To give and to assist birth after cesarean

Rietveld, A.L.

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Effect of interpregnancy interval on the success rate of trial of labor after cesarean

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Anna L. Rietveld
Pim W. Teunissen
Brenda M. Kazemier
Christianne J.M. De Groot

ABSTRACT

Objective

The objective of this study is to investigate the association between interpregnancy interval and success of vagina! birth after cesarean.

Study design

Retrospective 10-year cohort study of pregnant women with one prior cesarean, who opted for trial of labor (n = 36 653). lnterpregnancy interval is the time between cesarean and next conception. Vagina! birth success rates were compared between six interval groups. Analysis was performed pooled as well as stratified for induction of labor. Adjusted odds ratios were calculated.

Results

Success rate in the reference group (12 to 24 months) was 72%. Success rates were sim i lar among those with an interval of less than 24 months. lntervals of 24 months or more showed a decrease in success rate; 70% in 24- to 35-month intervals (adjusted odds ratio 0.92 (0.87 to 0.98)), 67% in 36- to 59-month intervals (adjusted odds ratio 0.87 (0.81 to 0.94)) and 62% in intervals of more than 60 months (adjusted odds ratio 0.77 (0.67 to 0.88)).

Conclusion

An interpregnancy interval of < 24 months is not associated with a decreased success of vagina! birth after cesarean. Success rates decrease when interval increases.

INTRODUCTION

The rate of cesareans has been rising, reaching 32% of all births in the United States.[1] Cesareans are associated with short term maternal and neonatal risks, as well as complications in subsequent pregnancies, including uterine rupture, placenta previa and massive hemorrhage.[2,3] The risk of complications increases with every repeat cesarean.[4] The biggest contributor to increasing risks associated with multiple cesareans is the elective repeat cesarean after a first cesarean.[5] Vaginal birth after cesarean is considered a reasonable manner to bring the rising cesarean rate and its accompanying morbidity to a halt. All women eligible for vaginal birth after cesarean are counseled by their obstetrician to determine the intended mode of delivery. Factors known to influence success chance include maternal age, ethnicity, neonatal birth weight and indication for the priorcesarean.[6,7] Another factor guidelines consider to reduce success chance is an interval of less than two years between previous cesarean and next pregnancy.[8,9] The evidence underlying this assumption is limited. To our knowledge, only two studies focused on the role of interpregnancy interval on success chance of trial of labor, showing no difference in success rates.[10,11] When guidelines state a short interpregnancy interval reduces chance of a vaginal delivery after a first cesarean, obstetrician smight discourage women pregnant within 2 years after their cesarean to opt for trial of labor. In order to provide evidence-based prelabor counseling, more information about the influence of interpregnancy interval on success chance of vaginal delivery is needed. We conducted a retrospective 10-year cohort study to investigate the relation between interpregnancy interval and success rate of trial of labor after a first cesarean.

MATERIALS AND METHODS

We studied women who delivered twice between 1 January 2000 and 31December 2009 in the Netherlands. Data were collected by the Netherlands Perinatal Registry (PRN). This registry contains information on pregnancies, deliveries and neonatal (re)admissions until 28 days after birth. The database consists of three different registries that are linked by a validated linkage procedure; the midwifery registry, the obstetrics registry and the neonatology registry.[12,13] All data in the PRN are registered routinely by caregivers during prenatal care, delivery and the neonatal period. After informing women on the database, consent in presumed for the collection of information on pregnancy, delivery and neonate, if a woman did not make use of the opportunity to object. Data are sent annually to a national registry office, where they are checked for inconsistencies by data managers. Inconsistent records are sent back to the caregiver with a request to correct them. If compulsory items are not scored, the record is eliminated from the database. The PRN covers ~ 95%of all deliveries in the Netherlands.[14] As records included in the registry are entered at child level, there is no unique maternal identifier available to follow-up on outcomes of subsequent pregnancies of the same mother. A longitudinal probabilistic linkage procedure was performed to link records of children of the same mother. At the moment of our analysis, this linkage procedure was completed up until 31 December 2009. A more detailed description of this procedure is described by Schaaf et al.[15] The PRN approved usage of the database for our study (approval number 15.41). No procedural changes were made during the 10-year study period regarding data registry maintenance or gathering. The neonatal registry was updated in 2008. As for our cohort, only the scoring of wet lung might have been affected by this update. Concerning our cohort, the vast majority of data on the delivery stemmed from the obstetrics registry, as deliveries of women with a previous cesarean take place under responsibility of an obstetrician. Data on demographic characteristics and previous delivery may stem from either the midwifery or the obstetrics

