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Maternal and Neonatal Outcomes by Attempted Mode of Operative Delivery From a Low Station in the Second Stage of Labor

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Abstract

Objective—To evaluate maternal and neonatal outcomes by attempted mode of operative delivery from a low station in the second stage of labor.

Methods—Retrospective study of 2,518 women carrying singleton fetuses at 37 weeks gestation who underwent attempted forceps-assisted delivery, attempted vacuum-assisted vaginal delivery, or cesarean delivery from a low station in the second stage of labor. Primary outcomes were stratified by parity and included a maternal adverse outcome composite (postpartum hemorrhage, transfusion, endometritis, peripartum hysterectomy, or intensive care unit {ICU} admission) and a neonatal adverse outcome composite (5 minute Apgar<4, respiratory morbidity, neonatal intensive care unit {NICU} admission, shoulder dystocia, birth trauma, or sepsis).

Results—In nulliparous patients the maternal adverse composite was not significantly different between women who underwent attempted forceps (12.1% vs. 10.8%, aOR 0.77, 95% CI 0.40–1.34) or vacuum (8.3% vs. 10.8%, aOR 0.68, 95% CI 0.40–1.16) delivery compared to cesarean delivery. Among parous women, the maternal adverse composite was not significantly different with attempted forceps (10.7% vs. 12.5%, aOR 0.40, 95% CI 0.09–1.71) or vacuum (11.3% vs. 12.5%, aOR 0.44, 95% CI 0.11–1.72) compared to cesarean delivery. Compared to infants delivered by cesarean, the neonatal adverse composite was significantly lower among infants born to

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For a list of institutions involved in the Consortium, see Appendix 1 online at <http://links.lww.com/xxx>.

nulliparous women who underwent attempted forceps (9.4% vs. 16.7%, aOR 0.44, 95% CI 0.27–0.72) but not among those who underwent vacuum delivery (11.9% vs. 16.7%, aOR 0.68, 95% CI 0.44–1.04). Among parous women, the neonatal adverse composite was not significantly different after attempted forceps (4.1% vs 12.5%, aOR 0.28, 95% CI 0.06–1.35) or vacuum (12.5% vs. 12.5%, aOR 1.03, 95% CI 0.28–3.87) compared to cesarean delivery.

Conclusion—A trial of forceps delivery from a low station compared to cesarean delivery was associated with decreased neonatal morbidity among infants born to nulliparous women.

Introduction

Operative vaginal delivery rates have declined significantly over the past several decades. By 2013, the cesarean delivery rate rose to 32.7 %, from a nadir of 4.5 % in 1965 (1). In contrast, by 2013 the use of operative vaginal delivery had decreased to 3.3 % of all deliveries, as compared to 9.0 % in 1990. Currently 0.6 % of all births are accomplished with the use of forceps, and 2.7 % with vacuum devices (2).

While the literature has delineated benefits of spontaneous vaginal birth over cesarean with respect to maternal and neonatal morbidity, shorter recovery, and decreased costs, less clear is the question of operative vaginal delivery as compared to cesarean section in the second stage of labor, particularly from a low station (3). Additionally prior studies have been limited to actual mode of delivery, not attempted mode of delivery, and thus are prone to selection bias. Furthermore, in 2012 the Cochrane Collaborative endeavored to perform a meta-analysis of randomized trials to investigate outcomes of attempted operative vaginal delivery versus immediate cesarean section, but was not able to identify any suitable studies for inclusion (4).

Therefore we evaluated maternal and neonatal adverse outcomes by attempted mode of operative delivery from a low station in the second stage of labor.

Materials and Methods

The Consortium on Safe Labor (CSL) was a retrospective cohort study of electronic medical records from 228,562 deliveries, including 12 clinical centers with 19 hospitals across 9 American College of Obstetricians and Gynecologists (ACOG) districts between 2002 and 2008 (5). All participating institutions obtained Institutional Review Board (IRB) approval. IRB approval also was obtained for the present analysis.

Women with singleton pregnancies who delivered ≥ 37 weeks of gestation, in cephalic presentation, achieved 10 cm dilation, attained at least low fetal station (+2/3 or +3/5, depending on the scale used by each institution), and underwent either attempted operative vaginal delivery via forceps or vacuum, or cesarean section without an attempt of operative vaginal delivery were included (Figure 1). Women with pregnancies complicated by severe anomalies, antepartum or intrapartum stillbirth, prolonged second stage of labor more than 12 hours, and sequential procedures (e.g. forceps followed by vacuum or vice versa; n = 12) were excluded. Intrapartum stillbirths were excluded because timing of stillbirth in labor was unknown, so it could not be determined whether it occurred during the first or second

stage of labor. The number of individual exclusions may exceed the total at each point due to patients being excluded for multiple reasons (Figure 1).

