Journal of Obstetrics, Gynecology and Cancer Research | ISSN: 2476-5848

# Vaginal Birth After Two Cesarean Sections (VBAC-2), Success Rate and Adverse Outcomes of VBAC-2 Versus VBAC-1 and Repeat Cesarean Sections: Systematic Review and Meta-Analysis

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**Article Info**

10.30699/jogcr.9.3.240

**Received:** 2023/09/28;
**Accepted:** 2023/12/25;
**Published Online:** 15 May 2024;

Use your device to scan and read the article online

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**ABSTRACT**

**Background & Objective:** Vaginal birth after Cesarean (VBAC) is often offered as an option after a single cesarean section (CS). To evaluate the success rate of vaginal birth after two cesarean sections (VBAC-2).

**Materials & Methods:** We searched MEDLINE, EMBASE, PubMed, Scopus, using search terms (cesarean OR cesarean OR caesarean OR caesarian) AND ("Vaginal birth after cesar Keywords: Vaginal birth after Cesarean, Cesarean section, Maternal, Fetal outcomesean" OR VBAC) AND (two OR Twice OR second OR multiple). Two independent reviewers performed the study selection, and abstracted and tabulated data and pooled estimates were obtained. Meta-analyses were performed using Open-meta and Comprehensive Meta-Analysis.

**Results:** Mean success rate of VBAC-2 was 72% (2174 out of 3020 cases) with a range of 24-90%. The mean hysterectomy rate was 0.43% ranging from 0% to 1.7%. Our meta-analysis showed no significant difference between VBAC-2 and CS-3 in the case of hysterectomy, with a pooled odds ratio (OR) of 0.699, but with a wide confidence interval (95% CI was 0.347-1.407). VBAC-2 being associated with 2-fold increased risk of perinatal mortality compared to CS-3.

**Conclusion:** Vaginal delivery is a suitable option for women with two previous cesarean sections; the outcomes are significantly more favorable for women with a history of vaginal birth.

**Keywords:** Vaginal Birth After Cesarean, Cesarean Section, Maternal, Fetal Outcomes

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## Introduction

The National Health institutes have declared that cesarean section is a safe alternative for natural vaginal delivery in 1980; its rate has been increasing. In 1983, cesarean section was the most common surgical procedure in the United States. Shino et al. showed that the most common indication for cesarean section is previous cesarean section followed by fetal distress and dystocia **(1)**. Patients with previous cesarean section have an 80 to 85% chance of a successful vaginal delivery and vaginal birth after cesarean section (VBAC) is a safe choice both for mother and fetus **(2)**. However, few studies have evaluated vaginal birth after two cesarean sections (VBAC-2). The American College of Obstetricians and Gynecologists (ACOG) has not clarified whether women with a history of multiple previous cesarean sections can proceed to a vaginal birth. Because the rate of cesarean sections is increasing, the number of patients with a history of two cesarean sections is also increasing **(3)**. The ACOG has stated that women with a history of two cesarean

sections are suitable candidates for vaginal delivery **(4)**.

After each cesarean section the chance of maternal morbidities, such as blood transfusion and hysterectomy increase. Another alternative is vaginal delivery, which is associated with maternal and fetal dangers. The ACOG suggests that patients should be counseled about the advantages and disadvantages of these options and choose the desired route of delivery with the help of their physician.

In England, according to the National Sentinel Cesarean Audit (NSCA) percentage of cesarean section in women with a previous cesarean section is 67 percent, whereas in primigravida women it is 24% **(5)**. Multiple Cesarean sections are associated with higher risk of placenta previa or accreta, which are major surgical challenges and significant causes of maternal mortality and morbidity **(6)**. The trial of labor, for women with a previous cesarean section, can allow patients to choose the route of delivery and decrease the number of unnecessary cesarean sections.

Multiple studies have supported the efficacy and safety of vaginal birth after cesarean section **(7-9)**. Although physicians generally suggest VBAC after one previous cesarean section, a trial of vaginal birth is not recommended for patients with a history of two cesarean sections, and these patients usually receive controversial recommendations and unhelpful counselling **(10)**. Vaginal birth after two previous cesarean sections (VBAC-2) is a clinically important issue, especially as numbers of cesarean sections have increased, that has not received the required attention and needs further investigations. In this study we carried out a systematic review and meta-analysis, when feasible, to compare the complications of VBAC-2 with a cesarean section for the third time (CS-3).

## Methods

This study was based on MOOSE (Meta-analysis of Observational Studies in Epidemiology). We searched the literature from 1980 until 2022 using the following search terms: (cesarean OR cesarean OR caesarean OR caesarian) AND ("Vaginal birth after" OR VBAC) AND (two OR Twice OR second OR multiple). We searched the ISI, Pub med, Cochrane and Scopus electronic databases for relevant articles. Moreover, we manually searched the important key organization websites including American College of Obstetricians and Gynecologists (ACOG), Society of Obstetricians and Gynecologists (SOGC), Royal College of Obstetricians and gynecologists (RCOG), and National Institute for Clinical Excellence (NICE) for relevant studies. We also cross-referenced the retrieved articles for further relevant literature.

