

# Vaginal birth after cesarean section: Trial of labor or repeat cesarean section? A decision analysis

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**OBJECTIVE:** The risk of perinatal death associated with labor after previous cesarean section appears higher than with a repeated cesarean section. On the other hand, repeated cesarean sections are associated with increased maternal morbidity and mortality from placental pathologic conditions (previa or accreta) on subsequent pregnancies. The study was undertaken to analyze the decision for a trial of labor or a repeated cesarean section, after a prior cesarean section, with varying desire for an additional pregnancy.

**STUDY DESIGN:** A model was formulated using a decision tree, based on the reported risks of the two approaches. Sensitivity analysis was performed over a variety of probabilities (eg, chance of uterine rupture or neonatal death, chance of rescue cesarean section, desire for an additional pregnancy) and utilities (eg, use of hysterectomy or neonatal death).

**RESULTS:** The model favors a trial of labor if it has a chance of success of 50% or above and if the wish for additional pregnancies after a cesarean section is estimated at near 10% to 20% or above because the delayed risks from a repeated cesarean section are greater than its immediate benefit. The model was robust over a wide range of assumptions.

**CONCLUSION:** An optimal decision for a trial of labor or a repeated cesarean section is substantially determined by the wish for future pregnancies. The default option of a repeated cesarean section is not directly applicable in populations in which family planning often extends over two children. (Am J Obstet Gynecol 2003;189:714-9.)

**Key words:** Vaginal birth after cesarean section, placenta accreta, placenta previa, decision analysis

Recent large cohort studies have shown increased morbidity and mortality associated with labor after previous cesarean section compared with a planned repeated cesarean section. In one study,<sup>1</sup> the incidence of uterine rupture ranged from 5.2 to 24.5 per 1000 women who were delivered of a second singleton infant after a prior cesarean section, during spontaneous or induced labor, compared with 1.6 per 1000 with repeat cesarean section without trial of labor. In a larger and more recent study,<sup>2</sup> delivery-related perinatal death was 12.9 per 10 000 women who had a trial of labor after previous cesarean section, a rate 11 times greater than the risk associated with planned repeat cesarean section. These data seem to favor elective repeated cesarean section and informed consent for any patient who requests a trial of labor, with

a discussion of the risks and benefits of each alternative.<sup>3,4</sup> A potential late risk of recurrent cesarean sections is an increased incidence of placenta previa and placenta accreta<sup>4-7</sup> with complications such as hysterectomy and even maternal death.<sup>8,9</sup> These risks may be less important in developed countries where many women have now only one or two children.<sup>4</sup> The current study analyzes the decision for a trial of labor versus a cesarean section, taking into account a viable option for an additional pregnancy. The analysis relates only to placental complications in the third subsequent pregnancy after the delivery by cesarean section. The variable is the mode of delivery in the second delivery after cesarean section: trial of labor or an elective cesarean section.

## Methods

A decision tree (Fig 1) was built by using DATA 4.0 (TreeAge Software, Inc). The arm "trial of labor" subdivides in "normal delivery" or "rescue C/S", which means a need for an emergency cesarean section, including a possibility of neonatal death. The arm "C/S" means elective repeated cesarean section and subdivides into successful delivery or neonatal death. Further subdivisions describe options for an additional pregnancy ("Third Py") or no more pregnancies ("No More Py").