registry, since antenatal care for women with a previous cesarean and an uncomplicated pregnancy in the Netherlands may take place in midwife-led care until the 36th week of gestation. We included women with a history of one cesarean and no previous vaginal delivery who opted for a trial of labor in their subsequent ongoing pregnancy. We excluded women with a gestational age of less than 37 or more than 43 weeks, a multifetal pregnancy, or congenital malformations in their first or second pregnancy. Women with a non-cephalic presentation or antepartum fetal demise in their second pregnancy were also excluded. We divided the study group into subgroups based on interpregnancy interval. Interpregnancy interval was chosen over interdelivery interval to provide data that can be used in antepartum counselling on the intended mode of delivery. During the antepartum counselling, a woman and her obstetrician know what the woman's interpregnancy interval is, while it is still uncertain what her interdelivery interval will be. Interpregnancy interval was defined as time in months between cesarean in first pregnancy and the start of amenorrhea in next ongoing pregnancy. Conception date was estimated by subtracting gestational age from date of delivery. We created subgroups based on available literature on this topic and guided by current clinical practice: less then 6 months, 6 to 11completed months, 12 to 23 completed months, 24 to 35 completed months, 36 to 59 completed months and 60 months or more. Primary outcome was mode of delivery: unplanned repeat cesarean (unsuccessful trial of labor) or vaginal birth (successful trial of labor), including instrumental deliveries. Secondary outcomes were adverse events, defined as uterine rupture, postpartum hemorrhage (defined as blood loss more than 1000 ml), manual removal of placenta, 5 min Apgar < 7, neonatal death and wet lung disease. Secondary outcomes were analyzed in three interpregnancy interval groups, that is, < 12 months, 12 to 23 completed months, and 24 months and more. This division was made to increase power of theanalyses given the low occurrence of adverse events.

Statistical analysis

Results were analyzed using Statistical Analysis Software 9.2 (SAS Institute Inc., Cary, NC, USA). To compare baseline characteristics, we calculated statistical significance for differences in discrete measures using the $\chi 2$-testand analysis of variance. For testing differences in success percentages between interpregnancy intervals we used multivariate logistic regression calculating odds ratios and 95% confidence intervals, adjusting for maternal age in second delivery, low socio-economic status based on postal code (yes/no), Caucasian ethnicity (yes/no), first cesarean planned(yes/no) and year of second delivery. The largest group was taken as the reference group, which was the group with an interpregnancy interval of 12 to 23 completed months. After initial analysis, we inserted non-reassuring fetal status as a reason for intervention (yes/no) into the multivariate logistic regression to test its influence on odds ratio and 95% confidence interval. To compare the occurrence of adverse events we used the chi square statistic, without adjusting. For baseline characteristics and secondary outcome measures, a P-value < 0.01 was considered statistically significant.

RESULTS

Figure 1 shows the flow diagram of data extraction of our studypopulation from the PRN. Our cohort consisted of 36 653 pregnant women with one prior term cesarean and no history of vaginal birth who started a term trial of labor. Of the 36 653 women, 1157(3.2%) had an interpregnancy interval of o 6 months, 6153 (17%)of 6 to 11 months, 15 891 (43%) of 12 to 23 months (reference group), 8033 (22%) of 24 to 35 months, 4472 (12%) of 36 to59 months and 947 (2.6%) of 60 months or more.