The current project as a research proposal (code No. 941303) was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code of Ethics: IR.MUMS.FM.REC.1395.475).

We included studies that evaluated vaginal birth after two previous cesarean sections, their study design was RCT, cohort, case-control or case series, had a control group of patients that underwent cesarean section for the third time and were written in English. We excluded studies that included patients with uterine scars for reasons other than cesarean section. In the case of studies with duplicate study population, we included the one that had a bigger sample size and was more recent.

Two independent researchers carried out the study selection and data extraction. Controversies were resolved by discussion and in case of disagreement a third reviewer made the final decision. Extracted data included, the name of first author, country, study year, study type, sample population, the success rate of VBAC-2, rate of maternal morbidities (uterine rupture, hysterectomy and blood products transfusion) and neonatal morbidities (perinatal mortality, NICU admission, Five-minute APGAR score of less than 7).

Two independent authors carried out the validity and quality assessment of studies using the Joanna Briggs Institute (JBI) checklist, any discrepancies were resolved by discussion and in case of disagreement a third author made the final decision.

### Statistical analysis

We carried out the statistical analysis according to the guidelines provided by the Meta-analysis of Observational Studies in Epidemiology (MOOSE) group. To assess the association of the mode of delivery and complications, Pooled odds ratios (ORs) and 95% confidence intervals (CI) were used. The significance of pooled OR was assessed using Z-test and $P<0.05$ was considered as statistically significant. Inter studies heterogeneity was defined as the percentage of total variations throughout studies that occurred due to heterogenicity rather than chance ($I^2$) **(11)**; and it was evaluated using chi-square test at a significance level of P-value=0.05. When $I^2$ was less than 50%, the fixed effects (Mantel-Haenszel) model was used to measure pooled OR, otherwise, the random effect model was used. In order to assess the stability of our results, the sensitivity analysis was carried out by deleting each study independently and doing the meta-analysis on the remaining studies for each of the variables. Publication bias was assessed using visual inspection of Begg's funnel plots symmetry and Egger's regression test and if the p-value was less than 0.05, then publication bias was suspected. Statistical analysis was carried out using Open-meta and Comprehensive Meta-Analysis (CMA) (Biostat, Englewood, NJ, USA).

### Study selection

Our search resulted in 8724 articles from the following databases: MEDLINE/Pubmed (3628), Scopus (2005), and Cochrane (242), ISI (2850) (Figure 1). The results of our search did not contain any RCT or case-control studies, and all retrieved studies were

cohorts or case series. Two independent reviewers carried out the study selection, any discrepancies were resolved after consulting a third reviewer. Search results were assessed by their titles and after removing the duplicates, 180 studies were initially selected. After reading their abstracts, 160 irrelevant studies were removed and 21 studies remained for full-text assessment. Thirties studies were selected to be included in our study, however, after quality assessment using JBI (Joanna Briggs Institute; developed the highest number of methodological assessment tools) one of these studies was removed due to poor methodology.

Jamelle **(11)** have reported cases of unscheduled VBACs and included those VBAC-2s that were carried out in homes without any specific and careful supervision **(11)**. Guettier, Marpeau **(12)** reported 17 patients with a history of two uterine scars, however, one of the patients had a scar of hysterotomy or myomectomy **(12)**. Wijesinghe and Ekanayake **(13)** article was a review of VBAC-2 which was also removed from the analysis **(13)**. Bretelle, Cravello **(14)** study lacked the information about morbidities after cesarean section **(14)**. Flamm, Newman **(15)** did not provide separate data about VBAC-2 and Porreco and Meier **(16)** Pruett, Kirshon and Cotton **(17)** Humphries, Tjioe **(18)** studies did not contain a control group of cesarean section for the third time, therefore we removed these studies from our final analysis. Garg and Ekuma-Nkama **(19)** published an article in 2005 that was the summary of the original article published previously in 2004, therefore we only included the original article **(19, 20)**.

## Results

We finally included twelve studies in our study (Table 1). These studies reported 3207 cases of vaginal birth after two previous cesarean sections (VBAC-2) of which the majority were previously scheduled. They also reported 17039 cases of cesarean section for the third time (CS-3) (either elective or due to the failure of VBAC-2).

