Beyond the short term effects of caesarean delivery and gynaecological surgery
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Chapter 6

Balancing risks and benefits: Preventing first birth Caesarean section due to non-progressive labour

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ABSTRACT

Objective
To estimate the risks of maternal and neonatal complications in a pregnancy after a first delivery Caesarean Section (CS) for non-progressive labour in a low risk population and to compare these to a first vaginal delivery.

Study design
Prospective national cohort study using the Dutch Perinatal Registry.

Population
We analyzed data of 169,792 women with a first and second delivery from 2000-2007. The total cohort consisted of 15,045 women with a history of first delivery CS due to non-progressive labour (CS cohort) and 154,747 women with a first birth vaginal delivery (VD cohort).

Results
In the CS cohort, 31% of the women delivered their second infant by elective CS, 45% had a vaginal delivery and 24% had an emergency CS. In the VD cohort, 95% delivered again vaginally, 3% had an elective CS and 2% had an emergency CS. We found significant more uterine rupture (0.1% vs 0.006% P<0.0001) and blood transfusions (0.29% vs 0.14% P=0.02) after prior CS compared to prior VD. Perinatal death rates were lower after prior CS than after prior VD (0.13% vs 0.23% p<0.0001)(0.06% vs 0.08% p<0.02).

Conclusion
In women who had a CS due to non-progressive labour, adverse maternal and neonatal rates in a subsequent pregnancy are low. The successful VBAC rates in our low risk cohort justify counselling for TOL. The protective effect of prior CD for antenatal death in a next pregnancy requires further evaluation. The reason for this protective effect is not clear and requires further evaluation.
INTRODUCTION

Historical context of caesarean delivery
Surgical termination of pregnancy or delivery by operative opening of the uterus has been practiced for centuries, initially as a post-mortem procedure, with incidental survival of the infant. Numa Pompilius, Roman king (716-673 BC) issued a law called The Lex Caesarea that refers to the post-mortem delivery of a child through incision in the abdomen. In Roman times priests performed this procedure as a burial procedure as it was forbidden to bury a pregnant woman before the child was extracted from the womb. Our modern caesarean section (CS) procedure may have derived its name from this first legal reference. The initial objective of the CS was mainly post-mortem delivery of a dead or live child as a religious rather than a medical event. This changed in the Renaissance were the concept of CS birth emerged as a medical procedure. Until the 18th century CS resulted almost always in death of the mother. The main indication for caesarean delivery was complete arrest of labour, usually after intrauterine foetal death had occurred.

In the 19th century with improvement of surgical techniques, introduction of anaesthesia, anti-septic measures and superior methods of closing the womb, maternal mortality rates decreased, and safety of both mother and child became the objective of caesarean section. (1)

In the 20th century caesarean section became an established procedure. In many countries, the CS rate was 5% for a long time, and CS where mainly done for non-progressive labour. Introduction of continuous foetal monitoring in the early 70s contributed to an increase in the CS rate, resulting in non-progressive labour and suspected foetal distress as the most common indications for Caesarean section.

The 21st century shows an exponential growth of the number of CS. In contrast to the Renaissance, when CS implicated certain death of the patient, CS rates in well-resourced settings nowadays rarely results in the death of the woman during or after the procedure. CS is considered a safe procedure. This diminished the threshold for the obstetrician to perform CS.

The WHO stated that a population-level CS rate above 10–15 per cent is hardly justified from the medical perspective, and exceeding this rate implicates an overuse of CS without improvement of neonatal outcome. Recently Jiangfeng Ye et al confirmed this WHO statement based on the ecological association of caesarean delivery rate and perinatal outcomes. (2,3)

Although immediate mortality of CS in well-resourced sections is very low and maternal morbidity is low, it is still considerably higher than after vaginal delivery. Maternal
adverse outcomes such as adhesion formation, surgical injury, postoperative infection, haemorrhage and transfusion, hysterectomy, and death progressively increase as the number of previous caesarean deliveries increase. The long term obstetric perspective after CS is less good than after vaginal delivery, with the risk of placenta growing into the uterine scar in subsequent pregnancy and rupture of the uterine wall during subsequent delivery. (4) Also, the health of children born after CS is at state, as there is report of a higher risk of obesity and asthma. (5,6)

The challenge we face in the 21st century is to prevent unnecessary medicalization and long-term negative effects from CS in future pregnancies. Our focus thereby should be the health of the mother and child, and normalization of CS rates in high-income countries should not be a goal in itself, but functional to the improvement of outcomes for mothers and babies.

