Thai Journal of Obstetrics and Gynaecology
September 2017, Vol. 25, pp.199-205

OBSTETRICS

Study of Delivery Forces used during a Shoulder Dystocia Simulation for 6th years Medical Students

Uravee Limpivest, M.D.*,
Panwara Paritakul, M.D., MMed Sci MedEd.*.

** Department of Obstetrics and Gynaecology, Faculty of Medicine, Srinakharinwirot University, Bangkok 10110, Thailand*

ABSTRACT

Objectives: To describe the average force for a normal delivery and a shoulder dystocia using a force monitoring birthing simulator. We also study the influence of gender, weight, height and body mass index (BMI) on the delivery force.

Materials and Methods: After a small group teaching about managing a shoulder dystocia, consenting 6th year medical students were asked to pull on the force monitoring birthing simulator in three scenarios. Normal delivery (NL force), shoulder dystocia (SD force), and maximum force they are courage to use on a fetal head (Max force). The mean and peak force of each participant was computerized and recorded in newton (N). The effect of gender on delivery force was tested with t-test and Chi-square test. The association between weight, height, BMI, number of previous vaginal delivery and the delivery force was tested using Pearson's correlation. A $p \leq 0.05$ was considered statistically significant.

Results: A total number of 103 students participated in this study. Two were excluded due to data loss and the remaining data from 101 students were analyzed. The average force was 51.2 ±20.8 N, 83.0± 26.3 N, and 100.82 ± 34.0 N for the NL force, SD force and Max force, respectively. 84.2% of students exerted peak force of more than 100 N during a shoulder dystocia simulation. There was no effect of gender, weight, height, and BMI on the delivery force.

Conclusion: Medical students tend to use forceful traction to resolve shoulder dystocia despite the teacher verbally addressing that physicians should exert a "routine axial traction" even in the event of shoulder dystocia. A force monitoring birthing simulator may be useful in providing feedback to the students and help the students to recognize the appropriate force for delivering a shoulder dystocia. Gender and body habitus had no effect on the delivery force.

Keywords: shoulder dystocia, delivery force, simulation

Correspondence to: *Uravee Limpivest, M.D., Department of Obstetrics & Gynaecology, Faculty of Medicine, Srinakarinwirot University, 67 Moo 2, Ongkark, Nakorn Nayok 26120, Thailand, E-mail urv.limpivest@gmail.com, Phone +66 61-7727374*

การศึกษาแรงดึงช่วยคลอดติดไหล่โดยใช้หุ่นจำลองในนิสิตแพทย์เวชปฏิบัติชั้นปีที่ 6

อุรวี ลิมปิเวศน์, พรรณวรา ปริตกุล

บทคัดย่อ

***วัตถุประสงค์**: เพื่อศึกษาแรงดึงช่วยคลอดปกติและดึงสำหรับช่วยคลอดติดไหล่ โดยใช้หุ่นจำลองชนิดมีเครื่องวัดแรงดึง และศึกษาหาความสัมพันธ์ระหว่างเพศ น้ำหนัก ส่วนสูงและดัชนีมวลกายกับแรงดึงที่ใช้ในการช่วยคลอดในสถานการณ์ต่างๆ*

***วัสดุและวิธีการ**: หลังจากได้รับการสอนเรื่องการช่วยคลอดติดไหล่ ผู้เข้าร่วมวิจัยจะได้แสดงการดึงช่วยคลอดในสถานการณ์คลอดปกติ (NL force), สถานการณ์คลอดติดไหล่ (SD force) และแรงดึงสูงสุดที่จะกล้าใช้ในการทำคลอดทารก (Max force) โดยการดึงนั้นจะมีการบันทึกข้อมูลแรงดึงด้วยหุ่นจำลองชนิดบันทึกแรงได้ แรงดึงเฉลี่ยและแรงดึงสูงสุดจะถูกบันทึกในหน่วยนิวตัน (N) และคำนวณด้วยคอมพิวเตอร์ ผู้วิจัยวิเคราะห์ความแตกต่างของแรงดึงระหว่างเพศด้วยสถิติ Chi square และ t-test และวิเคราะห์ความสัมพันธ์ระหว่างน้ำหนัก ส่วนสูง ดัชนีมวลกาย จำนวนประสบการณ์ในการทำคลอดกับแรงดึงคลอดติดไหล่ด้วย Pearson's correlation*

