Published in final edited form as:

Obstet Gynecol. 2009 November ; 114(5): 1017–1022. doi:10.1097/AOG.0b013e3181bbf3be.

Failed Operative Vaginal Delivery

James M. Alexander, M.D., Kenneth J. Leveno, M.D., John C. Hauth, M.D., Mark B. Landon, M.D., Sharon Gilbert, M.S., M.B.A., Catherine Y. Spong, M.D., Michael W. Varner, M.D., Steve N. Caritis, M.D., Paul Meis, M.D., Ronald J. Wapner, M.D., Yoram Sorokin, M.D., Menachem Miodovnik, M.D., Mary J. O'Sullivan, M.D., Baha M. Sibai, M.D., Oded Langer, M.D., and Steven G. Gabbe, M.D. for the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units Network (MFMU)
Departments of Obstetrics and Gynecology at the University of Texas Southwestern Medical Center, Dallas, TX; University of Alabama at Birmingham, Birmingham AL; The Ohio State University, Columbus, OH; University of Utah, Salt Lake City, UT; University of Pittsburgh, Pittsburgh PA; Wake Forest University Health Sciences, Winston-Salem, NC; Thomas Jefferson University, Philadelphia, PA; Wayne State University, Detroit, MI; University of Cincinnati, Cincinnati, OH; University of Miami, Miami, FL; University of Tennessee, Memphis, TN; University of Texas Health Science Center at San Antonio, San Antonio, TX; Vanderbilt University, Nashville, TN; The George Washington University Biostatistics Center, Washington, DC, and the Eunice Kennedy Shriver National Institute of Child Health and Human Development, Bethesda, MD.

Abstract

Objective—To compare maternal and neonatal outcomes in women undergoing a second stage cesarean after a trial of operative vaginal delivery with women undergoing a second stage cesarean without such an attempt.

Methods—This study is a secondary analysis of the women who underwent second stage cesarean. The maternal outcomes examined included blood transfusion, endometritis, wound complication, anesthesia use, and maternal death. Infant outcomes examined included umbilical artery pH < 7.0, Apgar of 3 or less at 5 minutes, seizures within 24 hours of birth, hypoxic ischemic encephalopathy (HIE), stillbirth, skull fracture, and neonatal death.

Results—Of 3189 women who underwent second stage cesarean, operative vaginal delivery was attempted in 640. Labor characteristics were similar in the two groups with the exception of the admission to delivery time and cesarean indication. Those with an attempted operative vaginal delivery were more likely to undergo cesarean delivery for a non-reassuring fetal heart rate tracing (18.0% vs 13.9%, $p=.01$), have a wound complication (2.7% vs 1.0%; OR 2.65 95% CI 1.43–4.91), and require general anesthesia (8.0% vs 4.1%, OR 2.05 95% CI 1.44–2.91). Neonatal outcomes including umbilical artery pH less than 7.0, Apgar at or below 3 at 5 minutes, and hypoxic ischemic encephalopathy were more common for those with an attempted operative vaginal delivery. This was not significant when cases with a non-reassuring fetal heart rate tracing were removed.

Address correspondence to: James M. Alexander, M.D., Department of Obstetrics and Gynecology, University of Texas Southwestern Medical Center at Dallas, 5323 Harry Hines Blvd., Dallas, Texas 75235-9032, Phone: 214-648-4746, Fax: 214-648-4763, james.alexander@utsouthwestern.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

*For a list of other members of the NICHD MFMU, see the Appendix online at <http://links.lww.com/xxx>.

Conclusion—Cesarean delivery after an attempt at operative vaginal delivery was not associated with adverse neonatal outcomes in the absence of a non-reassuring fetal heart rate tracing.

