ORIGINAL ARTICLE

Introduction of forceps delivery education for residents at a single perinatal institution

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Key words:

forceps delivery, operative vaginal delivery, vacuum delivery

Received: October 18, 2016

Revised: January 18, 2017

Accepted: February 6, 2017

J-STAGE Advance published date: April 5, 2017

DOI:10.14390/jsshp.HRP2016-006

Background: The Japan Society of Obstetrics and Gynecology (JSOG) guidelines, revised in 2013, recommend that the numbers of traction should be at most five repetitions in vacuum extraction. Forceps extraction is less likely to fail compared with vacuum extraction and requires less equipment and preparation. At our institution, forceps delivery was not a standard procedure, but in response to revisions of the JSOG guidelines, we launched an education program on forceps delivery for residents in January 2013. We report the results of introduced delivery at our institution.

Methods: An education program for residents covering forceps delivery was introduced at our institution in January 2013. We conducted a retrospective review of medical records of 108 patients who had deliveries by either forceps or vacuum extraction from January 2013 through July 2015 in our institution. We compared maternal and neonatal outcomes between forceps and vacuum deliveries for all cases as well as those delivered by trainees.

Results: The rates of forceps and vacuum deliveries performed by trainees were 60.9% and 50.0%, respectively. Two or more tractions were required in 18/62 (29.0%) of vacuum deliveries vs. 3/46 (6.5%) of forceps deliveries. There was significantly more bleeding in forceps deliveries compared with vacuum deliveries (616.3 ± 322.3 g vs. 465.2 ± 274.9 g). There was one failed vaginal delivery in each group. The rate of cephalohematoma was significantly higher in vacuum deliveries (12/62, 19.4%) vs. forceps deliveries (1/46, 2.17%). Facial abrasion caused by the equipment was significantly more frequent in forceps deliveries (6/46, 13.0%) vs. vacuum deliveries (1/62, 1.6%). Similar results were found between all cases and cases delivered by trainees.

Conclusion: Forceps delivery was introduced as a clinical practice that is as safe as vacuum delivery. It is conceivable that training and indication for forceps delivery were of importance.

Introduction

The current worldwide trend shows a decline in the numbers of operative vaginal deliveries, likely due to the increase in cesarean sections to prevent injuries associated with operative vaginal delivery.¹⁾ In Japan, the majority of obstetrics teaching facilities train residents in vacuum extraction because forceps delivery is more difficult to learn and perform.²⁾ However, according to a meta-analysis, forceps delivery is as safe as vacuum extraction and the rate of failed procedures is lower than that of vacuum extraction.³⁾ Vacuum extraction

usually requires a uterine fundal pressure maneuver.⁴⁾ The Japan Society of Obstetrics and Gynecology (JSOG) Guidelines were revised in 2013, and the number of vacuum extractions with fundal pressure was restricted to at most five repetitions.⁴⁾ For vacuum extraction, there was no defined requirement for the descent of the fetal head which likely leads to a failed vacuum extraction. However, for forceps extraction, the indication with respect to station of the fetal head is strictly defined and it is of critical importance in reducing the risk of fetal distress.⁵⁾ In addition, forceps extractions require less complex equipment and preparation.

An education program for residents covering forceps delivery was introduced at our institution in January 2013. We conducted a retrospective study to evaluate the utility of forceps delivery compared with vacuum delivery in all cases as well as those performed by trainees. Our findings might be useful for other institutions considering the introduction of and training for forceps delivery for residents, and may help with introduction of forceps delivery at their institutions as well.

Materials and methods

After approval was obtained from the institutional review board of Jichi Medical University, we conducted a retrospective review of medical records of patients who had delivered by either forceps or vacuum extraction from January 2013 through July 2015. The study conformed to the provisions of the 1995 Declaration of Helsinki (revised in Tokyo, 2004).

Before introducing the practice of forceps delivery, we held hands-on seminars for residents on forceps delivery using a simulator. The residents learned skills not only in forceps placement but also in traction force by using a simulator.^{6,7)} In addition, all cases of forceps and vacuum deliveries were retrospectively reviewed and discussed with regard to indication, procedure, and outcomes with lectures from the trainer at the seminars.

