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REVIEW ARTICLE

Myomectomy during cesarean delivery

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ABSTRACT

Background: The optimal management of leiomyomas during cesarean delivery is unclear. *Objectives:* To assess the safety of myomectomy performed during cesarean delivery. *Search strategy:* PubMed, MEDLINE, EMBASE, and Cochrane Library were searched to identify potentially relevant studies published prior to June 30, 2012. *Selection criteria:* Case-control study comparing myomectomy with no myomectomy in patients undergoing cesarean delivery. *Data collection and analysis:* The quality of the studies was assessed and data were extracted independently by 2 authors. *Main results:* Nine studies, including 1 082 women with leiomyomas, met the inclusion criteria; 443 (41.0%) women underwent cesarean myomectomy and 639 (59.1%) underwent cesarean delivery alone. The drop in hemoglobin after surgery was 0.30 g/dL greater in the cesarean myomectomy group than in the control group, but the difference was not significant. The operative time was 4.94 minutes longer in the cesarean myomectomy group, but again the difference was not significant. The overall incidence of fever was comparable in the 2 groups. No hysterectomies were performed in any of the included studies. *Conclusions:* Cesarean myomectomy may be a reasonable option for some women with leiomyoma. However, no definite conclusion can be drawn because the data included in the meta-analysis were of low quality.

1. Introduction

Uterine leiomyomas are the most common uterine neoplasm. By age 35, more than 60% of nonpregnant African-American women and almost 40% of nonpregnant white women have leiomyomas identifiable by imaging [1]. Indeed, leiomyomas are found in up to 77% of women if the uterus is examined closely at autopsy [2]. Most leiomyomas are asymptomatic and might not need any therapy, but some induce abnormal uterine bleeding, pain or menorrhagia, pressure symptoms, urinary tract symptoms, infertility, anemia secondary to chronic blood loss, and recurrent pregnancy loss. In addition, leiomyomas can grow rapidly and continue to grow after menopause, and sarcomatous changes might occur, which will become major indications for aggressive management. Approximately 25% of women with leiomyomas experience symptoms that require treatment [3].

The incidence rate of uterine leiomyomas in pregnancy varies between 1.6% and 10.7% depending on the trimester of assessment [4–7], with fibroids more common among women of advancing maternal age. As cesarean rates continue to rise [8] and as the obstetric population ages [9–11], obstetricians can expect to be confronted with increasing myoma numbers during cesarean delivery.

Cesarean myomectomy has traditionally been discouraged because of concerns about intractable hemorrhage, requiring hysterectomy in extreme cases, and concerns about increased postoperative morbidity. Women who have successfully carried a pregnancy to cesarean delivery probably do not fulfill the conventional indications for medical intervention for their fibroid. Some authors [12,13] have challenged the traditional viewpoint, however, and suggest that myomectomy may, in fact, be performed at the time of cesarean delivery with selected patients. Reported benefits of such an approach include reduction of the risk associated with anesthesia by decreasing the need for subsequent operation, and reduction of the total cost [14]. The adequate management of leiomyomas, whether newly identified or previously known, is not as straightforward as once thought.

The present review aims to assess the advantages and disadvantages of myomectomy during cesarean delivery by meta-analysis of a series of case-control studies.

2. Materials and methods

PubMed, MEDLINE, EMBASE, and the Cochrane Library of Systematic Reviews were used to identify potentially relevant studies. The databases were searched without language restrictions, using the keywords “cesarean delivery”, “myomectomy”, “uterine myoma”, and “pregnancy with leiomyoma”. The proceedings of international meetings and the reference lists of identified studies, textbooks, and previously published reviews were also searched. The latest date for

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the search was June 30, 2012. The studies for inclusion were selected by 2 authors.

Studies were included if they met the following criteria: (1) Case-control study; (2) compared the advantages and disadvantages of removing myomas as opposed to not removing them in women undergoing cesarean delivery; (3) reported on at least 1 of the outcomes mentioned later in this section. If the same study (conducted at the same institution and/or by the same authors) was reported twice in different journals, the paper published in the journal with the highest impact factor or the most recent publication was included in the analysis.

