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Two-step shoulder delivery method reduces the incidence of shoulder dystocia

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Summary

Objective: To compare two-step method of shoulder delivery with one-step for the maternal and neonatal outcomes. *Materials and Methods:* This was a randomized controlled clinical trial. Women scheduled for vaginal delivery without severe complications were enrolled and randomly arranged into two groups. Women in study group were delivered by two-step method for shoulder delivery, that is to wait for at least one contraction after head delivery, and naturally delivery of shoulder. Women in controlled group were delivered by one-step method, that is after the head was delivered, gentle press of head was applied to facility shoulder delivery. Maternal and neonatal outcomes as Apgar score, rate of shoulder dystocia, and postpartum bleeding were recorded. Interval of head to shoulder was timed in second. *Results:* The study group had lower rate of shoulder dystocia than that in control group ($\chi^2 = 4.27$, $p = 0.03$), no increasing of asphyxia, and postpartum bleeding. The average interval of head to shoulder in study group was longer than that in control group. There was no difference in interval between shoulder dystocia *vs.* normal birth group, neither was there a difference in interval between asphyxia babies and normal babies group. By two-step method, the mean value of head to shoulder interval was 59.025 seconds, 95% CI (20.000~150.000 seconds), mean+2×SD = 148.927 seconds. In one-step group, mean was 44.172 seconds, 95% CI = (10.000~105.000 seconds), mean +2×SD = 94.812 seconds. *Conclusion:* Two-step method of shoulder delivery had a lower rate of shoulder dystocia than one-step method, no increasing of neonatal asphyxia and postpartum bleeding. The longer interval of head to shoulder did not relate to shoulder dystocia and asphyxia. The normal value of head to shoulder interval might be longer than 60 seconds.

Key words: Two-step method of shoulder delivery; One-step method of shoulder delivery; Shoulder dystocia; Asphyxia.

Introduction

Incidence of shoulder dystocia was reported to be from 0.15% to 0.38% in 18th century [1], and 0.2% to 0.6% [2], 0.73% (n = 14,820) [3], 1.4% [4], 2.4% (234/9,767) [5] of all deliveries in recent years. The rate has not changed and has even increased, despite more liberal use of cesarean section and greater effort of training on this problem.

Birth weight, induction of labour, use of epidural analgesia at delivery, prolonged labour, forceps-assisted and vacuum-assisted delivery, parity, and period of delivery were considered as risk factors of shoulder dystocia, but there are no clear findings to support or refute the use of prophylactic maneuvers to prevent shoulder dystocia. One study showed in the prophylactic group that the rate of cesarean section increased [6].

Many experts agree that shoulder dystocia occurs when the usual and standard technique of downward traction of the fetal head fails to accomplish delivery. In the study conducted by Spong *et al.* in 1995, found that the prolonged head to body interval was a significant characteristic of shoulder dystocia and suggested that shoulder dystocia was defined as a prolonged head to body delivery time of more than 60 seconds, and/or the necessitated use of ancillary obstetric maneuvers [7].

Usually there are two methods for shoulder delivery: one step-method and two-step method. Two-step method is to wait for at least a contraction in all vaginal deliveries after the head is delivered. As reported by Hart in 1997, this method will prevent shoulder dystocia and decrease the rate of baby injury [8]. "One-step method" as described by Robert A. Welch, is that as soon as head is delivered, downward pressure is continued to be applied on the head until the anterior shoulder appears at the introitus. The author stated that by delivering the head and anterior shoulder in one continuous maneuver, "he's seen tight shoulders but never a turtle sign" [9].

To wait for contractions allows shoulder to be delivered spontaneously by the force of uterine contraction or to apply gentle force to deliver the shoulders, debate exists and continues. The present authors hypothesis is that by waiting for shoulders, the rate of dystocia will be decreased.