Data were collected from electronic antenatal, obstetric and neonatal records, including maternal demographics, labor and delivery characteristics, gravidity, parity, insurance status, body mass index (BMI), chronic hypertension (CHTN), gestational hypertensive disease (inclusive of gestational hypertension and preeclampsia), pregestational diabetes mellitus (DM), gestational DM, prior uterine scar, gestational age at delivery, oxytocin use, duration of the first and second stages of labor, birth weight, and hospital type.

Primary study outcomes were separate maternal and neonatal adverse outcome composites from diagnoses or interventions as recorded in the medical record. The maternal adverse outcome composite was defined as any of the following: postpartum hemorrhage, blood transfusion, endometritis, peripartum hysterectomy, intensive care unit (ICU) admission, and mortality. The neonatal adverse outcome composite consisted of the following: five minute Apgar score < 4, respiratory morbidity (defined as the use of any supplemental oxygen), neonatal intensive care unit (NICU) admission, shoulder dystocia, birth trauma, sepsis, and mortality. Secondary outcomes included the individual outcomes from the each composite as well as maternal venous thromboembolism, wound complications (infection or separation), episiotomy, third-degree and fourth-degree lacerations, cervical or sulcal lacerations, and length of stay in days (median, 10th, 90th percentile). Analyses were performed by attempted mode of delivery, stratified by parity.

Bivariate analyses were performed to determine associations between maternal demographics and the type of delivery. Student's t or Mann-Whitney U tests were used to evaluate continuous variables as appropriate. Chi-squared and Fischer's exact test were used for the analysis of categorical variables. Multivariable logistic regression models were performed to calculate adjusted odds ratios (aORs) with corresponding 95% confidence intervals (CI) of maternal and neonatal outcomes for attempted forceps or vacuum compared to cesarean delivery (referent group). Models were stratified by parity status and controlled for maternal race, diabetes (pregestational and gestational), BMI, insurance status, and hospital type. Statistical analysis was performed using SAS 9.3 (SAS Institute Inc., Cary, NC),

Results

There were 2,518 deliveries that met inclusion criteria for this analysis. These occurred among 1,974 nulliparous and 544 parous women (Figure 1). The overall rate of operative delivery by any method (forceps, vacuum or cesarean) in the second stage of labor within the entire Consortium on Safe Labor cohort was 20.5 %.

Women who attempted operative vaginal delivery were slightly younger, more likely to be non-Hispanic white, have private insurance, have a lower BMI, be less likely to have pregestational diabetes, and deliver at a community teaching or non-teaching hospital (Table 1). Among women who attempted operative vaginal birth, the gestational age at delivery was three days earlier and neonates weighed 119 grams less on average (Table 1).

In nulliparous women, the maternal adverse outcome composite was not significantly different by attempted mode of delivery (Table 2). Attempted forceps was associated with a decreased risk of endometritis (0.7 vs. 3.0 %; aOR 0.20; 95 % CI 0.05–0.86) and wound complications (0.5 vs. 2.0 %; aOR 0.16; 95 % CI 0.03–0.78), but an increased risk of episiotomy use (69.5 vs. 1.5 %, aOR 104.4; 95 % CI 31.5–320.3) and cervical or sulcal lacerations (9.0 vs. 1.0 %, aOR 8.74; 95 % CI 2.07–37.02). Attempted vacuum was associated with a decreased risk of endometritis (0.3 vs. 3.0 %; aOR 0.10; 95 % CI 0.02–0.44), and wound complications (0.3 vs. 2.0 %; aOR 0.13; 95 % CI 0.03–0.55). Similarly to forceps, vacuum was associated with increased episiotomy use (52.0 vs. 1.5 %, aOR 63.30; 95 % CI 20.00–200.00) (Table 2).

In parous women, the maternal adverse outcome composite was not significantly different with either attempted forceps or vacuum. Blood transfusion occurred less frequently with vacuum use (8.9 vs. 18.8 %; aOR 0.20; 95 % CI 0.04–0.95) (Table 3).

