

# Normal Range of Head-to-body Delivery Interval by Two-step Delivery

Hong-Yu Zhang<sup>1</sup>, Ren-Fei Guo<sup>2</sup>, Yan Wu<sup>2</sup>, Yi Ling<sup>1</sup>

<sup>1</sup>Department of Midwifery, Hainan Medical University, Haikou, Hainan 571119, China

<sup>2</sup>Department of Obstetrics, Haikou Maternal and Child Hospital, Haikou, Hainan 571101, China

## Abstract

**Background:** The one-step method was routine practices in China, scientific evidence to support this intervention is scarce. The purpose of this study was to observe the natural process of head-to-body delivery interval by waiting for at least one contraction (two-step) after head delivered in normal birth.

**Methods:** From March 1 to March 30 in 2015 at Haikou Maternal and Child Hospital in China, normal vaginal birth with normal baby condition were recorded by video. Videotapes were transferred to computer then replayed and observed.

**Results:** Ninety-two cases were enrolled in this study. The average head-to-body delivery interval by two-step delivery was  $71.04 \pm 61.02$  s, (mean + 2 standard deviation = 193.07 s, 95% confidence interval [15.65–229.15] s). Fifty-one patients (51/92, 55.43%) were <60 s, 41 patients (41/92, 44.57%) were over 60 s. Shoulders delivered at the first contraction were 96.74% (89/92), 3.26% (3/92) had delivered by the second contraction. Shoulders emerged from perineum were 71.73% (66/92), 15.21% (14/92) transversely, and 13.04% (12/92) emerged from under pubic arch. Babies cried before the shoulder were 31.52% (29/92), cried after birth 52.17% (48/92), and 16.30% (15/92) did not cry after birth. Baby activities included as making faces, sucking, and bubbled from mouth and noses, and the lighter blue color of skin with good perfusion.

**Conclusions:** The average time of head-to-body delivery interval was longer than 60 s by two-step delivery. Majority shoulders were delivered at the first contraction. Majority shoulders emerged from perineum rather from under pubic arch. The routine one-step method of shoulder delivery where the downward force applied is not necessary and is not the right direction. Baby's breath, making faces, sucking, bubble from noses and mouth, and the light blue color of the faces, all those signs during shoulder delivery indicated a normal live birth.

**Key words:** Head-to-body Delivery Interval; Neonatal Asphyxia; One-step Delivery; Two-Step Delivery

## INTRODUCTION

The tension in labor room rises when the head of the fetus is delivered, to wait or to pull, the debate over one-step and two-step method of shoulder delivery exists and continues. The physiological mechanism of the baby rotation after the head delivered is that the baby's head firstly restitutes, internal rotation of the body occurs, and the whole body is delivered. The head-to-body delivery interval is the time of baby's body rotate and delivery, it is the interval of external rotation. Birth attendants were advised to wait for a contraction, not to push or pull, instead, allowing the shoulder necessary time to rotate; this is so-called two-step method of shoulder delivery.<sup>[1]</sup> As advised by Hart in 1997, by waiting for a contraction after the head is delivered, the incidence of shoulder dystocia was reduced

dramatically.<sup>[2]</sup> Where one-step method described by Welch was a corresponding letter to the editors, but no data to support this method so far.<sup>[3]</sup>

How long should we wait that is a puzzling question. Since Spong *et al.* defined the 60 s of interval head-to-body as an objective standard of shoulder dystocia, the concern of asphyxia with every second passing puts greater pressure on

**Address for correspondence:** Prof. Hong-Yu Zhang,  
Department of Midwifery, Hainan Medical University, Haikou,  
Hainan 571119, China  
E-Mail: 13158942317@163.com

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

© 2016 Chinese Medical Journal | Produced by Wolters Kluwer - Medknow

**Received:** 03-12-2015 **Edited by:** Li-Min Chen

**How to cite this article:** Zhang HY, Guo RF, Wu Y, Ling Y. Normal Range of Head-to-body Delivery Interval by Two-step Delivery. *Chin Med J* 2016;129:1066-71.