Materials and Methods

Enrollment criteria of the study: 1) women in vaginal delivery, 2) term, single fetus, in vertex presentation, 3) no severe complications before and during pregnancy, and 4) women and their fam-

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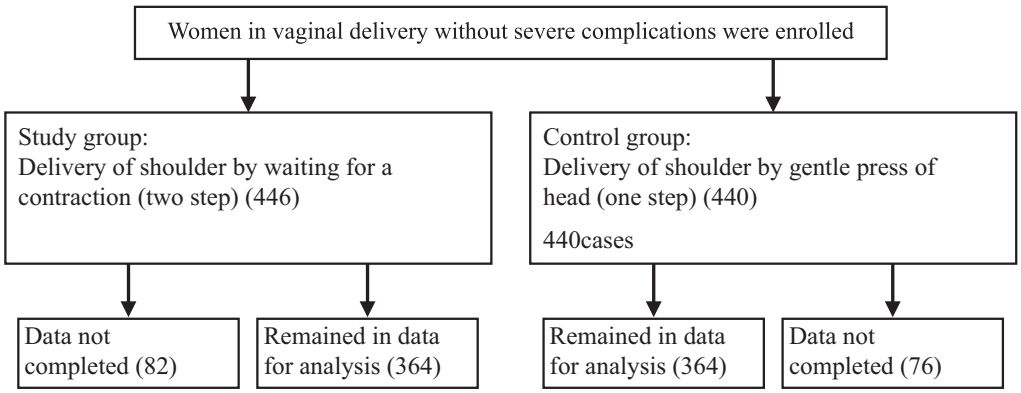


Figure 1. — Design of the study.

Table 1. — *Comparison of maternal and neonatal outcomes between two groups.*

Indicators	Study group (n=364) (%)	Control group (n=257) (%)	$\chi^{2/t}$	*p*	OR (95% CI)
Pregnant age (weeks)	39.725 ± 1.311	39.521 ± 2.296	1.283	0.200	0.410 (0.373-0.451)
Maternal age (years)	25.862 ± 3.808	25.575 ± 3.853	0.918	0.357	
Nulliparous	255 (58.5)	181 (41.5)	0.010	0.920	0.7 (0.201-2.450)
Birth weight (grams)	3337.445 ± 433.699	3307.237 ± 403.398	0.891	0.373	
Rate of Shoulder dystocia (%)	0 (0.00)	4 (1.55)	5.702	0.017	
Postpartum bleeding (ml)	179.16 ± 81.98	179.96 ± 90.01	0.113	0.910	
1-minute Apgar score ≤ 7 (%)	5 (1.37)	5 (1.94)	0.310	0.577	
5-minute Apgar score ≤ 7 (%)	0 (0.00)	0 (0.00)			

ily members agree to join in the study

Exclusive criteria of the study: 1) women want to be selective cesarean section, 2) women and their family members refuse to joy in the study, 3) preterm, twins, breech or transverse position, and 4) women with severe complications before and during pregnancy as hypertension, diabetes, placenta previa, etc.

The study was performed at four hospitals in China from May to November in 2012. Women with vaginal delivery without pregnant complications were enrolled and informed consent were signed. The study was approved by the ethical committee of all the hospitals in the study.

The patients were randomly arranged into two groups before delivery. Women in study group were delivered by two-step method for shoulder delivery, that is after the head is delivered, there has to be at least one contraction for spontaneous rotation of shoulders. Women in control group were delivered by one-step method that is after head is delivered, gentle pressure of head was applied to help shoulder delivery. Maternal and neonatal outcomes as age, gestational age, Apgar scores, rate of shoulder dystocia, rate of asphyxia, and postpartum bleeding were recorded. Interval of head to shoulder was timed in seconds with a clock in delivery room. Maternal and neonatal outcomes between subgroups of shoulder dystocia to normal birth and asphyxia babies to normal babies were also compared (Figure 1).

Interval of head to shoulder was defined as from the delivery of the head to either shoulder emerging from either the perineum or from under the pubic bone. Shoulder dystocia was diagnosed by doctors in clinical setting when additional maneuvers were applied to deliver the shoulder.

The SPSS 16.0 was used to undertake the analysis. The indicators of the rate of shoulder dystocia and rate of asphyxia were analyzed using Pearson's chi-square test, and relative risk ratios and odds ratios with confidence intervals. The Student's *t*-test was applied to compare indicators of pregnant weeks, maternal age, neonatal birth weight, postpartum bleeding, and interval of head to shoulder between groups. Results were expressed as mean ± standard deviation. A p value < 0.05 was considered as significant, and all inferential tests were two-tailed.