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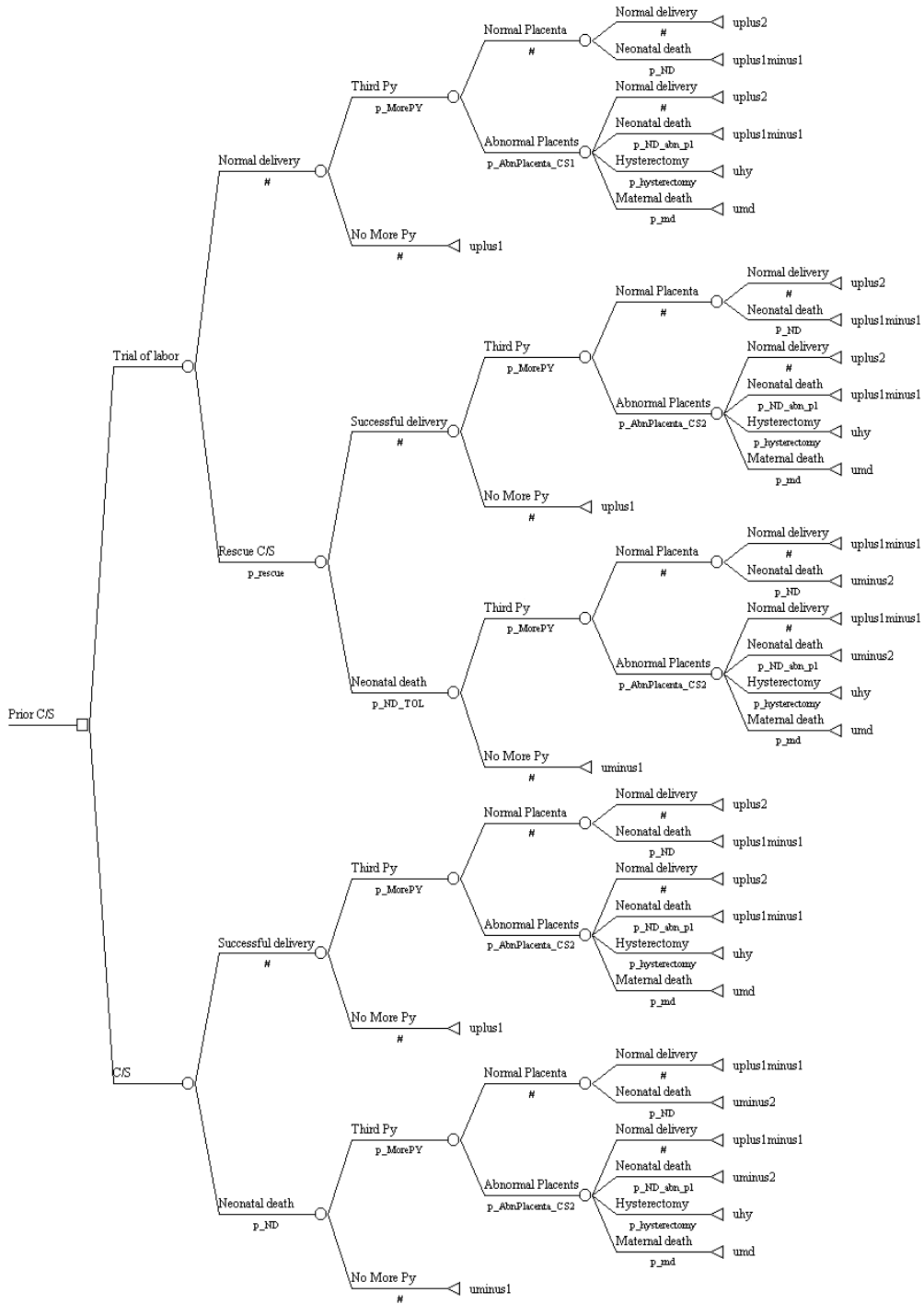


Fig 1. Decision tree for trial of labor versus repeat cesarean section.

Under an eventual subsequent pregnancy, the possibility of an abnormal placental implantation is represented (placenta previa or accreta) with four potential outcomes: normal delivery (with a live newborn infant), neonatal death, hysterectomy, and maternal death (under the assumption that simultaneous occurrence of these bad

outcomes is sufficiently rare to be omitted). We included in bad outcomes irreversible damage and did not include reversible morbidity (such as major uterine hemorrhage or fetal injury). The model is a simplified model, with the option of only one additional pregnancy (third pregnancy).