Figure 1. Mode of delivery in the Netherlands, 1999 through 2010

Figure 2. Indication Caesarean
Nowadays the variation in CS rates in Europe is wide, from 52.2% CS rate in Cyprus to 14.8% in Iceland in 2010. Especially rates of planned caesarean section for breech presentation, multiple births and women with previous caesarean section vary among different countries. (7) However, abnormal position of the foetus, such as occurs in breech pregnancy, captures not more than 5% of all pregnancies. The main source of variation in the CS rate is the nulliparous woman with a child in cephalic presentation that delivers at term. The main indication for CS during labour is non-progression of labour. (8,9,10)

**Trends in mode of delivery**

The course of a first pregnancy and delivery stipulates to a great extent the provided care and way of delivery in a subsequent delivery. In the Netherlands, healthy women with an uneventful pregnancy and delivery receive antenatal care by community midwives; women with intermediate or high-risk receive antenatal care from gynaecologists.

The continuous existence of home delivery and the well-organized maternity homecare is one of the features that make the Dutch obstetric care different from other sections in the Western world. Birth is considered as a natural process which results in a tendency to limit the amount of medical interventions. However, the obstetric care system in the Netherlands is evolving and there is an increasing degree of medicalization of childbirth in the Netherlands, illustrated by the decrease in home deliveries (In 1989 the number of women delivering at home was 38%, while in 2013 only 18% of women delivered at home (11)), increased usage of epidural analgesia (from 8 to 26% in the period 1999-2008 (12)) and increased amount of caesarean sections.

In the Netherlands we see the amount of operative vaginal deliveries decreasing in favour of the emergency caesarean section. Also a steep rise of planned caesarean following the publication of the Term Breech trial published in 2000 can be noticed. (13,14)

The overall CS rate increased from 10.5% in 1999 to 17% in 2010. (Figure 1) Kwee at al showed an overall CS rate increase of CS rate from 8 to 14 % in the period 1993–2002 and an increase from 12 to 20% in nulliparous term women with a singleton in vertex presentation. (15)

The indications for emergency caesarean section remained stable over the years 1999-2010. The main indication for emergency caesarean over the years 1999 to 2010 was non-progressive labour, accounting for 58% of the overall caesarean deliveries, 21% due to non-reassuring foetal status and 11% a combination of non-reassuring foetal status and non-progressive labour. (Figure 2)

Barber et al performed a large cohort study investigating which indications contribute to the increasing CS rate in the USA. They concluded that between 2003 and 2009, the majority of primary e.g. first birth CS are attributable to labour arrest disorders (87.9 per
Term singleton pregnancy
(37-42+6 weeks gestation)
\(n=240\,950\)

Exclusion *:
- 1st pregnancy fetal demise >20 weeks GA \(n=585\)
- Planned CS \(n=9\,002\)
- Congenital malformation \(n=4\,350\)
- Small for gestation age (<5th percentile) \(n=9\,533\)
- Malpresentation \(n=12\,889\)
- Emergency CS fetal distress or non specified \(n=23\,052\)
- Hypertensive and diabetic disorder \(n=29\,571\)

Low risk population
\(n=153\,228\)

Emergency CS non progression of labor
\(n=11\,689\)

Successful Vaginal delivery
\(n=141\,539\)

* Exclusions do not add up, because more than one criterium can occur in one pregnancy

**Figure 3.** Flow of patients based on in- and exclusion criteria

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Total cohort
\(n=153\,228\)

First delivery

Emergency CS  
\(n=11\,689\)

Vaginal delivery  
\(n=141\,539\)