The following outcomes were used to compare patients undergoing myomectomy during cesarean delivery with those undergoing cesarean delivery alone: Preoperative and postoperative hemoglobin, drop in hemoglobin, estimated blood loss, incidence of hemorrhage (defined as a decrease in hematocrit of 10 points from the preoperative value to the postoperative value), operative time (calculated from skin incision to skin closure), length of hospital stay, frequency of blood transfusion, incidence of fever (defined as temperature higher than or equal to 38.0 °C), and need for hysterectomy.

The meta-analysis was performed according to recommendations from QUORUM [15], MOOSE [16], and the Cochrane Collaboration [17]. For dichotomous data, results for each study are described as an odds ratio (OR) with 95% confidence intervals (CIs). For continuous outcomes, a fixed-effects model was used and data were pooled to calculate the weighted mean difference (WMD) with 95% CIs. Some studies reported a mean change or percentage change from baseline values, whereas other studies only reported medians and ranges; in such instances, the median was regarded as being identical to the mean and an estimate of the standard deviation was calculated from the range [(range × 0.95)/4].

Heterogeneity was evaluated using the I^2 statistic [18], with an I^2 value of more than 50%, $P < 0.01$ being considered statistically significant for heterogeneity. Fixed-effect models were used if the heterogeneity was not significant. Otherwise, a random-effects model was used. The Yates correction was used for outcomes with 0 events of interest in 1 of the study groups [19,20]. Outcomes with 0 events in either group were discarded from the meta-analysis. A funnel plot was performed for all significant outcomes to consider the possibility of bias. The analysis was performed using the statistical software Review Manager (RevMan) 5.0 (Nordic Cochrane Centre, Cochrane Collaboration, Copenhagen, Denmark).

3. Results

The search identified 9 case-control studies [12,13,21–27] that compared the outcomes of women with uterine leiomyomas who underwent cesarean myomectomy versus cesarean delivery alone (Fig. 1). The analysis included 3 studies [21,24,27] in which the control group (cesarean delivery alone) comprised women without

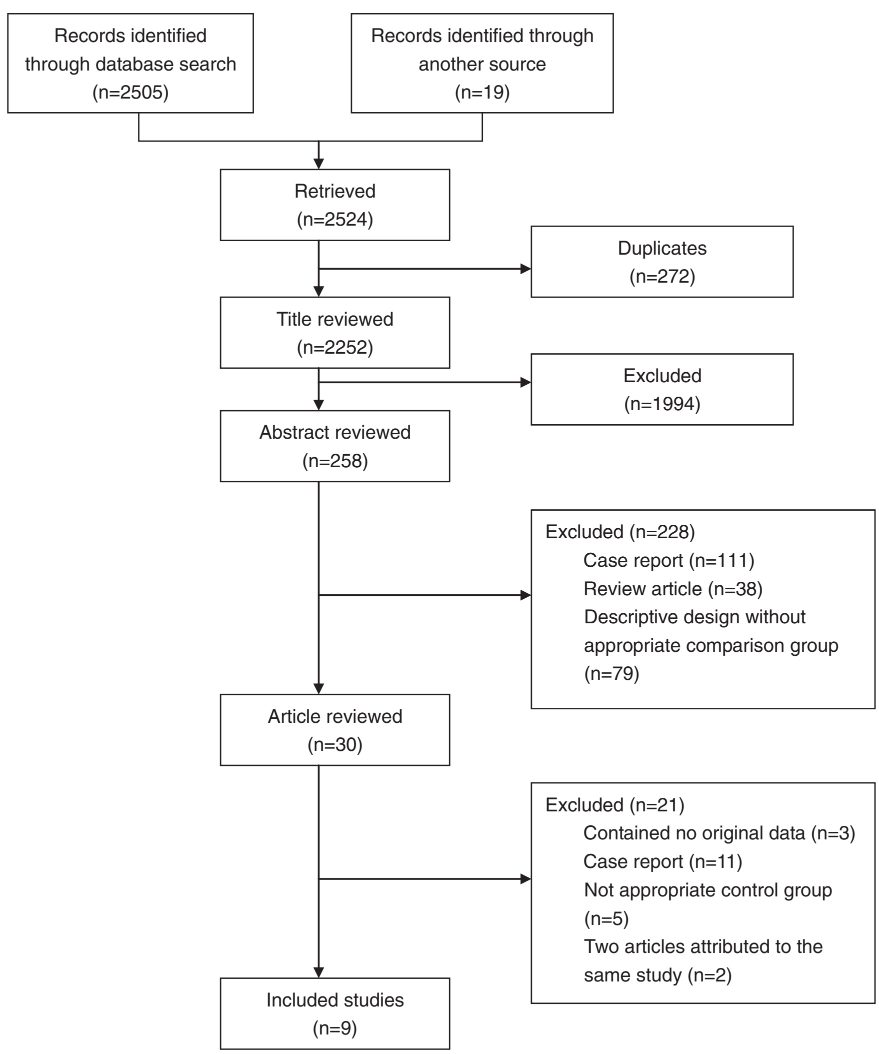

Fig. 1. Flow diagram of study selection for the systematic review.