***ผลการศึกษา**: จำนวนผู้เข้าร่วมวิจัยทั้งหมด 103 คน ข้อมูลจากนิสิต 2 คน ถูกคัดออก เนื่องจากมีการสูญเสียข้อมูลดิบระหว่างเก็บข้อมูล คงเหลือข้อมูลจากนิสิต 101 คนสำหรับวิเคราะห์ แรงดึงเฉลี่ยสำหรับการคลอดปกติคือ 51.2 ± 20.8 N แรงดึงเฉลี่ยสำหรับการคลอดติดไหล่คือ 83.0 ± 26.3 N และแรงดึงสูงสุดที่จะกล้าใช้ในการทำคลอดทารกคือ 100.82 ± 34.0 N 84.2% ของผู้เข้าร่วมวิจัยใช้แรงดึงมากกว่า 100 N ในการช่วยคลอดติดไหล่ เพศ น้ำหนัก ส่วนสูงและดัชนีมวลกายไม่มีผลต่อแรงดึงในการช่วยคลอดของผู้เข้าร่วมวิจัย*

***สรุป**: นิสิตแพทย์มีแนวโน้มที่จะใช้การเพิ่มแรงดึงในการช่วยคลอดติดไหล่ แม้ผู้สอนจะย้ำโดยวาจาให้ออกแรงดึงที่ไม่มากเกินไปกว่าการทำคลอดทั่วไป การใช้หุ่นจำลองที่สามารถตรวจวัดแรงและให้ข้อมูลป้อนกลับได้อาจช่วยให้นิสิตประเมินแรงดึงที่เหมาะสมของตนเองได้ดีขึ้น เพศ และลักษณะรูปร่างนั้นไม่มีผลต่อแรงดึงในการช่วยคลอด*

***คำสำคัญ**: คลอดติดไหล่ แรงดึงคลอด หุ่นจำลอง*

Introduction

Shoulder dystocia is a catastrophic obstetric condition which complicates 0.2 – 3.0 % of all vaginal deliveries[1]. Despite many efforts to identify the risk factors, shoulder dystocia remains unpredictable and unpreventable[2]. During a shoulder dystocia, maneuvers to release the impacted shoulder such as McRoberts maneuver and suprapubic pressure are employed along with traction of the fetal head. The appropriate force for delivery of shoulder dystocia has never been clarified. According to The Royal College of Obstetricians and Gynecologist guideline for shoulder dystocia, it is recommended that the physicians exert a "routine axial traction" even in the event of shoulder dystocia[3], suggesting that the physicians should resort to the maneuvers to release the impacted shoulder rather than increasing the traction force. Such recommendation was based on a possibility that excessive force may cause the brachial plexus injuries. A study by Allen et al done in real delivery using a force sensing device reports that average clinician-applied peak forces are 47 newtons (N) for normal deliveries, and 100 N for a shoulder dystocia delivery whose neonate had a brachial plexus injury[4]. There are also other studies that evaluated the delivery forces in a simulated scenario. Croft et al., studied forces applied by 140 obstetricians and midwives during a shoulder dystocia simulation and found that 66% of the participants applied more than 100 N[5]. Deering et al studied in 47 obstetricians and family physicians and reported an average force of 92 N for a shoulder dystocia scenario[6].

Despite the various studies on the shoulder dystocia delivery forces using a simulation, the data are from Western countries which may not compare well with our population, as Asians tends to have smaller body habitus. Moreover, the main providers who manage normal deliveries in Thailand are the general practitioners, who may have limited training and experience regarding the management of shoulder dystocia. We design a descriptive study to evaluate the delivery force of the 6th year medical student as this population represents the future doctors responsible for managing deliveries in community hospitals. The objective of this study is to describe the average force for a normal delivery and a shoulder dystocia using a birthing simulator. We also study the influence of gender, weight, height and BMI on the delivery force.

