Purpose of review
The prevalence of cesarean delivery is increasing worldwide despite the advance of Trial of Labor After Cesarean section. In many countries, a history of previous cesarean section is an almost absolute indication for a repeat cesarean section. The purpose of this review was to examine if the perioperative anesthetic management of patients with repeat cesarean section is different from the anesthetic management of patients with primary cesarean section.

Recent findings
This review discusses important topics, such as early diagnosis of cases with a potentially high risk for complications; the need for assessment of patients diagnosed with abnormal placentation; the importance of a multidisciplinary approach that includes interaction of the anesthesiologist, gynaecologist, and invasive radiologist; emphasizing the need for reinforcement of new methods of invasive procedures; management of massive bleeding, use of new technologies, and development of an institutional protocol for management of patients with abnormal placentation.

Summary
According to this review, we show that the management of patients with repeat cesarean section without abnormal placentation is almost the same as the management of patients for primary cesarean section. Timely diagnosis of patient with abnormal placentation and multidisciplinary approach is crucial for prevention of morbidity or even mortality.

Keywords
abnormal placentation, invasive radiology, massive bleeding, obstetric anesthesia, repeat caesarean section

INTRODUCTION
Cesarean section is one of the most common surgeries performed in the world. The prevalence of cesarean section increases from year to year [1], at the same time, the incidence of repeat cesarean section is increasing. In the United States, for example, the rate of cesarean section reaches 32–33% and the rate of repeat cesarean section is around 22% [2]. Previous cesarean section is the main reason for the next operation. In highly populated countries, such as Brazil and Egypt, the rate of cesarean sections is as high as 55% and we can see thousands or even hundreds of thousands of transabdominal deliveries [3*]. The same picture is observed in China [4] and even up to 85% of all labors in few Iranian public hospitals are transabdominal deliveries [5]. Many countries are making efforts to increase and encourage the implementation of Trial of Labor After Cesarean section (TOLAC), for example, recommendations of the American College of Obstetricians and Gynecologists (ACOG), point out that most women with one previous cesarean section should be offered TOLAC [6*]. But despite all recommendations, there is no increase in TOLAC and Vaginal Birth After Cesarean section (VBAC). The rate of VBAC in the United States is between 6% in the state of Mississippi to a maximum of 22% in Colorado State (https://evidencebasedbirth.com/2015-vbac-rates-by-state/). There are some places that report a relatively high rate of VBAC with as many as 85–89% of women with one previous cesarean section [7]. In different national obstetric anesthesia guidelines, for example, Belgian [8], United
planning of anesthesia for a repeat cesarean section

One of the questions that come up during the planning of anesthesia for a repeat cesarean section is the length of surgery and whether spinal anesthesia is adequate or needs to be extended and combined spinal epidural (CSE) or epidural anesthesia should be performed for such cases.

According to the work of Rashid [13], the mean operation time was 45 min for lower order cesarean section and 1 h for higher order cesarean section. Almost the same picture can be seen in the United States, and according to the work of Silver et al. [11], the duration of higher order cesarean section was around 60–70 min.

The length of surgery may be longer in a university teaching hospitals, and can be affected by the degree of adhesions, the possibility of intraoperative organ injury, and other procedures that may be performed during a cesarean section.

Almost 80% of patients with repeat cesarean section have adhesions, and up to 50% have severe adhesions [18,19]. These adhesions may be the most common reason for a longer surgery time in a repeat cesarean section. On the other hand, according to other works [16,17], even with a rate of adhesions of up to 86%, the surgery time was just around 40 min. Even in cases with severe adhesions, the operation time increased by 15–30 min, compared with primary or lower orders cesarean section.

The next reason for increased surgery time is intraoperative organ injuries. In cases of higher order repeat cesarean section, the risk for urinary bladder injury is from 0.56% [20] to 1% [13]. Relatively low risk of bladder injury has been observed for many years, from 0.6 to 0.8% in 1969 [21] to 0.47% in 2017 [22]. The risk of bowel injury is significantly lower – from 0 [23] to 0.3% [13].