Results

Maternal and neonatal outcomes between study and control groups were assessed in 621 cases that were enrolled. Study group were 364 cases and control group were 257 cases. Gestational age ranged from 37 to 42 weeks, with an average of 39.640 ± 1.787 weeks, and average maternal age was 25.744 ± 3.826 years, ranging from 17 to 42 years. There were no significant differences regarding pregnancy age, maternal age, parity, and neonatal birth weight between two groups.

The rate of shoulder dystocia was higher in control group (4/257, 1.55%) than in study group (0/364, 0.00%). Among four cases with shoulder dystocia, one had temporally Erb's palsy that recovered ten days later without permanent damage. Postpartum bleeding was not different between the two groups. The first minute asphyxia rate was not significantly different between the groups. There was no five-minute asphyxia in both groups (Table 1).

The mean of the interval of head to shoulder in study group (two-step) was longer than that in control group (one-step), (58.587 ± 45.097 *vs.* 44.451 ± 25.643 seconds) (t = 5.303 p = 0.000, equal variances not assumed). The data was

frequencies of interval of head to shoulder in two-step method

headtoshoulderinterval

N	Valid	364
	Missing	0
Mean		59.5879
Median		48.8400[a]
Std. Deviation		45.09782
Skewness		3.512
Std. Error of Skewness		.128
Kurtosis		22.942
Std. Error of Kurtosis		.255
Minimum		5.00
Maximum		480.00
Percentiles	10	25.1304[b]
	20	30.3733
	30	35.3036
	40	41.4638
	50	48.8400
	60	51.6000
	70	59.8381
	80	85.8500
	90	117.5833

a. Calculated from grouped data.

b. Percentiles are calculated from grouped data.

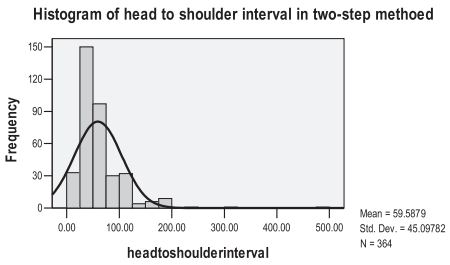
frequencies of interval of head to shoulder in one step method

headtoshoulderinterval

N	Valid	257
	Missing	0
Mean		44.4514
Median		39.2708[a]
Std. Deviation		25.64372
Skewness		1.470
Std. Error of Skewness		.152
Kurtosis		2.490
Std. Error of Kurtosis		.303
Minimum		5.00
Maximum		150.00
Percentiles	10	19.2148[b]
	20	25.5179
	30	30.0500
	40	32.9200
	50	39.2708
	60	44.6250
	70	50.3200
	80	58.9385
	90	78.8333

a. Calculated from grouped data.

b. Percentiles are calculated from grouped data.



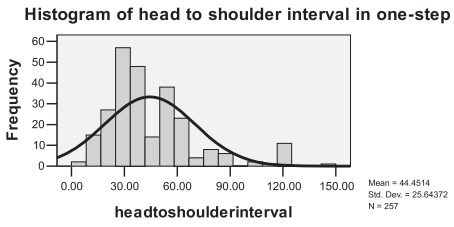


Figure 1. — Frequency of interval of head to shoulder between two groups.

not a normal distribution model (Figure 1).

The proportion of interval less 60 seconds, 60 to 150 seconds, and over 150 seconds in study group were 75.8% (276/364), 20.9% (76/364), 3.3% (12/364), respectively, and 87.2% (224/257), 12.8% (33/257), and 0%, respectively in control group. Study group had lower rate of interval less than 60 seconds ($\chi^2 = 12.338$, $p = 0.000$), higher rate of interval between 60 to 150 seconds ($\chi^2 = 6.727$, $p = 0.009$) and over 150 seconds ($\chi^2 = 8.639$, $p = 0.003$) than that in control group (Figure 2).

Among total 621 cases, 617 cases were normal vaginal deliveries, of which four cases were reported with shoulder dystocia. Maternal age, pregnant frequency, pregnant age, second stage of labor, neonatal birth weight, and the range of macrosomic babies were not different: 6.3% (39/617) and 25% (1/4), respectively (Table 2).