Materials and Methods

A single center, observational study was conducted at HRH Princess Maha Jakri Sirindhorn Medical Center, Thailand during the period of June 2015 – March 2016. The ethical approval has been granted by the Human Research Ethics Committee, Srinakharinwirot University (registration number SWUEC/X-260/2558). The sample size calculation was not needed in the study due to the use of census population, which including all the 6th year medical students at the Faculty of Medicine, Srinakharinwirot University who have performed at least three normal vaginal deliveries were invited to participate in the study and informed consent was obtained prior to the enrollment. During the clinical placement in the obstetrics and gynecology department, all students attended a small group teaching about management of shoulder dystocia. During the session, clinical instructor explicitly informed the students that the force applied during shoulder dystocia should not exceed 100 N. After the small group teaching, students who consented to participate the study were invited to the simulation room to record their force using a computerized birthing simulator.

The PROMPT birthing simulator (Limbs & Things Ltd, Bristol, UK) was used to measure the delivery force in this study. The simulator was equipped with an internal force measuring system which can be recorded when connected to a computer. The electronic force measurement system of the PROMPT birthing simulator has been explained elsewhere in a previous literature[5]. On the simulation day, the participants' age, gender, weight, height and body mass index (BMI) were recorded. We placed the PROMPT birthing simulator on a clothed table. The baby mannequin was placed in the maternal pelvis with the head at vaginal outlet in left occiput anterior position. One research assistant was responsible for holding the baby mannequin in place during the simulation. The participants were asked to pull on the fetal head as hard as they believe they would do in real practice in three scenarios. All participants would be facing the same simulation setting for all situations; 1) When performing normal delivery (NL force) 2) When managing shoulder dystocia (SD force) and 3) Maximum force they are courage to use on a fetal head (Max force). In all circumstances, the baby mannequin can actually be delivered but the participants would not be expecting the delivery of the body during a simulation. The force was recorded in newton and the force data were then exported into an excel file with each file containing details of recorded force for individual participant. The mean force was computerized and the peak force was recorded for each participant in the three scenarios (NL force, SD force and Max force). Fig. 1. shows a typical force recording graph for each participant. Any participant who did not complete the force recording for all three scenarios or whom the data was lost during simulation recording were excluded form data analysis. The data analysis was done using SPSS Statistics for Windows, Version 14.0. Chicago: SPSS Inc. The average delivery force in each scenario between the male and female participants were compared using student t-test. A chi-square test of independence was calculated to examine the relation between gender and a chance of peak force exceeding 100N during a pull in shoulder dystocia scenario. The association between age, weight, height, BMI, number of previous vaginal delivery and the delivery force was tested using Pearson's correlation. A $p \le 0.05$ was considered statistically significant.

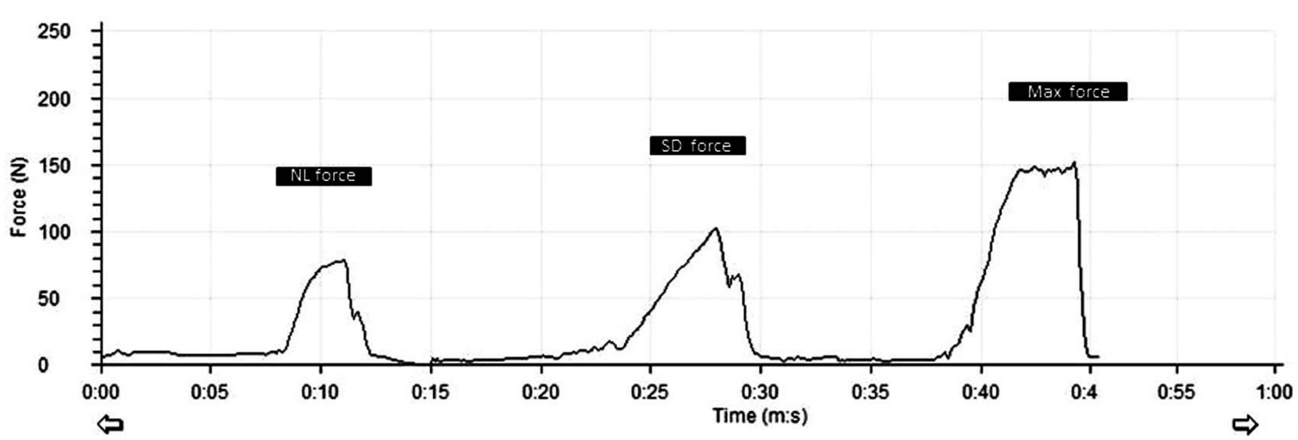

Fig 1. A force recording graph reproduced during a simulation

Results

A total number of 128 students were invited to enroll in the study and 103 students consented to participate. Two participants were excluded because their data was lost while exporting the force recording into an Excel file. Therefore the data from a total number of 101 participants were analyzed.

