Archives of Gynecology and Obstetrics (2018) 297:1151–1156
https://doi.org/10.1007/s00404-018-4698-4

MATERNAL-FETAL MEDICINE

The risk of placenta accreta following primary cesarean delivery

Gil Zeevi[1] · Dan Tirosh[1] · Joel Baron[1] · Maayan Yitshak Sade[2] · Adi Segal[2] · Reli Hershkovitz[1]

Received: 5 July 2017 / Accepted: 30 January 2018 / Published online: 5 February 2018

Abstract

Objective To (a) evaluate the risk for placenta accreta following primary cesarean section (CS), in regard to the stage of labor, the cesarean section was taken (elective prelabor vs. unplanned during labor); and (b) investigate whether the association between placenta accreta and maternal and neonatal complications is modified by the type of the primary CS.

Study design In a population-based retrospective cohort study, we included all singleton deliveries occurred in Soroka University Medical Center between 1991 and 2015, of women who had a history of a single CS. The deliveries were divided into three groups according to the delivery stage the primary CS was carried out: 'Unplanned 1' (first stage—up to 10 cm), 'Unplanned 2' (second stage—10 cm) and 'Elective' prelabor CS. We assessed the association between the study group and placenta accreta using logistic generalized estimation equation (GEE) models. We additionally assessed maternal and neonatal complications associated with placenta accreta among women who had elective and unplanned CS separately.

Results We included 22,036 deliveries to 13,727 women with a history of one CS, of which 0.9% ($n = 207$) had placenta accreta in the following pregnancies: 12% ($n = 25$) in the 'Unplanned 1' group, 7.2% ($n = 15$) in the ' Unplanned 2' group and 80.8% ($n = 167$) in the 'elective' group. We found no difference in the risk for subsequent placenta accreta between the groups. In a stratified analysis by the timing of the primary cesarean delivery, the risk for maternal complications, associated with placenta accreta, was more pronounced among women who had an unplanned CS (OR 27.96, $P < 0.01$) compared to women who had an elective cesarean delivery (OR 13.72, $P < 0.01$).

Conclusions The stage in which CS is performed has no influence on the risk for placenta accreta in the following pregnancies, women who had an unplanned CS are in a higher risk for placenta accrete-associated maternal complications. This should be taken into consideration while counselling women about their risk while considering trial of labor after cesarean section.

Keywords Placenta accreta · Cesarean section

Introduction

Placenta accreta is a result of an abnormal placental implantation that occurs when placental trophoblasts invade into the uterine wall. Placenta accreta is a dangerous pregnancy complication that becomes more prevalent with the increasing trend in cesarean section (CS) rates, especially multiple cesarean sections.

Placenta accreta occurs in approximately 1:1000 deliveries with a reported range of 0.04–0.9% [1–3].

There are three types of abnormal placentation, which differ by the depth of invasion (defined by histological examination): The most common is placenta accreta—chorionic villi attach to the myometrium; placenta increta—chorionic villi invade into the myometrium; and placenta percreta—chorionic villi penetrate the uterine serosa [4, 5].

The pathophysiology for accreta is not fully understood. Histologically, abnormal attachment of the placenta to the uterine wall, due to absence of the decidua basalis and the nitabuch's layer is observed. The major risk factor and most common is a history of previous uterine scar. Other risk factors are placenta previa, maternal age and uterine procedure such as myomectomy and curettage. [1, 3, 4].

✉ Gil Zeevi
zeevi07@gmail.com

[1] US Unit, Department of Obstetrics and Gynecology, Ben Gurion University of the Negev, Beer Sheva, Israel

[2] Clinical Research Center, Soroka University Medical Center, Faculty of Health Sciences, Ben Gurion University of the Negev, Beer Sheva, Israel

Placenta accreta is considered a severe and life-threatening pregnancy complication that may be associated with massive intrapartum and postpartum hemorrhage, an emergency hysterectomy, perinatal mortality and high rate of maternal morbidity in the subsequent pregnancy [1–3]. Thus, it is of great importance to diagnose placenta accreta before the onset of labor.