The mean success rate of VBAC-2 was 72% (2174 out of 3020 cases) with a range of 24-90%. Uterine rupture was reported in all the studies except one **(20)** and encountered in 33 of 3038 cases (mean 1% with a range of 0-28%) of VBAC-2 compared to 19 of 16971 cases (0.1%) of CS-3. Others reported maternal morbidities included fever-causing diseases, duration of hospital stay, hysterectomy, transfusion of blood and blood products, urinary tract infections, surgical injuries and uterine scar dehiscence. Fever-causing diseases were compared between VBAC-2 and CS-3 in all the studies except Novas, Myers and Gleicher **(21)** and Chattopadhyay, Sherbeeni and Anokute **(22)** where they did not give any information in this regard **(21, 22)**. The duration of hospital stay was reported in three studies as a range of time, which had a mean of 4 days for VBAC-2 and 11 days for CS-3 **(19, 23, 24)**. Hysterectomy was reported in all studies except **(25)** and its mean rate was 0.43% for VBAC-2 (range 0-1.7%). Blood or blood products transfusion was reported in only three studies **(1, 20, 22)**. Data about urinary tract infection and surgical injuries had a high heterogeneity, therefore, we could not utilize them in our meta-analysis. Uterine dehiscence was reported as partial, complete or sub-peritoneal. We only reported cases that were symptomatic, and asymptomatic cases were not included in our study. However, we did not include the uterine dehiscence in our meta-analysis because of heterogeneity of studies (some studies reported only symptomatic patients **(19, 21, 23, 26)**. whereas others reported both symptomatic and asymptomatic patients).

Limited data were reported on neonatal morbidities; therefore, only morbidities that were reported in all studies were included in our study. We only collected data pertaining to perinatal mortality, APGAR scores <7 at minute 5 and the need for admission to NICU or NNU. Whenever the definition of a complication was different in a study compared to others, we excluded that study from the meta-analysis. Chattopadhyay, Sherbeeni and Anokute **(22)** reported no perinatal morbidities **(22)**. APGAR scores were reported differently in various studies, however, the majority of the studies reported APGAR as less than 7 in minute 5 **(1, 4, 20, 27)**, therefore we only reported the APGAR score of less than 7 in minute 5 as a neonatal morbidity.

### Maternal complications

The rate of hysterectomy was reported in 10 studies. The mean hysterectomy rate was 0.43% ranging from 0% to 1.7%. However, our meta-analysis revealed no significant difference between VBAC-2 and CS-3 with a pooled odds ratio (OR) of 0.699 (95% CI was 0.347-1.407) (Figure 2).

The amount of bleeding was not reported specifically in any of the included studies; however the number of patients that required blood or blood products transfusion was reported in 8 studies. In the VBAC-2 group, 2% (range 0%-15.1%) of patients required transfusion. Our meta-analysis returned a pooled OR of 0.753 (95% CI 0.371-1.528) for transfusion comparing VBAC-2 and CS-3 and showed no statistical difference between the two groups (P-value=0.432, $I^2$=64.21%) (Figure 3).

Fever-causing diseases were reported in 9 studies, and the mean rate was 6.5% and 4.9% for VBAC-2 and CS-3, respectively. Meta-analysis of these nine studies revealed a pooled OR of 0.753 with 95% CI of 0.509 to 1.114 (P=0.155, $I^2$=62.45%). Therefore, no statistical difference was observed between VBAC-2 and CS-3 in the case of fever-causing diseases (Figure 4).

Moreover, sensitivity analysis of maternal morbidities showed that removing none of the studies changes the outcome and the difference between the two groups remained insignificant. We also assessed

the publication bias, and it turned out that no publication bias influenced our results.

Novas, Myers and Gleicher **(21)** reported the maternal complications non-specifically and stated that maternal morbidities are similar to the general population of pregnant patients **(21)**.