Table 1
Description of studies included in the meta-analysis.[a]

First author	Publication year	Study design	Patient numbers		Mean age, y		Gestational age, wk	
			Study group	Control group	Study group	Control group	Study group	Control group
Brown [21]	1999	Retrospective	16	16	33.4 ± 3.6	24.6 ± 6.5	–	–
Kwawukume [12]	2002	Prospective	12	12	33.8 ± 5.3	30.1 ± 5.0	–	–
Roman [13]	2004	Retrospective	111	257	37 (23–48)	35 (17–48)	38.0 (27.3–41.6)	39.1 (24.0–42.6)
Kaymak [22]	2005	Retrospective	40	80	31.9 ± 4.5	30.8 ± 3.1	37.7 ± 2.5	37.6 ± 1.4
Hassiakos [23]	2006	Retrospective	47	94	32.1 ± 4.5	30.9 ± 3.3	37.7 ± 2.5	37.6 ± 1.4
Owolabi [24]	2007	Retrospective	14	14	32.4 ± 4.1	27.3 ± 4.2	–	–
Park [25]	2009	Retrospective	97	60	32.7 ± 4.7	32.1 ± 4.6	38.3 (28.0–41.4)	38.4 (27.3–41.2)
Lin [26]	2010	Prospective	36	36	30.9 ± 4.1	30.3 ± 3.6	37.9 ± 1.2	37.8 ± 1.1
Simsek [27]	2012	Retrospective	70	70	31.9 ± 5.4	28 ± 4.3	38.1 ± 1.9	38.7 ± 1.2

[a] Values are given as mean ± SD or median (range).

leiomyomas. This decision was based on the view that the outcome of patients in the control group would not be markedly altered by the presence of a fibroid. Two of the 9 studies were prospective and 7 were retrospective. All studies included a control group but none was randomized.

The analysis included 1 082 patients, 443 (41.0%) of whom underwent cesarean myomectomy and 639 (59.1%) underwent cesarean delivery alone (Table 1). The mean age was similar between the groups in 7 studies, but in 2 studies [21,24] patients who underwent myomectomy were significantly older than patients who underwent cesarean delivery alone, which likely reflects the association between leiomyomas and older age. The control group and the cesarean myomectomy groups were matched for gestational age in 6 studies, but in 3 studies [12,21,24] the gestational age was unknown. The description of parity differed between the studies, but there was no significant difference in terms of parity between the 2 groups in any of the studies. The leiomyomas were located at multiple sites and spanned a large size range in most studies (Table 2).

The pre- and postoperative values for the outcomes of interest are summarized in Table 3. Fig. 2 shows forest plots displaying the results of the meta-analyses for the various outcome measures. Heterogeneity between studies was significant for drop in hemoglobin, operative time, and length of hospital stay. The I^2 value was greater than 50% ($P < 0.01$) for all outcome measures. Therefore, random-effects models were used.

Eight studies reported a drop in hemoglobin; 1 study [24] was excluded from the analysis because it was not possible to extract data. The drop in hemoglobin levels in the cesarean myomectomy group was 0.30 (95% CI, −0.11 to 0.71) g/dL higher than that in the cesarean delivery group, but the difference was not significant ($P = 0.15$) (Fig. 2A).

Four studies [12,21,24,26] reported the estimated blood loss, whereas another 4 studies [13,22,23,27] reported the incidence of hemorrhage; 1 study [25] was excluded from the analysis for lack of data. There was no significant difference between the cesarean myomectomy and the cesarean delivery groups for either estimated blood loss (WMD 19.37 mL; 95% CI, −13.88 to 52.61, $P = 0.25$) or incidence of hemorrhage (OR 1.25; 95% CI, 0.79–1.97, $P = 0.34$) (Fig. 2B,C).