Diagnosis of placenta accreta prior to labor can be achieved by ultrasound (including the use of Doppler) or MRI. The major sonographic characteristics of placenta accreta are: (1) loss of continuity of the uterine wall; (2) multiple vascular lacunae within the placenta; (3) lack of a hypoechoic border (myometrial zone) between the placenta and the myometrium; (4) bulging of the placental/myometrial site into the bladder; and (5) increased vasculature evident on color Doppler. [5, 6].

The treatment for placenta accreta depends on the severity of penetration to the uterine wall, the clinical presentation, the woman's hemodynamic status and future pregnancy plans. When there is a high suspicion for the presence of abnormal placental implantation, an elective CS with experienced obstetric team should be planned because of the high risk for intrapartum and postpartum hemorrhage and life-threatening potential [5–8].

All recent studies have shown that the incidence of placenta accreta has increased dramatically in the past two decades with the increasing number of cesarean sections. The number of previous cesarean sections and the presence of placenta previa exponentially increase the risk for placenta accreta [1, 5–9].

Primary CS can be executed electively (not in active labor) or during labor, either first stage of labor (up to 10 cm of cervical dilatation) or second stage of labor (from 10 cm dilatation to fetus expulsion).

The association between placenta accreta after a primary CS regardless to the co-existence of placenta previa in the subsequent pregnancy has not been fully evaluated [9–11].

The aims of the present study were: (1) to compare the risk for placenta accreta in the next pregnancy, in regard to the stage of labor the previous cesarean section was performed (elective vs. Unplanned 1-on the first stage of labor and Unplanned 2 on the second stage of labor), (2) to investigate whether the association between placenta accreta and maternal and neonatal complications are associated with the stage of labor the primary CS was carried out.

Materials and methods

A population-based retrospective cohort study was conducted. We included all singleton deliveries of women who had a history of a single CS that was performed between 1991 and 2015 at the Soroka University Medical Center. Soroka University Medical Center is a tertiary medical center that exclusively serves the population of the Negev (southern Israel) and all deliveries of the region take place in its labor and delivery suites (around 16,000 births per year). Deliveries following multiple CS, deliveries of women younger than 18 years and pregnancies with multiple fetuses were excluded to minimize potential confounders.

The study complied with the Declaration of Helsinki and ethical approval was obtained by the review board of the Soroka University Medical Center.

Primary CS was defined as the first cesarean section delivery, regardless of whether the woman had a previous vaginal delivery.

The deliveries were divided into three groups according to the stage of labor the primary CS was carried out: 'Unplanned 1' CS (during the first stage of labor—up to 10 cm of cervical dilation), ' Unplanned 2' CS (during the second stage—10 cm dilation) and 'elective' prelabor CS.

The indications for unplanned CS, in this study, includes a combination of life-threating, urgent, indications such as: non-reassuring fetal status, fetal distress, suspected abruption, uterine rupture and a more moderate indication: maternal exhaustion and arrest of labor.

Data were collected from the computerized perinatal database and the hospital's computerized charts. The obstetrical information entered immediately after birth by an obstetrician, and medical secretaries complete the missing data.

All the eligible placenta accreta cases were reviewed and checked for pathologic report that indicates for placenta accreta, increta, percreta or operative report written by an expert surgeon that showed difficulties of removing the placenta. Cases that were not confirmed by pathological or operative report were excluded.

The following clinical characteristics were evaluated: maternal age, gestational age at birth, gravidity, parity, type of CS and placenta previa. The following maternal complications were assessed: postpartum hemorrhage, surgical site infection, uterine rupture, peripartum hysterectomy and other peripartum uterine surgeries. The following neonatal complications and birth outcomes were assessed: low birth weight and Apgar score at 1 and 5 min.

Statistical methods

Categorical outcomes were compared using Chi-square test and are presented as proportions. Continuous, normally distributed variables were compared using independent 2-sample *t* tests and are presented as mean and standard deviation. Non-normally distributed variables were compared using Mann–Whitney *U* test and are presented as medians with interquartile range.

We assessed the association between the study group and placenta accreta using logistic generalized estimation equation (GEE) models to account for multiple births of the same woman. The model was adjusted for maternal age and gestational age at birth.

We additionally performed a stratified analysis to assess potential modification by the type of CS; we assessed the association between placenta accreta and maternal or neonatal complications among women who had elective and unplanned CS separately. For this analysis, we combined the group of women in 'Unplanned 1' with ' Unplanned 2' due to reduced number of cases.