**Table 1. Characteristics of the included studies**

| First author (Country) | Year | Study design | | Number of cases | Success rate | Uterine rupture | Hysterectomy | Transfusion | Fever-causing diseases | Perinatal mortalities | NICU admission | Low APGAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [51]Farmakides (North America) | 1987 | Case series | VBAC-2 | 57 | 44 (77%) | 0 (0%) | 0 (0%) | - | 0 (0%) | - | - | - |
| | | | CS | 64 | - | 0 (0%) | 0 (0%) | - | 3 (4.7%) | - | - | - |
| [49]NOVAS (North America) | 1989 | Case series | VBAC-2 | 36 | 29 (81%) | 1 (28%) | 0 (0%) | - | - | - | - | - |
| | | | CS | 33 | - | 0 (0%) | 2 (6%) | - | - | - | - | - |
| [19]PHELAN (North America) | 1989 | Case series | VBAC-2 | 501 | 346 (69%) | 0 (0%) | 1 (0.2%) | - | 55 (11%) | 12 (2%) | - | 13 (2.6%) |
| | | | CS | 587 | - | 1 (0.2%) | 7 (1.2%) | - | 74 (12.6%) | 7 (1%) | - | 8 (1.4%) |
| [53]HANSELL (North America) | 1990 | Case series | VBAC-2 | 35 | 27 (77%) | 0 (0%) | 0 (0%) | 1 (2.8%) | 4 (11.4%) | - | - | - |
| | | | CS | 135 | - | 1 (0.7%) | 2 (1.5%) | 11 (8.1%) | 39 (28%) | - | - | - |
| [50]CHATTOPADHYAY (Saudi Arabia) | 1994 | Case series | VBAC-2 | 115 | 103 (90%) | 1 (0.8%) | 1 (0.8%) | 1 (0.8%) | - | 3 (2.6%) | - | - |
| | | | CS | 1006 | - | 7 (0.7%) | 15 (1.4%) | 15 (1.4%) | - | 10 (1%) | - | - |
| [52]GRANOVSKY-GRISARU (Israel) | 1994 | Case series | VBAC-2 | 26 | 19 (73%) | 0 (0%) | 0 (0%) | 0 (0%) | 2 (7.7%) | 0 (0%) | 0 (0%) | - |
| | | | CS | 26 | - | 0 (0%) | 0 (0%) | 0 (0%) | 5 (19%) | 0 (0%) | 0 (0%) | - |
| [21]SPAANS (The Netherlands) | 2003 | Cohort | VBAC-2 | 59 | 49 (24%) | 1 (1.7%) | 1 (1.7%) | 4 (8%) | 5 (8%) | - | 15 (34.9 %) | 3 (7%) |
| | | | CS | 187 | - | 2 (1.06 %) | 0 (0%) | 19 (10%) | 17 (9%) | - | 39 (22.8 %) | 6 (3.5%) |
| [33]Garg (Saudi Arabia) | 2004 | Case series | VBAC-2 | 134 | 66 (49.2%) | - | 0 (0%) | 1 (15.1%) | 0 (0%) | - | - | - |
| | | | CS | 68 | - | - | 0 (0%) | 8 (57.5%) | 8 (11.8%) | - | - | - |
| [41]MACONES (North America) | 2005 | Cohort | VBAC-2 | 1082 | 807 (74.6%) | 20 (1.8%) | - | 10 (0.92%) | 96 (8.8%) | - | - | - |
| | | | CS | 2888 | - | 1 (0.03 %) | - | 34 (1.18%) | 366 (12.7%) | - | - | - |
| [45]LANDON (North America) | 2006 | Prospective Cohort | VBAC-2 | 975 | 684 (66%) | 9 (0.9%) | 6 (0.6%) | 31 (3.2%) | 30 (3.1%) | - | 75 (11.2 %) | - |
| | | | CS | 6035 | - | 0 (0%) | 27 (0.4%) | 93 (1.5%) | 129 (2.1%) | - | 514 (9.1%) | - |

| First author (Country) | Year | Study design | | Number of cases | Success rate | Uterine rupture | Hysterectomy | Transfusion | Fever-causing diseases | Perinatal mortalities | NICU admission | Low APGAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [20]MILLER (North America) | 2015 | Cohort | VBAC-2 | 152 | - | 1 (0.7%) | 0 (0%) | 3 (2%) | 4 (2.6%) | - | 25 (18.7%) | 3 (2%) |
| | | | CS | 6010 | - | 7 (0.1%) | 22 (0.4%) | 105 (1.8%) | 143 (2.4%) | - | 817 (13.6%) | 81 (0.9%) |
| [22] Modzelewski Poland | 2019 | Cohort | VBAC-2 | 22<br>35 | -<br>- | ،<br>، | ، | 1 (45%) | -<br>- | -<br>- | - | - |
| | | | CS | | | | 0 | 1 (2.9%) | | | - | - |
| TOTAL | - | - | VBAC-2 | 3172 | 2174.3020 (72%) | 33.3038 (1%) | 9.2090 (0.43%) | 51.2635 (2%) | 196.3021 (6.5%) | 15.642 (2.3%) | 115.1212 (9.5%) | 19.712 (2.7%) |
| | | | CS | 17039 | - | 19.16971 (0.1%) | 75.14151 (0.53%) | 285.16419 (1.7%) | 784.16000 (4.9%) | 17.1619 (1.1%) | 137.12258 (11.2%) | 65.6784 (1%) |

**Neonatal complications**

As mentioned before, the included studies reported APGAR scores in various formats. We used the Apgar score of <7 in minute 5, which was reported in three studies, as our format of choice for further analysis. 2.7% of the VBAC-2 group and 1% of CS-3 groups reported Apgar score of less than 7 in minute 5. Meta-analysis of the results returned a pooled OR of 1.944 with 95% CI of 1.020 to 3.706 (P=0.043, Mantel-Haenszel) (Figure 5). Therefore, the number of newborns with low Apgar score was significantly higher in the VBAC-2 group compared to the CS-3 group. Sensitivity analysis showed that removing any of the studies greatly changes the results, and each of the studies can be accounted as a source of heterogeneity.