**Table I.** Estimated probabilities for variables in decision tree

Name in tree	Description	Base value	Low	High	Reference
p_AbnPlacenta_CS1	Probability of abnormal placenta after 1 CS	0.032	0.008	0.04	5,8,18,20
p_AbnPlacenta_CS2	Probability of abnormal placenta after 2 CS	0.057	0.02	0.08	5,8,20
p_hysterectomy	Probability of hysterectomy with abnormal placenta	0.03	0.01	0.6	9,18,19
p_md	Probability of maternal death from abnormal placenta	0.003	0.001	0.06	14,16
p_MorePY	Probability of an additional pregnancy	0.5	0	1	15,21
p_ND	Probability of neonatal death in low-risk script (CS, normal placenta)	0.0001	0.00005	0.00015	2
p_ND_abn_pl	Probability of neonatal death with placenta previa or accreta	0.0005	0.0001	0.001	*
p_ND_TOL	Probability of neonatal death with TOL	0.001	0.0004	0.0017	2
p_rescue	Probability of rescue CS	0.4	0	1	4

CS, Cesarean section; TOL, trial of labor.

\*In the absence of data, chosen as intermediate between p\_ND and p\_ND\_TOL.

**Table II.** Attributed utilities for outcomes in decision tree

Name in tree	Description	Base value	Low	High
uhy	Utility of hysterectomy	0.5	0.3	0.7
umd	Utility of maternal death	0	0	0.1
uminus1	Utility of 1 infant death	0.7	0.5	0.9
uminus2	Utility of 2 infants deaths	0.6	0.4	0.7
uplus1	Utility of 1 more infant alive	0.9	0.8	1.0
uplus1 minus1	Utility of 1 neonatal death, 1 living infant	0.8	0.6	0.9
uplus2	Utility of 2 more infants alive	1.0	0.9	1.0

Table I shows the base values and ranges for the probabilities of occurrence of the variables in the tree, based on the literature<sup>5-8</sup> or, when the information in the literature is poor, on a range of assumed chances. Table II shows the list of utilities (base and range values) for the various outcomes in the tree. These utilities were chosen between 0 and 1 so that the natural ranking of the outcomes was preserved (ie, higher utility values were assigned for delivery of one or two infants alive and lower utility values were assigned for bad outcomes such as neonatal death, hysterectomy, and maternal death). Most health states have a utility between 0 (death) and 1 (perfect health). Utilities of very poor health states may even be negative. Utilities can be assigned by experts or can be elicited from patients or healthy people. Common methods for eliciting utilities are the Time Trade Off method (TTO), the Standard Gamble (SG), and the visual analog scale (VAS). In this study, experts elicited the utilities by using the VAS method. We also analyzed our model with utilities obtained by the following formula  $TTO = 1 - (1 - VA)$ . For a specific individual, one could insert her utility values into the model, which would then suggest her own best choice.<sup>10,11</sup>

Two- and three-way sensitivity analyses were performed with all probabilities and utilities for the ranges listed in Tables I and II.

## Results

The model favors a trial of labor, if the wish for an additional pregnancy after the current delivery is estimated at near 10% to 20% or above, because the delayed risks from a repeated cesarean section are greater than its immediate benefit. The probability for an additional future pregnancy is the result of several factors that may change with time (eg, the desire for having more children, the ability to conceive, and the possibility of an unplanned pregnancy). Although subject to many psychologic and other biases, a rational decision is based on the best available information and beliefs available at the time of the decision.<sup>12</sup> As shown in Fig 3, above an estimated probability for an additional pregnancy of about 10% to 20%, a trial of labor is the preferred option for the delivery, after a cesarean section, over a wide range of risks for delayed, irreversible complications from an abnormal placenta (hysterectomy, maternal death). An elective cesarean section is the preferred option only if the probability of an additional pregnancy and the risks from an abnormal placenta are both low. If the chances of hysterectomy or maternal death from an abnormal placenta are each as low as 1 in a 1000, a trial of labor is still the preferred option, when the probability of an additional pregnancy is above 30%. The left panel in Fig 3 shows a sensitivity analysis assuming a risk of maternal death from abnormal placenta of 0.1%: Under this assumption, even if the probability of hysterectomy from abnormal placenta is less than 10%, a trial of labor is the preferred option whenever the chance of an additional pregnancy is more than 10%. The middle panel shows a sensitivity analysis assuming a risk of maternal death from abnormal placenta of 1.9%: Under this assumption, even if the probability of hysterectomy from abnormal placenta is less than 10%, a trial of labor is the preferred option whenever the chance of an additional pregnancy is