Indications for a forceps or vacuum delivery included non-reassuring fetal status, prolonged second stage of labor, shortened second stage of labor due to a medical indication, and uterine inertia. When a trainee performed a forceps or vacuum delivery, a skilled operator directly supervised the application of the device and the traction procedure. In principle, vacuum extraction cases that were mid-station (0–1) were performed by educators. Mid forceps deliveries were strictly prohibited. DeLee's concept of station was used to evaluate fetal head descent; however, for forceps delivery, we introduced *t*-station and estimation of the largest circumference of the fetal head.⁸⁾ For the pelvic examination, the operator palpates the ischial spine, the inner surface of the symphysis pubis, and the anterior space of the sacrum before opting for an operative delivery.^{4,8)} We use UTokyo Naegele forceps (Atom Medical Corp., Tokyo, Japan) for forceps deliveries. We use a metal or soft silicon cup (Soft Medical Co., Ltd., Tokyo, Japan) and a kiwi cup (Atom Medical Corp., Tokyo, Japan) for vacuum delivery.

We evaluated indication, anomaly of the rotation, station, traction, failed vaginal delivery, blood loss, deep perineal lacerations, cervical laceration, and maternal hospital stay as maternal outcomes. Neonatal outcomes included Apgar score, cord arterial blood pH, cephalohematoma, subgaleal hematoma, intracranial hemorrhage, facial abrasion, hyperbilirubinemia, and

admission to neonatal intensive care unit (NICU).

The station of engagement of head was defined as follows: Mid forceps/vacuum: station 0–1, low forceps/vacuum: station 2, outlet forceps/vacuum: station under 3.⁴⁾ As a general rule, indication of the station for operative vaginal delivery was low and outlet forceps/vacuum levels. Especially, mid forceps were not allowed.^{9,10)}

Statistical analysis

We used JMP software for Windows (version 10.0.0, SAS Institute, US) for statistical analyses. Demographic variables are presented as mean $\pm$ standard deviation. Student's *t*-test and Fisher's exact test were used for two categorical variables. For all statistical tests, a two-sided *P*-value < 0.05 was considered statistically significant.

Results

A total of 108 cases of forceps ($n=46$) and vacuum delivery ($n=62$) were identified. Table 1 shows maternal characteristics in all cases and cases delivered by trainees. The forceps group had significantly lower parity than the vacuum group. There were no other significant differences in maternal demographic profiles between the forceps and vacuum delivery groups in all cases and those delivered by trainees.

Table 2 lists maternal intrapartum and postpartum courses. No mid forceps deliveries were performed. In all cases, vacuum delivery had significantly more traction applications (two or more). There was significantly more bleeding in the forceps delivery group. However, no blood transfusions were performed in either group. There was one failed vaginal delivery in the vacuum group, which was a mid-vacuum extraction performed by the teaching staff and followed by an emergency caesarean section. In forceps delivery, 3 cases performed 2 times, two of whom were nulliparous women. All cases were low forceps deliveries, but due to a short uterine construction, two, but not three, traction applications were required. In both cases, there were no serious complications for mother or neonate. In cases delivered by trainees, although there were no significant differences in background, the amount of blood loss was significantly higher with forceps delivery than vacuum delivery. Results of deliveries by trainees were similar to the compilation of all cases.

Infant outcomes in both delivery groups are shown in Table 3. In all cases, there was no delivery group-dependent difference in immediate neonatal status, such as Apgar scores and cord arterial blood gases. However, the rate of cephalohematoma was significantly higher in the vacuum group. Facial abrasion from equipment was significantly more frequent in the forceps group; however,

Table 1. Maternal characteristics

	All cases (<i>n</i> = 108)			Cases delivered by trainees (<i>n</i> = 59)		
	Forceps group (<i>n</i> = 46)	Vacuum group (<i>n</i> = 62)	<i>P</i> value	Forceps group (<i>n</i> = 28)	Vacuum group (<i>n</i> = 31)	<i>P</i> value
Age, (years), mean ± SD	33.2 ± 5.4	34.6 ± 6.3	n.s. (0.22)	33.1 ± 5.5	32.9 ± 5.4	n.s. (0.57)
Null parity, <i>n</i> (%)	43 (93.5%)	50 (80.6%)	n.s. (0.089)	25 (89.3%)	26 (83.9%)	n.s. (0.71)
Gestational age, (weeks), mean ± SD	38.2 ± 1.9	38.4 ± 1.7	n.s. (0.46)	37.9 ± 1.8	37.9 ± 1.8	n.s. (0.63)

n.s.; statistically not significant.