Three studies specifically reported the perinatal mortality rate and its mean rate was 2.3% and 1.1% in VBAC-2 and CS-3, respectively. Our meta-analysis revealed a significant difference between VBAC-2 and CS-3 in case of mortality and showed that VBAC-2 had around 2-fold chance of perinatal mortality compared to CS-3 (pooled OR=2.186, 95% CI of 1.003 -4.763) (Figure 6). Furthermore, we carried out a sensitivity analysis, and it demonstrated that removing each of the Chattopadhyay, Sherbeeni and Anokute **(22)** or Phelan et al. studies significantly changed the outcome of our meta-analysis and these articles are sources of heterogenicity **(1, 22)**.

NICU admission was observed in 9.5% of VBAC-2 group, whereas 11.2% of CS-3 group required NICU admission. The meta-analysis of the available data from four studies showed a pooled OR of 0.993 and demonstrated that no significant difference exists between these two groups (Figure 7). Moreover, sensitivity analysis showed that removing any of the studies does not change this result.

Three of the included studies reported neonatal complications non-specifically. Farmakides, Duvivier **(23)** stated that no obvious neonatal complications were observed in both VBAC-2 and CS-3 groups **(23)**. Novas, Myers and Gleicher **(21)** reported that no significant difference exists in gestational age, APGAR scores and birth weight between two groups **(21)**. Moreover, in their study, no cases of perinatal deaths occurred. Garg and Ekuma-Nkama **(20)** reported no difference in neonatal complications between VBAC-2 and CS-3 patients **(20)**. Nevertheless, no data about neonatal complications were extracted from these articles.

## Discussion

Pooled data from twelve studies showed that vaginal birth after two previous cesarean sections (VBAC-2) has an acceptable success rate of 72%. Although maternal complications were found to be slightly higher in VBAC-2 patients, our pooled analysis demonstrated that maternal complications such as hysterectomy, blood and blood products transfusion

and fever were not significantly higher in VBAC-2 patients compared to patients undergoing cesarean section for the third time (CS-3). Data pertaining to neonatal complications were limited; however, pooled analysis of the available data showed that the rate of NICU admission is not significantly different between the two groups. On the other hand, perinatal mortality and APGAR score of <7 in minute 5 are significantly higher in VBAC-2 patients and these patients have around twofold risk compared to CS-3 patients. All things taken together, VBAC-2 is associated with higher risks, especially for neonates, compared to CS-3 and vaginal delivery remains the alternative choice for patients with a history of two previous cesarean sections.

Although many fear VBAC-2 because of the risk of uterine rupture or dehiscence, these complications are uncommon; approximately 1% of these patients developed uterine rupture. All of our included studies except one reported uterine rupture, and little difference was observed in the definition of uterine rupture between studies **(19)**. Miller and Grobman **(4)**, Landon, Spong **(28)** defined uterine rupture as dehiscence of uterine muscle and peritoneum or dehiscence of uterine muscle and its expansion of the bladder and broad ligament. Macones, Cahill **(25)** defined it as signs and symptoms of intraperitoneal bleeding or scar dehiscence that is immediately diagnosed by decelerations in neonatal heart rate **(25)**. In more recent studies, the risk of uterine rupture is decreased owing to the knowledge about previous uterine scars in most of the cases.

The overall risk of hysterectomy is 0.43%, and it is not significantly different between VBAC-2 and CS-3. High risk of hysterectomy is partly due to the development of placenta accreta and/or placenta previa because of previous cesarean sections.

Fever causing diseases included endometritis and other infections and no significant difference was observed between VBAC-2 and CS-3, however, older studies reported a higher incidence of fever-causing diseases which may be due to lack of the usage of prophylactic antibiotics prior to surgery.

The percentage of women that underwent VBAC-2 was different in various studies because of distinct inclusion criteria. This percentage was lowest in Miller et al. study (1.5%) **(4)** and highest in Novas, Myers and Gleicher (21) study (52%) It is obvious that the success rate of VBAC-2 is higher in studies with more meticulous inclusion criteria, however, no definite inclusion criteria were observed in our included studies.

The rate of perinatal mortality was considerably higher in VBAC-2 (2.3%) compared to CS-3 (1.1%). The three included studies that reported perinatal mortality were carried out during the last 6 decades and during this period neonatal care equipment have developed significantly, therefore it seems logical that nowadays the rate of perinatal mortality is not as high as observed in these studies.

