Risk Factors of Caesarean Section due to Cephalopelvic Disproportion

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Objective: *To identify risk factors of cesarean section due to cephalopelvic disproportion*
Setting: *Department of Obstetrics and Gynecology, Faculty of Medicine, Siriraj Hospital*
Study Design: *Case-control study*
Material and Method: *One hundred and three singleton, viable, term pregnant women in cephalic presentation delivered by cesarean section due to cephalopelvic disproportion (CPD) and 105 controls gave normal birth just before or after the study case. Demographic, anthropometric data, labor characteristics, and neonatal outcomes were obtained from medical records. The expected risk indicators of the case and control groups were compared by using independent unpaired T-test and exact probability test as appropriate. Multiple logistic regression analysis was used to determine the significant risk factors ($p < 0.05$).*
Results: *Significant independent risk factors of cesarean section due to CPD were: estimated fetal weight (EFW) > 3,000 g (OR = 3.96, 95%CI = 2.06, 7.63), pre-pregnancy BMI $\geq$ 25 kg/m^2 (OR = 5.06, 95%CI = 1.67, 15.34), nulliparity (OR = 2.98, 95%CI = 1.31, 6.78) and the inadequacy of clinical pelvimetry (OR = 8.49, 95%CI = 1.01, 71.78), ($p < 0.05$).*
Conclusion: *Risk factors for cesarean section due to CPD were EFW > 3,000 g, pre-pregnancy BMI $\geq$ 25 kg/m^2, nulliparity and the inadequacy of clinical pelvimetry. They are useful in the categorization of individual women into high and low CPD-risk groups.*

Keywords: *Risk factors, Cephalopelvic disproportion, Cesarean section*

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Achievement of safe motherhood and childbirth develops primarily from good antenatal care, standardized labor and postpartum care. Planning for the birth can be partly done at the time of antenatal evaluation. However, the most critical period for determining a delivery route is the intrapartum period. Although, there are many important factors[1], such as fetal position, adequacy of birth passage, uterine contractility and cervical progression, which can be evaluated clinically to reassure success of vaginal delivery, there still exist groups of pregnant women who fail vaginal delivery and hence inevitably should delivery via abdominal route or cesarean section for their childbirth. As a result, these pregnant women need urgent detection and prompt management on obstructed labor as known in terms of "cephalopelvic disproportion (CPD)"

Cephalopelvic disproportion (CPD) is one of the most common problems in obstetrics and may lead to hazardous complications of both mother and child if the diagnosis is delayed. Therefore, it would be beneficial if we could predict CPD before it occurred. In the past, numerous antenatal strategies for predicting CPD were developed and received considerable attention. The variables[2-11] determining fetal size, such as gestational age, maternal body size, nutritional status, complications of pregnancy or maternal diseases, and total weight gain during pregnancy, and other associated factors such as gravidity and parity were used for determining the risks of cesarean section especially due to CPD. Most of those studies, however, were con-

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ducted in the Western or African countries where the population is different from Asian.

In Thailand, there were only a few studies on this topic, including that of Suthit[12] from Lampoon Hospital. In that study, the population was limited only in the northern part, where anthropometry, nutritional status and lifestyle differ from those of other parts of Thailand. As we wanted our study to cover a more diverse group of population, we opted for Siriraj Hospital as our location as it is a medical school whose patients come from different regions of the country. The results of the study could thereby be applied to many medical care services, especially in the rural part of Thailand where medical personnel and preparedness are insufficient. Furthermore, it could lead to the improvement of the transferring system of patient with multiple risk factors of CPD to prevent adverse outcome.

Material and Method

The objective of this research was to identify the risk factors of cesarean section due to cephalopelvic disproportion.