Data analyses were performed using SAS version 9.4 (SAS institute Inc., Cary, USA). Odds ratios (ORs), 95% confidence intervals (CIs). All hypothesis tests were two-sided and $P < 0.05$ was considered statistically.

Results

We included 22,036 deliveries to 13,727 women with a history of one CS, 0.9% ($n = 207$) of which had placenta accreta in the subsequent pregnancies (Fig. 1).

Despite statistical significance, the median age (31 years) and the gestational age at birth (273) were similar in deliveries with and without placenta accreta. No difference was observed in the number of pregnancies and births between the groups. The rate of history of elective surgeries also did not differ between the groups ($P = 0.520$): with 80.8% history of elective surgeries in deliveries with placenta accreta and 79.9% in deliveries without placenta accreta. The prevalence of placenta previa was significantly higher in deliveries with placenta accreta (4.8%) compared to other deliveries (0.7%, $P = 0.001$) (Table 1).

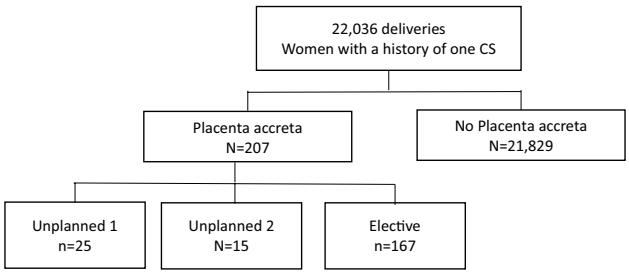

Fig. 1 Study groups

Table 1 Clinical characteristics

Maternal characteristics	Placenta accreta ($N = 207$ deliveries)	Non-placenta accreta ($N = 21,829$ deliveries)	p value
Maternal age (years) Median (IQR)	31 (28–36)	31 (27–35)	0.031
Gestational age (days) Median (IQR)	273 (259–281)	273 (266–280)	0.003
Gravidity Median (IQR)	4 (3–7)	4 (3–6)	0.085
Parity Median (IQR)	3 (2–6)	3 (2–6)	0.485
Type of first CS % (N) Elective Unplanned 1 Unplanned 2	80.8% (167) 12% (25) 7.2% (15)	79.8% (17,429) 14.2% (3112) 6% (1288)	0.520
Placenta Previa % (N)	4.8% (10)	0.7% (166)	0.001

We assessed the association between the type of CS and placenta accreta in the subsequent pregnancy. There was not a higher risk of placenta accreta among women how had an elective surgery, compared with women in whom the primary cesarean section was conducted at the first or second stage of labor (OR 1.016; 95% CI 0.706–1.463, $P = 0.928$) (Table 2).

In a stratified analysis by the timing of the primary cesarean delivery, the risk for maternal complications (postpartum hemorrhage, hysterectomy and uterine surgeries), associated with placenta accreta, was more pronounced among women who had an Unplanned CS (postpartum hemorrhage: OR 15.20; 95% CI 5.61–41.14, $P < 0.01$, Uterine complications—uterine rupture, peripartum hysterectomy and other peripartum uterine surgeries: OR 26.42; 95% CI 11.56-60.40, $P < 0.01$) compared to women who had an elective surgery (postpartum hemorrhage: OR 6.95; 95% CI 3.68-13.11, $P < 0.01$, Uterine complications: OR 22.57; 95% CI 14.24–35.78, $P < 0.01$).

Table 2 The association between the type of CS and placenta accreta in the subsequent pregnancy

Risk factor	OR (95% CI)	*p* value
History of elective CS	1.016 (0.706–1.463)	0.928
Maternal age	1.029 (1.003, 1.055)	0.028
Gestational age (days)	0.985 (0.980, 0.988)	< 0.001

The risk for neonatal complications (low Apgar at the first and fifth minute and low birth weight), associated with placenta accreta, was slightly more pronounced among women who had an elective CS (Low Apgar 1 min: OR 1.68; 95% CI 0.99–2.86, $P = 0.05$, Low Apgar 5 min: OR 2.64; 95% CI 1.52–4.60, $P < 0.05$, Low birth weight: OR 1.95; 95% CI 1.15–3.32, $P = 0.013$) compared to women who had an unplanned surgery (Low Apgar 1 min: OR 1.28; 95% CI 0.38–4.35, $P = 0.68$, Low Apgar 5 min: OR 1.47; 95% CI 0.32–6.74, $P = 0.61$, Low birth weight: OR 1.40; 95% CI 0.39–4.99, $P = 0.60$) (Fig. 2).