Introduction

The rate of operative vaginal delivery in the United States was 9% in 2005, a 42% reduction over the previous decade.¹ The reasons for this decline are not fully understood, but may include concern for fetal injury such as skull fracture and intracranial hemorrhage and maternal tissue trauma, a decrease in the training and experience of obstetricians in use of forceps and vacuum, and an overall increase in cesarean delivery rates. The potential for harm of the obstetric forceps and vacuum has been recognized since their introduction into practice. Until the development of cesarean delivery as a safe alternative, however, trauma related to the use of the obstetric forceps was unavoidable. As cesarean delivery became more widely available in the early to mid-20th century, the use of the forceps and vacuum for the more difficult cases of cephalopelvic disproportion (CPD) decreased and new practices were developed to minimize morbidity and maximize safety of operative vaginal delivery. The concept of a trial of forceps or vacuum has evolved into one such practice. This approach, first developed in the 1950's, stresses the importance of the ability to perform an immediate cesarean delivery in those cases in which an initial attempt at operative vaginal delivery fails. The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD), Maternal-Fetal Medicine Units Network observational study of cesarean delivery offered an opportunity to study maternal and infant outcomes in women undergoing a cesarean delivery after a trial of operative vaginal delivery and compare these outcomes to women undergoing second stage cesarean without such intervention.³

The objective of our study was to compare maternal and neonatal outcomes in women undergoing a second stage cesarean after a trial of operative vaginal delivery with women undergoing a second stage cesarean without such an attempt.

Materials and Methods

This is a secondary analysis of the Maternal-Fetal Medicine Units Network (MFMU) cesarean registry. This registry was an observational study conducted by the NICHD to assess several contemporary issues related to cesarean delivery. Between 1 January 1999 and 31 December 2000, all women undergoing a cesarean delivery with an infant of at least 500 grams or 20 weeks gestation at participating centers were prospectively ascertained. Each of the 13 centers participating in this NICHD MFMU Network study obtained Institutional Review Board approval prior to enrollment.

The primary outcomes for the cesarean registry have been previously reported.³ In brief, detailed information regarding medical and obstetrical history, intrapartum course, postpartum complications, and infant outcomes was abstracted directly from maternal and infant charts by specially trained and certified research nurses. All data were entered into a computerized database without patient identifiers, and transmitted electronically to the George Washington University Biostatistics Center on a weekly basis. Electronic edit reports were generated each week and transmitted back to each center for correction or identification.

For this secondary analysis, maternal and neonatal outcomes of women who underwent a second stage cesarean delivery who had an attempted operative vaginal delivery were compared with those women who underwent a second stage cesarean delivery without such an attempt. This analysis was limited to singleton non-anomalous gestations with a vertex

presentation. Demographics, labor characteristics, and the indication for the cesarean delivery were compared in the two groups. The indication for the operative vaginal delivery attempt was not available.

Maternal outcomes examined included the need for a blood transfusion, endometritis (defined as a persistent postpartum temperature $\geq 37.8^{\circ}\text{C}$ with uterine tenderness and no other infection), wound complications (defined as infection at the skin incision site, seroma, or hematoma) and maternal death. We compared the type of anesthesia used including regional and general. Infant outcomes examined included umbilical artery pH < 7.0 , Apgar 3 or less at 5 minutes, seizures within 24 hours of birth, hypoxic ischemic encephalopathy (HIE), stillbirth, skull fracture, and neonatal death. We also looked at fetal injury and intracranial hemorrhage in the infants diagnosed with HIE.

A separate data collection form was completed for all infants who had a clinical diagnosis of HIE, or any of the following: seizures, cardiopulmonary resuscitation during the first 24 hours of life, umbilical cord pH value below 7.0, head injury at term or a 5-minute Apgar score of less than 4, or a maternal uterine rupture. All instances of HIE underwent secondary review by a local study investigator.

Statistical analyses included the Wilcoxon rank-sum test for continuous variables and the chi-square test or Fisher's exact test for categorized variables. Unless otherwise noted, the response rate for the variables was 95% or greater. Nominal two-sided p values are reported with statistical significance are considered as a p value of < 0.05 . No adjustment was made for multiple comparisons. SAS software (SAS Institute, Cary, NC) was used for analysis.