Second delivery

- 31% Planned CS  
  \(n=3\,597\)
- 29% VBAC  
  \(n=3\,384\)
- 95% Vaginal delivery  
  \(n=134\,530\)
- 1% Planned CS  
  \(n=1\,732\)
- 27% Emergency CS  
  \(n=3\,208\)
- 13% operative VBAC  
  \(n=1\,500\)
- 2% operative  
  Vaginal delivery  
  \(n=3\,159\)
- 2% Emergency CS  
  \(n=2\,118\)

**Figure 4.** Mode of delivery in the subsequent pregnancy
1,000) and 18% of the increase of overall CS rate can be attributed to arrest of labour, mainly arrest of dilation. CS performed for arrest of dilation increased 3.9% per year (95% CI 1.4 – 6.5). Furthermore, they reported a decrease of Vaginal Birth after Caesarean (VBAC) rate from 43.9% to 7.8% in the USA. (10)

When comparing our national data with other countries, the Netherlands still has a low, although increasing, CS rate, a stable low induction rate and a stable moderate instrumental vaginal delivery rate. The rates of VBAC in the Netherlands are still high (74%) compared with other countries, but possibly the same trends as in the USA will become noticeable in the Netherlands in upcoming decennia. (15,16)

Prevention of CS due to Non-progression of labour
The main focus of safe prevention of caesarean section in recent literature has been the caesarean without medical indication, so called “Caesarean on request or non-indicated caesarean”, and ways to safely increase the rates of VBAC, without increasing the risk of adverse outcomes. The recent article of ACOG/SMFM Obstetric care consensus by Caughey et al explores the idea of safe reduction of CS by preventing the CS indicated by non-progressive labour in first pregnancy. It has been hypothesized that the historically fixed curves of normal labour do not apply to our modern deliveries with increasing application of induction of labour, epidural analgesia, increased maternal and neonatal weight. (17) Non-progression of labour CD rates are highest among nulliparous women, have great variation among hospitals and are highly affected by provider practices. The subjectiveness thus indicates that reduction is feasible and preventing the CS in first pregnancy will result in reducing the rate of repeat CS. (8)

To gain more insight in the consequences of CS due to non-progression in a second pregnancy, we explored the mode, safety and risks of deliveries after a CS due to non-progressive labour in the Netherlands.

Epidemiologic evaluation of the effects of CD in a low risk population on subsequent deliveries
We analysed data of women with their first and second delivery from the Dutch Perinatal Registry (PRN) between January 2000 and December 2007. We divided our cohort in two groups; Women with a CS due to non-progression of labour (CS cohort) and women with a successful vaginal (operative) delivery (VD cohort). (Figure 3)

We assessed the rate of planned an unplanned repeat CS, successful VBAC, operative vaginal deliveries in both groups. In the PRN registry, planned CS is defined as an elective caesarean section on the basis of obstetrical or medical indication, or at maternal request, generally executed prior to labour. Emergency CS is defined as caesarean section performed during labour by necessity because of foetal distress or non-progressive labour. Further explanation of our methods can be found in Addendum 1.
Table 1. Significant baseline differences

<table>
<thead>
<tr>
<th></th>
<th>CS cohort N=11 689</th>
<th>VD cohort N=141 539</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>10446 (89.4%)</td>
<td>125291 (88.5%)</td>
<td>p=0.006</td>
</tr>
<tr>
<td>Low social economic status</td>
<td>2648 (22.7%)</td>
<td>30684 (21.7%)</td>
<td>p=0.01</td>
</tr>
<tr>
<td>Mean maternal age (2nd delivery, in years)</td>
<td>31.8 SD 4.0</td>
<td>30.9 SD 4.2</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Spontaneous labour (2nd delivery)</td>
<td>4915 (42.1%)</td>
<td>114123 (80.6%)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Mean gestational age (2nd delivery, in weeks)</td>
<td>39.4 SD 3.0</td>
<td>39.6 SD 3.0</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Mean neonatal weight (2nd delivery, in grams)</td>
<td>3682 SD 506</td>
<td>3634 SD 502</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