Discussion

Placenta accreta is characterized by complete or partial absence of the decidua basalis and failure of the fibrinoid layer (Nitabuch layer) [9, 12].

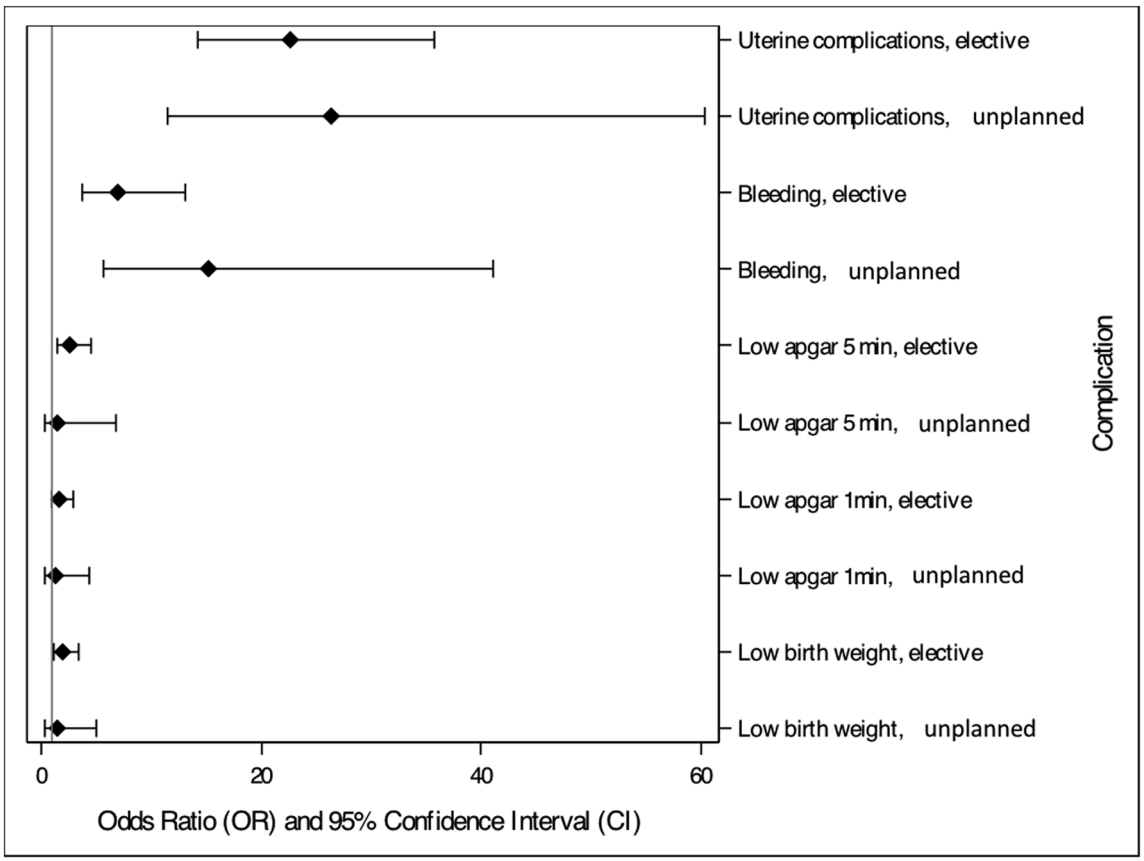

Fig. 2 The relationship between placenta accreta to maternal and neonatal complications, GEE-logistic regression results: *Uterine complications: uterine rupture, peripartum hysterectomy and other peripartum uterine surgeries

The strong association between placenta accreta and a history of CS has been investigated in previous studies. This has a great impact on population's health, mainly due to the increased rate of CS in the last two decades [1, 5–9].

In the present study, we evaluated the risk for placenta accreta after a single primary CS, and the possible relation to the stage of labor the CS was taken.

We have found that the risk for placenta accreta in subsequent pregnancies is not related to the stage in which the primary CS was performed. Our results are not in concordance with Kamara et al.'s study, [11] which showed that women with primary elective CS had a higher risk for placenta accreta in subsequent pregnancy.