Interval of head to shoulder between shoulder dystocia group and normal birth group was not statistically different (75.00 ± 31.09) and (53.50 ± 40.19) ($t = 1.396$ $p = 0.255$, equal variances not assumed).

There were several cases with longer intervals of head to shoulder in normal delivery group; the longest one (code 357) was 480 seconds, code 53 = 300 seconds, code 475 = 230 seconds, code 222 = 180 seconds, but all cases with

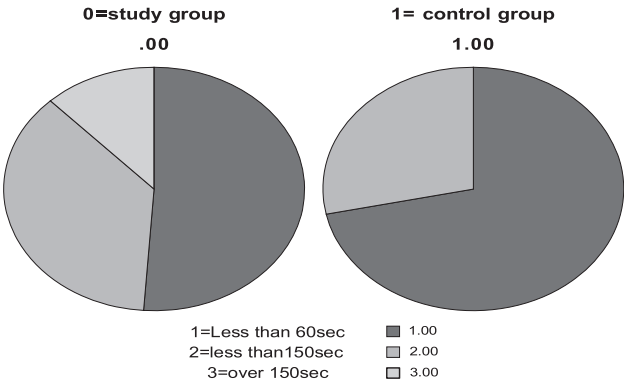


Figure 2. — Proportion of head to shoulder interval between study group and control group.

shoulder were delivered naturally with normal babies, and no severe maternal and neonatal complications occurred.

In four cases of shoulder dystocia, two cases (50%) had less than 150 seconds. In 617 cases with normal labor, 80.7% (498/617) had intervals less than 60 seconds, 17.3% (107/617) had 60 seconds to less than 150 seconds, and 1.9% (12/617) had over 150 seconds. There were no dif-

Table 2. — *Maternal and neonatal outcomes between shoulder dystocia and normal birth.*

Indicators	Normal delivery group (n=617)	Shoulder dystocia (n=4)	$\chi^{2/t}$	*p*
Maternal age (years)	25.747 ± 3.838	25.250 ± 0.957	0.259	0.796
Pregnant frequency	1.296 ± 0.457	1.500 ± 0.577	0.886	0.376
Pregnant age (weeks)	39.638 ± 1.792	40.000 ± 0.816	0.403	0.687
Birth weight (grams)	3323.079 ± 420.864	3612.500 ± 458.938	1.370	0.171
Macrosomic infant (%)	39 (6.3)	1 (25)	2.301	0.129
Process of second stage of labor (min.)	44.181 ± 33.453	40.750 ± 6.500	0.205	0.838
Postpartum hemorrhage (ml)	179.149 ± 85.205	232.500 ± 101.118	1.247	0.213

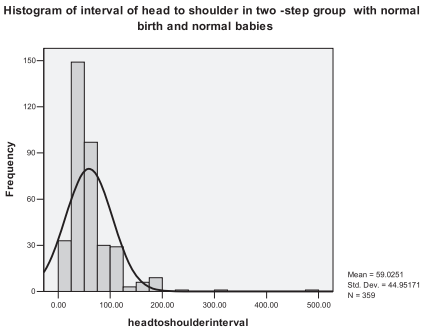
Table 3. — *Maternal and neonatal outcomes between asphyxia babies and normal babies.*

Indicators	Normal babies group (n=611)	Neonatal asphyxia (n=10)	*t*	*p*
Maternal age (years)	25.749 ± 3.792	25.400 ± 5.815	0.286	0.775
Pregnant frequency	1.299 ± 0.458	1.200 ± 0.421	0.682	0.496
Pregnant age (weeks)	39.643 ± 1.796	39.500 ± 1.178	0.251	0.802
Process of second stage (of labor (min.)**	43.612 ± 32.907	77.600 ± 44.247	3.221	0.001
Birth weight (grams)	3331.603 ± 392.772	3360.000 ± 791.201	0.222	0.824
Postpartum hemorrhage (ml)	179.566 ± 85.806	175.000 ± 50.166	0.168	0.867