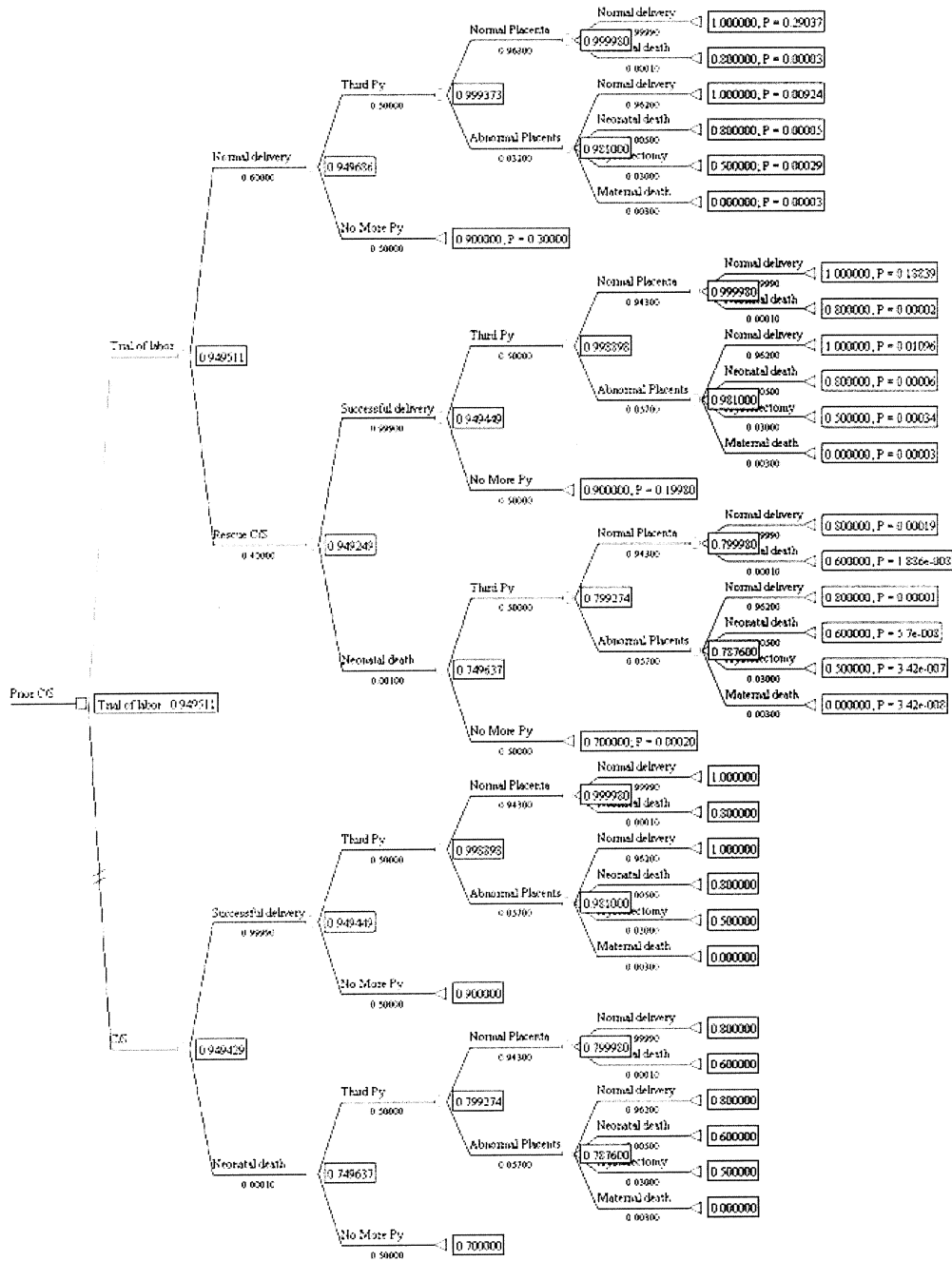
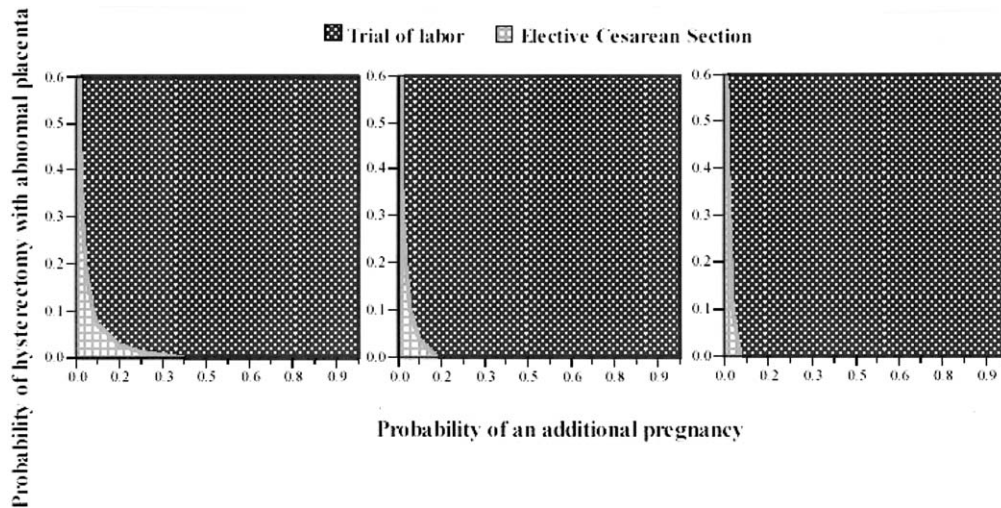