### Access this article online

Quick Response Code:



Website:  
www.cmj.org

DOI:  
10.4103/0366-6999.180522

birth attendant in the field.<sup>[4]</sup> But by Locatelli *et al.*'s study which allowed the shoulders to deliver in two-step, the mean head-to-body interval was  $88 \pm 61$  s.<sup>[5]</sup> The relationship of the interval of head to shoulder and baby asphyxia was controversial. Locatelli *et al.* stated head-to-body interval was significantly correlated to umbilical artery pH ( $P = 0.02$ ) but not of clinically significant (0.0078 units for every additional minute of the interval).<sup>[5]</sup> Stallings *et al.*'s study 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 was also not significantly correlated with decreasing 5 min Apgar score.<sup>[6]</sup>

Two-step delivery is a natural way of delivery, while one-step is an intervention invented by a human being in an attempt to fasten the delivery yet without grounded scientific evidence. As recommend by WHO normal birth guideline, any intervention in normal birth should be adjusted with supporting evidence.<sup>[7]</sup> This study aimed to resolve what is the normal time range from the delivery of the head to shoulder by waiting for shoulder delivered on the force of uterus contraction.

The hypothesis of this study is that the time interval of head-to-body by natural way of delivery (two-step) in normal birth with good neonate condition may be longer than 60 s.

## METHODS

### Patients

Observation study by video tape recording the interval from the head crowning until the shoulder and baby delivered was conducted during March in 2015 in Haikou Maternal and Child Hospital in China. Ninety-two cases of normal birth by two-step delivery were recorded by videotape. The consent forms of patients were signed. The study was approved by Ethical Committee of Haikou Maternal and Child Hospital.

Real-time video was recorded at the site from the crowning of head to the shoulder and the whole body delivered using the phone camera. Women were allowed to move freely during labor and delivery in whatever position they preferred, on their side, on hands and knees, or supine. Perineum was protected by allowing the women in modified breathing over the contraction (hand-off). After head delivered, women were asked to continue long exhalation over the shoulder delivery, shoulders were delivered by the natural force of the uterus contraction, and no man force was applied.

When there was any emergency situation, as too tight cord around the neck, or the face of babies turned to black or pale, and the heartbeat of the fetus was lower than 100 beats/min, emergency care undertaken immediately by caregivers in the clinical setting.

### Enrollment criteria

(1) Women in vaginal delivery (VD) with singleton, cephalic presenting, 36 or more weeks gestation; (2) no high-risk

maternal complications such as diabetes, hypertension, heart disease, and anaemia; (3) natural process of labor, no augmentation with oxytocin, or receiving of anesthesia; (4) fetal condition is stable during labor; and (5) women agreed to join in the study.

### Exclusion criteria

(1) Women having cesarean section (CS); (2) twins, breech, and forceps delivery; (3) women with any severe complication during pregnant; (4) fetal distress heartbeat lower than 100 beats/min lasting 1 min or longer, cord tightly around neck at birth, history of heavy bleeding at birth or postpartum period, or baby's face turn black or pale after the head delivered; and (5) women or family members refuse to take part in.

### Measurement

Videotapes were observed by transferring to the computer. (1) Head-to-body delivery interval was timed from head emerged to either shoulder emerged from perineum or pubic and (2) fetus conditions were assessed by the color of face, heartbeat, face movement, and breathe or cry activities.

### Statistical analysis

The IBM SPSS 16.0 package (IBM Corporation, Chicago, USA) was used to undertake the analysis. The Student's *t*-test was applied to compare indicators of the time of head crown, head to shoulder, and neonatal birth weight. Results were expressed as a mean  $\pm$  standard deviation (SD). Correlation analysis was applied for an interval of head to shoulder and birth weight. A  $P < 0.05$  was considered as significant, and all inferential tests were two-tailed.