Among neonates born to nulliparous women, the neonatal adverse outcome composite was significantly lower with attempted forceps (9.4 vs. 16.7 %, aOR 0.44; 95 % CI 0.27–0.72); it was not significantly different in women with attempted vacuum. Attempted forceps delivery was associated with significantly less NICU admission (5.6 vs. 13.6 %; aOR 0.35; 95 % CI 0.20–0.63), respiratory morbidity (1.7 vs. 6.6 %; aOR 0.28; 95 % CI 0.11–0.69), and sepsis (0.4 vs. 2.5 %; aOR 0.18; 95 % CI 0.03–0.99). Attempted vacuum was associated with reduced NICU admission (6.5 vs. 13.6 %; aOR 0.49; 95 % CI 0.30–0.80) and respiratory morbidity (2.8 vs. 6.6 %; aOR 0.48; 95 % CI 0.24–0.95), similarly to forceps (Table 4).

Among neonates born to parous women, the neonatal adverse outcome composite was not significantly different between groups. Birth trauma was significantly less for both forceps (0.8 vs. 8.3 %; aOR 0.03; 95 % CI 0.002–0.40) and vacuum (2.8 vs. 8.3 %; aOR 0.15; 95 % CI 0.03–0.95) (Table 5).

Actual mode of delivery correlated with attempted mode of delivery in 99.3 % of nulliparous women who attempted forceps delivery and 99.25 % of nulliparous women who attempted vacuum use. The actual mode of delivery matched the attempted route in all parous women (Table 6).

Discussion

In our large, diverse cohort attempted forceps or vacuum delivery compared to cesarean section from a low station in the second stage was associated with decreased maternal and neonatal risks, specifically blood transfusion, endometritis, neonatal infectious and respiratory morbidities, as well as NICU admission. These improvements should be balanced with increased incidences of episiotomy and cervical or sulcal lacerations in nulliparous women.

Early literature reported increased operative vaginal delivery related retinal hemorrhage, cephalohematoma, facial injury, or maternal lacerations (6, 7). Studies that followed found increased intracranial hemorrhage rates with forceps or vacuum use compared to pre-labor

cesarean delivery (8–12). Recently, epidemiological cohorts have found either no associations, or benefits of operative vaginal birth over cesarean in terms of umbilical cord gas parameters, encephalopathy, neonatal death, or composite outcomes (13–15). Other literature has delineated the results of patients undergoing cesarean delivery after a failed operative vaginal attempt, with conflicting findings as to the potential associated risks (16–18). Previous literature compared operative vaginal delivery against cesarean section from disparate stations as well (e.g. mid-labor cesarean compared with operative vaginal delivery from an unknown station), diminishing applicability (8–15).

Blood transfusion was lower in parous women attempting vacuum assisted birth, likely due to avoidance of increased blood loss with second stage cesarean, (> 1000 mL in 10 % of such patients) (12). Wound complications were diminished in nulliparous women attempting operative vaginal birth, likely attributable to avoidance of a laparotomy incision. This is in contrast to a Maternal-Fetal Medicine Units Network study that reported increased incision site infections, seroma, or hematoma with forceps or vacuum use compared to cesarean section (16). Decreased endometritis with both forceps and vacuum in nulliparous women demonstrates the potential benefit of reducing infectious risks associated with second stage cesarean birth (over 10 % in some cohorts) (16). Decreased respiratory morbidity may be explained by the known lower incidence in this with vaginal delivery compared to cesarean as well (3). Our findings are in agreement with a study of 122,000 birth records that found forceps use was associated with lower composite morbidity than either vacuum or cesarean birth (14).

In a seminal report of 580,000 neonates, intracranial hemorrhage occurred in 1 of 664, 1 of 860, and 1 of 907 births for forceps assisted, vacuum assisted, and intrapartum cesarean delivery, respectively (8). Another publication noted no differences in peripartum death or encephalopathy between either vacuum or forceps compared to cesarean delivery in the second stage for nearly 65,000 neonates (13). Our investigation is similarly reassuring in regards to attempted operative vaginal delivery versus cesarean overall, and in agreement with other literature reporting improved outcomes with completed operative vaginal birth as compared to cesarean section in the second stage (12–14,18).

The rate of operative delivery by any method (forceps, vacuum, or cesarean) in the second stage overall has been reported at 18 %, similar to 20.5 % in our cohort (11). Episiotomy use increased with attempted operative vaginal delivery in our cohort (up to 69 %), in keeping with the reported incidence in such circumstances (88 %) (19). Cervical or sulcal lacerations were elevated in nulliparous women undergoing operative vaginal birth, though overall occurred in less than 1 in 10 with attempted forceps and 1 in 20 patients with attempted vacuum use.