Table 2. Outcomes second pregnancy

<table>
<thead>
<tr>
<th></th>
<th>CD cohort N=11 689 (%)</th>
<th>VD cohort N=141 539 (%)</th>
<th>OR*</th>
<th>95%CI</th>
<th>P</th>
<th>adj OR*</th>
<th>95%CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal death</td>
<td>0 (0.0%)</td>
<td>9 (0.006%)</td>
<td>0.6</td>
<td>0.04-11</td>
<td>0.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>13 (0.11)</td>
<td>4 (0.003)</td>
<td>39</td>
<td>13-121</td>
<td>P&lt;0.0001</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Blood loss &gt; 1000ml</td>
<td>595 (5.1%)</td>
<td>5808 (4.1%)</td>
<td>1.2</td>
<td>1.1-1.4</td>
<td>P&lt;0.0001</td>
<td>1.0</td>
<td>0.9-1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Transfusion</td>
<td>35 (0.3)</td>
<td>194 (0.14)</td>
<td>2.2</td>
<td>1.5-3.1</td>
<td>P&lt;0.0001</td>
<td>1.6</td>
<td>1.1-2.3</td>
<td>0.02</td>
</tr>
<tr>
<td>5 minute Apgar score &lt;7</td>
<td>273 (2.3)</td>
<td>1917 (1.35)</td>
<td>1.7</td>
<td>1.5-2.0</td>
<td>P&lt;0.0001</td>
<td>1.1</td>
<td>1.0-1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Birth trauma</td>
<td>17 (0.15)</td>
<td>209 (0.15)</td>
<td>1.0</td>
<td>0.6-1.6</td>
<td>P=1.0</td>
<td>0.6</td>
<td>0.4-1.0</td>
<td>0.06</td>
</tr>
<tr>
<td>Antenatal death</td>
<td>15 (0.13)</td>
<td>325 (0.23)</td>
<td>0.6</td>
<td>0.3-0.9</td>
<td>P=0.03</td>
<td>0.2</td>
<td>0.1-0.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Neonatal death</td>
<td>7 (0.06)</td>
<td>120 (0.08)</td>
<td>0.7</td>
<td>0.3-1.5</td>
<td>P=0.4</td>
<td>0.4</td>
<td>0.2-0.8</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Consequences of first birth caesarean section due to non-progression

Figure 3 shows the flow of patients based on in- and exclusion criteria. 153,228 Women were available for analysis. We included 11,689 women in the CS group and 141,539 women in the VD group.

Figure 4 shows the mode of delivery in the subsequent pregnancy. In the CS cohort, 3,597 women (31%) delivered through planned repeat CS, 3,384 women (29%) had a unassisted VBAC, 1,500 (13%) had a successfully assisted VBAC, either vacuum or forceps delivery
and 3208 women (27%) had an emergency caesarean section. Of women having a VBAC, 60.4% succeed, this means 41% of the CS cohort.

In the VD cohort 134 530 (95%) of the women had a second successful vaginal birth. 3159 (2%) had a successfully assisted vaginal birth, 2 118 (2%) had an emergency CS and 1732 (1%) had a planned CS.

The baseline characteristics for the CS cohort and the VD cohort that were significantly different are summarized in Table 1.

Table 2 shows the outcomes of adverse maternal and neonatal outcomes at second delivery among low risk women whose first delivery was a CS due to non-progression of labour, compared with women with a vaginal birth. Therefore, we adjusted the analyses for confounding by ethnicity, maternal age, induction of labour, gestational age and neonatal weight.

There were 9 maternal deaths (0.01%), all in the VD cohort versus none in the prior CS cohort; this difference did not reach statistical significance. The reported occurrence of uterine rupture in was very low; 1 in 1000 but occurred more often after prior CS (OR 39 95%CI 13-121 P<0.0001). Calculation of aOR was not possible due to small numbers.

After adjustment we found differences in transfusion rates between prior CS and prior VD of 0.3 vs. 0.14% (aOR 1.6 95%CI 1.1-2.3 p<0.02). Blood loss more than 1000 ml occurred in 5.1% after prior SC, and 4.1% after prior VD, after adjustment there was no significant difference.