## RESULTS

### Patient profiles

During the study period, 92 cases normal birth where shoulders were delivered naturally without additional maneuver of birth attendants were recorded, 67 cases were nulliparous. The mean age of women was  $24.24 \pm 3.12$  years. Ninety-two cases were live birth, all babies were in good condition (Apgar score over eight at birth and survived at 1-month follow-up), and had 100% breastfeeding at 1 month. No baby was sent to Neonatal Intensive Care Unit (NICU) or receiving medical treatment.

Cord around the neck was in 31.52% (29/92) cases, 80.43% (74/92) had intact perineum, 18.48% (17/92) were a first-degree laceration, one case (1.09%, 1/92) second-degree laceration, no third- and fourth-degree laceration. No episiotomy applied, and no case had a baby injury of any kind.

### Descriptive analysis of head-to-body delivery interval

The mean head-to-body delivery interval was ( $71.04 \pm 61.02$ ) s, mean + 2 SD is 193.07 s, 95% confidence interval (CI) (15.65–229.15) s. Interval less than 60 s were in 55.43% (51/92) cases, 45.57% (41/92) were over 60 s.

## Shoulder delivery style

From the video, we could see exactly how the shoulders were delivered.

Eighty-nine cases (89/92, 96.74%) shoulders were delivered within the first contraction after head delivered, 3.26% (3/92) had delivered at twice contractions, which the shoulder emerged from perineum at the first contraction but returned to vaginal again, then delivered at next contraction. This phenomenon had never been described previously; we name it as “shoulder visible on vulvar gapping.”

Contrary to the popular belief, 71.73% (66/92) shoulder emerged from the perineum, 15.21% (14/92) transversely, and 13.04% (12/92) emerged from under pubic space [Figure 1].

## Neonate activities during delivery

Apgar score over eight at birth was in all 92 cases, no baby had received emergency resuscitation, and no baby was transferred to NICU. All babies survived and were well at 1 month follow-up.

Babies cried before the shoulder were 31.52% (29/92), 52.17% (48/92) cried after birth, and 16.30% (15/92) did not cry after birth and had normal skin color, normal breathing, and heartbeat. All babies had normal pattern of live signs, and no baby was sent to NICU [Figure 2].

Maternal and neonate condition and interval of head-to-body delivery. There was no statistical difference between two groups in maternal age, pregnant week and newborns birth weight, Apgar score; no difference in rate of parity and occipitoposterior (OP) position, delivery position, but there were four macrosomia babies in over 60 s group and none in less 60 s group [Table 1].

In view of sorting out factors that may affect the head-to-body delivery interval, subgroup by parity, delivery position, fetus position, degree of perineum laceration, cord around the neck or not, macrosomia or not, and the number of contractions for shoulder delivered. Macrosomia babies (four cases) had a longer interval of head to shoulder than normal birth weight babies, and shoulder delivered at the second contraction (three cases) had longer interval than those delivered at the first contraction after head delivered [Table 2]. Logistic regression analysis applied, independent varies interval of head to shoulder over 60 s = 1, <60 s = 0. Results revealed that macrosomia and shoulder delivery at the second contraction were the risk factors to interval over 60, OP position had a shorter interval [Table 3].

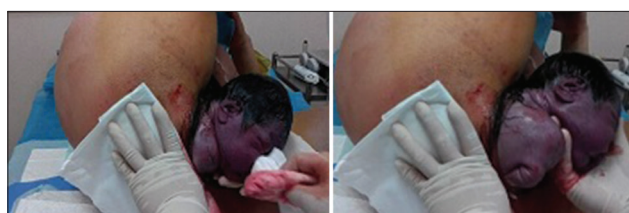


Figure 1: Shoulder emerged from the perineum.

## DISCUSSION

### Normal range of head-to-body delivery interval is longer than 60 s

This study revealed the natural process of shoulder delivery by two-step delivery, all babies were born spontaneously without any maneuver of man force and vigorous in normal condition. The average time of head-to-body delivery interval was  $(71.04 \pm 61.02)$  s, 44.57% (41/92) interval was over 60 s, 95% CI was (15.65–229.15) s. Mean + 2 SD was 193.07 s. The longest interval was 355 s. This result questions the definition of shoulder dystocia when an over 60 s delay interval occurs. This also questions the accuracy of clinical diagnosis of shoulder dystocia.<sup>[4]</sup> When babies delivered by uterus force without additional maneuver and no adverse maternal and neonatal event occur, those births should be defined as normal birth, not shoulder dystocia (thought the interval of head to shoulder may be longer than 60 s).