The strength of our study is the comparison of attempted mode of delivery at equivalent low station, as opposed to the limitation of prior investigations that included all second stage cesarean births as a referent. Weaknesses are the retrospective nature, inability to adjust for non-uniformly abstracted variables, including estimated fetal weight and indication for delivery, and possible selection bias of patients undergoing attempted operative vaginal birth. It is likely that women thought to be better candidates were offered forceps or vacuum,

as the attempted operative vaginal delivery group had lower birth weight, incidence of diabetes, BMI, and shorter labors, and this must be considered when interpreting our results. As this cohort was retrospective and non-interventional, these differences are likely due to provider judgment, and therefore similar to usual clinical practice however. The high success rates for operative vaginal birth attempts may be the result of such bias as well. Regardless, our findings are reassuringly consistent with those of others that have assessed outcomes by completed route of delivery (12–14). Some outcomes occurred rarely (e.g. mortality), limiting the ability to detect a significant result. Lastly, analyses with multiple comparisons may experience a significant finding due to chance.

The results of our study can be used in counseling women who achieve full dilation and a low station but are unable to complete a spontaneous vaginal delivery. For both mother and neonate, attempted forceps or vacuum delivery demonstrates potential benefits without clinically significant excess harms compared to the risks of a second stage cesarean birth. Moreover, this information can be used to support the practice of operative vaginal delivery as an alternative to immediate cesarean section from a low station, and thus may help lower the rate of primary cesarean delivery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Cohort selection. *The sum of individual exclusions may exceed the total at each point due to deliveries being excluded for multiple reasons.

Table 1

Characteristics of cohort

	Attempted operative vaginal delivery (n=2296)	Cesarean delivery (n=222)	P value
Age, years – mean (S.D.)	26.8 (5.7)	27.9 (6.8)	0.016
Race - n (%)			
Non-Hispanic white	1642(71.5 %)	133 (59.93 %)	0.005
Non-Hispanic black	159 (6.9 %)	24 (10.8 %)	
Hispanic	256 (11.2 %)	34 (15.3 %)	
Asian/Pacific Islanders	106 (4.6 %)	17 (7.7 %)	
Other/Unknown	133 (5.8 %)	14 (6.3 %)	
Insurance - n (%)			<.001
Private	1488 (64.8 %)	107 (48.2 %)	
Public	406 (17.7 %)	60 (27.0 %)	
Other/unknown	402 (17.5 %)	55 (24.8 %)	
Gravidity – median (10th, 90 th percentiles)	1 (1,3)	1 (1,3)	0.092
Parity – median (10th, 90th percentiles)	0 (0,1)	0 (0,1)	<.001
BMI at delivery – mean (S.D.)	29.2 (5.0)	30.0 (5.3)	0.022
Chronic hypertension	15 (0.7 %)	4 (1.8 %)	0.080
Gestational hypertension or preeclampsia	151 (6.6 %)	20 (9.0%)	0.164
Pregestational diabetes	15 (0.7 %)	9 (4.1 %)	<.001
Gestational diabetes	72 (3.1 %)	11 (5.0 %)	0.164
Oxytocin use	1783 (77.7 %)	190 (54.6 %)	0.006
Gestational age at delivery, in weeks (SD)	39.5 (1.0)	39.8 (1.1)	<.001
Duration of first stage of labor, in minutes – median (10 th , 90 th percentiles)	537 (232, 1112)	825 (353, 1550)	<.001
Duration of second stage of labor, in minutes – median (10th, 90th percentiles)	89 (18, 204)	193 (57, 338)	<.001
Birth weight, in grams (SD)	3383.6 (431.0)	3503.4 (346.4)	<.001
Hospital type - n (%)			
University affiliated	713 (31.1 %)	134 (60.4 %)	<.001
Community teaching	906 (39.5 %)	59 (26.6 %)	
Community non-teaching	677 (29.5 %)	29 (13.1 %)	