The operative time was 4.94 (95%, CI −3.32 to 13.21) minutes longer in the cesarean myomectomy group than in the cesarean delivery group in 8 studies, but the difference was not significant ($P = 0.24$). One study [21] did not report the operative time (Fig. 2D).

Eight studies [12,13,21–25,27] reported the length of hospital stay, but 2 studies [12,24] did not present the data in a form amenable to inclusion, so only 6 were meta-analyzed. There was no difference in the length of hospital stay between the 2 groups (WMD 0.30 days; 95% CI, −0.02 to 0.63, $P = 0.07$) (Fig. 2E).

All 9 studies reported on blood transfusion frequency, but 3 [12,23,26] were excluded from the analysis because there was no transfusion in either study group. There was no difference in the blood transfusion frequency between the 2 groups (OR 1.55; 95% CI, 0.80–3.02, $P = 0.20$) (Fig. 2F).

Five studies [13,22,23,25,27] reported the incidence of fever. The overall incidence was comparable in the 2 groups (OR 1.16; 95% CI, 0.67–1.99, $P = 0.60$) (Fig. 2G). No hysterectomy was reported in any of the studies.

A funnel plot of the studies included in the meta-analysis was performed for all significant outcomes. All studies were within the 95% CI and were distributed evenly across the vertical axis, implying minimal publication bias.

4. Discussion

The majority of obstetricians have been taught not to perform myomectomy during cesarean delivery because of the risks of intractable bleeding, massive hemorrhage, and hysterectomy. The present meta-analysis, however, suggests that the outcomes of patients with leiomyomas who undergo cesarean myomectomy do not differ greatly from those undergoing cesarean delivery alone. Although the drop in hemoglobin was 0.30 g/dL higher among women with cesarean myomectomy than among undergoing cesarean delivery alone, the difference

Table 2
Type and size of removed fibroids.[a]

First author	Fibroid type						Fibroid size		
	Pedunculated	Subserosal	Intramural	Submucosal	Multiple sites	Not recorded	<3 cm	≥3 cm and <6 cm	≥6 cm
Kwawukume [12]	0.0%	0.0%	8.3%	0.0%	91.7%	0.0%	Average 6 cm		
Roman [13]	23.0%	24.0%	24.0%	5.0%	18.0%	5.0%	10.0%	10.9%	22.7%
Kaymak [22]	10.0%	32.5%	27.5%	5.0%	25.0%	0.0%	5.0%	35.0%	60.0%
Hassiakos [23]	10.0%	38.5%	24.5%	5.0%	22.0%	0.0%	Not reported		
Owolabi [24]	0.0%	0.0%	35.7%	7.1%	57.1%	0.0%	Range 2–6 cm		
Park [25]	4.1%	63.9%	21.6%	1.0%	8.2%	0.0%	47.40%	34.0%	18.6%
Lin [26]	0.0%	0.0%	69.0%	31.0%	0.0%	0.0%	Average 9.3 ± 3.3 cm		
Simsek [27][b]	0.0%	42.4%	45.2%	12.4%	15%	0.0%	16.4%	57.5%	26.0%

[a] Brown et al. [21] reported that all types of fibroid were removed, but details were not provided.
[b] Data reported by type and location in article.

Table 3
Outcomes reported in the studies included in the systematic review and meta-analysis.[a,b]