We conducted our case-control study on singleton, term pregnant women in cephalic presentation who were admitted in the labor ward of Siriraj Hospital and gave birth between January 2, 2006 and May 12, 2006. Approval from Siriraj Ethics Committee and written consents from all participants were obtained. Sample size[13] was calculated using the same three variables - fundal height, maternal height, and total weight gain - as in the original study of Suthit[12]. The calculated sample size was 89 for each group. The study cases included 103 pregnant women who experienced cesarean section due to cephalopelvic disproportion as described by the strict criteria of The Royal Thai College of Obstetricians and Gynaecologists[14] as:

(1) Cervical dilatation at least 4 cm and effacement at least 80% at the time of diagnosis

(2) Regular uterine contraction for at least 2 hours before the time of decision-making

(3) Abnormal partograph, such as protraction disorders, arrest disorders or second stage disorders

The control group consisted of 105 pregnant women who underwent vaginal delivery around the same time of each study case. This was done to avoid individual physician variability.

Multifetal gestation, non-cephalic presentation and intrauterine fetal death were excluded because the course or nature of labor might be different. Preterm birth was also excluded because the likelihood of obstructed labor was considered low in comparison with term birth.

Demographic, anthropometric data, and other variable outcomes were collected. Age, gravidity, parity, height, and pre-pregnancy weight were reviewed from antenatal chart. Body mass index (BMI) was calculated at the time of admission by using height and pre-pregnancy weight. The foot length, one of our interesting variables, but not routinely recorded during the process of antenatal care, was measured later after eligible case had already been enrolled.

Some antepartum information such as weight gain during pregnancy was collected. The fundal height and clinical estimation of fetal weight (EFW) was assessed at the time of admission by the attendant doctor.

Some information about labor and delivery, including neonatal gender, birth weight, Apgar score at 1^{st} and 5^{th} minutes, and head circumference were also obtained for analysis.

Maternal age, gravidity, parity, height, pre-pregnancy weight, BMI, total weight gain, foot length, gestational age, fundal height, EFW, and clinical pelvimetry were mainly focused.

Statistical analysis was performed using SPSS PC version 10. The case and the control group were compared by using independent unpaired T-test and exact probability test as appropriate. Multiple logistic regression analysis was used to determine the significant independent risk factors of cesarean section due to CPD. The level of statistical significant was $p < 0.05$. Continuous variables - BMI, total weight gain, and fundal height - were categorized into dichotomous indicators using the cut off point value as in the original study of Suthit[12].

Results

In the two hundreds and eight cases enrolled in this study, the number of the patients used as the cases and the control group were 103 and 105 respectively.

The comparison of various maternal characteristics e.g. demographic and anthropometric data, it was found that the demographic characteristics revealed no statistically significant differences in the average age between the cesarean group (25.6 ± 6.5 years) and normal labor group (23.9 ± 6.1 years). Most patients were primigravida, and accounted for 70.6% in the cesarean and 61% in the normal labor groups, with no statistically significant difference. On the other hand, the number of parity was found to have statis-

tically significant difference ($p < 0.05$): nulliparity were accounted for 84.3% in the cases and 67.6% in the control group. The anthropometric characteristics also yielded no differences in the average height and the foot length between two groups. However, we found statistically significant differences ($p < 0.05$) in pre-pregnancy BMI present weight and weight gain during pregnancy between two groups (Table 1).

Table 2 shows obstetric characteristics of the study groups. There were statistically significant differences ($p < 0.05$) in gestational age fundal height, EFW and clinical pelvimetry between the cesarean and normal labor groups.

The analysis of neonatal outcomes revealed 59.2% and 48.5% of male gender in cesarean and normal labor groups. There were statistically significant differences ($p < 0.05$) in birth weight and head circumference between two groups, but the differences were too small and criticized to have no clinical significance. The Apgar score at 1st and 5th minute were not different (Table 3).

Multiple logistic regression analysis revealed that significant independent contribution in the prediction of cesarean section due to CPD was provided by EFW > 3,000 g. (OR = 3.96, 95%CI 2.06, 7.63), pre-pregnancy BMI $\geq$ 25 kg/m^2 (OR = 5.06, 95%CI 1.67, 15.34), nulliparity (OR = 2.98, 95%CI 1.31, 6.78), inadequacy of clinical pelvimetry (OR = 8.49, 95%CI 1.01, 71.78) (Table 4). Although pre-pregnancy weight was also statistically significant, we chose pre-pregnancy BMI instead, because it could better relate to maternal nutritional status.