Results

During the two-year study period, there were 29,612 singleton, vertex, non-anomalous pregnancies that underwent cesarean delivery. A second stage cesarean was experienced by 3,189 patients. Of these women, 640 underwent an attempt at operative vaginal delivery, 395 were forceps, 182 were vacuum, and 63 underwent both a forceps and vacuum attempt prior to the cesarean delivery. A second stage cesarean without an attempt at operative delivery was experienced by 2,549 patients.

Table 1 shows selected demographic and pregnancy characteristics. Women undergoing an attempt at operative vaginal delivery were younger, more likely to be nulliparous, and less likely to have undergone a previous cesarean delivery. Although birthweight was different between the groups, this difference was slight and not clinically significant. Table 2 shows labor characteristics between the groups. The use of labor epidural, oxytocin, and amniotomy was similar between the groups. The interval from admission to delivery was longer in the no attempt group but this difference was less than 1 hour and not clinically significant. The primary indication for cesarean delivery was also different with more women undergoing cesarean delivery for a non-reassuring fetal heart rate in the group that underwent an attempt at operative vaginal delivery (18.0% vs 13.9%, $p = .01$).

Maternal outcomes are shown in Table 3. Women who underwent an attempt at operative vaginal delivery were more likely to have a wound complication and undergo general anesthesia due to a failed regional anesthetic. An increased need for blood transfusion in the attempted operative vaginal delivery group was seen however this was not significant. No maternal deaths occurred in the cohort.

Table 4 shows neonatal outcomes in the two groups. The attempted operative vaginal delivery group had an increased incidence of umbilical artery pH < 7.0 . This information was not recorded for 57% of the infants. The frequency of an infant with an Apgar score of 3

or less at 5 minutes, seizure or HIE were greater in the attempted operative vaginal delivery group. Stillbirth and neonatal death were not different in the two groups. There were 2 cases of skull fracture in the attempted vaginal delivery group, but none were seen in the no attempt group (0.31% vs 0, $p = .04$). Further examination of the HIE cases revealed that all 10 cases involved some level of concern about the fetal heart rate. Two of the 10 cases had a prolapsed cord, six cases had non-reassuring fetal heart rate listed as the primary reason for delivery, and four cases had non-reassuring heart rate listed as a secondary indication for delivery. There were no cases of fetal injury including intracranial or skull fracture hemorrhage in these 10 cases.

There were 733 (23%) cases that had a non-reassuring fetal heart rate tracing listed as the primary or secondary indication for cesarean. More than two-thirds (69%) of the adverse neonatal outcomes were in this group for an incidence of 5.7%. In the remaining 2,456 cases, there were 19 cases of adverse neonatal outcome for an incidence of 0.8%. Table 5 shows the neonatal outcomes in the two groups excluding those cases without a primary or secondary indication of a non-reassuring fetal heart rate. There were no longer any differences between the two groups.

Discussion

We found that an unsuccessful attempt at operative vaginal delivery was associated with a greater rate of adverse maternal and neonatal outcomes relative to second stage cesarean delivery without such an attempt. Adverse neonatal outcomes associated with an attempt at operative vaginal delivery included an Apgar of 3 or less at 5 minutes, an umbilical artery cord pH of less than 7.0, seizures within 24 hours of birth, or HIE. Although an umbilical artery cord pH < 7.0 was greater in the attempted operative vaginal delivery group, this may reflect the indication for obtaining the umbilical artery cord gas rather than a true increase in the incidence of this outcome. The HIE cases had no evidence of injury to the fetus secondary to the unsuccessful attempt including skull fracture or intracranial hemorrhage. The increased maternal morbidity seen included wound complications, failed regional anesthesia resulting in the need for intubation and general anesthesia. We also found that the indication for delivery was different in the two groups with intervention for a non-reassuring fetal heart rate being more common in the operative vaginal delivery group. Excluding those cases with an indication for cesarean of a non-reassuring fetal heart rate eliminated the differences seen in neonatal outcomes in the two groups. Indeed, all of the cases of HIE had evidence of fetal jeopardy prior to delivery.