The length of surgery in repeat cesarean section may also be extended as a result of additional surgeries and procedures, some of which may also be performed during primary cesarean section, such as ovarian cystectomy, hernioplasty, and myomectomy, but multiparity and repeat cesarean section accompanied many times by intraoperative Salpingectomy or Bilateral Tubal Ligation [24]. Bilateral Tubal Ligation or Salpingectomy may extend the duration of the surgery by a few minutes and has no significant effect on the length of surgery [16].

As a mid-conclusion, although there is a high rate of adhesions, we can see that there is a low risk of bowel, bladder, or visceral injury and the mean operation time is 40–60 min. According to this, simple one-shot spinal anesthesia is good enough as an anesthetic approach in the majority of these cases. In cases where multiple adhesions are suspected or the average length of surgery in a specific hospital is longer than usual, it is recommended that combined spinal epidural (CSE) anesthetic technique will be used [25**] or as an option, addition

Kingdom [9] and United States [10], there is no specific reference to the topic of anesthesia in recurrent cesarean section and thus, we will try to clarify a number of important issues in the planning of anesthesia for repeat cesarean section.

Do we need any additional specific recommendations for patients with repeat cesarean section? In order to answer this question, we ought to discuss a few points: what are lower and higher order repeats cesarean section; what is the duration of a repeat cesarean section; and what are the additional risks in these operations?

LOWER AND HIGHER ORDER REPEAT CESAREAN SECTION

According to works from the United States [11], Saudi Arabia [12–14], Turkey [15], Israel [16], and others, it is acceptable to divide repeat cesarean sections to lower order – with one to two previous cesarean sections – and higher order – with three or more previous cesarean sections.

Before 2000–2005, in most parts of the world, a fifth cesarean section was accompanied by tubal ligation, but later, the tubal ligation after fifth cesarean section was lowered and this resulted in a significant increase in cases of higher order repeat cesarean section. Two studies performed in the same medical center, in the same population, but in different years, show that before 2005 in a 12-year period, 16 cases of repeat cesarean section number seven were performed [17], whereas after 2007, nine cases of cesarean section number seven were performed in only one year in the same hospital [16].

WHAT IS THE DURATION OF A REPEAT CESAREAN SECTION?

One of the questions that come up during the planning of anesthesia for a repeat cesarean section

- The repeat cesarean delivery rate has steadily increased worldwide.
- The anesthetic management of repeat cesarean section without abnormal placentation and primary cesarean section is the same.
- High suspicion and early diagnosis of abnormal placentation is crucial.
- Multidisciplinary approach and appropriate anesthetic equipment must be available in cases with suspected placenta accreta.

KEY POINTS

- The repeat cesarean delivery rate has steadily increased worldwide.
- The anesthetic management of repeat cesarean section without abnormal placentation and primary cesarean section is the same.
- High suspicion and early diagnosis of abnormal placentation is crucial.
- Multidisciplinary approach and appropriate anesthetic equipment must be available in cases with suspected placenta accreta.
of intrathecal epinephrine as an adjuvant that improves the intraoperative quality of the block and prolongs the block time by 45 min [26*].

REPEAT CESAREAN SECTION AND ABNORMAL PLACENTATION

The increased rate of uterine scar leads to an increased rate of invasive placentation, such as placenta accreta, increta, or percreta, and as a result of this, an increased rate of cesarean hysterectomy and massive perioperative bleeding.

The rate of abnormal placentation increases from 0.24% as a risk for second cesarean section to 0.57% for third, 2.33% for fifth, and 6.74% for additional higher order repeat cesarean section [27]. We can observe that over time, the rate of placenta accreta increases from 0.13–0.17% in 1999 up to 0.5–0.8% in 2013 [28]. These cases complicated by massive bleeding, maternal morbidity, or even mortality.

In the United States, in lower rate repeat cesarean section, the risk of peripartum hysterectomy as a result of abnormal placentation is 0.4–0.6% and this rate increases to 2.5% for higher order repeat cesarean section [18]. The same picture, with 0.6–2.5%, respectively, was reported in Israel [16].

The risk of massive bleeding accompanied by a decrease in hemoglobin over 4 g/dl or accompanied by a transfusion of more than 4 U of packed red blood cells in women with high order cesarean section is 2.3% [16].

According to the data found in the literature, the rate of caesarean hysterectomy is almost equal to the rate of placenta accreta and to the rate of massive perioperative hemorrhage. This is our ‘risk group’ and this is our biggest worry for the perioperative anesthetic management.