The story of recommended delivering the shoulder in one-step manner by gentle pulling downward the neck of the fetus once the head is delivered in an attempt to fasten the delivery of the baby is rather controversial. In 1973, Wood *et al.* reported that the blood pH of neonates had dropped about 0.1 unit/min if the expulsion of the body had not followed that of the head immediately.<sup>[8,9]</sup> Thought all the newborns in the study were vigorous and live with high Apgar scores, this report influences the physicians in the clinical setting to shorten the head-to-body interval as possible.<sup>[10]</sup>

However, the more active management protocol replaced a conservative philosophy which had recommended abstinence from intervention on the normal birth did not turn optimal outcomes. Moreover, it is possible that the intervention may be largely responsible for the exponential increase in the rates of shoulder dystocia. The incidence of shoulder dystocia with associated brachial plexus injury has not changed over time and even rising, despite the fact that more effort is paid to the training of the management shoulder dystocia maneuvers and more liberal use of caesarean section.<sup>[11]</sup> Experts in the field recommend adherence to the traditional method of delivery.<sup>[12]</sup>

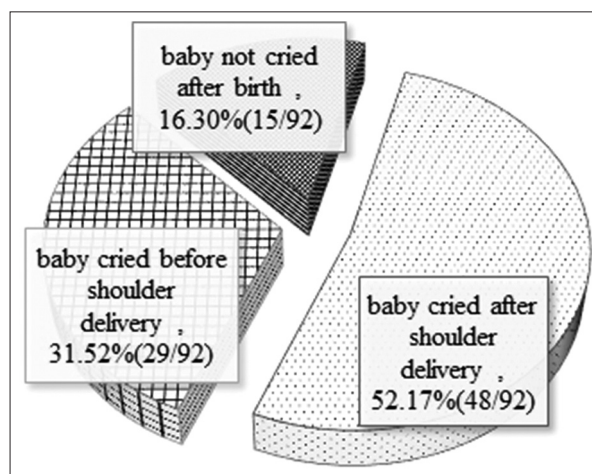


Figure 2: Babies cry activities in normal vaginal birth by a two-step method.

**Table 1: Maternal and neonate condition between head-to-body delivery interval less and over 60 s**

Indicators	Head-to-body delivery interval ≤60 s (n = 51)	Head-to-body delivery interval >60 s (n = 41)	Statistical values	P
Head-to-body delivery interval (s)	32.51 ± 13.95	118.98 ± 63.07	9.517 <sup>†</sup>	<0.01
Maternal age (years)	30.63 ± 5.12	29.63 ± 4.61	0.966 <sup>†</sup>	0.336
Macrosomia	0	4	5.202*	<0.05
Gestational age (weeks)	38.61 ± 1.66	38.56 ± 2.09	0.120 <sup>†</sup>	0.905
Birth weight (g)	3250.06 ± 304.79	3251.00 ± 464.35	0.966 <sup>†</sup>	0.336
Apgar score (at 1 min)	9.84 ± 0.50	9.95 ± 0.22	1.277 <sup>†</sup>	0.205
Baby cried before shoulder, n	16	13	0.001*	0.973
Cord around neck, n	18	11	0.754*	0.358
Intact perineum, n	44	30	2.569*	0.109
OP, n	3	0	2.493*	0.114
Primiparas, n	34	33	2.194*	0.139
No supine position delivery, n	45	38	0.509*	0.475

Data are presented as a mean ± SD, \* $\chi^2$  value; <sup>†</sup>t value; SD: Standard deviation; OP: Occipitoposterior.