Historically, a failed forceps or vacuum delivery has been associated with unacceptably high maternal and neonatal morbidity. Freeth in 1950 reported a fetal mortality rate of 38% and a maternal mortality rate of 2% in cases of failed forceps.⁴ Similarly, Law in 1953 reviewed 37 cases of failed forceps operations and found perinatal mortality to be 24.3% and maternal morbidity to be 27%. There were no maternal deaths.⁵ These reports occurred during a time of very low cesarean delivery rates when vaginal delivery was pursued regardless of the fetal consequences. In response to these reports and others, Douglas and Kaltreider introduced the concept of a trial of forceps.⁶ In their paper they describe a new approach to forceps which briefly consisted of the correction of abnormality of position and gentle traction with the forceps. If progress with the forceps was not immediately obtained the patient was prepped for an urgent cesarean delivery. This paper marked the beginning of a new era in the use of the obstetric forceps, and came about in part due to the increased safety and use of cesarean delivery.

As the concept of a trial of forceps or vacuum became accepted, reports supporting this approach began to appear in the literature. Boyd in 1986 reported that the rates of adverse

outcomes, including asphyxia in infants born after an unsuccessful forceps attempt were not different in infants born by cesarean delivery for failure to progress.⁷ Both groups of infants were at significantly higher risk of these outcomes however, than infants who were spontaneously delivered. Revah et al reported no significant difference in neonatal outcomes when comparing infants born after a failed forceps, vacuum or both to those delivered by women undergoing a cesarean delivery without such an attempt.⁸ These authors were careful to point out that study design is important in interpreting studies of this subject due to the multiple confounders present in these cases, most importantly the indication for which the forceps or vacuum attempt is attempted. Towner et al made this point in their 1999 study of the effect of delivery mode on neonatal intracranial injury.⁹ They reported that cesarean performed during labor as well as forceps and vacuum extraction were associated with an increased risk of intracranial hemorrhage when compared to spontaneous vaginal delivery. This association was driven by abnormal labor, that is, the method of delivery was not the primary factor associated with intracranial hemorrhage, but the indication for delivery was.

Although the concept of a trial of operative vaginal delivery with availability of immediate cesarean delivery for those cases that fail has become well established, the overall use of operative vaginal delivery has greatly declined.¹ Murphy has recently raised concerns about the wisdom of such a decline due to the morbidity of a second stage cesarean. She reports increased risks of maternal hemorrhage, prolonged hospital stay, increased risk of bladder trauma and extensions of the uterine incision into the broad ligament and vessels with second stage cesarean delivery.^{10,11} Our recent report on the morbidity of a second stage cesarean delivery as compared to a first stage cesarean delivery also found increased maternal morbidity including uterine incision extension and incidental cystotomy, as well as an increase in fetal injury, primarily due to laceration.¹² The existing data therefore suggest that the use of operative vaginal delivery in the properly selected patient minimizes maternal risk without increasing neonatal morbidity.

Our study examined the consequences of an unsuccessful operative vaginal delivery attempt in the context of second stage cesarean delivery. We are unable to make a definitive statement on safety as we do not have information on the women who had a successful attempt at operative vaginal delivery. In addition, the indications for which the operative vaginal delivery was attempted were unavailable. We are able to say however, that the neonates with the most serious adverse outcome measured, HIE, did not appear to suffer injury directly attributable to the instrument such as intracranial hemorrhage or skull fracture. Furthermore, those cases experiencing adverse neonatal outcomes were strongly associated with evidence of fetal jeopardy prior to the attempt at operative vaginal delivery and may have little to do with the route of delivery itself.. Our findings suggest that the circumstances leading to an operative second stage delivery play a significant role in the ultimate outcome of the infant. In the absence of a non-reassuring fetal heart rate tracing, an attempt at operative vaginal delivery prior to performing a cesarean delivery was not associated with adverse neonatal outcome.

Acknowledgments

The authors thank Elizabeth Thom, Ph.D. for protocol and data management and statistical analysis and Francee Johnson, BSN, and Julia Gold, BSN/APN, for protocol development and coordination between clinical research centers.

Supported by grants from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (HD21410, HD21414, HD27860, HD27861, HD27869, HD27905, HD27915, HD27917, HD34116, HD34122, HD34136, HD34208, HD34210, and HD36801).