First author	Preoperative hemoglobin, g/dL	Postoperative hemoglobin, g/dL	Change in hemoglobin, g/dL	Estimated blood loss, mL	Incidence of hemorrhage, %	Operative time, min	Length of hospital stay, d	Blood transfusion frequency, n/N	Incidence of fever, n/N
Brown [21]	11.7 ± 1.1 vs 11.4 ± 1.2	10.1 ± 1.8 vs 10.1 ± 1.0	1.6 ± 1.7 vs 1.4 ± 1.3	403 ± 196 vs 356 ± 173	–	–	3 (2–7) vs 4 (3–5)	1/16 vs 1/16	–
Kwawukume [12]	11.7 ± 1.7 vs 12.1 ± 1.7	9.9 ± 1.1 vs 10.3 ± 0.9	1.8 ± 1.1 vs 1.7 ± 1.6	392 ± 108 vs 388 ± 105	–	62.08 ± 7.22 vs 50.83 ± 10.97	[c]	0/12 vs 0/12	–
Roman [13]	–	–	5.5 (−1.1 to 15) vs 6.1 (−3.3 to 18.3)	–	12.6 vs 12.8	55 (25–161) vs 51 (20–107)	3.6 (2–7) vs 3.4 (2–12)	1/111 vs 3/257	5/111 vs 12/257
Kaymak [22]	11.9 ± 0.9 vs 12.2 ± 1.1	10.3 ± 0.9 vs 10.7 ± 1.1	1.6 ± 0.7 vs 1.5 ± 0.7	–	12.5 vs 11.3	53.3 ± 18.6 vs 44.4 ± 6.7	3.3 ± 0.8 vs 2.7 ± 0.6	4/40 vs 5/80	3/40 vs 8/80
Hassiakos [23]	11.6 ± 0.8 vs 11.2 ± 1.6	10.6 ± 1.1 vs 10.4 ± 1.2	1.0 ± 0.3 vs 0.8 ± 0.4	–	10.6 vs 9.6	63.2 ± 16.4 vs 48.5 ± 5.6	3.7 ± 0.6 vs 3.3 ± 0.8	0/47 vs 0/94	2/47 vs 7/94
Owolabi [24]	–	–	–	507 ± 272 vs 418 ± 144	–	66.8 ± 5.4 vs 56.4 ± 4.6	5–8 vs 5–8	1/14 vs 0/14	–
Park [25]	11.6 ± 1.3 vs 11.7 ± 1.4	10.4 ± 1.6 vs 10.6 ± 1.5	–	–	–	60.1 ± 19.2 vs 55.8 ± 15.0	5.5 ± 1.3 vs 4.9 ± 1.4	5/97 vs 3/60	2/97 vs 1/60
Lin [26]	11.8 ± 0.8 vs 11.7 ± 0.9	10.5 ± 1.0 vs 10.4 ± 0.8	1.3 ± 0.4 vs 1.2 ± 0.5	354 ± 97 vs 338 ± 68	–	64 ± 10 vs 53 ± 10	–	0/36 vs 0/36	[d]
Simsek [27]	12.7 ± 1.1 vs 12 ± 1.1	9.6 ± 1.5 vs 10.8 ± 1.0	3.1 ± 1.2 vs 1.3 ± 0.3	–	17.1 vs 7.1	32.81 ± 9.3 vs 58.1 ± 23	3.0 ± 1.6 vs 2.4 ± 1.1	10/70 vs 5/70	15/70 vs 8/70

[a] Results are reported for the study group vs the control group.
[b] Values are given as mean ± SD or median (range) unless indicated otherwise.
[c] All patients discharged at fifth day after the operation.
[d] Average temperature (mean ± SD) was 37.3 ± 0.2 vs 37.5 ± 0.3 °C.

was not statistically significant. Indeed, estimates of blood loss and transfusion were not significantly different between the 2 groups.

To avoid hemorrhage during cesarean myomectomy, various methods have been tried. The most common practice in the studies included in the present analysis was to administrate high-dose oxytocin intra- and postoperatively, although Lin et al. [26] and Kwawukume [12] routinely used uterine artery occlusion and a tourniquet to control intraoperative blood loss. Umezurike [28] also reported a dramatic decrease in the risk of severe hemorrhage as a result of using a tourniquet and high-dose oxytocin in 3 women with cesarean myomectomy. Kriplani et al. [29] reported the removal of a myoma measuring $25 \times 20 \times 15$ cm and weighing 1.2 kg at the time of cesarean delivery, using uterine artery ligation to control blood loss. Nine pregnant patients undergoing elective cesarean delivery with myomectomy were treated with uterine devascularization by Desai et al. [30] with a mean blood loss of 430 ± 97.5 mL, a mean change in hemoglobin from 11.3 ± 2.2 g/dL to 10.2 ± 1.2 g/dL, and a mean operative time of 1 hour 29 minutes ± 41 minutes. Many of the reported techniques used to control blood loss are quite common, but as already noted most studies included in the present meta-analysis did not require any techniques beyond the use of oxytocin.

In extreme cases, massive blood loss can necessitate a hysterectomy, but there were no such cases in the present review. Kim et al. [31], however, reported a series of 110 women aged 20–43 years who underwent cesarean myomectomy between January 2006 and December 2008. Of these women, 100 had no complications, but 10 experienced significant complications (3 units of blood transfusion, ileus, or hospital stay extended by 2 days). In the group with complications, 90% of patients required uterine artery embolization. There were no hysterectomies among these patients, however, and there was no need for reoperation. Exacoustòs et al. [6] also reported complications: Three of 9 cases of cesarean myomectomy were complicated by severe hemorrhage and did, in fact, require removal of the uterus.

