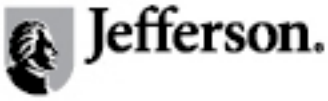

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Vincenzo Berghella
Thomas Jefferson University, vincenzo.berghella@jefferson.edu

Alexis C. Gimovsky
The George Washington University School of Medicine and Health Sciences

Lisa D. Levine
University of Pennsylvania Perelman School of Medicine

Joy Vink
Columbia University Medical Center

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Cesarean in the second stage: a possible risk factor for subsequent spontaneous preterm birth

Vincenzo Berghella, MD, **Alexis C. Gimovsky, MD**, **Lisa D. Levine, MD**, and **Joy Vink, MD**

Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Sidney Kimmel Medical College of Thomas Jefferson University (Dr Berghella), and Maternal and Child Health Research Center, Department of Obstetrics and Gynecology, University of Pennsylvania Perelman School of Medicine (Dr Levine), Philadelphia, PA; Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, The George Washington University School of Medicine and Health Sciences, Washington DC (Dr Gimovsky); and Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Columbia University Medical Center, New York, NY (Dr Vink).

In this issue of the Journal, Wood el al[1] report, in a retrospective cohort study, an increased risk of spontaneous preterm birth (SPTB) in women with a prior cesarean delivery (CD) done in the second stage compared with women with a prior spontaneous vaginal delivery.

After adjusting for some confounders (maternal age, smoking, and maternal weight), prior second-stage CD was found to have an odds ratio of 2.44 (95% confidence interval [CI], 1.91–3.10) for the risk of subsequent SPTB <32 weeks. No effect on the risk of subsequent SPTB was seen with a history of operative vaginal delivery (OVD), CD before labor, or CD in the first stage of labor. Moreover, after controlling for route of delivery, Wood et al[1] did not find a significant association between length of the second stage (even >3 or >4 hours) and subsequent SPTB (but they did find non-statistically significant 47% and 48% increases, respectively, at these time cutoffs), making the case that it was the CD in the second stage, and not the length of the second stage alone, that was associated with SPTB.

One limitation of the study is the fact that interval pregnancies <20 weeks were not included. This would exclude, for example, a woman who had a dilation and evacuation for an abortion at 16 weeks. Therefore, unaccounted risk factors (and confounders) for SPTB could have affected results.[2] This also, in turn, excludes women that may have had a spontaneous second-trimester loss, which would thereby underestimate the prevalence of the SPTB outcome.

Additionally, many other risk factors for SPTB were not controlled for (ie, no data on race/ethnicity was provided as well as a prior preterm birth before the index pregnancy). Also, compared with the United States, this study had a higher rate of OVD (24%) and a lower overall rate of CD (23%). Moreover, 3.2% of the CDs were done in an unknown stage of labor.

Corresponding author: Vincenzo Berghella, MD. vincenzo.berghella@jefferson.edu.

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Regarding the association between second stage CD and subsequent SPTB, a recent study agrees with Wood et al[1] that there is indeed a significant increase in SPTB in the pregnancy following one with second-stage CD.[3] In this study, the investigators found a 6-fold higher odds of SPTB for women with a second-stage CD compared with women with a first-stage CD (adjusted odds ratio [aOR], 5.8 [95% CI 1.08–30.8]).

Why would a CD done in the second stage be associated with an increased risk of subsequent SPTB? A couple of hypotheses have been proposed and evaluated. First, prolonged second stage has been evaluated as a possible risk for subsequent SPTB. The first study reported an association,[4] whereas subsequent larger studies[5–7] failed to find such a link; the current study by Wood et al[1] confirms that, overall, there does not seem to be a consistent association between prolonged second stage (or the length of the second stage in general) in the prior pregnancy and subsequent SPTB.[4–7]

Another study reported a nonsignificant aOR of 2.08 (95% CI 0.32–13.78) for subsequent risk of SPTB in women with prior prolonged second stage and CD compared with women also with prolonged second stage and vaginal delivery.[7] This is an important analysis because it reinforces the fact that it does not seem that prolonged second stage per se increases the future risk of SPTB, but if a CD is done in the second stage, and perhaps even more significantly, with a prolonged second stage, the risk of subsequent SPTB is increased compared with a vaginal delivery.

Given that a recent randomized controlled trial found a higher chance of spontaneous vaginal delivery with prolonging the second stage more than 3 hours to 4 or more hours, without associated maternal or perinatal harm, allowing nulliparous women with an epidural to labor in the second stage more than 4 hours if the maternal and fetal conditions allow it, still seems safe, even when evaluating outcomes in the next pregnancy.[8]

Second, structural cervical damage has been evaluated as a possible explanation for the association between second-stage CD and subsequent SPTB.[4,7] It has been reported that cervical trauma such as excision of cervical tissue[9,10] or uterine evacuation for abortion[2] is associated with an increased risk of subsequent SPTB.

Previously, cervical tissue was thought to be a primarily collagenous tissue (85–90%) with minimal cellular content (10–15%).[11] Thus, cervical tissue damage (either by excision, cervical laceration at delivery, or uterine extension) was hypothesized to be due to the disruption of the collagen network in the cervix. However, a recent study found that the tissue structure at the internal os is drastically different from the tissue structure at the external os.[12]

Specifically, the area of the internal os contains 50–60% smooth muscle cells that are circumferentially oriented around the endocervical canal and the external os is mostly collagen with 10e15% smooth muscle cells. This study also showed the internal os is more contractile compared with the external os.[12] Although further studies are needed, the concept of a sphincter at the internal os was proposed.

Given these new findings linking structural cervical damage as a possible cause for an increased risk of SPTB following a second-stage CD, several questions must be considered. First, as a cervix effaces, does the smooth muscle at the internal os get pulled upward into the lower uterine segment?