References

1. Martin JA, Hamilton BE, Sutton PB, Ventura SJ, Menacker F, Kirmeyer S. Division of Vital Statistics. Births: final data for 2004. National Vital Statistics Reports. 2006; 53(1):1–102.
2. American College of Obstetricians and Gynecologists. Operative Vaginal Delivery. ACOG Practice Bulletin. 2000; 17:543–550.
3. Landon MB, Hauth JC, Leveno KJ, Spong CJ, Leindecker S, Varner MW, Moawad AH, Caritis SN, Harper M, Wapner RJ, Sorokin Y, Miodovnik M, Carpenter M, Peaceman AM, O'Sullivan MJ, Sibai B, Langer O, Thorp JM, Ramin SM, Mercer BM, Gabbe SG. National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. N Engl J Med. 2004 Dec 16; 351(25):2581–2589. Epub 2004 Dec 14. [PubMed: 15598960]
4. Freeth HD. The cause and management of failed forceps cases. Br. Med J. 1950; 2:18. [PubMed: 15426793]
5. Law RG. Failed forceps: a review of 37 cases. Br Med J. 1953; 2:955–957. [PubMed: 13094080]
6. Douglass LH, Kaltreider DF. Trial forceps. Am J Obstet Gynecol. 1953; 65(4):889–896. [PubMed: 13030623]
7. Boyd ME, Usher RH, McLean FH, Norman BE. Failed forceps. Obstet Gynecol. 1986; 68(6):779–783. [PubMed: 3785789]
8. Revah A, Ezra Y, Farine D, Ritchie K. Failed trial of vacuum or forceps – maternal and fetal outcome. Am J Obstet Gynecol. 1997; 176:200–204. [PubMed: 9024114]
9. Towner D, Castro MA, Eby-Wilkins E, Gibling WM. Effect of mode of delivery in nulliparous women on neonatal intracranial injury. N Engl J Med. 1999; 341(23):1709–1714.
10. Spencer C, Murphy DJ, Bewley S. Cesarean delivery in the second stage of labor. BMJ. 2006; 333:613–614. [PubMed: 16990297]
11. Patel RR, Murphy DJ. Forceps delivery in modern obstetric practice. BMJ. 2004; 326:1302–1305. [PubMed: 15166069]
12. Alexander JM, Leveno KJ, Rouse DW, et al. Comparison of maternal and infant outcomes from primary cesarean delivery during the second compared with first stage of labor. Obstet Gynecol. 2007; 109(4):917–921. [PubMed: 17400854]

Table 1

Demographic Characteristics of Women Who Underwent a Cesarean Delivery After an Operative Vaginal Delivery Attempt Compared to Those Undergoing Cesarean Without Such an Attempt

Characteristics	Attempted operative Vaginal delivery n = 640	No attempt n = 2,549	P value
Maternal age, yrs.	25.8 ± 6.3	27.3 ± 6.4	<0.001
Race:			0.03
Caucasian	315 (49.2)	1,223 (48.0)	
African-American	109 (17.0)	528 (20.7)	
Hispanic	180 (28.1)	613 (24.0)	
Other	36 (5.6)	185 (7.3)	
Nulliparous	503 (78.7)	1,867 (73.5)	0.007
Previous cesarean	54 (8.6)	287 (11.3)	0.04
Gestational age, wks	39.8 ± 1.4	39.7 ± 1.8	0.74
< 37 weeks	27 (4.2)	122 (4.8)	0.54
< 34 weeks	2 (0.3)	22 (0.9)	0.20
Birthweight, gms	3,500 ± 456	3,586 ± 534	<0.001
> 4000 grams	87 (13.6)	488 (19.2)	0.001
> 4500 grams	11 (1.7)	81 (3.2)	0.05

Data presented as n (%) or mean ± standard deviation.