Table 1. Maternal characteristics of the study groups (n = 208 cases)

	Cesarean section (n = 103) Mean $\pm$ SD	Normal labor (n = 105) Mean $\pm$ SD	p-value
Mean age (yr)	25.6 $\pm$ 6.5	23.9 $\pm$ 6.1	0.058
Height (cm)	156.8 $\pm$ 5.0	156.6 $\pm$ 5.2	0.77
Pre-pregnancy weight (kg)	56.1 $\pm$ 13.2	50.4 $\pm$ 6.7	<0.001
Pre-pregnancy BMI (kg/m^2)	22.7 $\pm$ 4.8	20.6 $\pm$ 2.7	<0.001
Present weight (kg)	70.8 $\pm$ 13.8	62.9 $\pm$ 7.7	<0.001
Total weight gain (kg)	14.7 $\pm$ 5.6	12.6 $\pm$ 4.4	0.002
Foot length (cm)	22.5 $\pm$ 1.7	22.8 $\pm$ 1.2	0.17
Gravidity			0.43
1	72 (70.6%)	64 (61%)	
2	20 (19.6%)	29 (27.6%)	
3	8 (7.8%)	8 (7.6%)	
$\geq$ 4	2 (2%)	4 (3.8%)	
Parity			0.02
0	86 (84.3%)	71 (67.6%)	
1	12 (11.8%)	28 (26.7%)	
$\geq$ 2	4 (3.9%)	6 (5.7%)	

BMI = Body mass index

Table 2. Obstetric characteristics of the study groups (n = 208 cases)

	Cesarean section (n = 103) Mean $\pm$ SD	Normal labor (n = 105) Mean $\pm$ SD	p-value
Gestational age (wk)	39.5 $\pm$ 1.5	38.9 $\pm$ 1.5	0.015
Fundal height (cm)	34.9 $\pm$ 2.7	33.8 $\pm$ 2.3	0.002
Estimated fetal weight (g)	3,146.0 $\pm$ 297.5	2,910.2 $\pm$ 256.0	<0.001
Clinical pelvimetry			0.012
Inadequate	10 (9.7%)	1 (1.0%)	
Adequate	93 (90.3%)	104 (99.0%)	

Table 3. Neonatal outcomes of the study groups (n = 204 cases)

Neonatal outcome	Cesarean section (n = 103) Mean ± SD	Normal labor (n = 101) Mean ± SD	p-value
Sex			0.163
Female (%)	42 (40.8)	52 (51.5)	
Male (%)	61 (59.2)	49 (48.5)	
Birth weight (g)	3,241.1 ± 410	3,017.7 ± 361	<0.001
APGAR score at			
1 min	8.5 ± 1.1	8.9 ± 1.2	0.06
5 min	9.8 ± 0.4	9.8 ± 0.8	0.531
Head circumference (cm)	33.9 ± 1.4	33.0 ± 1	<0.001

Table 4. Analysis of risk factor exposures using odds ratio by Stepwise Logistic Regression

	CS (%)	NL (%)	Odds Ratio	95%CI	p-value
Estimated fetal weight > 3,000 g	60 (58.3%)	24 (22.9%)	3.96	2.06, 7.63	<0.001
BMI ≥ 25 kg/m^2(Pre-pregnancy)	23 (22.3%)	7 (6.7%)	5.06	1.67, 15.34	0.004
Nulliparity	86 (83.5%)	71 (67.6%)	2.98	1.31, 6.78	0.009
Inadequacy of clinical pelvimetry	10 (9.7%)	1 (1%)	8.49	1.01, 71.78	0.049

BMI = Body mass index

Discussion

In the past, the traditional diagnosis of cephalopelvic disproportion (CPD) was made by using maternal and fetal characteristics and features of labor. The diagnosis was often late and could mostly be done only when the course of labor was already more advanced. Because of the unequal standards of health care services, cesarean section was unavailable in some areas. Moreover, this service unavailability was thereby one cause of maternal or fetal adverse outcomes. Therefore, prediction of CPD, if possible, may be useful, especially in the territory.