Table 2. Maternal intrapartum and postpartum courses

	All cases (<i>n</i> = 108)			Cases delivered by trainee (<i>n</i> = 59)		
	Forceps (<i>n</i> = 46)	Vacuum (<i>n</i> = 62)	<i>P</i> value	Forceps (<i>n</i> = 28)	Vacuum (<i>n</i> = 31)	<i>P</i> value
Anomaly of the rotation, <i>n</i> (%)						
Occipito anterior	41 (89.1%)	55 (88.7%)	n.s. (1.00)	25 (89.3%)	29 (93.6%)	n.s. (0.66)
Occipito posterior	5 (10.9%)	7 (11.3%)		3 (10.7%)	2 (6.4%)	
Station, <i>n</i> (%)						
mid	0	8 (12.9%)	* (0.0043)	0	3 (9.7%)	n.s. (0.21)
low	24 (52.2%)	17 (27.4%)		13 (46.4%)	11 (35.5%)	
outlet	22 (47.8%)	37 (59.7%)		15 (53.6%)	17 (59.7%)	
Indication, <i>n</i> (%)						
Non reassuring fetal status	25 (54.4%)	31 (50.0%)	* (0.0069)	15 (53.6%)	15 (48.39%)	n.s. (0.072)
Prolonged second stage of labor	13 (28.3%)	20 (32.26%)		8 (28.6%)	11 (35.48%)	
Shortening of the second stage of labor	6 (13.0%)	0		4 (14.3%)	0	
Maternal exhaustion	2 (4.3%)	11 (17.74%)		1 (3.5%)	5 (16.13%)	
Traction 2 times or more, <i>n</i> (%)	3 (6.5%)	18 (29.0%)	* (0.0033)	2 (7.1%)	6 (19.4%)	n.s. (0.26)
Failed vaginal delivery, <i>n</i> (%)	0	1 (1.6%)	n.s. (1.00)	0	0	
Blood loss (g), mean ± SD	616.3 ± 322.3	465.2 ± 274.9	* (0.024)	632.1 ± 370.1	436.6 ± 275.3	* (0.024)
Deep perineal lacerations (3rd or 4th degree), <i>n</i> (%)	0 (0%)	5 (8.1%)	n.s. (0.24)	0 (0%)	3 (9.7%)	n.s. (0.24)
Cervical laceration, <i>n</i> (%)	5 (10.9%)	7 (11.3%)	n.s. (1.00)	3 (10.7%)	3 (9.7%)	n.s. (1.00)
Maternal hospital stay (days), mean ± SD	6.52 ± 1.56	6.23 ± 1.56	n.s. (0.36)	6.5 ± 2.1	6.1 ± 1.5	n.s. (0.36)

*; *P* < 0.05: statistically significant, n.s.; statistically not significant.**Table 3. Neonatal outcome**