The incidence of antenatal death in a pregnancy following a caesarean delivery was 1.3 per 1000 pregnancies; the incidence of antenatal death in the VD cohort was 2.3 per 1000 pregnancies (aOR 0.2, 95% CI 0.1-0.3, P<0.0001). The incidence of neonatal death before 28 days was 0.6 per 1000 pregnancies in the CS cohort versus 0.8 in the VD cohort (aOR 0.4 CI 0.2-0.8, p=0.02).

DISCUSSION
The main indication of first birth caesarean during labour is non-progression. We conducted this study in order to canvass the idea of preventing the first caesarean due to non-progression and to explore the success rates of TOL and the associated risks of TOL in this specific group.

We analysed data of 153 228 women, 11 689 women in the CS cohort and 141 539 women in the VD cohort. In the CD cohort 42% had a VBAC, 31% delivered through planned repeat CS, 27% had an emergency repeat CS. Women having a Trial of labour after CD (TOL) succeed in 60.4%. In the VD cohort 95% of the women had a second successful vaginal birth, 1% had a planned CS and 2% had an emergency CS.
Having a history of CS due to non-progression increases the chance of uterine rupture, blood loss and need for transfusion compared to women having a history of vaginal birth. When having a TOL there is a higher risk of operative vaginal delivery compared to overall operative vaginal delivery rates. There were 9 maternal deaths, all occurred in the VD cohort. Antenatal and neonatal deaths were lower in the CD cohort compared to the VD cohort.

The fact that in a low risk population there seems to be a protective effect of a prior CD for antenatal death is a remarkable finding. Only two studies looked at the association of intrauterine demise and prior caesarean, with conflicting results.

In a population based cohort study Smith et al found that women whose first birth was by caesarean section were at significantly increased risk of having an unexplained antepartum stillbirth from 34 weeks gestation onwards in their second pregnancy (aOR 2.74 95% CI 1.74–4.30, p<0.001). In their cohort the absolute risk of stillbirth after 24 weeks’ gestation was 3.8 per 1000 women who had had a previous CS and 2.3 per 1000 in those who had not. However, Bahtiyar et al. analysed a large U.S. data set of more than 11 million term deliveries and concluded that a prior CS was not associated with an increased risk of unexplained term IUFD in a subsequent pregnancy. Their analysis of term women with only 1 prior CS resulted in antenatal death of 0.7 per 1000 deliveries for prior CS and 0.8 per 1000 deliveries for VD (relative risk 0.90; 95% confidence interval 0.76-1.06). Their crude term intrauterine foetal demise rate was 1.3 per 1000 births for prior CS and 1.5 per 1000 births for prior VD. In our study the incidence of antenatal death in the CS cohort was equal to Bahtiyar et al (1.3 per 1000 deliveries) The incidence of antenatal death in the VD cohort was 53% higher (2.3 per 1000 deliveries) (aOR 0.2, 95% CI 0.1-0.3, P <0.0001) leading to a statistical significant protective effect of a prior CS for antenatal death.

The explanation for the protective effect of CD in a low risk population is not immediately apparent, although differences in timing of delivery and difference in obstetric management could be an explanation, at least in part, for this effect. All low risk women with a history of CD in the Netherlands are classified as intermediate or high-risk pregnancies in their next pregnancy and will receive antenatal care by gynaecologists. It would be most interesting to see if differences in antenatal death can be explained by our Dutch obstetric care system. The Cochrane review about midwifery-led care from 2013 reported no differences in the risk of losing the baby after 24 weeks or overall antenatal or neonatal death in women who received midwife-led continuity model of care compared to women who received other models of care. No Dutch study was included in this review. All trials included licensed midwives, and none included lay or traditional midwives. No trial included models of care that offered out of hospital birth. It is an argument to further examine our Dutch obstetric care system, however it is not a reason to shy away from prevention of first birth caesarean delivery.
Balancing risks and benefits

Observational studies of the effects of CD on subsequent pregnancies are numerous, but the observed cohorts mainly consist of high risk or mixed case populations. We were able to compose a low risk cohort by including only non-progression and excluding all CD due to foetal distress or a combination of non-progression and foetal distress, excluding all maternal morbidity and foetal congenital or chromosomal abnormalities. To our knowledge this is the first study to investigate solely the effects of CD due to non-progression; the main indication for CD during labour and the most subjective indication during labour.