Table 2

Maternal outcome by planned mode of delivery in nulliparous women

N=1974 Outcome [†]	Cesarean (n=198)		Attempted Forceps (n=577)		Attempted Vacuum (n=1199)	
	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)
Overall maternal composite [*]	20 (10.8)	1.00 (Referent)	70 (12.1)	0.77 (0.40–1.34)	99 (8.3)	0.68 (0.40–1.16)
Postpartum hemorrhage (PPH)	10 (5.1)	1.00 (Referent)	19 (3.3)	0.56 (0.25–1.29)	51 (4.3)	0.88 (0.43–1.81)
Peripartum hysterectomy	0 (0)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a
Blood transfusion	5 (3.6)	1.00 (Referent)	53 (9.7)	1.40 (0.54–3.66)	52 (4.9)	1.03 (0.39–2.69)
ICU admission	1 (0.6)	1.00 (Referent)	1 (0.2)	0.21 (0.01–4.47)	2 (0.2)	0.39 (0.03–5.72)
Endometritis	6 (3.0)	1.00 (Referent)	4 (0.7)	0.20 (0.05–0.86)	3 (0.3)	0.10 (0.02–0.44)
Venous thromboembolism	1 (0.5)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a
Wound complications (infection or separation)	4 (2.0)	1.00 (Referent)	3 (0.5)	0.16 (0.03–0.78)	4 (0.3)	0.13 (0.03–0.55)
Episiotomy	3 (1.5)	1.00 (Referent)	401 (69.5)	100.40 (31.5–320.3)	624(52.0)	63.30 (20.00–200.00)
3 rd /4 th degree Lacerations	0 (0)	1.00 (Referent)	127(22.0)	n/a	185(15.4)	n/a
Cervical or sulcal lacerations	2 (1.0)	1.00 (Referent)	52 (9.0)	8.74 (2.07–37.02)	51 (4.3)	4.14 (0.99–17.29)
Length of stay, in days (median, 10 th , 90 th percentile)	4 (3.5)	n/a	2 (1.2)	n/a	2 (2.3)	n/a
Mortality	0 (0)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a

^{*} Composite includes PPH, blood transfusion, endometritis, cesarean hysterectomy, and ICU admission.[†] Results adjusted for maternal race, insurance status, diabetic status, BMI at admission, and hospital type.[#] Not all of the sites provided this information. 1,739 observations were available for measuring blood transfusion, 1,805 were available for measuring ICU admission, and 1,974 were available for measuring episiotomy.

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[‡] The Cesarean group had significantly higher length of stay than FAVD ($p < 0.001$) and VAVD ($p < 0.001$).
N/A denotes “not applicable”.

Table 3

Maternal outcome by planned mode of delivery in parous women

N=544 Outcome [†]	Cesarean (n=24)		Attempted Forceps (n=121)		Attempted Vacuum (n=399)	
	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)
Overall maternal composite *	3 (12.5)	1.00 (Referent)	13 (10.7)	0.40 (0.09–1.71)	45 (11.3)	0.44 (0.11–1.72)
Postpartum hemorrhage (PPH)	0 (0)	1.00 (Referent)	1 (0.8)	n/a	14 (3.5)	n/a
Peripartum hysterectomy	0 (0)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a
Blood transfusion	3 (18.8)	1.00 (Referent)	11 (9.4)	0.21 (0.04–1.08)	31 (8.9)	0.20 (0.04–0.95)
ICU admission	0 (0)	1.00 (Referent)	1 (0.8)	n/a	4 (1.1)	n/a
Endometritis	0 (0)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a
Venous thromboembolism	0 (0)	1.00 (Referent)	0 (0)	n/a	3 (0.7)	n/a
Wound complications (infection or separation)	1 (4.2)	1.00 (Referent)	0 (0)	n/a	2 (0.5)	0.17 (0.01–3.38)
Episiotomy	0 (0)	1.00 (Referent)	54 (44.6)	n/a	128 (32.1)	n/a
3 rd /4 th degree lacerations	0 (0)	1.00 (Referent)	5 (4.1)	n/a	17 (4.3)	n/a
Cervical or sulcal lacerations	0 (0)	1.00 (Referent)	2 (1.7)	n/a	5 (1.3)	n/a
Length of stay, in days (median, 10 th , 90 th percentile)	4 (2.5)	n/a	2 (1.2)	n/a	2 (1.3)	n/a
Mortality	0 (0)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a

* Composite includes PPH, blood transfusion, endometritis, cesarean hysterectomy, and ICU admission.

[†] Results adjusted for maternal race, insurance status, diabetic status, BMI at admission, and hospital type.[#] Not all of the sites provided this information. 480 observations were available for measuring blood transfusion, 502 were available for measuring ICU admission, and 544 were available for measuring episiotomy.

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[‡] The Cesarean group had significantly higher length of stay than FAVD ($p < 0.001$) and VAVD ($p < 0.001$).
N/A denotes “not applicable”.

