Table 5. The most common indication for CS in the study group was myoma *previa* (33.3%), while in the control group the most frequent indications were disproportion and other (nonobstetric) indications (18.2% each).

The characteristics of surgeries in both groups are shown in Table 6. The groups did not differ in relation to the experience of the surgeon, the incidence of emergency CS and the number of uterine incisions. In 8 of the patients CM was performed through low transverse cesarean incision. Duration of surgery was significantly different between the groups. The operation on the patients of the study group was significantly longer (on average, 14.53 minutes). None of the patients underwent postpartum hysterectomy and/or ligature of hypogastric arteries.

Discussion

CM is advised only in cases where it is necessary for safe extraction of fetus and the performance and/or suture a low uterine segment (LUS) incision of the uterus [9]. Sometimes, CM is unavoidable, or represents an alternative to corporal CS [10]. The only absolute contraindication for CM is a significant risk of hemorrhage, particularly in cases with uterine hypotony [11, 12]. An important factor in the decision making is myoma localization in relation to the large blood vessels, as enucleation of myomas in the proximity of uterine arteries significantly increases the risk of hemorrhage [11, 12]. Indications for CM are not clearly defined neither in the literature nor in obstetrical textbooks [2]. According to Ortac et al. [13] CM indications include patient's desire, symptomatic and degenerative myoma and myoma that may lead to postoperative complications and adverse perinatal outcomes in subsequent pregnancies.

Table 5

Indications for cesarean section (CS)

Indication for CS	Study group n (%)	Control group n (%)	Total n (%)
Disproportion	2 (5.6)	12 (18.2)	14 (13.7)
Previous CS	1 (2.8)	4 (6.1)	5 (4.9)
Previous myomectomy	5 (13.9)	2 (3.0)	7 (6.9)
Hypertension	4 (11.1)	5 (7.6)	9 (8.8)
Fetal malpresentation	3 (8.3)	11 (16.7)	14 (13.7)
Prolonged first stage of labor	0 (0.0)	4 (6.1)	4 (3.9)
Myoma *previa*	12 (33.3)	5 (7.6)	17 (16.7)
Fetal indications	4 (11.1)	11 (16.7)	15 (14.7)
Other (nonobstetric) indications	5 (13.9)	12 (18.2)	17 (16.7)
Total	36 (100.0)	66 (100.0)	102 (100.0)

Study group – patients with intraoperative hemorrhage;
Control group – patients without intraoperative hemorrhage.

Table 6

Surgery characteristics of cesarean section (CS) delivery patients

Characteristic	Study group	Control group	*p*
Duration of surgery (min)	77.64 ± 22.54	63.11 ± 16.43	0.000
Surgeons years of practice (year)	18.19 ± 7.03	16.02 ± 6.26	0.111
Number of incisions	2.25 ± 0.69	2.10 ± 0.75	0.342
Incidence of emergency CS (n)	12	27	0.452

Data are expressed as mean ± standard deviation unless otherwise indicated.
Study group – patients with intraoperative hemorrhage;
Control group – patients without intraoperative hemorrhage.

Similar views are presented by other authors [2, 14]. Most authors agree that myomas localized in the area of LUS incision should be removed if possible, without additional incision in the uterus [4–6, 9], as we did in 8 of the patients . On the contrary, there are attitudes that all visible myomas should routinely be removed during CS [4, 15].

The most important reason for controversies regarding CM is the risk of intraoperative hemorrhage. Myomectomy is associated with significant risk of intraoperative hemorrhage, even outside of pregnancy, and this is further pronounced in pregnancy due to increased vascularization gravid uterus [1, 16, 17]. Also, the most common complication of the CS itself is bleeding and/or blood transfusion, with an incidence of 8.6% [18]. Studies on massive hemorrhage, postpartum hysterectomy, and even death due to hemorrhagic shock after CM mainly do not address the issue of CM [3, 19].

There is a difference in the incidence of intraoperative hemorrhage between our study, with the frequency of 35.29%, compared to the data of other authors [5]. Our investigation demonstrated a higher incidence of intraoperative hemorrhage during CM. There are several explanations for such a difference. One of those is the number of patients included. In some studies, the number of patients was several times smaller than in our study [14–16, 20]. In the study of Burton et al. [20], out of 13 patients who underwent CM, one (7.69%) exhibited intraoperative hemorrhage that resolved after uterine artery ligation and transfusion of a single dose of packed red blood cells. There are publications indicating the incidence of intraoperative hemorrhage even lower than that observed in the general population after CS [21]. Another possible cause of the difference is a selection bias, related to the type and size of the fibroids. According to our results, the type and size of fibroids are the most important factors that influence the occurrence of intraoperative hemorrhage. Kaymak et al. [22] documented the incidence of intraoperative hemorrhage of 12.5%. Multiple myomas in this study were present in only 10 patients. The incidence of intraoperative hemorrhage of 12.6% was observed by Roman and Tabsh [23] in women with fibroids the average diameter of 35 mm, out of which 18% were multiple and 23% pedunculated. Hassiakos et al. [11] reported the incidence of 10% in a study with also lower incidence of multiple fibroids.