The objective of this study was to identify risk factors of cesarean section due to CPD. The expected and desirable principles of risk factors identification and selection were as follows: easy to do, accurate, entirely objective, non- instrumental and optimal for clinical usage,

From the univariant analysis of maternal characteristics e.g. demographic characteristics, antepartum data, and some obstetric data collected at the time of admission (Table 1, 2), the significant risk factors of the maternal, fetal, and labor related characteristics were found to be pre-pregnancy weight and BMI, total weight gain during pregnancy, gestational age, fundal height, EFW and clinical pelvimetry.

Among these seven significant risk factors, the gestational age was excluded (Table 2): its mean differences, though statistically significant, were too small and considered to have no clinical significance. After conducting the multivariate regression analysis in order to exclude confounding factors, the only true strongest associated risk factors were derived.

In the final step, the four significant risk factors associated with the higher rate of cesarean section due to CPD ($p < 0.05$) were found: EFW > 3,000 g, BMI ≥ 25 kg/m^2, nulliparity and the inadequacy of clinical pelvimetry (Table 4). On the other hand, two variables: total weight gain > 15 kg and fundal height > 35 cm were excluded from the analysis.

Clinical estimation of fetal weight by palpation[11] is the conventional method to assess the fetal size, even though its accuracy is considered low. Until now, no definite cut off level between the estimated fetal weight and the likelihood of obstructed labor has been established. From our study, the best cut off level of the estimated fetal weight was 3000 gm. So if EFW was more than 3,000 g, the risk for cesarean section due to CPD increased significantly by 3.96 folds, (95%CI = 2.06, 7.63) ($p < 0.05$) (Table 4).

The higher pre-pregnancy BMI, the more likely the significant disproportion is. That is the risk of obese

women[3] (pre-pregnancy BMI $\geq$ 25 kg/m^2 for cesarean section was significantly increased by 5.06 folds, (95%CI 1.67,15.34) ($p < 0.05$) of normal or lean women (BMI < 25 kg/m^2). The pre-pregnancy BMI was selected for analysis instead of the statistically significant pre-pregnancy weight, because it could better represent the maternal nutritional status and determine the fetal size.

Nulliparity[8] is the third strong independent risk factor of cesarean section due to CPD with the odds ratio of 2.98, (95%CI = 1.31, 6.78) ($p < 0.05$) when compared with the control group. This finding was similar to that of the other previous study[8,12] while in the multiparous women with history of normal labor, there is usually the lower chance of the obstructed labor in the subsequent delivery.

There was no bias in using direct measurement of the pelvis for determining the adequacy of pelvis in relation to the chance for cesarean section. Length of labor and type of delivery were therefore used as proxy measures for the adequacy. Clinical pelvimetry[15] was also useful. In this study, risks for cesarean section was 8.49 folds, (95%CI = 1.01, 71.78) ($p < 0.05$) of normal labor. The range of 95%CI was rather wide because of low percentage of inadequacy group of clinical pelvimetry both in the cases (9.71%) and control group (0.95%). The clinical pelvic assessment must be strictly concerned if revealed inadequate. We chose a short study time to avoid confounding factors that could occur from different personnel.

The height of fundus[15] was associated with the fetal size, the amount of amniotic fluid, and the level of the presenting part. In this study, at first we found the statistical significance in fundal height ($p < 0.05$). After multivariate logistic regression analysis, we found no correlation between the fundal height and risk of cesarean section. The possible explanation was that the majority of our study population was in the active phase of labor: the phase where the fetal presenting part had already been partly descended into their maternal birth canal. Therefore, we could not find any suggestive evidence from this variable that could be used as the risk factors of CPD.