We can conclude from our results that 60% of those women motivated to undertake TOL after a CD indicated by non-progression have a successful VBAC. As a whole this group has a lower chance of successful VBAC compared to overall VBAC success rates (74%) and the chance of an operative VD delivery is higher (18.5%, n=1500/8092) compared to overall operative delivery rates of 10.7% (10-12%) (Figure 1)(15,16).

Attempted operative vaginal delivery is associated with a highly increased risk of neonatal birth trauma (0.95%) compared with emergency caesarean (0.07%) (aOR 15.0, 95% CI 5.94 to 38.0) (21) In this study we did not find significant differences for birth trauma.

This relatively high successful VBAC rate means the majority of women do not have a pelvis unable for childbearing. Rather most of the increase in caesarean for labour arrest disorders manifested in arrest of dilation. (10) The diagnosis of arrest of dilation is relatively subjective, with large variability in frequency of cervical examinations, determination of adequate uterine contractions, and judgment of supposedly normal duration. Especially when other clinical issues, such as insufficient pain relief or maternal fever, arise. Patients may also play a role in the decision to intervene during slowly progressing labours.

Friedman identified the pattern of progressive cervical dilation in normal labour in 1967 and Philpottin developed application and adjustment with the aid of a partogram. Worldwide implementation of the partogram was encouraged by the WHO in order to promote safe motherhood. (22-26) Recently it has been suggested, in order to prevent the overuse of caesarean sections in developed countries, to adjust the partogram to modern standards.(17)

Maternal characteristics such as increased age, increased maternal weight, racial diversity and medical interventions such as induction of labour, epidural analgesia and changes in obstetric practices are associated with prolongation of labour. (27-30) In a large cohort study by Zang et al 2010, a contemporary population was compared to a cohort from the 1960s previously described by Friedman. Remarkably, the duration of first stages of labour in nulliparous and in multiparous women were longer and only accelerated after 6 cm, in comparison to the partogram based on Friemans cohort assuming acceleration
after 3 cm. They pleaded that in order to reduce the rate of intra partum, labour should be allowed to continue for a longer period before 6 cm of cervical dilation. (31)

Diagnoses of labour arrest before 6 cm in women undergoing induction should be made even more cautiously. Harper et al conducted a comparative study of induced versus spontaneous labour that indicate that the latent phase of labour is longer in induced labour compared with spontaneous labour although the active phase of labour (again greater than 6 cm) is similar between the two groups. In the setting of induction of labour, non-intervention in first 6 cm of dilation, when foetal and maternal condition is reassuring, seems to reduce the risk of caesarean delivery. (32)

The disadvantages of by having more patience in order to prevent CS and a subsequent longer first and second stage of labour could be and increase of shoulder dystocia, birth trauma, neonatal sepsis, asphyxia, endometritis and blood loss. (33,34) To achieve optimal obstetric and perinatal outcome, balancing risks and benefits for both the mother and the neonate and individualized counselling is essential.

Limitations
Our results reflect outcomes for the women with non-progression of dilatation (first stage) and non-progression in the active phase of labour (second stage). In our database we could not differentiate between first and second stage non-progression. This means that adverse events and VBAC rates might differ for women with first stage dystocia compared to second stage dystocia. We are aware that an unbiased evaluation of the risk of adverse neonatal and maternal outcomes and estimation of TOL success rates can only be achieved if all women in our cohort would undergo TOL and PCS would only be performed for absolute contra indications such as placenta praevia.

CONCLUSION
Preventing the first birth caesarean section should have the fullest attention of the obstetrician in order to decrease CS rates or at least maintain a certain CS rate. Our country has low CS rates compared to other countries; we are however not exempted of the overall CS rate increase. Our 17% CS rate has risen above the WHO medically justifiable limit of 10-15%. In the last decades maternal characteristics such as increased age, increased maternal weight, racial diversity, medical interventions such as induction of labour, epidural analgesia and changes in obstetric practices have caused a longer duration of labour. In clinical practice this would mean; certain restraint in diagnosing failed induction, accepting longer duration of first and second stage as long as foetal and maternal conditions are not compromised.