**Table 2: Comparison of head-to-body delivery interval in subgroups**

Items	Head-to-body delivery interval (mean ± SD) (s)	t value	P
Parity			
Primiparas (n = 67)	77.87 ± 65.11	1.776	0.079
Multiparas (n = 25)	52.76 ± 44.51		
Delivery position			
No supine position delivery (n = 83)	72.00 ± 62.49	0.455	0.650
Supine position delivery (n = 9)	62.22 ± 47.17		
Fetal presentations			
OP (n = 3)	19.67 ± 14.50	1.493	0.139
OA (n = 89)	72.78 ± 61.25		
Degree of perineum laceration			
Intact perineum (n = 74)	66.41 ± 60.01	1.545	0.126
First degree laceration and second degree laceration (n = 18)	92.25 ± 63.93		
Cord around neck			
Yes (n = 29)	59.69 ± 49.72	-1.214	0.228
No (n = 63)	76.27 ± 65.27		
Birth weight			
Macrosomia (n = 4)	206.00 ± 86.39	-5.109	<0.01
Normal birth weight (n = 88)	64.91 ± 52.55		
Number of uterus contraction			
Delivery at the first contraction (n = 89)	66.34 ± 55.20	-4.421	<0.01
Delivery at the second contraction (n = 3)	210.67 ± 71.67		

Data are presented as a mean ± SD, OP: Occipitoposterior; OA: Occipitoanterior; SD: Standard deviation.

We had to follow the natural print of the normal birth process for better maternal and neonate outcomes. At the very begin, we had to know what is the normal process, how the shoulder rotates and deliver, how long the interval of head to shoulder is, and how long is safe for the fetus. This study opened a fresh new option to this puzzle. From this study, we can

conclude that the interval of head-to-body in normal birth by two-step method is longer than 60 s.

### Factors may influence the length of head-to-body delivery interval

From this study, the interval of head-to-body between parity was not significant, OP position versus occipitoanterior position had no difference. The relationship between birth weight and the interval was paradoxical, thought the birth weight between less 60 s and over had no difference, all four cases of macrosomia babies were over 60 s, and when compare of the interval between macrosomia with normal birth weight, it had a much longer interval in macrosomia group. The cause may be the small number of macrosomia in this study, but it offered a clue that birth weight is a risk factor to slower delivery of shoulder. The results of this study were consistent with the former study that indicated bigger baby contributes to difficult labor.<sup>[13,14]</sup>

### How shoulder delivered by waiting for one contraction

In one-step delivery, shoulders were expected to emerge from under the pubic bone. The gentle downward force was applied in an attempt to help the baby born. By waiting for the shoulder delivered by uterus contraction, it was found that the majority of shoulder emerged from the perineum, or transversely in vaginal, not from pubic. From this study, we can conclude that downward force to deliver the shoulder under pubic is not necessary and even not the right direction. In natural process of normal birth, it should be always kept in mind that help will be reserved only it is necessary.

In this study, 96.74% (89/92) cases shoulders were delivered at the first contraction after head delivered, only 3.26% (3/92) cases had delivered by twice contractions. That fact offered a clue that caution should be given when the shoulder did not deliver at the first contraction. We see an interesting phenomenon that similar to head visible at vulvar gapping that before the crown of head, the head will return to vaginal after the contraction and emerged again and bigger. In those three cases with twice contractions, we



**Table 3: Factors contribute to the head-to-body delivery interval over 60 s**

Items	B	SE	Wald	Significant	Exp(B)	95.0% CI for EXP(B)	
						Lower	Upper
Macrosomia	20.570	17,934.598	0.000	0.999	857,732,426.679	0.000	–
Shoulder delivery at second contraction	20.071	19,765.125	0.000	0.999	520,880,263.008	0.000	–
OP position	-20.915	23,205.472	0.000	0.999	0.000	0.000	–
Constant	-20.013	35,366.715	0.000	1.000	0.000	–	–

Head-to-body delivery interval over 60 s: 1; Less 60 s: 0; Macrosomia: 1; Normal birth weight: 0; shoulder delivery at second contraction: 1; first contraction: 0; Occiput posterior (OP): 1; Occiput anterior (OA): 0; B: Partial correlation coefficient; SE: Standard error of regression; Exp(B): Odds ratio; CI: Confidence interval.

can see that the shoulders were emerged from vulvar and return to vaginal, we named it “shoulder visible on vulvar gapping.” That phenomenon indicated the shoulder take the effort to descent and come out the same way as head visible to crown and delivery though it is much shorter than that from head visible to crown, but it does take time.