Statistics

headtoshoulderinterval

N	Valid	359
	Missing	0
Mean		59.0251
Median		45.0000
Std. Deviation		44.95171
Skewness		3.609
Std. Error of Skewness		.129
Kurtosis		23.798
Std. Error of Kurtosis		.257
Minimum		5.00
Maximum		480.00
Percentiles	5	20.0000
	95	150.0000



Statistics

headtoshoulderinterval

N	Valid	249
	Missing	0
Mean		44.1727
Median		40.0000
Std. Deviation		25.40618
Skewness		1.494
Std. Error of Skewness		.154
Kurtosis		2.610
Std. Error of Kurtosis		.307
Minimum		5.00
Maximum		150.00
Percentiles	5	10.0000
	95	105.0000

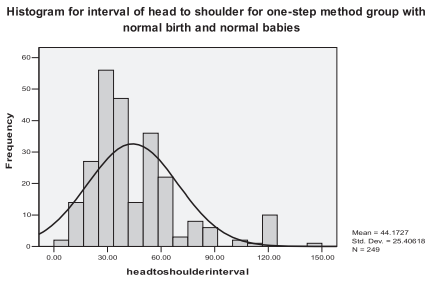


Figure 3. — Frequency of interval of head to shoulder between two groups with normal birth and normal babies.

ferences between the proportions of two groups ($\chi^2 = 2.958$, $p = 0.228$).

There were ten babies reported to have asphyxia at one minute, and non at five minutes in both groups. The second stage of labor in asphyxia baby subgroup was longer than that in normal babies group. Other maternal and neonatal indicators did not show differences (Table 3). Ten cases babies were reported to have asphyxia at one minute, and 611 cases were normal babies. The interval of head to shoulder between asphyxia babies and normal birth (67.500 ± 45.169 seconds *vs.* 53.091 ± 39.850 seconds) was not significant ($t = 1.003$ $p = 0.342$, equal variances not assumed). Among ten asphyxia babies, 60.0% (6/10) had an interval of less than 60 seconds, and 40.0% (4/10) had an interval between 60 to 150 seconds. Among 611 normal babies, 80.9% (494/611) had an interval less than 60 seconds,

17.2% (105/611) had intervals between 60 to 150 seconds, and 2.0% (12/611) had intervals over 150 seconds. There were no differences between the proportions of two groups ($\chi^2 = 3.646$, $p = 0.162$).

In study group (two-step), there were five cases of asphyxia, and 359 cases remained in group as normal cases. Mean of interval of head to shoulder in normal cases was 59.025 seconds, 5% CI = 20.000 sec, 95% CI =150.000 seconds, with a mean of +2×SD = 148.927 seconds.

In control group (one-step), there were five case asphyxia babies, and four cases with shoulder dystocia (one also with asphyxia), and 249 cases remained in group as normal cases. Mean of interval was 44.172 seconds, 5% CI = 10.000 seconds, 95% CI = 105.000 seconds, with a mean of +2×SD=94.812 seconds (Figure 3).

Discussion

Whether to wait or pull is the debate over one-step and two-step methods of shoulder delivery exists and continues. However the incidence of shoulder dystocia and associated brachial plexus injury have not changed over time, and have even increased, despite the fact that more efforts have been made on the training of shoulder dystocia maneuvers and with the more liberal use of cesarean section [10]. Perhaps the problem should be considered from a different perspective. As reported by Hart in 1997, by waiting for a contraction after head delivered, the incidence of shoulder dystocia was reduced dramatically [8]. The physiological mechanism of baby rotation in the birth canal was that after the head was delivered, the baby first go restitution, then external rotation while the body was delivered, that was the time window of interval of head to shoulder. So healthcare providers were advised to wait for a contraction, not to push or pull, instead, allow the shoulder the necessary time to rotate [11]. One-step method as described by Robert A. Welch, was a corresponding letter to the editors, with no data to support this method [9].

In the present study, all four cases of reported shoulder dystocia were in control group, with one cases with temporal Erb palsy that recovered ten days later. The birth weight and maternal condition in two groups were not different. Furthermore, the interval of head to shoulder between shoulder dystocia and normal birth was also not different. It was stated that the brachial plexus stretch is greatest when the head is deviated laterally to the side (i.e., ear to shoulder [12]. The result of this study supported the two-step shoulder delivery method. It suggests that when shoulder is delivered spontaneously without additional force applied, less shoulder dystocia and less baby injury would occur.