The adverse maternal and neonatal events, in a subsequent pregnancy due to non-progression are low. The protective effect of CD in a low risk population is not immediately
apparent, further evaluation of difference in obstetric management is necessary. The successful VBAC rates in our low risk cohort are encouraging and justify counselling for TOL even with a history of CS due to non-progression as majority of women attempting TOL succeed. This way further unnecessary increase of repeat caesarean section can be prevented. Long-term effects of CS should be further investigated, the effects of differences in obstetric management between low risk women with or without CD should be further investigated and qualitative studies about doctor behaviour and patient preferences should be carried out.

We thank the Netherlands Perinatal Registry for giving permission for use of registry data (registration number 12.02).
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16. N.Kok, L.Ruiter, R. Lindeboom, C. de Groot, E. Pajkrt, B.W. Mol, B.M. Kazemier Elective repeat caesarean delivery compared with trial of labour after a prior caesarean delivery: a propensity score analysis, submitted
Balancing risks and benefits


ADDENDUM 1

Inclusion criteria:
Data of the first and second pregnancies were collected from a database by the Dutch Perinatal Registry (PRN). The PRN database is a national database that contains linked maternal and neonatal data entered by midwives, obstetric care givers and pediatricians. The coverage of the PRN registry is about 96% of all deliveries in the Netherlands. The records included in the PRN registry are entered at the child’s level. There is no unique maternal identifier. This database contains linked maternal and neonatal data entered by obstetric caregivers and pediatricians. The coverage of the PRN registry is about 96% of all deliveries in the Netherlands. The records included in the PRN registry are entered at the child’s level. There is no unique maternal identifier available in the registry to follow-up on outcomes of subsequent pregnancies of the same mother. Therefore a longitudinal probabilistic linkage procedure in which we linked records of children of the same mother was performed in order to create a mother identifier. (35) Permission for use of registry data was given by the Netherlands Perinatal Registry (registration number 12.02). For a more elaborate description of the methods used for this longitudinal linkage, we refer to the article of Schaaf et al 2011. (36)

Our analysis included women with a first live, singleton and term gestation that had a successful vaginal delivery or a CD due to non progression of labor. Our main outcomes were maternal and neonatal complications at second births associated with caesarean section due to non-progressive labour at the first birth.

Neonatal complications consisted of neonatal mortality, antenatal death, preterm birth, low Apgar score, and birth trauma. Maternal complications consisted of maternal mortality, uterine rupture, placental abruption, postpartum haemorrhage, blood transfusion and instrumental delivery.

We compared baseline characteristics of both groups first pregnancy by calculating the appropriate measure for either parametric or non-parametric continuous variables. In this way, unequal distribution of known covariates was identified and could be adjusted by logistic regression.

We calculated crude odds ratios (ORs) and adjusted odds ratios (aORs) using univariate and multivariate logistic regression in SAS 9.2 (SAS Institute Inc, Cary, NC, USA). We corrected for gestational age at delivery, birth weight, spontaneous start of labour and maternal age.
Term was defined as beyond 36 weeks and 6 days and before 43 weeks of gestation. Women with a pregnancy complicated by hypertensive disorders, diabetic disorders, congenital abnormalities or a planned caesarean section, caesarean section due to foetal distress or non-specified indication were excluded.

Neonatal mortality was defined as death within 28 days of birth. Stillbirth was defined as death of the foetus before or during delivery. Low Apgar scores were defined as 10-minute Apgar scores below or equal to seven (AS ≤ 7). Birth trauma included all traumata that were reported as being caused by delivery, such as fractures, brachial plexus damage, and subdural or cerebral hematoma.

Maternal mortality was defined as the death of a woman while pregnant or within 42 days of termination of pregnancy from any cause related to or aggravated by the pregnancy, or its management, but not from accidental or incidental causes. Uterine rupture was defined as the complete separation of the uterine scar resulting in communication between the uterine and peritoneal cavities. Postpartum haemorrhage was defined as blood loss of more than 1000 ml during and after delivery. Instrumental delivery was defined as vacuum or forceps extraction.