Attention should be paid to and preparation for shoulder dystocia must be considered when the shoulder failed to delivery at the first contraction, but action may be delayed by careful assessment of the fetus condition. Fortunately, all babies were born naturally in this study, if the second contraction failed to deliver the shoulder, further action as Gaskin Maneuver (on all fours) may be tried and whatever maneuvers feasible be applied.<sup>[11,15,16]</sup>

### Assessment of baby condition while waiting for the contraction

The main concern about the process of shoulder delivery is the condition of the babies. Caregiver may become tenser with every second passing. The reported evidence about the interval of head to shoulder related to baby asphyxia was controversial. Leung *et al.* study found a statistically significant, albeit small, correlation between head-to-body delivery interval and umbilical artery pH ( $r = -0.210$ ,  $P = 0.003$ ) and umbilical artery base excess ( $r = 0.144$ ,  $P = 0.045$ ). If the head-body delivery interval was <5 min, the risk of severe acidosis (pH <7.0) was 0.5%, whereas this risk was 5.9% when the delivery interval was 5 min or greater.<sup>[17]</sup> In a study by Lerner *et al.*, a positive relationship was observed between increasing length of the delivery interval and neonatal depression, the percentage of a neonate with depression rose sharply after 3 min.<sup>[18]</sup> However, as indicated by the same author, even the shortest interval affects some neonate with respiratory depression.<sup>[18]</sup> Zanardo *et al.* reported that pH values significantly lower ( $7.31 \pm 0.09$  vs.  $7.33 \pm 0.06$ ,  $P = 0.003$ ) in “two-step” VD neonates than in CS delivered neonates.<sup>[19]</sup> The bias in this study is that they should compare the two-step with one-step in VD, not with CS. The pH values in “two-step” in this study were within normal range, and the author did not report the rate of asphyxia, those value may be the physiological changing in vaginal birth if all the babies in that study were survived without complications.<sup>[20]</sup> In this study, we have found no baby depression in all cases, though 44.57% (41/92) interval was over 60 s. We did not measure the value of pH of the fetus. By observing the activities of the fetus, normal

heartbeat, color, face movement, and even cry, the signs served as good indicators of the babies’ health.

In conclusion, the normal range of head-to-body interval in natural birth by waiting for a contraction (two-step delivery) is longer than 60 s. The majority of shoulders were delivered by the first contraction. If the shoulders are allowed to deliver by uterus forces, most shoulders emerged over the perineum not from under pubic arch. The traditional practice of downward force to deliver the shoulder from under pubic is not necessary and even not the right direction. Baby live signs including face movement, sucking, burble from nose and mouth, good color of skin are good indicators of baby condition assessment during the head-to-body delivery interval.

### Financial support and sponsorship

This study was supported by a grant from the Health and Family Planning Commission of the Hainan Province of China (No. 15A200039).

### Conflicts of interest

There are no conflicts of interest.