The mean age of the students was 22.3±2.3 year and 38 (37.6%) were male. The students' mean weight was 59.7±10.7 kilograms, the mean height was 166.0±7.7 centimeter, and the mean body mass index (BMI) was 21.6±3.2 kg/m^2. The average number of vaginal delivery that the students performed during their training was 8.8±3.9 cases. The participants' characteristics were shown in Table 1.

The average force that the student used during the simulation was 51.2±20.8 newton (N) for a normal delivery scenario, 83.0±26.3 N for a shoulder dystocia scenario, and 100.8±34.0 N for a maximum force the participants were willing to use on a baby.

We evaluated the peak force during the three scenario for each participant and the participants were grouped into those with peak traction force less than 100N and those to exceed 100N. The proportion of participants who exerted more than 100 N were 36 (35.6%) during a normal delivery simulation, 85 (84.2%) during a shoulder dystocia simulation, and 97 (97.0%) during a simulation for their maximum force they were eager to use to deliver a baby (Table 2)

There was no statistically significant in the mean delivery force for the three scenarios between the male participants and the female participants as determined by t-test. The proportion of using peak force of more than 100N was not different between both genders as determined by Chi-square test (Table 3). With regards to age, weight, height and BMI, no significant correlation was found between weight, height, BMI and the average/peak SD force as determined by Pearson's correlation (Table 4).

Table 1. The participants' baseline characteristics.

Characteristics	N = 101 participants
Age (years)	22.28 ± 2.3
Gender	
Male (N, %)	38 (37.6%)
Female (N, %)	63 (62.8%)
Weight (kg)	59.7 ± 10.7
Height (cm)	166.0 ± 7.7
BMI (kg/m^2)	21.6 ± 3.2
Number of vaginal delivery cases performed	8.8 ± 3.9

* All data are presented in mean ± SD if not otherwise specified

Table 2. Average and peak force during a simulation of three scenarios.

Scenario type (N = 101)	Average force (newton) Mean ± SD	Peak force > 100 N N (%)
Normal delivery	51.2 ± 20.8	36 (35.6%)
Shoulder dystocia	83.0± 26.3	85 (84.2%)
Maximum	100.82 ± 34.0	97 (97.0%)

Table 3. Force value in three scenarios according to gender.

Scenario type (N=101)	Average Force (newton) Mean ± SD			Peak force > 100 N N (%)		
	Male	Female	p^a	Male	Female	p^b
Normal delivery	50.0 ± 20.3	51.9 ± 21.3	0.65	13 (34.2%)	23 (36.5%)	0.81
Shoulder dystocia	84.9 ± 26.0	81.9 ± 26.7	0.57	35 (92.1%)	50 (75.4%)	0.08
Maximum	101.2 ± 35.9	100.5 ± 33.1	0.92	37 (97.4%)	61 (96.8%)	0.87

p^a = p value from Student t test, p^b = p value from Chi square test

Table 4. Pearson correlation between weight, height, BMI, delivery experience and the applied force.

	Average SD force r (p value)	Peak SD force r (p value)
Weight	0.06 (0.69)	0.05 (0.59)
Height	0.07 (0.47)	0.07 (0.48)
BMI	0.03 (0.71)	0.02 (0.84)
Number of previous vaginal deliveries performed	0.07 (0.44)	0.15 (0.14)

* r = correlation coefficient

Discussion

In our study, the mean forces that the participants used during the simulation were 51.2±20.8 N for a normal delivery, 83.0± 26.3 N for a shoulder dystocia, and 100.5±33.1 N for a maximum force. When compared to the study by Deering et al., which studied the mean force that US healthcare providers used in a simulated scenario, our mean forces were higher in all three scenarios. The reason for such discrepancy may be due to the fact that our studied population was a cohort of medical students who were considered to be less experienced compared to the studied population of Deering et al., who were the family medicine doctors and obstetric providers. Previous study has shown that less experienced healthcare provider tends to pull harder when compared with experienced hands[6].