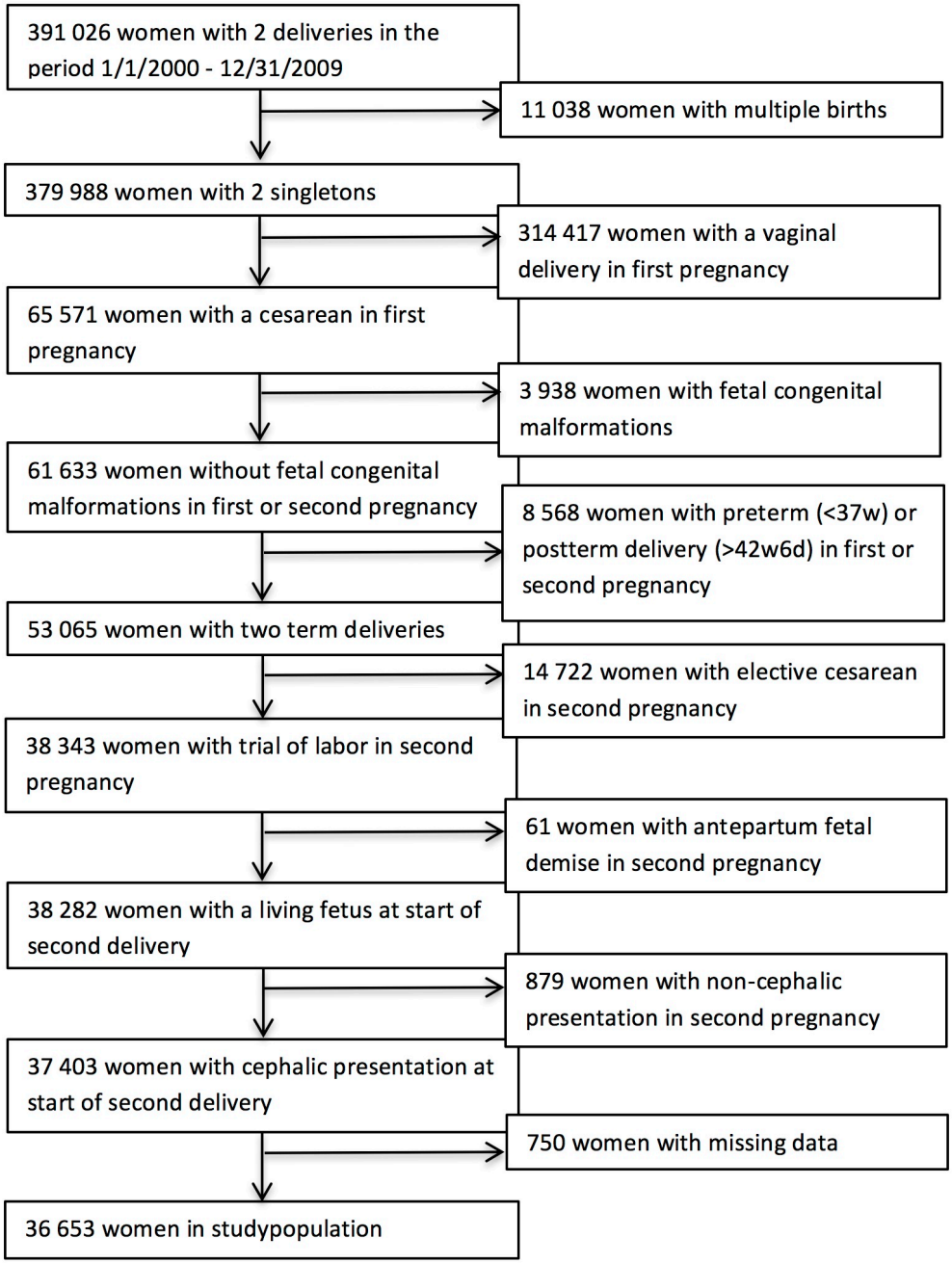

Figure 1 . Flow diagram of data extraction.