Table 4

Neonatal outcome by planned mode of delivery in nulliparous women

N=1974 Outcome [‡]	Cesarean (n=198)		Attempted Forceps (n=577)		Attempted Vacuum (n=1199)	
	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)
Overall Neonatal Composite *	33 (16.7)	1.00 (Referent)	354 (9.4)	0.44 (0.27–0.72)	143 (11.9)	0.68 (0.44–1.04)
5 minute Apgar < 4	0(0)	1.00 (Referent)	1 (0.2)	n/a	0 (0)	n/a
NICU admit	27 (13.6)	1.00 (Referent)	32 (5.6)	0.35 (0.20–0.63)	78 (6.5)	0.49 (0.30–0.80)
Shoulder Dystocia	0 (0)	1.00 (Referent)	6 (1.0)	n/a	32 (2.7)	n/a
Respiratory Morbidity	13 (6.6)	1.00 (Referent)	10 (1.7)	0.28 (0.11–0.69)	34 (2.8)	0.48 (0.24–0.95)
Birth trauma	2 (1.0)	1.00 (Referent)	17 (3.0)	1.97 (0.44–8.85)	36 (3.0)	2.59 (0.61–11.05)
Sepsis (diagnosed or evaluated for)	5 (2.5)	1.00 (Referent)	2 (0.4)	0.18 (0.03–0.99)	24 (2.0)	1.00 (0.36–2.79)
NICU length of stay, in days (median, 10 th , 90 th Percentile)	5.5 (1.8)	n/a	4.5 (2.16)	n/a	4.2 (2.8.4)	n/a
Mortality	1 (0.4)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a

* Composite includes 5 minute Apgar score < 4, respiratory morbidity, NICU admission, shoulder dystocia, birth trauma, sepsis (diagnosed or neonatal evaluation for).

[‡] Results adjusted for maternal race, insurance status, diabetic status, BMI at admission, and hospital type.[‡] There is no significant difference in NICU length of stay among three groups (p = 0.838). Only neonates with NICU admission were measured.

N/A denotes "not applicable".

Table 5

Neonatal outcome by planned mode of delivery in parous women

N=544 Outcome [‡]	Cesarean (n=24)		Attempted Forceps (n=121)		Attempted Vacuum (n=399)	
	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)	n (%)	Adjusted OR (95 % CI)
Overall Neonatal composite *	3 (12.5)	1.00 (Referent)	5 (4.1)	0.28 (0.06–1.35)	50 (12.5)	1.03 (0.28–3.87)
5 minute Apgar < 4	0 (0)	1.00 (Referent)	0 (0)	n/a	1 (0.3)	n/a
NICU admit	1 (4.2)	1.00 (Referent)	3 (2.5)	0.68 (0.06–7.46)	21 (5.3)	1.57 (0.19–13.08)
Shoulder dystocia	0 (0)	1.00 (Referent)	1 (0.8)	n/a	19 (4.8)	n/a
Respiratory morbidity	1 (4.2)	1.00 (Referent)	2 (1.7)	0.37 (0.03–4.88)	8 (2.0)	0.38 (0.04–3.79)
Birth trauma	2 (8.3)	1.00 (Referent)	1 (0.8)	0.03 (0.002–0.40)	11 (2.8)	0.16 (0.03–0.95)
Sepsis (diagnosed or evaluated for)	0 (0)	1.00 (Referent)	0 (0)	n/a	5 (1.3)	n/a
NICU length of stay, in days (median, 10 th , 90 th percentile)	11.8 (11.8,11.8)	n/a	3.4 (1,21.6)	n/a	2.3 (0.5,8.5)	n/a
Mortality	0 (0)	1.00 (Referent)	0 (0)	n/a	0 (0)	n/a

* Composite includes 5 minute Apgar score < 4, respiratory morbidity, NICU admission, shoulder dystocia, birth trauma, sepsis (diagnosed or neonatal evaluation for).

[‡] Results adjusted for maternal race, insurance status, diabetic status, BMI at admission, and hospital type.[‡] There is no significantly difference in NICU length of stay among three groups (p=0.327). Only neonates with NICU admission were measured.

N/A denotes “not applicable”.

Table 6

Correlation of actual mode of delivery with attempted mode

Nulliparous births			
	Attempted mode	Actual delivery mode	Rate
Forceps	577	573	99.31 %
Vacuum	1199	1190	99.25 %
Cesarean	198	198	100 %
Parous births			
Forceps	121	121	100 %
Vacuum	399	399	100 %
Cesarean	24	24	100 %