It is suggested that when faced with shoulder dystocia, the care provider should resort to maneuvers to release the impacted shoulder rather than using the excessive force, as increasing traction is counterproductive for shoulder dystocia[7]. During the small group teaching about the management of shoulder dystocia, the clinical instructor emphasized this point and clearly point out that current evidence support the use of force less than 100N. However, when considering the peak force in our study, a significant proportion (84.2%) of our participants pulled harder than 100N during the shoulder dystocia simulation and almost all participants (97.0%) exerted more than 100N when asked to pull at maximum force they were courage to perform on the real baby. This finding suggests that verbally addressing that the delivery force should be limited is not enough to help the students grasp the idea of how hard they should pull. Therefore, we suggest that training with a force recording birthing simulators, when available, should be used to provide feedback to each student and help them calibrate and estimate the appropriate delivery force for a shoulder dystocia.

In common sense, it may be thought that female doctors would exert less force than male doctors, or body habitus may effects the traction force. However, in our study, gender, weight, height, BMI did not associate with the applied force and the result was in consistency with the previous studies[6, 8]. The implication on practice of this finding is that when training for management of shoulder dystocia delivery, the students should made aware that even small female doctors can exert an overload force. A trial traction with a force monitoring birthing simulator should be performed where possible to aid the students with perception of an appropriate force.

There were some limitations of our study. Our procedure of recording the forces relied on the participants imitating the force that they usually do in real practice. This procedure was subject to some error and recall bias. We also did not include the maneuvers to release the shoulder dystocia in our simulation and this may led to the participants being unable to relate the simulation well to real clinical environment. Therefore, the recorded force in this study may not completely represent their true practice. Another limitation of our study was the generalizability of the results. Our study was conducted exclusively at a single medical school. Each medical school has different teaching plan for a shoulder dystocia management. Therefore, the delivery forces in this study may not represent those of the newly graduated doctors in Thailand. We suggest that another study with larger sample size from medical schools of varied regions is still needed to confirm our findings.

Conclusion

Medical students should exert appropriate force during delivery of shoulder dystocia but they tend to use a forceful traction to resolve a shoulder dystocia despite the teacher verbally addressing that physicians should exert a "routine axial traction" even in the event of shoulder dystocia. A force monitoring birthing simulator may be useful in providing feedback to the students and help the students to recognize the appropriate force for delivering a shoulder dystocia. Gender and body habitus had no effect on the delivery force.

Acknowledgement

This study received funding from Faculty of Medicine, Srinakharinwirot University

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Gherman RB, Chauhan S, Ouzounian JG, Lerner H, Gonik B, Goodwin TM. Shoulder dystocia: the unpreventable obstetric emergency with empiric management guidelines. Am J Obstet Gynecol 2006;195:657-72.
2. Mehta SH, Sokol RJ. Shoulder dystocia: risk factors, predictability, and preventability. Semin perinatol 2014; 38:189-93.
3. Royal College of Obstetricians and Gynaecologists. Shoulder dystocia green-top guideline no. 42[Internet]. Second edition, London (UK); 2012[updated 2014 December; cited 2016 10 MAY]; p. 1-18. Available from: https://www.rcog.org.uk/globalassets/documents/guidelines/gtg_42.pdf.
4. Allen R, Sorab J, Gonik B. Risk factors for shoulder dystocia: an engineering study of clinician-applied forces. Obstet Gynecol 1991;77:352-5.
5. Crofts JF, Ellis D, James M, Hunt LP, Fox R, Draycott TJ. Pattern and degree of forces applied during simulation of shoulder dystocia. Am J Obstet Gynecol 2007;197: 156.e1-6.
6. Deering SH, Weeks L, Benedetti T. Evaluation of force applied during deliveries complicated by shoulder dystocia using simulation. Am J Obstet Gynecol 2011; 204:234.e1-5.
7. Crofts JF, Fox R, Ellis D, Winter C, Hinshaw K, Draycott TJ. Observations from 450 shoulder dystocia simulations: lessons for skills training. Obstet Gynecol 2008;112: 906-12.
8. Allen RH, Bankoski BR, Butzin CA, Nagey DA. Comparing clinician-applied loads for routine difficult and shoulder dystocia deliveries. Am J Obstet Gynecol 1994;171:1621-7.