Leaving uterine leiomyomas in place at cesarean delivery seems like a good strategy to prevent intraoperative complications. This may be a short-term view, however, that does not properly account for long-term risks. Among 22 patients who underwent cesarean delivery, an average leiomyoma volume increase of 34% was reported during a follow-up period of 38.5 months [32]. Of these patients, 40.9% underwent myomectomy ($n = 7$) or hysterectomy ($n = 2$) within 6–38 months because of their symptoms [32]. Overall, uterine leiomyomas are the most common indication for hysterectomy in the USA. According to the National Women's Health Information Center, approximately 175 000 hysterectomies are performed annually for fibroids, and their economic impact is considerable. Estimates of the direct cost of treating uterine leiomyomas have been as high as US$2.15 billion per year [33]. If the likelihood of repeat operation for recurrent myomas is lower after cesarean myomectomy, as opposed to leaving myomas in place for future operative treatment, removal at the time of cesarean delivery may, in fact, be the safer and more cost-effective course of action.

In the current study, cesarean myomectomy was performed without regard to location and size of the myoma. Myomas located in multiple sites and larger myomas were reported in all studies, but only 2 studies reported comparisons between subgroups. One study [22] compared the incidence of hemorrhage by myoma size, and there was no statistically significant difference in any size group between myomectomy patients and controls. Another study [25] compared drop in hemoglobin, frequency of blood transfusion, and operative time between myomectomy and control group patients with similarly sized myomas. The only difference was a longer operative time in the myomectomy group, and this difference was only found for the subgroup with myomas exceeding 6 cm.

Unfortunately, the present literature search did not provide information on the criteria for, or means of, selecting appropriate candidates for cesarean myomectomy. Kim et al. [31] found that, among women