Table 1 reports demographic characteristics, obstetrical history and characteristics of the second pregnancy for each of the six interpregnancy interval groups. Most characteristics differed significantly between the groups. In Supplementary Table S1 distribution of years of second delivery among the different intervals is presented. Table 2 reports rates of successful trial of labor after cesarean per interpregnancy interval group, adjusted odds ratios and 95% confidence intervals. Success rates at intervals < 24 months did not differ. We detected a difference in success rates when the interpregnancy interval exceeded 24 months. This effect was seen in women with spontaneous onset of labor, as well as in the group whose labor was induced. Table 3 shows the analysis of adverse outcomes. Adverse events were uncommon and no significant differences in adverse outcomes were found.

Table 1. Maternal characteristics by interpregnancy interval

	Interpregnancy interval (completed months)						
	<6 (n=1 157)	6-11 (n=6 153)	12-23 (n=15 891)	24-35 (n=8 033)	36-59 (n=4 472)	60> (n=947)	*p*
Demographic characteristics in second delivery							
Low SES	310 (27)	1 160 (19)	2 759 (17)	1 622 (20)	1 115 (25)	275 (29)	<.01
Caucasian ethnicity	941 (81)	5 501 (89)	14 682 (92)	7 159 (89)	3 703 (83)	731 (77)	<.01
Maternal age (y)	30.3 (5.0)	31.4 (4.3)	31.8 (3.9)	32.2 (3.9)	32.6 (4.1)	33.6 (4.3)	<.01
Obstetrical history							
First cesarean planned	283 (24)	1 737 (28)	4 638 (29)	2 430 (30)	1 240 (28)	237 (25)	<.01
GA 1st delivery (wk)	40.0 (1.4)	40.0 (1.4)	40.0 (1.4)	39.9 (1.4)	40.0 (1.4)	40.0 (1.4)	<.01
2nd delivery characteristics							
GA 2nd delivery (wk)	40.0 (1.2)	40.3 (1.1)	40.1 (1.2)	40.0 (1.2)	40.0 (1.2)	39.9 (1.2)	<.01
Induction of labor	523 (45)	2 653 (43)	6 770 (43)	3 554 (44)	2 020 (45)	506 (53)	<.01
NRFS	244 (21)	1 305 (21)	3 393 (21)	1 935 (24)	1 183 (26)	268 (28)	<.01
OVD	186 (16)	1 080 (18)	2 845 (18)	1 430 (18)	820 (18)	162 (17)	.56
Macrosomia[1]	43 (3.7)	271 (4.4)	693 (4.4)	330 (4.1)	145 (3.2)	26 (2.8)	<.01

Abbreviations: GA, gestational age; NRFS, non-reassuring fetal status; OVD, operative vaginal delivery; SES, socio-economic status. Data are presented as number (percentage) or mean (s.d.). [a]Birth weight above 4500g.

Table 2. Association between interpregnancy interval and successful TOLAC

Interpregnancy interval	Successful TOLAC	*Total population* aOR (95% CI)[1] n = 36 653	*Induction of labor* aOR (95%CI)[1] n = 16 026	*Spontaneous* aOR (95% CI)[1] n = 20 627
Less than 6 months	814 (70)	0.94 (0.82-1.07)	0.84 (0.70-1.02)	0.99 (0.83-1.20)
6-11 months	4 421 (72)	0.99 (0.92-1.05)	0.97 (0.88-1.07)	0.99 (0.91-1.09)
12-23 months	11 477 (72)	Reference	Reference	Reference
24-35 months	5 633 (70)	0.92 (0.87-0.98)	0.91 (0.83-0.99)	0.90 (0.83-0.98)
36-59 months	3 017 (67)	0.87 (0.81-0.94)	0.81 (0.73-0.90)	0.79 (0.72-0.88)
More than 60 months	591 (62)	0.77 (0.67-0.88)	0.68 (0.56-0.81)	0.63 (0.52-0.77)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; TOLAC, trial of labor after cesarean. Data are presented as number (percentage). [a]Multivariate models included the following covariates: maternal age in second delivery, low socio-economic status (yes/no), Caucasian ethnicity (yes/no), first cesarean planned (yes/no), year of second delivery.