The average maternal height and the foot length of cases and controls were found to have no statistically significant difference because of similar anthropometric characteristics of the study population. We also found no statistically significant difference in between genders.

Although there was statistical significance of actual neonatal birth weight and the risk of CPD, the difference was only 200 g. with no clinical significance (Table 3). Besides, it could not be used as the risk factors during antepartum period.

This research was designed to explore only some parts of clinical risk factors associated CPD, especially during early stage of labor. There also exist many other factors relating to CPD occurrence, especially during course of labor, to be concerned with and studied in the future.

The study results could be used in partitioning women in labor into categories, according to their potential risk for cesarean section due to CPD. Consequently, low risk cases could be managed principally by midwives or in-training personnel. Alternatively, high risk cases could receive more intensive intrapartum care from attending obstetricians, especially in the case of pregnant women with EFW more than 3,000 g, pre-pregnancy BMI $\geq$ 25 kg/m^2, nulliparity, or clinical pelvimetry evaluation are inadequate.

Conclusion

The four risk factors associated with CPD are EFW > 3,000 g, pre-pregnancy BMI $\geq$ 25 kg/m^2, nulliparity and inadequacy of clinical pelvimetry. They are useful in the categorization, but not discrimination, of individual women into high and low CPD-risk groups. Although those risk factors are not definite predictors, they add precision to decision making.

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References

1. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gilstrap III LC, Wenstrom KD. Williams obstetrics. 22nd ed. New York: McGraw-Hill; 2005: 495-525.
2. Kathleen M. Merchant, JV, Edgar K. Maternal height and newborn size relative to risk of intrapartum caesarean delivery and perinatal distress. BJOG 2001; 108: 689-96.
3. Connolly G, Naidoo C, Conroy RM, Byrne P, McKenna P. A new predictor of cephalopelvic disproportion? J Obstet Gynaecol 2003; 23: 27-9.
4. Sheiner E, Levy A, Katz M, Mazor M. Short stature-an independent risk factor for Cesarean delivery. Eur J Obstet Gynecol Reprod Biol 2005; 120: 175-8.
5. Prasad M, Al-Taher H. Maternal height and labour outcome. J Obstet Gynaecol 2002; 22: 513-5.

6. Nuthalapaty FS, Rouse DJ, Owen J. The association of maternal weight with cesarean risk, labor duration, and cervical dilation rate during labor induction. Obstet Gynecol 2004; 103: 452-6.
7. McGuinness BJ, Trivedi AN. Maternal height as a risk factor for caesarean section. Arch Gynecol Obstet 2005; 271: 336-7.
8. Wilkes PT, Wolf DM, Kronbach DW, Kunze M, Gibbs RS. Risk factors for cesarean delivery at presentation of nulliparous patients in labor. Obstet & Gynecol 1999; 94: 600-7.
9. Mahmood TA, Campbell DM, Wilson AW. Maternal height, shoe size, and outcome of labour in white primigravidas: a prospective anthropometric study. BMJ 1988; 297: 515-7.
10. Brabin L, Verhoeff F, Brabin B. Maternal height, birthweight and cephalo pelvic disproportion in urban Nigeria and rural Malawi. Acta Obstet Gynecol Scand 2002; 81: 502-7.
11. Tanprasertkul C, Somprasit C. Effect of high gestational weight gain on birth weight and cesarean section rate in pregnant women with a normal prepregnant body mass index. J Med Assoc Thai 2004; 87(Suppl 3): 24-8.
12. Khunpradit S, Patumanond J, Tawichasri C. Risk indicators for cesarean section due to cephalopelvic disproportion in Lamphun Hospital. J Med Assoc Thai 2005; 88(Suppl 2): 63-8.
13. Lemeshow S, Hosmer DW, Klar J, Lwanga SK. Adequacy of sample size in health studies. New York: John Wiley & Sons; 1990: 1-40.
14. Sub-committee of Maternal and Child Health diagnostic guideline for caesarean section due to cephalopelvic disproportion or failure to progress of labor. Obstet Gynecol Bulletin 2001; 10: 17-22.
15. Frame S, Moore J, Peters A, Hall D. Maternal height and shoe size as predictors of pelvic disproportion: an assessment. Br J Obstet Gynaecol 1985; 92: 1239-45.