Table 2

Intrapartum Characteristics of Women Who Underwent a Cesarean Delivery After an Operative Vaginal Delivery Attempt Compared to Those Undergoing Cesarean Without Such an Attempt

Characteristics	Attempted operative Vaginal delivery n = 640	No attempt n = 2,549	P value
Labor epidural	557 (87.0)	2,288 (89.8)	0.05
Oxytocin augmentation	305 (47.7)	1,177 (46.2)	0.50
Oxytocin induction	190 (29.7)	834 (32.7)	0.14
Amniotomy	377 (58.9)	1,462 (57.5)	0.52
Admission to delivery, hrs	14.5 (10.0, 19.8)	15.3 (10.8, 21.4)	0.007
Major indication for cesarean delivery			0.02
Labor dystocia	502 (78.4)	2,116 (83.0)	
Non-reassuring fetal heart	115 (18.0)	355 (13.9)	
rate tracing	23 (3.6)	78 (3.1)	
Other			

Data presented as n (%) or median (1st and 3rd quartile).

Table 3

Maternal Outcomes of Women Who Underwent a Cesarean Delivery After an Operative Vaginal Delivery Attempt Compared to Those Undergoing Cesarean Without Such an Attempt

	Attempted operative Vaginal delivery n = 640	No attempt n = 2,549	OR (95% CI)
Blood transfusion	23 (3.6)	70 (2.7)	1.32 (0.82 – 2.13)
Endometritis	65 (10.2)	264 (10.4)	0.98 (0.73 – 1.30)
Wound complication *	17 (2.7)	26 (1.0)	2.65 (1.43 – 4.91)
Failed regional anesthesia requiring general	50 (8.0)	101 (4.1)	2.05 (1.44 – 2.91)

OR, odds ratio; CI, confidence interval

Data presented as n (%).

* Includes wound infection, seroma or hematoma.

Table 4

Neonatal Outcomes of Women Who Underwent a Cesarean Delivery After an Operative Vaginal Delivery Attempt Compared to Those Undergoing Cesarean Without Such an Attempt

	Attempted operative Vaginal delivery n = 640	No attempt n = 2,549	OR (95% CI)
Umbilical artery pH < 7.0*	16 (4.7)	18 (1.7)	2.79 (1.41 – 5.53)
Apgar ≤ 3 at 5 minutes	11 (1.7)	16 (0.6)	2.77 (1.28 – 6.00)
Seizures within 24 hours of birth	6 (0.9)	3 (0.1)	8.04 (2.00 – 32.23)
HIE	7 (1.1)	3 (0.1)	9.37 (2.42 – 36.34)
Stillbirth	0 (0.0)	3 (0.1)	----
Neonatal death	3 (0.5)	5 (0.2)	2.39 (0.57 – 10.02)

OR, odds ratio; CI, confidence interval; HIE, hypoxic ischemic encephalopathy

Data presented as n (%). Dash represents not applicable.

* Umbilical artery pH data is based on 341 infants in the attempted operative group and 1,038 in the no attempt group.

Table 5

Neonatal Outcomes of Women Who Underwent a Cesarean Delivery After an Operative Vaginal Delivery Attempt Compared to Those Undergoing Cesarean Without Such an Attempt*

	Attempted operative Vaginal delivery n = 453	No attempt n = 2,003	OR (95% CI)
Umbilical artery pH < 7.0 [†]	3 (1.3)	6 (0.8)	1.67 (0.41 – 6.72)
Apgar ≤ 3 at 5 minutes	0 (0.0)	7 (0.3)	----
Seizures within 24 hours of birth	2 (0.4)	1 (0.1)	8.90 (0.81 – 98.41)
HIE	0 (0)	0 (0)	----
Stillbirth	0 (0.0)	2 (0.1)	----
Neonatal death	1 (0.2)	1 (0.1)	4.42 (0.28 – 70.73)

OR, odds ratio; CI, confidence interval; HIE, hypoxic ischemic encephalopathy

Data presented as n (%). Dash represents not applicable.

* Excludes any case with a primary indication or secondary indication of a non-reassuring fetal heart rate.

[†] Umbilical artery pH data is based on 223 infants in the attempted operative group and 740 in the no attempt group.