### REFERENCES

- Gurewitsch ED. Optimizing shoulder dystocia management to prevent birth injury. *Clin Obstet Gynecol* 2007;50:592-606. doi: 10.1097/GRF.0b013e31811eaba2.
- Hart G. Waiting for shoulders. *Midwifery Today Childbirth Educ* 1997;(42):32-4.
- Welch RA. “Head and shoulder” maneuver. *Am J Obstet Gynecol* 1997;176:1118. doi: 10.1016/S0002-9378(97)70419-8.
- Spong CY, Beall M, Rodrigues D, Ross MG. An objective definition of shoulder dystocia: Prolonged head-to-body delivery intervals and/or the use of ancillary obstetric maneuvers. *Obstet Gynecol* 1995;86:433-6. doi: 10.1016/0002-9378(95)90782-3.
- Locatelli A, Incerti M, Ghidini A, Longoni A, Casarico G, Ferrini S, *et al.* Head-to-body delivery interval using ‘two-step’ approach in vaginal deliveries: Effect on umbilical artery pH. *J Matern Fetal Neonatal Med* 2011;24:799-803. doi: 10.3109/14767058.2010.531307.
- Stallings SP, Edwards RK, Johnson JW. Correlation of head-to-body delivery intervals in shoulder dystocia and umbilical artery acidosis. *Am J Obstet Gynecol* 2001;185:268-74. doi: 10.1067/mob.2001.116730.
- World Health Organization partograph in management of labour. *World Health Organization Maternal Health and Safe Motherhood Programme. Lancet* 1994;343:1399-404.
- Wood C, Ng KH, Hounslow D, Benning H. The influence of difference of birth times upon fetal condition in normal deliveries. *J Obstet Gynaecol Br Commonw* 1973;80:289-94. doi: 10.1111/j.1471-0528.1973.tb11193.x.
- Wood C, Ng KH, Hounslow D, Benning H. Time – An important

- variable in normal delivery. *J Obstet Gynaecol Br Commonw* 1973;80:295-300. doi: 10.1111/j. 1471-0528.1973.tb11194.x.
10. Pritchard JA, MacDonald PC. *Williams Obstetrics*. 15<sup>th</sup> ed. New York: Appleton-Century-Croft; 1976. p. 337-8.
  11. Gaskin IM. Shoulder dystocia: Controversies in management. *Birth Gaz* 1988;5:14.
  12. Iffy L, Varadi V, Papp Z. Epidemiologic aspects of shoulder dystocia-related neurological birth injuries. *Arch Gynecol Obstet* 2015;291:769-77. doi: 10.1007/s00404-014-3453-8.
  13. Young BC, Ecker JL. Fetal macrosomia and shoulder dystocia in women with gestational diabetes: Risks amenable to treatment? *Curr Diab Rep* 2013;13:12-8. doi: 10.1007/s11892-012-0338-8.
  14. Larson A, Mandelbaum DE. Association of head circumference and shoulder dystocia in macrosomic neonates. *Matern Child Health J* 2013;17:501-4. doi: 10.1007/s10995-012-1013-z.
  15. Stitely ML, Gherman RB. Shoulder dystocia: Management and documentation. *Semin Perinatol* 2014;38:194-200. doi: 10.1053/j.semperi.2014.04.004.
  16. Crofts JF, Lenguerrand E, Bentham GL, Tawfik S, Claireaux HA, Odd D, *et al*. Prevention of brachial plexus injury-12 years of shoulder dystocia training: An interrupted time-series study. *BJOG* 2016;123:111-8. doi: 10.1111/1471-0528.13302.
  17. Leung TY, Stuart O, Sahota DS, Suen SS, Lau TK, Lao TT. Head-to-body delivery interval and risk of fetal acidosis and hypoxic ischaemic encephalopathy in shoulder dystocia: A retrospective review. *BJOG* 2011;118:474-9. doi: 10.1111/j.1471-0528.2010.02834.x.
  18. Lerner H, Durlacher K, Smith S, Hamilton E. Relationship between head-to-body delivery interval in shoulder dystocia and neonatal depression. *Obstet Gynecol* 2011;118(2 Pt 1):318-22. doi: 10.1097/AOG.0b013e31822467e9.
  19. Zanardo V, de Luca F, Trevisanuto D, Simbi A, Scambia G, Straface G. 'Two-step' head-to-body delivery activates foetal gluconeogenesis. *Acta Paediatr* 2013;102:e334-8. doi: 10.1111/apa.12261.
  20. Strobelt N, Locatelli A, Casarico G. Head-to-body delivery interval time: What is the normal range? *Obstet Gynecol* 2006;195S:110-4.