The undoubted cause of the observed differences is the difference in type of anesthesia used for CS. Intraoperative hemorrhage during CS is pronounced in women operated in general anesthesia [18]. The observed patients were operated on under general anesthesia, which is one of the drawbacks of the presented research. Skjeldestad and Øian [24] demonstrated that CS under general anesthesia is associated with two times higher risk of excessive bleeding compared to CS under regional anesthesia. The reason for this is the relaxation of muscles of the uterus caused by anesthetics. In contrast to our study, some researchers have used a tourniquet following the extraction of the fetus in order to reduce intraoperative blood loss, as well as various methods ligation of the blood vessels for devascularization of the operative field [5, 21]. The literature describes numerous surgical approaches to reduction of intraoperative hemorrhage during CM, but the data on their impact on the outcome of future pregnancies are scarce. Some of these techniques are recommended only for patients who no longer want to have children, but are interested in the preservation of the uterus. Our preliminary experience in this field indicates that application of the intraoperative blood salvage could be the method of choice for avoiding allogeneic blood transfusion during CM, without jeopardizing future fertility [25].

The difference between the groups in terms of the type and size of fibroids supports the significant impact of these myoma characteristics on the occurrence of intraoperative hemorrhage. Most patients in the study group had multiple myomas, whereas in the control group subserous myomas were most common. Intraoperative hemorrhage is more frequent with multiple myomectomy, even outside of pregnancy [26]. Most authors agree that the pedunculated and subserous myomas are those which can be safely enucleated during CS [5, 23], as supported by our results.

The size of myomas had an effect on the occurrence of intraoperative bleeding. The risk of hemorrhage was pronounced in women with fibroids larger than 60 mm. Intraoperative hemorrhage was registered in 75% of patients with myomas bigger than 60 mm. Roman and Tabsh [23] registered hemorrhage in 10.9% of women with myomas ≥ 30 mm diameter and < 60 mm, and in 22.7% of the women with myomas bigger than 60 mm. The influence of the size of myomas on the occurrence of intraoperative hemorrhage during myomectomy outside the pregnancy is well known. Bleeding occurs during myoma enucleation and suturing the uterine defect. Thus the size of the defect resulting from myoma enucleation and speed of suturing it have a significant influence on the occurrence of intraoperative hemorrhage. In our study, operation on the patients of the study group lasted 14.53 minutes longer and their myomas were 39 mm bigger, with no difference in surgical experience of the obstetricians. According to Fok et al. [27], surgical experience affect both the duration of CS and intraoperative blood loss. They suggested that experienced surgeons sutured operative wounds more quickly, that shortened the surgery and made the intraoperative blood loss less. This conclusion cannot be fully applied to CM, since in these cases the time required to establish hemostasis, and thus the duration of operation, are mainly affected by the characteristics of the removed myoma, primarily its size. For the establishment of full uterine contractility, and thus stopping bleeding, it is necessary to establish its anatomical integrity. This may explain why surgical experience did not significantly affect the incidence of intraoperative hemorrhage in our study. Furthermore, in some cases, younger doctors operated with more experienced surgeons. Maybe, in some cases CS was done by less experienced obstetricians, and CM by their experienced first assistants, while that in cases of intraoperative hemorrhage, experienced surgeons took over the operation. In both instances, the operative notes recorded younger doctors as leading surgeons. All these are the reasons why surgical experience did not affect the occurrence of intraoperative hemorrhage in our research. Similar results were found by Bergholt et al. [28], who did not find a relationship between the experience of the surgeon and intraoperative blood loss during CS in a teaching hospital.

Uncontrolled hemorrhage, the most severe complication of this procedure, which may lead to postpartum hysterectomy, was not registered in the presented research, despite the differences between our study and research published by other authors, as seen through the incidence of intraoperative hemorrhage. Also, none of the patients in our study required hypogastric artery ligation. According to Exacoustos and Rosati [3], out of nine patients who underwent CM, three required hysterectomy due to massive hemorrhage. On the contrary, there are many studies about CM without cases of postpartum hysterectomy [6, 9, 21, 22]. Those describing the cases of massive hemorrhage and consequent postpartum hysterectomies are rare and the number of cases published in the literature is probably less than what is really in practice [1, 3].

This study has some limitations. The main limitations of this study are retrospective design and small number of patients. In addition, this series provide the experience of a single teaching hospital. Possible influence of myoma localization, indications and types of CS, the number of incisions on the uterus and the neonatal birth weight on the risk of intraoperative hemorrhage would require testing on a bigger sample size. The lack of statistical significance in the presented study does not yet mean that these factors have no influence on the incidence of intraoperative hemorrhage. This investigation, analyzing the risk factors for intraoperative hemorrhage concluded that CM is associated with a substantial risk of hemorrhage. The most important factors that contribute to this are myoma type and size, in cases of multiple and intramural myomas, bigger myomas and prolonged surgeries.

CM was promoted in many studies, without any serious or life-threatening complications in the presence of experienced surgeons. Nevertheless, even if we have the benefit of two operations in just one surgery, clinicians had to consider a possible risk for intraoperative hemorrhage.

Conclusion

This study provides valuable information on concealing the women seeking CM. Interval myomectomy might represent a safer option in some of those patients. Furthermore, it would be advisable to discuss hemorrhage and transfusion risks with patients with big multiple and intramural myomas before making decision to perform CM. We hope that the presented results could be useful to obstetricians while deciding when to perform CM. Those who decide to perform CM should be prepared to manage intraoperative hemorrhage during surgery in cases they encounter it.

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