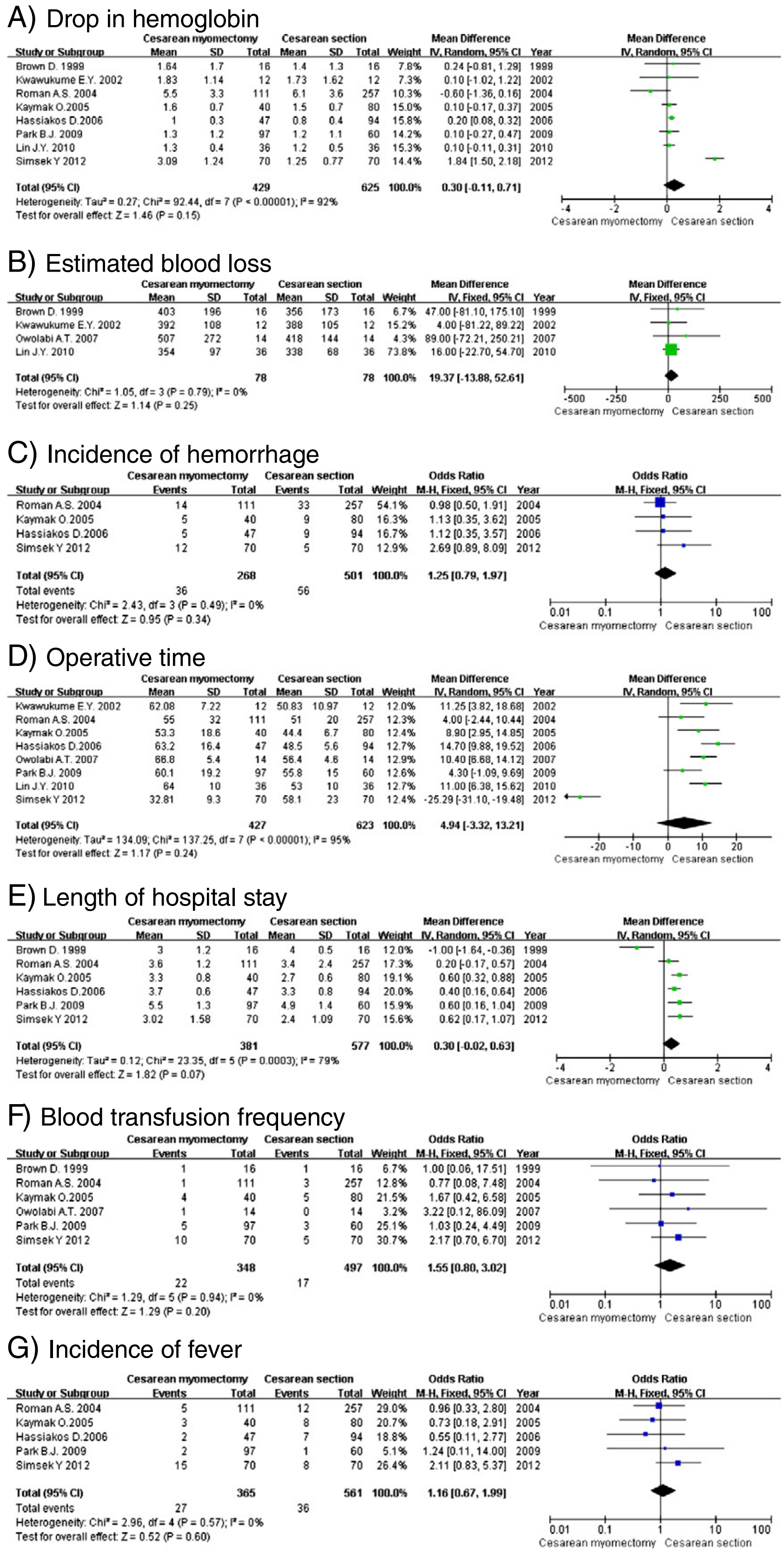

Fig. 2. Preoperative and postoperative parameters and outcomes for the cesarean myomectomy and cesarean delivery groups. (A) Drop in hemoglobin. (B) Estimated blood loss. (C) Incidence of hemorrhage. (D) Operative time. (E) Length of hospital stay. (F) Blood transfusion frequency. (G) Incidence of fever.

who underwent cesarean myomectomy without complications, 35% of the removed fibroids were subserosal and 25% were intramural; by contrast, 10% of the removed fibroids in the group with complications were subserosal and 90% were intramural. These findings seem to support the recommendation from other authors [12,13] that the optimal uterine myomas for removal at cesarean delivery are those which are easily accessible, such as subserosal or pedunculated myomas. Roman et al. [13] recommended that intramural myomectomies should be performed with caution, and Hassiakos et al. [23] suggested that intramural myomas in the fundus, myomas located proximal to the fallopian tubes, and myomas located in the cornua might not be good candidates for removal at the time of cesarean delivery, as doing so may affect subsequent fertility. However, long-term studies of myomectomy patients who attempted to become pregnant have shown pregnancy rates between 40% and 60% [34]. When 95 infertile patients with uterine fibroids were examined using magnetic resonance imaging, patients with fibroids showed a higher frequency of uterine peristalsis during the midluteal phase, which may contribute to infertility associated with intramural-type fibroids [35].

The present study had several limitations. Ideally, a meta-analysis should be based on randomized controlled trials. Unfortunately, no such studies were available in the literature, so the present analysis was based on retrospective and prospective controlled studies, which may have introduced a selection bias. No definite conclusion that myomectomy should be performed during cesarean delivery can be drawn because the data included in the meta-analysis were of low quality. Further limitations include the fact that the evaluation of operative blood loss in the included papers was based on estimates of blood loss, which are of limited reliability. In addition, it was only possible to comment on short-term morbidity, so long-term effects may have been missed. For example, no information was available regarding possible adverse effects on future pregnancies. Finally, the literature overall is limited and the present study population was not large. This might impair the generalizability of the conclusions.

Overall, the present results suggest that myomectomy during cesarean delivery may be a reasonable option for some patients, as it can be safely performed without serious or life-threatening complications by experienced hands. The present meta-analysis did not identify any hysterectomies resulting from massive hemorrhage. However, the presence of complications in the literature means that cesarean myomectomy might not be suitable for all patients, particularly those with intramural fibroids. A detailed discussion should be carried out with the patient regarding the associated risks, which will depend on myoma size and location, with most risks being similar to those of a cesarean delivery. Long-term risks and benefits, especially with regard to future pregnancies, remain unclear, however, and clarification of these issues may require a study with a large population or reliable design.

Conflict of interest

The authors have no conflicts of interest.

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