According to the recommendation of the American College of Obstetricians and Gynecologists, regular ultrasonography is sensitive and specific enough for the diagnosis of placenta accreta but MRI may be helpful [29]. Recently we can see more and more recommendations to use MRI for any borderline or unclear situation. There are discussions in literature about which MRI machine, 1.5 or 3 Tesla, can give us better information [30,31]. In large medical centers that manage patients with placenta accreta, the use of MRI for diagnosis of placenta accreta increased to 40% of obstetric centers [32].

ANESTHESIA FOR REPEAT CESAREAN SECTION WITH SUSPECTED MORBIDLY ADHERENT PLACENTA

The next question regarding the management of a patient with repeat cesarean section and suspected placenta accreta is the choice of anesthesia. The relatively conservative anesthetic approach for patients with placenta accreta is the use of general anesthesia from the beginning of the case. This approach got supported in a case series from Turkey [33]. Early airway protection and the absence of sympathectomy are two objectives for the support of general anesthesia as a first choice.

There are recommendations about the use of regional anesthesia with a possibility of general anesthesia conversion secondary to massive intraoperative hemorrhage in almost 30% [34]. The neuraxial approach is supported by a large retrospective analysis [35*] and is summarized in the recommendation that neuraxial anesthesia can be appropriate and performed in most cases of placenta accreta or percreta. In this retrospective analysis, 21% of all 129 cases, which started with regional anesthesia required conversion to general anesthesia and seven cases (around 5%) were done during cardiopulmonary resuscitation secondary to severe hemorrhagic shock. The editorial [36] for the same work warn that successful use of neuraxial anesthesia with possible successful intraoperative conversion of regional anesthesia to general anesthesia depend on the institutional resources and must be adapted to facilities of the institute. In places that are not as developed as the San Francisco general hospital, where all modern facilities exist, during the conversion from regional anesthesia to general anesthesia in a case with severe hemorrhagic shock, the outcome may be tragic.

An Israeli national survey reported that almost 100% of responders chose general anesthesia for cases of highly suspected placenta accreta. This relatively conservative approach makes sense and helps prevent maternal mortality especially in the centers with restricted facilities [32].

For cases of repeat cesarean section and incomplete placenta previa or even complete placenta previa without suspected accreta, neuraxial anesthesia may be successfully performed with a relatively low 6.6–8.2% possibility for conversion to general anesthesia [37]. We want to emphasize that in cases with placenta accrete, which started with neuraxial anesthesia, and were complicated with massive bleeding, a timely conversion to general anesthesia with early security of airway is crucial. Any patient suspected with placenta accreta must be directed to a territory reference center for optimal multidisciplinary treatment.

PERIOPERATIVE MANAGEMENT

Other important issues of anesthetic management of patients for repeat cesarean section and abnormal
placentation are monitoring, appropriate venous access and additional equipment.

Usually for cases with abnormal placentation, it is recommended to use two or more large peripheral intravenous lines. As an option, it is possible to insert a ‘high flow peripheral line’ (7.5F or 8F) as early as possible. The use of arterial line in all these cases may be very important both for invasive blood pressure monitoring and for repeated blood tests. Another important point is the use of a ‘rapid infusion system’ for rapid infusion of large volumes of warm solutions or blood products, and the use of transesophageal echocardiography or focused transthoracic echography for the assessment of the volemic status of the patients [38*].

In the setup of abnormal placentation, the use of cell salvage technology is very important and even crucial. Since 2005, there is a strong recommendation that cell saver ‘must be available in every obstetric theatre’ and that cell saver must be used as soon as possible in cases of abnormal placentation [39]. The use of cell salvage in the obstetric setup for repeat cesarean section with placenta accreta [40] allows to transfuse up to 2.5–3 l of red blood cell with hematocrit of 65% and significantly decrease transfusion of heterologous blood. On the other hand, the use of cell salvage for repeat cesarean section without suspicion of placenta accreta is economically unreasonable [41].