	All cases (<i>n</i> = 108)			Cases delivered by trainee (<i>n</i> = 59)		
	Forceps (<i>n</i> = 46)	Vacuum (<i>n</i> = 62)	<i>P</i> value	Forceps (<i>n</i> = 28)	Vacuum (<i>n</i> = 31)	<i>P</i> value
Birth weight (g), mean ± SD	2,957.2 ± 499.7	2,983.5 ± 417.6	n.s. (0.77)	2,883.2 ± 492.9	2,926.3 ± 426.4	n.s. (0.72)
Apgar score at 1 min, mean ± SD	7.70 ± 1.2	8.0 ± 0.7	n.s. (0.15)	7.7 ± 1.4	8.0 ± 0.5	n.s. (0.19)
Apgar score at 5 min, mean ± SD	8.85 ± 0.36	8.9 ± 0.5	n.s. (0.79)	8.8 ± 0.39	8.9 ± 0.2	n.s. (0.06)
Cord arterial pH, mean ± SD	7.279 ± 0.076	7.28 ± 0.07	n.s. (0.96)	7.284 ± 0.083	7.30 ± 0.07	n.s. (0.45)
Cephalhematoma, <i>n</i> (%)	1 (2.17%)	12 (19.4%)	* (0.0066)	1 (3.6%)	7 (22.6%)	n.s. (0.055)
Subgaleal hematoma, <i>n</i> (%)	0	3 (4.8%)	n.s. (0.26)	0	1 (3.23%)	n.s. (1.00)
Intracranial hemorrhage, <i>n</i> (%)	0	0	N.A	0	0	N.A
Facial abrasion, <i>n</i> (%)	6 (13.0%)	1 (1.6%)	* (0.040)	3 (10.7%)	1 (3.2%)	n.s. (0.33)
Hyperbilirubinemia, <i>n</i> (%)	10 (21.7%)	13 (21%)	n.s. (1.00)	8 (28.6%)	6 (19.4%)	n.s. (0.54)
Admission to NICU, <i>n</i> (%)	20 (43.5%)	26 (41.9%)	n.s. (1.00)	12 (42.9%)	14 (45.2%)	n.s. (1.00)

*; *P* < 0.05: statistically significant, n.s.; statistically not significant, N.A.; not assessed.

NICU; neonatal intensive care unit.

it disappeared spontaneously with no subcutaneous injury. There was no clinically diagnosed intracranial hemorrhaging or clavicle fracture. There were no differences in other events between both deliveries in all cases. In cases delivered by trainees, although there was no significant difference in all variables, all results were similar to that of all cases. Maternal and neonatal outcomes between trainees and trainers in cases of forceps deliveries showed no significant differences for any of the variables.

Discussion

This is the first report concerning the introduction of forceps delivery to clinical practice, which might be necessary for vaginal delivery in order to comply with the new restrictions on the number of tractions with vacuum delivery.⁴⁾ We introduced an education program for residents covering forceps delivery. Then we evaluated maternal and neonatal outcomes following deliveries by forceps vs. vacuum extraction, including cases performed by trainees. Our results showed that forceps delivery was introduced safely. It is conceivable that training and indication for forceps delivery were key issues.

In our study, forceps deliveries had significantly more bleeding than vacuum deliveries, but blood transfusion was not required and, although forceps delivery resulted in significantly more facial abrasion, there was less cephalohematoma. There were no severe complications in either operative delivery group. These results were similar to previous reports.^{3,11,12)} Although the rates of forceps and vacuum deliveries performed by trainees were 60.9% and 50.0%, respectively, this study shows similar results between all cases and cases delivered by trainees. Considering the above, we concluded that forceps delivery was introduced safely and satisfactorily.

Judgment of indications for forceps delivery using *t*-station and estimation of the largest fetal head circumference in the pelvis enable a complication-free delivery.⁸⁾ In cases of forceps delivery, obstetricians must assess adequately the capacity of the bony pelvis and detect the fetal position and station. We consider that after training with a simulator, review and discussion with a trainer of the indications, procedure, and outcomes of forceps delivery by trainees could improve their knowledge and skills. The presence of a skilled physician is also essential when trainees perform forceps delivery. Low forceps and outlet forceps are safer than mid forceps.^{1,10)} Hankins and Rowe reported that two of three cases of mid forceps operation failed.¹⁾ Actually, 1 of 8 mid vacuum procedures failed in this study. In the exceptional cases that were mid-station, vacuum

deliveries were performed by a skilled operator or supervised by an educator. Mid forceps deliveries were not performed. This restriction may also have contributed to the results.

Our study is limited as it is based on a retrospective chart review, and thus it is impossible to eliminate all biases and confounding factors.

In conclusion, we introduced an education program for residents covering forceps delivery, and forceps delivery was introduced to our clinical practice as a method that is as safe as vacuum delivery. It is conceivable that training and indication for forceps delivery were key issues.

Conflict of interest

None.

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