Our search did not return any studies in this field in Iran, however various studies were found throughout the world, indicating the importance of vaginal delivery after the second cesarean section. Our systematic review and meta-analysis included studies from 1980 until 2016. Various systematic reviews exist on the subject of vaginal delivery after cesarean section, but most of them discussed the complications and outcomes of VBAC-1 **(8, 29-31)**. Tahseen and Griffiths **(10)** published the most recent systematic review, where they aimed to compare the success rate and complications of VBAC-1 and VBAC-2 **(10)**. Furthermore, they compared VBAC-2 with CS-3. They demonstrated that complications of VBAC-1 are significantly lower than VBAC-2 however, the rate of complications of cesarean section for the third time was not significantly different from VBAC-2.

Results of some studies showed that women with a previous experience of vaginal delivery prior to cesarean section have a higher chance of success in VBAC **(1, 25, 32, 33)**. Although Chattopadhyay et al. and Spaan et al. demonstrated no superior success in VBAC for patients with a prior history of vaginal delivery compared to women who have only had cesarean sections **(22, 27)**, they studied a smaller sample size; thus, their results are incomparable to previously mentioned studies. Moreover, in women that request vaginal birth, a trial of labor is associated with lower maternal morbidity, fever-causing diseases and the need for transfusion compared to repeat cesarean section **(32)**. According to the ACOG guidelines in 2004, only women with a prior history of vaginal birth are suitable candidates for VBAC-2.

The study of Macones, Cahill **(25)** suggested that uterine rupture in VBAC-2 is more common in women that needed induction or augmentation or had no prior history of vaginal delivery **(25)**. Therefore, it is recommended that we only carry out VBAC-2 in patients with a history of prior vaginal birth **(25)**. Moreover, use of induction or augmentation is discouraged due to increased risk of uterine rupture. In a survey Modzelewski, Jakubiak-Proc **(34)** in 2019 it has shown that TOLAC-2 is a safe procedure with a reasonable success rate. Although, RCS and VBAC-2 are high risk operations, trained personnel and sufficient resources can decrease the risk significantly **(34)**.

Women with previous two cesarean sections should have the liberty to choose between the VBAC-2 and cesarean section for the third time; however, this choice can significantly affect the upcoming pregnancies and deliveries, as repetitive cesarean sections can increase the risk of placenta accreta and/or placenta previa. Moreover, a successful VBAC is a protective factor against future cesarean sections, failure in vaginal birth in upcoming pregnancies and placenta accreta and/or previa.

Doret, Touzet **(31)** reported that 23.8% of obstetricians recommend cesarean section to women with one or two previous cesarean sections **(31)**. Moreover, uterine rupture was reported to occur in 14.2% of VBACs which is significantly higher than the actual number. Evaluating the benefits and safety of vaginal birth after two previous cesarean sections can lead to a decreased number of cesarean sections, which in turn decreases the associated complications of multiple and repetitive cesarean sections. The acquired statistics from relevant studies may be helpful in approaching women with two prior cesarean sections and counseling the suitable candidates for VBAC-2.

Our study had several limitations, considering that the studies that were included were carried out over six decades their results have significant differences. Most cases of VBAC in America were carried out during 1980 and 1990s, and more recent studies had more strict criteria to carry out VBAC. Some studies reported data about VBAC irrespective of the number of previous cesarean sections (one or two previous cesarean sections). Furthermore, some studies included patients with uterine scars of unknown origin, which can accompany increased risks and complications, therefore causing bias in the outcome. Another important limitation is that all our included studies were observational, which may overestimate the complications. Nevertheless, due to the lack of experimental studies and randomized controlled trials, the results of our meta-analysis are acceptable.

## Conclusion

Vaginal delivery is a suitable option for women with two previous cesarean sections, however, the clinical outcomes are more favorable for women with a history of vaginal birth. Moreover, induction and augmentation are not recommended in VBAC-2 in order to prevent uterine rupture and improve the success rate. Considering the increased risk of neonatal mortality and morbidities in VBAC-2, patients undergoing a trial of labor should be monitored carefully in well-equipped centers. Additional research is required for further characterization of VBAC-2 complications and strategies to prevent them. Moreover, randomized control trials comparing VBAC-2 and cesarean section for the third time can aid specialists counsel their patients to choose the best delivery method.

## Acknowledgments

The present study has been adopted from medical thesis written by Dr. Reyhaneh Rahmani in obstetrics and gynecology at Mashhad University of Medical Sciences (code: P-8609). This study was conducted with the financial and spiritual supports of the Deputy of Research at Mashhad University of Medical Sciences.

## Conflict of Interest

The authors have no conflict of interest to disclose.

## Funding

None.