ปัจจัยเสี่ยงของการผ่าตัดคลอดเนื่องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและช่องเชิงกรานมารดา

ปภังกร สุรพันธพิศิษฐ์, วิบูลพรรณ ฐิตะดิลก

วัตถุประสงค์: *เพื่อหาปัจจัยเสี่ยงของการผ่าตัดคลอดเนื่องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและช่องเชิงกรานมารดา*

สถานที่ทำการศึกษา: *ภาควิชาสูติศาสตร์-นรีเวชวิทยา คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล*

รูปแบบการวิจัย*: การศึกษาแบบมีกลุ่มศึกษาและกลุ่มควบคุม*

วัสดุและวิธีการ: *กลุ่มศึกษาคือหญิงตั้งครรภ์เดี่ยว ทารกมีชีวิต ครบกำหนดที่มีศีรษะเป็นส่วนนำ จำนวน 103 ราย ที่ต้องผ่าตัดคลอดเนื่องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและช่องเชิงกรานมารดา ส่วนกลุ่มควบคุมคือ หญิงที่คลอดปกติในเวลาที่ใกล้เคียงกัน จำนวน 105 ราย รวบรวมข้อมูลเกี่ยวกับ ลักษณะทางภูมิหลัง ขนาดโครงสร้างของร่างกายมารดา รวมทั้งข้อมูลการคลอด และทารกแรกเกิด ทำการวิเคราะห์ทางสถิติเพื่อเปรียบเทียบข้อมูลต่างๆ ดังกล่าวของผู้ป่วยทั้งสองกลุ่มเพื่อค้นหาปัจจัยเสี่ยง วิเคราะห์ต่อโดยใช้สมการถดถอยเพื่อหาปัจจัยเสี่ยงที่สำคัญของการต้องทำผ่าตัดคลอดเนื่องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและช่องเชิงกรานมารดา (ใช้ระดับความเชื่อมั่นที่พีน้อยกว่า 0.05)*

ผลการศึกษา: *ปัจจัยเสี่ยงที่มีนัยสำคัญทางคลินิก (ค่าพี น้อยกว่า 0.05) คือ น้ำหนักทารกที่คะเนทางหน้าท้องมากกว่า 3,000 กรัม (โออาร์ = 3.96 ระดับความเชื่อมั่นที่ 95% = 2.06, 7.63), ดัชนีมวลกายก่อนการตั้งครรภ์ที่มากกว่าหรือเท่ากับ 25 กก./ม.^{2} (โออาร์ = 5.06 ระดับความเชื่อมั่นที่ 95% = 1.67, 15.34) ไม่เคยผ่านการคลอดบุตรมาก่อน (โออาร์ = 2.98, ระดับความเชื่อมั่นที่ 95% = 1.31, 6.78) และขนาดเชิงกรานประเมินทางคลินิกแคบ (โออาร์ = 8.49, ระดับความเชื่อมั่นที่ 95% = 1.01, 71.78)*

สรุป: *ปัจจัยเสี่ยงของการผ่าตัดคลอดเนื่องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและช่องเชิงกรานมารดา คือ น้ำหนักทารกที่คะเนทางหน้าท้องมากกว่า 3,000 กรัม, ดัชนีมวลกายก่อนการตั้งครรภ์ที่มากกว่าหรือเท่ากับ 25 กก./ม.^{2}, ไม่เคยผ่านการคลอดบุตรมาก่อน, ขนาดเชิงกรานประเมินทางคลินิกแคบ, ปัจจัยดังกล่าวมีประโยชน์ในการจำแนกว่า หญิงตั้งครรภ์รายใดบ้างที่เป็นกลุ่มเสี่ยงต่อการถูกผ่าตัดคลอดเนื่องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและช่องเชิงกรานมารดา*