The main concern of waiting for shoulder is the risk of increasing newborn asphyxia. The relationship of interval to asphyxia was controversial. In the study of Wood *et al.* the PH value of umbilical artery decreased by 0.14 with every minute, and proposed that the four-minute interval would be safe for the fetus [13]. Stallings *et al.* and Locatelli *et al.* studies reported that head-to-body delivery intervals (available for 44 cases) were not associated with statistically significant alterations in umbilical artery pH. Increasing head-to-body delivery interval also was not significantly correlated with decreasing five-minute Apgar score, and although head-to-body interval was significantly correlated to umbilical artery pH ($p = 0.02$), it was of no clinical significance (0.0078 units for every additional minute of the interval) [14, 15].

Zanardo *et al.* [16] reported that cord blood glucose concentration was significantly higher (95.5 ± 21.4 *vs.* 75.6 ± 16.4, mg/dl, $p < 0.001$), and pH values significantly lower (7.31 ± 0.09 *vs.* 7.33 ± 0.06, $p = 0.003$) in two-step vaginal delivery neonates than in cesarean section delivered neonates. The bias in this study is that the authors should have compared the two- step with one-step in vaginal delivery, not with cesarean section. Furthermore, the pH values in two-step in this study was within normal range, and the authors did not report the rate of asphyxia; those values may be due to physiological changes during vaginal birth if all the babies survived without complications.

In the present study, the interval of head to shoulder was longer in study group, but the asphyxia rate was not significant between two groups. The interval of head to shoulder between asphyxia babies and normal birth was also not significant. This indicates that the two-step shoulder delivery method did not increase the rate of asphyxia, at least in normal term labor, without severe complications.

As Spong *et al.* [7] defined in the 1960s the interval of head to body as objective standard of shoulder dystocia, the concern of asphyxia with every second passing is a challenge for medical workers in field. However, the Locatelli *et al.* study which allowed the shoulders to be deliver in two-step, methods, the mean head-to-body interval was 88 ± 61 seconds [15]. In this study, mean of interval of head to shoulder in two-step method (in normal babies only) was 59.025 seconds, 95% CI (20.000~150.000 seconds), with a mean of +2×SD=148.927 seconds. In control group (one-step), after eliminating the cases with shoulder dystocia and asphyxia, the mean was 44.172 seconds, 95% CI = (10.000~105.000 seconds), with a mean +2×SD=94.812 seconds. This indicated that the normal range of head to shoulder interval may be longer than 60 seconds.

There were several cases with longer intervals of head to shoulder in normal delivery group; the longest one (code 357) was 480 seconds, code 53 was 300 seconds, code 475 was 230 seconds, and code 222 was 180 seconds, but in all cases the shoulders were delivered naturally and no asphyxia or injury occurred; should these cases be defined as shoulder dystocia? This questions the definition of shoulder dystocia over 60 seconds and also questions the accuracy of diagnosis of shoulder dystocia. When babies are delivered by uterus force without additional maneuver and no adverse

maternal and neonatal events occur, these births should be defined as normal and not with shoulder dystocia (though the interval of head to shoulder may be longer than 60 seconds).

Conclusions

Two-step shoulder delivery method had a lower rate of shoulder dystocia than one-step method shoulder delivery, with no increasing of neonatal asphyxia and with no adverse maternal events.

Average interval of head to shoulder in study group was longer than that in control group. There were no difference in the shoulder to head interval between shoulder dystocia *vs.* normal birth groups, neither was there a difference between asphyxia and normal babies' groups. The longer interval of head to shoulder did not relate to increased rate of shoulder dystocia and asphyxia.

The normal value of head to shoulder interval might be longer than 60 seconds. By two-step method, the mean value of head to shoulder interval was 59.025 seconds, 95% CI (20.000~150.000 seconds), with a mean of +2×SD=148.927 seconds. In one-step group, mean was 44.172 seconds, 95% CI = (10.000~105.000 seconds), with a mean of +2×SD = 94.812 sec.

In conclusion, two-step shoulder delivery method reduces the incidence of shoulder dystocia and it can be applied in shoulder delivery management.

Acknowledgments

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