## References

1. Phelan JP, Ahn MO, Diaz F, Brar HS, Rodriguez MH. Twice a cesarean, always a cesarean? Obstet Gynecol. 1989;73(2):161-5.
2. Allameh T, Allameh Z, Javanmardi Z, Moazam E, Dehghan M. Comparison of the Maternal and Fetal Complications of Vaginal Birth After C-Section (VBAC) and Repeat Cesarean Section in Isfahan Province. J Obstet Gynecol Cancer Res. 2023;8(2):131-6. [DOI:10.30699/jogcr.8.2.131]
3. Dabiran S, Khosravi S, Pourali L, Ayati S, Mohaddes Ardebili Z, Delavari S. Childbearing in Advanced Maternal Age and Pregnancy Outcomes: A Cross-Sectional Study. J Obstet Gynecol Cancer Res. 2022;8(1):35-40. [DOI:10.30699/jogcr.8.1.35]
4. Miller ES, Grobman WA. Obstetric outcomes associated with induction of labor after 2 prior cesarean deliveries. Am J Obstet Gynecol. 2015; 213(1):89. e1-. e5. [DOI:10.1016/j.ajog.2015.02.003] [PMID]
5. Thomas J, Paranjothy S. The national sentinel caesarean section audit report. RCOG Press; 2001.
6. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal Morbidity Associated With Multiple Repeat Cesarean Deliveries. Obstet Gynecol. 2006;107(6):1226-32. [PMID] [DOI:10.1097/01.AOG.0000219750.79480.84]
7. Rosen MG, Dickinson JC, Westhoff CL. Vaginal birth after cesarean: a meta-analysis of morbidity and mortality. Obstet Gynecol. 1991;77(3):465-70.
8. McMahon MJ, Luther ER, Bowes Jr WA, Olshan AF. Comparison of a trial of labor with an elective second cesarean section. New Eng J Med. 1996;

335(10):689-95. [DOI:10.1056/NEJM199609053351001] [PMID]

9. Rossi AC, D'addario V. Maternal morbidity following a trial of labor after cesarean section vs elective repeat cesarean delivery: a systematic review with metaanalysis. Am J Obstet Gynecol. 2008;199(3):224-31. [DOI:10.1016/j.ajog.2008.04.025] [PMID]
10. Tahseen S, Griffiths M. Vaginal birth after two caesarean sections (VBAC-2)-a systematic review with meta-analysis of success rate and adverse outcomes of VBAC-2 versus VBAC-1 and repeat (third) caesarean sections. BJOG: Int J Obstet Gynaecol. 2010;117(1):5-19. [PMID] [DOI:10.1111/j.1471-0528.2009.02351.x]
11. Jamelle RN. Outcome of unplanned vaginal deliveries after two previous caesarean sections. J Obstet Gynecol Res. 1996;22(5):431-6. [PMID] [DOI:10.1111/j.1447-0756.1996.tb01053.x]
12. Guettier X, Marpeau L, Larue L, Jault T, RHINI Z, Barrat J. Utérus bicicatriciel: peut-on autoriser la voie basse? J de gynécologie obstétrique biologie de la reproduction. 1992;21(1):103-7.
13. Wijesinghe P, Ekanayake C. Twice a caesarean, always a caesarean: fact or fiction? Sri Lanka J Obstet Gynecol. 2013;34(4):131-4. [DOI:10.4038/sljog.v34i4.5926]
14. Bretelle F, Cravello L, Shojai R, Roger V, D'ercole C, Blanc B. Vaginal birth following two previous cesarean sections. Eur J Obstet Gynecol Reprod Biol. 2001;94(1):23-6. [DOI:10.1016/S0301-2115(00)00328-6] [PMID]
15. Flamm BL, Newman LA, Thomas SJ, Fallon D, Yoshida MM. Vaginal birth after cesarean delivery: results of a 5-year multicenter collaborative study. Obstet Gynecol. 1990;76(5 Pt 1):750-4. [PMID] [DOI:10.1097/00006250-199011000-00004]
16. Porreco R, Meier P. Trial of labor in patients with multiple previous cesarean sections. J Reprod Med. 1983;28(11):770-2.
17. Pruett KM, Kirshon B, Cotton DB. Is vaginal birth after two or more cesarean sections safe? Obstet Gynecol. 1988;72(2):163-5.
18. Humphries C, Tjioe Y, Mayhew S, Wright B, Epee-Bekima M, editors. VBAC2: Rates of Success and Maternal and Neonatal Morbidity with Attempted Vaginal Birth after Two Caesarean Sections in Western Australia. Aust N Z J Obstet Gynaecol. 2017;57:48-9.
19. Garg VK, Ekuma-Nkama E. Vaginal birth following two cesarean deliveries-are the risks exaggerated? Ann Saudi Med. 2004;24:276-9. [DOI:10.5144/0256-4947.2004.276] [PMID] [PMCID]
20. Garg V, Ekuma-Nkama E. Vaginal birth following two cesarean sections. Int J Gynecol Obstet. 2005;88(1):53-4. [DOI:10.1016/j.ijgo.2004.09.009] [PMID]
21. Novas J, Myers SA, Gleicher N. Obstetric outcome of patients with more than one previous cesarean section. Am J Obstet Gynecol. 1989; 160(2):364-7. [PMID] [DOI:10.1016/0002-9378(89)90446-8]
22. Chattopadhyay SK, Sherbeeni MM, Anokute CC. Planned vaginal delivery after two previous caesarean sections. BJOG: Int J Obstet Gynaecol. 1994;101(6):498-500. [PMID] [DOI:10.1111/j.1471-0528.1994.tb13149.x]
23. Farmakides G, Duvivier R, Schulman H, Schneider E, Biordi J. Vaginal birth after two or more previous cesarean sections. Am J Obstet Gynecol. 1987;156(3):565-6. [DOI:10.1016/0002-9378(87)90051-2] [PMID]
24. Granovsky-Grisaru S, Shaya M, Diamant YZ. The management of labor in women with more than one uterine scar: is a repeat cesarean section really the only "safe" option? J Perinat Med. 1994;22(1):13-7. [DOI:10.1515/jpme.1994.22.1.13] [PMID]
25. Macones GA, Cahill A, Pare E, Stamilio DM, Ratcliffe S, Stevens E, et al. Obstetric outcomes in women with two prior cesarean deliveries: is vaginal birth after cesarean delivery a viable option? Am J Obstet Gynecol. 2005;192(4):1223-8. [DOI:10.1016/j.ajog.2004.12.082] [PMID]
26. Dodd J, Crowther C. Vaginal birth after Caesarean versus elective repeat Caesarean for women with a single prior Caesarean birth: a systematic review of the literature. Aust N Z J Obstet Gynaecol. 2004;44(5):387-91. [DOI:10.1111/j.1479-828X.2004.00257.x] [DOI:10.1111/j.1479-828X.2004.00258.x]
27. Spaans WA, van der Vliet LM, Röell-Schorer EA, Bleker OP, van Roosmalen J. Trial of labour after two or three previous caesarean sections. Eur J Obstet Gynecol Reprod Biol. 2003;110(1):16-9. [DOI:10.1016/S0301-2115(03)00082-4] [PMID]
28. Landon MB, Spong CY, Thom E, Hauth JC, Bloom SL, Varner MW, et al. Risk of uterine rupture with a trial of labor in women with multiple and single prior cesarean delivery. Obstet Gynecol. 2006;108(1):12-20. [PMID] [DOI:10.1097/01.AOG.0000224694.32531.f3]
29. Guise J-M, Denman MA, Emeis C, Marshall N, Walker M, Fu R, et al. Vaginal birth after cesarean: new insights on maternal and neonatal outcomes. Obstet Gynecol. 2010;115(6):1267-78. [DOI:10.1097/AOG.0b013e3181df925f] [PMID]
30. Guise J-M, Berlin M, McDonagh M, Osterweil P, Chan B, Helfand M. Safety of vaginal birth after