Fig 2. Expected values for tree outcomes. At base, trial of labor the preferred outcome.

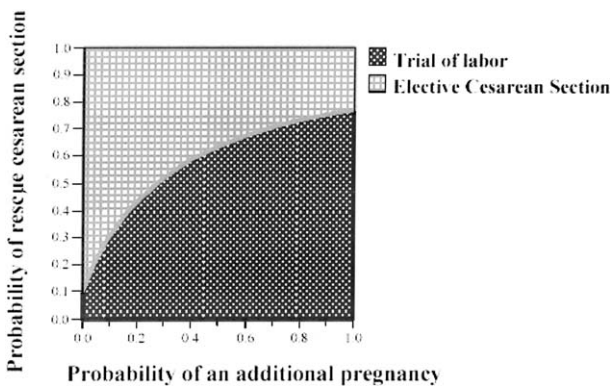
more than 7%. The right panel shows a sensitivity analysis assuming a risk of maternal death from abnormal placenta of 6%: Under this assumption, even if the probability of hysterectomy from abnormal placenta is less than 10%, a trial of labor is the preferred option whenever the chance of an additional pregnancy is more than 5%. As shown in Fig 4, if a trial of labor is likely to succeed (ie, the likelihood of a rescue cesarean section is less than 50%), then above an estimated probability for an

additional pregnancy of approximately 20%, a trial of labor is the preferred option. If the likelihood of a rescue cesarean section is more than 70%, an elective cesarean section is the preferred option, regardless of the probability of an additional pregnancy.