Tranexamic acid (TXA) is an antifibrinolytic agent, which blocks the degradation of fibrin clots and decreases peripartum bleeding. In literature, there is no strong recommendation for TXA use before any repeat cesarean section; however, WHO and ESA guidelines recommend the use of 1 g of TXA for cases of bleeding of more than 1 l or suspected massive bleeding. A second gram should be used if the bleeding persists after 30 min [42]. The most recent recommendations regarding the prevention and treatment of obstetric massive bleeding are presented in the NATA consensus statement [43**] and in the international (Germany–Austrian) peripartum hemorrhage guideline [44].

**INVASIVE RADIOLOGY**

In the practice of obstetric departments, different methods of intraoperative bleeding control are used, such as preoperative catheterization with intraoperative balloon-occlusion of the hypogastric arteries, internal iliac artery embolization [45], and intraoperative ligation of the hypogastric or uterine arteries. All reported methods of invasive radiology have enough literature support, and eventually the obstetrician may decide to use any of them according to the institutional obstetric policy. It is important to note that none of the regular methods give complete control over bleeding and we need to be prepared for bleeding of 3, 4, and even 5 l of blood [46].

Recently, there are reports in literature regarding resuscitative endovascular balloon occlusion of the aorta (REBOA) use for placenta increta and percreta cases [47,48], and now we can see first publications about the use of REBOA for obstetric patients with massive bleeding. Authors from different countries started to use REBOA for elective and even emergency situations in which patients with repeat cesarean section are diagnosed with abnormal placentation [49,50]. In 2018, the first metanalysis about REBOA and placenta accreta was published. This metanalysis shows that REBOA can be effective for the prevention of massive bleeding in the case of placenta accreta/percreta [51**].

During the planning of the anesthetic management for women with recurrent surgery, especially women with suspected abnormal placentation, it is recommended to consider the use of viscoelastic hemostatic assays (TEG, ROTEM), the use of a checklist [52], the development of institutional massive bleeding protocol [53,54] and other topics related to massive bleeding.

**UNDIAGNOSED PLACENTA ACCRETA**

Occasionally, even in cases with one previous cesarean section, with no additional risk factors, we may find ourselves in a case of undiagnosed placenta accreta mid-surgery [55]. Such situation may occur without diagnosis by ultrasound and Doppler or by MRI [56]. In a case of undiagnosed accreta, unlike in elective cases, the anesthesiologist must quickly call for help, expand monitoring and venous access, prepare for a situation of massive hemotransfusion, make sure to keep the patient’s temperature stable, and so forth. This does not only demand for medical knowledge but also for high communication skills with the various departments and services of the medical center are necessary. Every anesthesiology team must be prepared and go through occasional training for the treatment of unexpected changes in the condition of a patient, while giving her an ‘appropriate anesthetic management and advanced cardiovascular support’ [57**,58]. Pain after a repeat cesarean section is probably not worse than after a first cesarean section [59], and there is no need for a different way of treatment than the one regularly used in the hospital.

**CONCLUSION**

According to all literature data and our experience, the rate of repeat cesarean section will increase and
we should be ready to manage these potentially complicated cases. The perioperative management of patients with repeat cesarean section without signs of morbidly adherent placenta is almost identical to the management of primary cesarean section. It is important to timely identify patients with abnormal placentation and especially patients with placenta accreta as a risk group for massive bleeding, peripartum hysterectomy, and additional complications. Extended monitoring, invasive radiology, cell-selvage, and all other additional facilities for management of massive bleeding must be available and ready for treatment of these patients. A multidisciplinary approach and the development of an institutional protocol for these cases are both crucial for the prevention of maternal morbidity and even mortality (Fig. 1).

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REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:

■ of special interest

■■ of outstanding interest


FIGURE 1. Flowchart demonstrating management of repeat cesarean section. CSE, combined spinal epidural; MTP, massive transfusion protocol.
Obstetric and gynecological anesthesia


28. The aim of this last up-to-date consensus statement is to present recommendations on the prevention and treatment of postpartum hemorrhage as part of patient blood management in obstetric setup.


36. This last original systematic review provide clinical data supporting the use of REBOA in the management of pregnant women with placenta accreta undergoing elective cesarean delivery, and demonstrate the effectiveness of REBOA as a prophylactic intervention to improve outcomes in women with potential risk of catastrophic postpartum hemorrhage.


43. This up-to-date review supported the view that management of postpartum hemorrhage requires a coordinated team effort, and may not always be successful. The review reinforced our understanding that TTE and TEE can help as in the management of critical patients.