This difference can be explained by population differences between the studies. In our study, we included women after a single CS as opposed to Kamara et al., which included also women after multiple cesarean sections. By including women after only one previous CS we were able to differentiate between the different stages of labor in which this previous CS was performed, while eliminating confounders that might exist in cases with multiple CS.

Second, one of the inclusion criteria in Kamara et al.'s study was the coexisting of placenta previa while we did not use. This factor can also contribute to the differences in the study results, while it is well known that placenta previa by itself increases the risk for accreta.

As opposed to Kamara, we hypothesize that cutting the uterine wall during CS is the main reason damaging the Nitabuch's layer leading to the formation of placenta accreta, regardless of the uterine wall thickness while it has been done [12–14].

This hypothesis correlates with the suggestion that a uterine scar following cesarean section creates localized hypoxia, with subsequent defective decidualization and abnormal trophoblastic invasion.[9, 12–15] Furthermore, the inflammatory conditions during spontaneous labor and the infiltration of inflammatory cells predominant in the lower uterine segment demonstrated in Thomson et al.'s study [16], emphasize the effect of cutting the myometrium during unplanned CS after the onset of labor [16, 17].

In addition, we can assume that the small number of placenta accreta cases in our study is a possible explanation for lack of power for assessing differences between the two unplanned groups.

Pregnancies complicated with placenta accreta are prone to adverse outcomes, such as intrapartum and postpartum hemorrhage, peripartum hysterectomy, uterine rupture, maternal blood transfusion, wound infection as well as intensive care unit admissions and total hospitalization days [1, 18, 19].

Our stratified analysis revealed that placenta accreta is a risk factor for maternal complications, especially among women with a previous primary CS executed during labor ('Unplanned CS').

This result match Taylor et al.'s study [20] that found higher rates of postpartum hemorrhage, hysterectomy and manual removal of placenta among women who had a primary cesarean section during labor then in those who had not. Unplanned CS has higher maternal and neonatal complications compared to elective CS [20–22].

Our results strengthen this conclusion by showing that primary unplanned CS has a stronger influence on subsequent placenta accreta-associated pregnancies.

In conclusion, history of primary CS is a risk factor for several complications in subsequent pregnancies. In the present study, we found that women with a primary unplanned CS had a higher risk for placenta accrete-associated maternal complications. We did not find that the stage of delivery, in which the primary CS was preformed, had changed the risk for placenta accreta. These risks should be considered in the clinical judgment of whether to perform a primary cesarean delivery.

Study limitations: First, this is a retrospective design and the fact that the diagnoses are based on ICD-9 coding is a limitation of the current study. The ICD-9 code for placenta accreta (667.0) includes two diagnosis: (A) Placenta accreta without hemorrhage. (B) Retained placenta. However, to minimize the misclassification in the outcome definition, we reviewed the pathologic reports or the operative reports of all women who had the diagnosis and excluded those who did not had documentation for placenta accreta. Second, a large number of cases did not have a histological confirmed diagnosis of placenta accreta. All cases without this conformation had an operative report written by an expert surgeon that showed difficulties of removing the placenta (which is a relative subjective impression of the surgeon). Third, Due to reduced number of cases in Unplanned 1 and Unplanned 2 groups we had to combine these two groups ("Unplanned") for the stratified analysis to assess potential modification (maternal or neonatal complications) by the type of CS.

Acknowledgements Gil Zeevi wrote the first draft of the manuscript. No honorarium, Grant, or other form of payment was given to anyone to produce the manuscript.

Author contributions GZ: data collection, manuscript writing. RH: project development and management, manuscript editing. DT: manuscript editing, project management. JB: project development and consultant. MYS: data analysis (lead). AS: data collection (support), data analysis

Funding This study was not funded.

Compliance with ethical standards

Conflict of interest The authors report no conflict of interest.

Financial disclosures No financial disclosures.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethical approval was obtained by the review board of the Soroka University Medical Center.

Human rights and participant statement This article does not contain any studies with animals performed by any of the authors.