Table 3. Maternal and neonatal outcomes per interpregnancy interval in months

	Interpregnancy interval (completed months)			
	0-11 (n=7 310)	12-23 (n=15 891)	24 or more (n=13 452)	*p*
Maternal outcomes				
Successful TOLAC	5 235 (71.6)	11 477 (72.2)	9 241 (68.7)	<.01
PPH[1]	480 (6.6)	1 005 (6.3)	877 (6.5)	.71
Uterine rupture[2,3]	19 (0.26)	32 (0.20)	21 (0.16)	.27
Manual removal of placenta	176 (2.4)	372 (2.3)	346 (2.6)	.43
Neonatal outcomes				
5-minute Apgar <7	93 (1.3)	164 (1.0)	183 (1.4)	.03
Neonatal death	7 (0.10)	18 (0.11)	17 (0.13)	.82
Wet lung[3]	31 (0.42)	76 (0.48)	80 (0.59)	.19

Data are presented as number (percentage). TOLAC, trial of labor after cesarean; PPH, postpartum hemorrhage. [1]Defined as blood loss exceeding 1000ml. [2]Defined as the complete separation of the uterine scar resulting in communication between the uterine and peritoneal cavities. [3]Item not compulsory to score in PRN-database. Rates may be an underestimation.

DISCUSSION

In this large nationwide cohort, we demonstrated that in women with one prior cesarean and no history of vaginal delivery, an interpregnancy interval of < 2 years is not associated with a reduced success rate of trial of labor after cesarean. The success rate is lower in intervals of > 2 years. No association between adverse outcomes and interpregnancy interval was found. Two previous studies have investigated the role of time between a cesarean and next pregnancy or delivery in the success chance of trial of labor.[10,11] Landon et al.[11] studied 10 690women with an interdelivery interval of less or more than 2 years. Huang et al.[10] studied 1516 women, comparing interdelivery intervals of less and more than 19 months. Both studies found no difference in success rates after spontaneous labor onset. However, they lacked a subdivision into multiple interval categories. Our study shows, when considering smaller inter-pregnancy interval categories, that success rates do not differ in intervals shorter than 2 years (with success rates of 70 to 72%), and decreases with intervals of 2 years or longer (with success rates of 62 to 70%).Uterine rupture rates in women with short interpregnancy intervals differ in literature between 0.90 and 5.0%. A study investigating uterine rupture in the Netherlands estimated an overall rupture rate of 0.64% in trial of labor after cesarean.[16] In the current study, rates of uterine rupture were 0.16 to 0.26%, with a non-significant decrease in rupture rates when the interpregnancy intervals increased. The most plausible reason for this discrepancy is underreporting in our database since uterine rupture is not a compulsory item to score in the PRN. The percentage of induced deliveries in our cohort ranges from 43 to 53%. The mode of start of delivery (either spontaneous, induction or primary cesarean) is a compulsory item to score in the PRN, so we do not believe this is an inaccurate representation of reality. This study did not find an effect of induction on success rate of trial of labor. Previous research indicated that women who were induced and had an interval of less than 19 months, had a higher risk of unsuccessful trial of labor.[10] That subgroup consisted of only 7 women, whereas we were able to include 3176 women with an interpregnancy interval of less than 12 months, whose labor

was induced. It would be interesting to study reasons for the relatively high induction rate, especially in women with a uterine scar, as induction is a risk factor for uterine rupture.[17] Successful vaginal birth after cesarean rates differ widely across the Western world, from 9% in the United States to 55% in the Netherlands.[18] In our study, 72% of women with a prior cesarean underwent trial of labor. Because trial of labor after cesarean is common in the Netherlands, the Dutch cohort is apt to study a question as ours. We believe our results are generalizable to other countries with a comparable patient population. However, based on current data we cannot estimate what the effect of an obstetrician's practical experience with vaginal birth after cesarean on the success chance might be. Moreover, no adjustment could be made for the fact that obstetricians might treat women with different interpregnancy intervals differently. The exploration of these effects is beyond the scope of this article, but would be interesting to study internationally.