The model was robust over a wide range of assumptions for the other probabilities listed in Table I and for the utilities listed in Table II. Moreover, as long as the utility values reflect a natural ranking of the outcomes (eg, the



**Fig 3.** Sensitivity analysis for probability of an additional pregnancy and for probability of hysterectomy from abnormal placenta on a subsequent pregnancy. Risk of maternal death from abnormal placenta 0.1% (left), 1.9% (middle), and 6% (right).



**Fig 4.** Sensitivity analysis for probability of an additional pregnancy and for probability of rescue cesarean section in a trial of labor for current pregnancy.

utility of two infant deaths is smaller than the utility of one infant death), trial of labor is favorable.

### Comment

Recent data show reduced perinatal death and uterine rupture with elective repeated cesarean section in pregnant women with prior cesarean section.<sup>13</sup> An adverse effect from a repeat cesarean section is the increased chance of an abnormal placentation in a subsequent pregnancy. Whereas in the developed world most women would have only one or two children, in developing countries family size is much larger.<sup>4,14</sup> Because some women may wish an additional pregnancy (and this option may be the rule rather than the exception in developing populations), we attempted a formal decision analysis of this question. The model favors a trial of labor, if the wish for an additional pregnancy is estimated at near

10% to 20% or above, because the delayed risks from a repeated cesarean section are greater than its immediate benefit. If the trial of labor has a low chance of success anyway, an elective cesarean section is the preferred option, regardless of the probability of an additional pregnancy.

This conclusion was robust over a wide range of assumptions. The limitations of our study are several. We used a simplified model for only one additional pregnancy. Because the chances for abnormal placental implantation increase with each additional cesarean section, the analysis for more than one additional pregnancy is likely to show even stronger conclusion in favor of vaginal delivery. We used only irreversible outcomes (and even for these outcomes, current figures are not abundant); we did not include in our analysis morbidity and costs and we did not include in our model a distinction between spontaneous and induced labor, mostly because data about these events are scarce. We did not include in the analysis permanent neurologic impairment of the newborn infant because of paucity of accurate data on the incidence of this complication in the two modes of delivery. We did not include a formal discount of utilities for time delays (by which the utility of good outcome on the present pregnancy would be higher than a good outcome on a subsequent pregnancy). Further analysis, the use of discount rates up to 5%, for 2 to 10 years (between the present to the next pregnancy) did not alter the results.

The decision for or against a trial of labor in a pregnant woman is complex. Because our minds may have difficulty balancing very low incidence risks (the absolute risks in either alternative are very low, in the range of 1 in 1000 perinatal death with a trial of labor versus 1 in 10 000, with repeat cesarean section), formal decision analysis might help better define important issues. The choice of a

woman for a delivery method is largely influenced by her interaction with physicians, her reconstruction of the previous cesarean section, and her personal ideologies about reproduction and motherhood.<sup>15</sup> The final decision for the mode of delivery should be the patient's, but the physician's perspective is very influential. Number of future pregnancies and placental complications should be discussed but are difficult to quantify by the physician and even more so by the patient. It may be difficult to ask a woman about "more than 10% to 20% chance" of having one more pregnancy. The use of a qualitative grading may be easier to communicate: "Is another future pregnancy likely?" When the answer is yes, a trial of labor is a favorable option to recommend. Although in the future the woman may change her mind regarding another pregnancy (or fail to conceive after the cesarean section), the analysis remains valid for an optimal decision that is based on the present preference.

Although maternal and perinatal mortality are rare in developed countries, unfortunately they are not in the developing world.<sup>14,16,17,22</sup> The estimated probabilities (Table I) may well be in the high probability zone. The high parity rate could put these populations at a higher risk of placental pathologic conditions from repeat cesarean sections. The risk in these deliveries could be substantial because of the shortage of neonatal and maternal intensive care support systems. From the current study, we conclude that the degree of wish for an additional future pregnancy appears to be a major determinant in a rational decision for the current delivery.

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