Second, when doing a low transverse CD in the second stage of labor, are we actually disrupting the muscle body in the cervix that may potentially function to keep the internal os closed? Surgical damage to a completely dilated cervix may not allow the cervix to fully recover its collagen structure and muscular function at the internal os. This might happen in particular if the uterine incision in a fully dilated woman might not happen truly in the lower uterine segment, but in the cervix instead, and perhaps at the level of the internal os.[7]

Third, when we are repairing the uterine incision, does incorporating the muscle at the internal os predispose the patient to have a dysfunctional cervix in a subsequent pregnancy?[7] Structural damage to the area of what is the internal os might also occur from an impacted fetal head and subsequent difficult extraction.

Related to cervical structural damage, Wood et al[1] hypothesize that the increase in SPTB after a second-stage CD may be due to an increase in cervical lacerations at the time of CD, but they provide no data on cervical lacerations. The concern about cervical lacerations or cervical extensions contributing to the increased risk has also been postulated as a possible etiology for subsequent SPTB after a second-stage CD.[3,7]

Cervical lacerations, especially after vaginal delivery, can be difficult to diagnose, and some probably go unnoticed or at least undocumented. Unintentional uterine incision extensions are more common in a CD done in the second stage, compared with one done in the first stage.[13,14] Some experts have advocated an incision higher on the uterus in second-stage CD, but no supportive data on the benefit of this intervention have been published.

Significant uterine extensions that disrupt the muscle body at the lower uterine segment/internal os and repair of these extensions may perhaps influence cervical function in a subsequent pregnancy. Although several studies have failed to show a significant association between cervical lacerations or extensions in a prior pregnancy and subsequent SPTB, these studies have been limited by small sample sizes and lack of characterization of the depth/degree of these extensions into the cervix.[3,7,15,16] Larger studies are needed because this may be an area of significant concern; for example, one of these studies reported a significant increased incidence of SPTB of 13.5% with prior cervical extensions at CD vs 2.3% in controls ($P = .005$).[3]

In that same study, the investigators went on to explain that extensions themselves could not account for all of the increased risk related to a second-stage CD because, as even after excluding women with an extension during their CD, there was still a higher risk of SPTB after a second-stage CD compared with a first-stage CD (9.1% vs 0.9%, $P = .02$).

How frequent are these risks of subsequent SPTB after second-stage CD? Of the 32% of cesareans done in the United States, about 10–25% are done in the second stage.[1,13,17]

Prolonged second stage is a risk factor for a difficult extraction at cesarean/deeply impacted fetal head. About 10% of nulliparas with epidurals have prolonged second stage.[18]

The incidence of impacted fetal head is about 1.5% of all CDs.[19] The incidence of any cervical laceration at delivery is about 0.15%, with more than three quarters (78%) of these being diagnosed after vaginal birth and less than a quarter at cesarean.[15,16] If there is an association between CD in the second stage and subsequent SPTB, the magnitude of the increase risk is small (aOR, 2.4).[1] Given the low incidence of CD in the second stage and its possible complications, which have not been absolutely proven to be risk factors for subsequent SPTB, the impact of second-stage CDs on subsequent SPTB may not be large.

Future studies evaluating the possible association between CD in the second stage and subsequent SPTB should control for important variables, such as the length of the second stage, the presence of infection, possible cumulative effects of attempt at OVD followed by CD, the indication for CD in the second stage, whether the CD was emergent or not, the exact placement of the hysterotomy incision (in the cervix or not) at CD, how the impacted fetal head was delivered (push vs pull/reverse breech extraction), the effect of an impacted fetal head, the degree of difficulty in fetal delivery at CD, time between incision and delivery, and the detailed exploration and description of any extensions (and the details of any repair).

Clearly we need a lot more research on understanding where to place the incision on the uterus when performing a CD in the second stage. It is known that the location of the prior uterine incision has a major impact on a future pregnancy, such as in the risk of uterine rupture in trial of labor after CD; therefore, it is reasonable to hypothesize that incision location can have an impact on other perinatal consequences that are yet to be studied as accreta risk, subsequent adhesion formation, blood loss, peripartum hysterectomy, miscarriage, SPTB and stillbirth in a future pregnancy.

The focus should be on prevention. There are many interventions to prevent the first CD, as, for example, midwife-led labor, the presence of doulas, increased intravenous fluids, allowing longer time before a diagnosis of arrest or failed induction in the first stage, and delayed pushing in the second stage.[20–22] Allowing prolonged second stage past 3 hours also prevents CD,[18] as obviously does a more frequent use of OVD.[21]

These new data from Wood et al,[1] and a review of related literature, should not prevent obstetrical providers from encouraging a trial of labor, or a prolonged second stage if necessary, in a woman with reassuring maternal and fetal status. Cervical extensions at CD can be prevented by extending the transverse uterine incision cephalocaudally.[23] Additionally, there are techniques that have been associated with a decrease in extensions at CD with an impacted fetal head including the shoulder-first method, reverse breech extraction (pull method), and the vaginal fetal pillow.[24–26]

The emerging evidence from Wood et al[1] adds to the current understanding of risk factors for SPTB and confirms the fact that women with a prior SPTB are a heterogeneous group because so many different variables and pathophysio-logical mechanisms can lead to a SPTB. Studies on SPTB prevention should list as many as possible of the more than 30 risk

factors for SPTB because different interventions (eg, progesterone, cerclage, pessary, etc) may have a different efficacy in different populations. Research on the prevention of SPTB should continue to move toward precision medicine to tailor our therapies to more specific groups of women that are shown to benefit the most. Moreover, the understanding that a CD in the second stage may be a risk factor for subsequent SPTB gives us yet another reason to strive for either prevention of the first CD or performing the first CD as safely as possible.

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