Strengths and limitations

The data we analyzed originated from a database with a confined set of items. We experienced two disadvantages. First, we were not able to rule out a selection bias. Women with different intervals might be counseled differently on the intended mode of delivery, leading to a variation in baseline population between the groups. Furthermore, the labor itself might be conducted differently between the groups. For example, the results show a higher proportion of non-reassuring fetal status in women with longer interpregnancy intervals. The same proportions of operative vaginal deliveries were found, meaning that possibly more cesareans are performed because of suspected fetal distress. The increase in non-reassuring fetal status in longer intervals could mean fetal hypoxia is occurring more often in longer intervals, but by definition it only indicates that the fetal heart rate pattern is more often assessed as non-reassuring. We found no increase in low 5 min Apgar scores in longer intervals. This could mean the decision-making process during trial of labor is influenced by factors not directly labor-related, such as age. Second, we were unable to adjust for certain known and unknown confounders. The odds ratios we observed may be in a range of a zone of potential bias.[19] Therefore, we cannot rule out that bias of unknown kind accounts for the small associations we found between a relatively long interpregnancy interval and decreases success change of trial of labor. A possible confounder is body mass index, which might rise when interpregnancy interval increases. A body mass index above 30 kg/m^2 is known to reduce success chance of trial of labor after cesarean.[11] However, in the Netherlands, mean body mass index in 2009–2010 was 24.4 kg/m^2, which makes body mass index unlikely to fully account for the decline in success rate.[20] We adjusted for factors considered to influence success chance as far as available in our database, but were not able to adjust for unknown variables. This could make the statement that a longer interval results in a decreased success chance questionable. However, the observation that a shorter interval is not associated with a decreased success chance is probably a more important one, and can be retained. The strength of this study is the fact that we were able to investigate the outcomes of trial of labor in a very large group of women. We were able to subdivide the study group into multiple interpregnancy intervals, in order to provide a tailor-made answer to the question if interpregnancy interval is related to success chance in trial of labor after cesarean.

CONCLUSION

American and Dutch guidelines on vaginal birth after cesarean suggest that a short interpregnancy interval is a factor decreasing the likelihood of successful trial of labor after cesarean.[8,9] Based on our data, we cannot confirm this suggestion. Our results show a shorter interval is not associated with a decreased success chance. Therefore, we propose that the success chance based on interpregnancy interval should not be taken into account when counseling women who are pregnant after a cesarean and need to decide on the intended mode of their delivery.

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Supplementary Information

Accompanying the paper on the Journal of Perinatology website (http://www.nature.com/jp)

Supplemental table 1. Distribution of calendar year of second delivery per interpregnancy interval

	Interpregnancy interval (completed months)					
	<6 (n=1 157)	6-11 (n=6 153)	12-23 (n=15 891)	24-35 (n=8 033)	36-59 (n=4 472)	60> (n=947)
2000	113 (9.8)	253 (4.1)	0 (0)	0 (0)	0 (0)	0 (0)
2001	130 (11.2)	566 (9.2)	38 (0.24)	28 (0.35)	0 (0)	0 (0)
2002	127 (10.9)	640 (10.4)	1118 (7.0)	656 (8.2)	19 (0.42)	0 (0)
2003	126 (10.9)	776 (12.6)	1653 (10.4)	926 (11.5)	324 (7.3)	0 (0)
2004	145 (12.5)	709 (11.5)	1961 (12.5)	1106 (13.8)	580 (13.0)	4 (0.42)
2005	98 (8.5)	680 (11.1)	1881 (11.8)	1069 (13.3)	691 (15.5)	71 (7.5)
2006	108 (9.3)	616 (10.0)	1812 (11.4)	1162 (14.5)	734 (16.4)	124 (13.1)
2007	109 (9.4)	605 (9.8)	1830 (11.5)	1029 (12.8)	721 (16.1)	219 (23.1)
2008	102 (8.8)	673 (10.9)	1809 (11.4)	1101 (13.7)	746 (16.7)	254 (26.8)
2009	99 (8.6)	635 (10.3)	1799 (11.3)	956 (11.9)	657 (14.7)	275 (29.0)

Data are presented as number (percentage)