cesarean: a systematic review. Obstet Gynecol. 2004;103(3):420-9. [PMID] [DOI:10.1097/01.AOG.0000116259.41678.f1]

31. Doret M, Touzet S, Bourdy S, Gaucherand P. Vaginal birth after two previous c-sections: obstetricians-gynaecologists opinions and practice patterns. J Matern-Fetal Neonatal Med. 2010;23(12):1487-92. [DOI:10.3109/14767051003678176] [PMID]
32. Cahill AG, Stamilio DM, Odibo AO, Peipert JF, Ratcliffe SJ, Stevens EJ, et al. Is vaginal birth after cesarean (VBAC) or elective repeat cesarean safer in women with a prior vaginal delivery? Am J Obstet Gynecol. 2006;195(4):1143-7. [DOI:10.1016/j.ajog.2006.06.045] [PMID]
33. Hansell RS, McMurray KB, Huey GR. Vaginal birth after two or more cesarean sections: a five-year experience. Birth. 1990;17(3):146-50. [DOI:10.1111/j.1523-536X.1990.tb00722.x] [PMID]
34. Modzelewski J, Jakubiak-Proc M, Materny A, Sotniczuk M, Kajdy A, Rabijewski M. Safety and success rate of vaginal birth after two cesarean sections: retrospective cohort study. Ginekol Pol. 2019;90(8):444-51. [DOI:10.5603/GP.2019.0076] [PMID]

**How to Cite This Article:**

Salehi, M., Pourali, L., Rahmani, R., Ayati, S., Fardi, E., Mehrad-Majd, H., et al. Vaginal Birth After Two Cesarean Sections (VBAC-2), Success Rate and Adverse Outcomes of VBAC-2 Versus VBAC-1 and Repeat Cesarean Sections: Systematic Review and Meta-Analysis. J Obstet Gynecol Cancer Res. 2024;9(3):240-8.

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