References

1. Eshkoli T, Weintraub AY, Sergienko R, Sheiner E (2013) Placenta accreta: risk factors, perinatal outcomes, and consequences for subsequent births. Am J Obstet Gynecol 208(3):219.e1–219.e7 **(Elsevier Inc.)**
2. Vinograd A, Wainstock T, Mazor M, Mastrolia SA, Beer-Weisel R, Klaitman V et al (2015) A prior placenta accreta is an independent risk factor for post-partum hemorrhage in subsequent gestations. Eur J Obstet Gynecol Reprod Biol 187:20–24
3. Oyelese Y, Smulian JC (2006) Placenta previa, placenta accreta, and vasa previa. Obstet Gynecol 107:927–941
4. Tantbirojn P, Crum CP, Parast MM (2008) Pathophysiology of placenta acreta: the role of decidua and extravillous trophoblast. Placenta 29:639
5. Committee on Obstetric Practice (2012) Committee opinion no. 529: placenta accreta. Obstet Gynecol 120(1):207–211
6. Comstock CH (2005) Antenatal diagnosis of placenta accreta: a review. Ultrasound Obstet Gynecol 26:89–96
7. Perez-Delboy A, Wright JD (2014) Surgical management of placenta accreta: to leave or remove the placenta? BJOG 121:163–169 **(discussion 169–170)**
8. Lin K, Qin J, Xu K et al (2015) Methotrexate management for placenta accreta: a prospective study. Arch Gynecol Obstet 291:1259–1264
9. Clark SL, Koonings PP, Phelan JP (1985) Placenta previa/accreta and prior cesarean section. Obstet Gynecol 66:89–92
10. Chattopadhyay SK, Kharif H, Sherbeeni MM (1993) Placenta praevia and accreta after previous caesarean section. Eur J Obstet Gynecol Reprod Biol 52(3):151–156
11. Kamara M, Henderson JJ, Doherty DA et al (2013) The risk of placenta accreta following primary elective caesarean delivery: a case–control study. BJOG 120:879–886
12. Son G, Kwon J, Cho H, Kim S, Yoon B, Nam E et al (2007) A case of placenta increta presenting as delayed postabortal intraperitoneal bleeding in the first trimester. J Korean Med Sci 22:932–935
13. Belachew J, Cnattingius S, Mulic-Lutvica A, Eurenius K, Axelsson O, Wikstrom A (2014) Risk of retained placenta in women previously delivered by caesarean section: a population-based cohort study. BJOG 121:224–229
14. Gielchinsky Y, Rojansky N, Fasouliotis SJ, Ezra Y (2002) Placenta accreta–summary of 10 years: a survey of 310 cases. Placenta 23:210–214
15. Wehrum MJ, Buhimschi IA, Salafia C (2011) Accreta complicating complete placenta previa is characterized by reduced systemic levels of vascular endothelial growth factor and by epithelial-to-mesenchymal transition of the invasive trophoblast. Am J Obstet Gynecol 204:411.e1–411.e11
16. Thomson AJ, Telfer JF, Young A, Campbell S, Stewart CT, Cameron IT, Greer IA, Norman JE (1999) Leukocytes infiltrate the myometrium during human parturition: further evidence that labour is an inflammatory process. Hum Reprod 14:229–236
17. Osman I, Young A, Ledingham MA et al (2003) Leukocyte density and pro-inflammatory cytokine expression in human fetal membranes, decidua, cervix and myometrium before and during labour at term. Mol Hum Reprod 9:41–45
18. Garmi G, Salim R (2012) Epidemiology, etiology, diagnosis, and management of placenta accreta. Obstet Gynecol Int. 2012:873929
19. Balayla J, Bondarenko HD (2013) Placenta accreta and the risk of adverse maternal and neonatal outcomes. J Perinat Med 41:141–149
20. Taylor LK, Simpson JM, Roberts CL, Olive EC, Henderson-Smart DJ (2005) Risk of complications in a second pregnancy following caesarean section in the first pregnancy: a population-based study. Med J Aust 183:515–519
21. Pallasmaa N, Ekblad U, Gissler M (2008) Severe maternal morbidity and the mode of delivery. Acta Obstet Gynecol Scand 87:662–668
22. Arlier S, Seyfettinoğlu S, Yilmaz E, Nazik H, Adıgüzel C, Eskimez E, Hürriyetoğlu Ş (2017) Incidence of adhesions and maternal and neonatal morbidity after repeat cesarean section. Arch Gynecol Obstet 295(2):303–311