Validation of Risk Scoring Scheme for Cesarean Delivery due to Cephalopelvic Disproportion in Lamphun Hospital

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Objective: *To validate the risk scoring scheme for cesarean delivery due to cephalopelvic disproportion in Lamphun Hospital.*
Material and Method: *A case-control study was conducted between January 1st, 2005 and April 30th, 2006, including, prospectively collected, 132 women who had cesarean delivery due to cephalopelvic disproportion (CPD) as cases and 394 women who delivered by normal labor as controls. Cases and controls were evaluated for risk scores, the scoring scheme of which had previously been developed. The prediction by the risk score was tested with an area under the receiver operating characteristic (ROC) curve of a logistic regression. Another independent set of obstetric cases referred form community hospitals in Lamphun were also evaluated for the risk scores.*
Results: *The risk scores explained 84.5% of the probability of CPD as demonstrated by the area under the ROC curve. The scores of pregnant women referred from rural hospital underwent cesarean delivery were higher than those with vacuum extraction and with normal delivery (mean = 9.2 $\pm$ 2.4, 7.5 $\pm$ 3.2 and 6.4 $\pm$ 2.3 respectively). The score of cesarean delivery was significantly higher than normal delivery ($p < 0.001$) while the score of vacuum extraction was in between and only slightly higher. ($p = 0.116$)*
Conclusion: *Risk scores obtained form this scoring scheme predicted cesarean delivery with high precision. The scores also discriminated cesarean deliveries from normal deliveries among cases referred from community hospitals. Community hospitals may gain benefit by adopting this simple scoring scheme into their practices.*

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

J Med Assoc Thai 2006; 89 (Suppl 4): S163-8
Full text. e-Journal: *http://www.medassocthai.org/journal*

Among many obstetric characteristics, dystocia, fetal distress, breech presentation, and repeated cesarean delivery are generally recognized as the four main indications for cesarean deliveries[1-3]. Efforts had been made to forecast the probability of cesarean delivery due to cephalopelvic disproportion (CPD). Many of those studies yielded very high prediction ability, some as high as 67.3-82%[4-7].

Our previous study was conducted to develop a simple risk scoring scheme to forecast cesarean delivery due to CPD, the method for score development was publicized elsewhere[8]. The scheme required five basic obstetric characteristics measurable at the time of admission, which had been detected and reported previously. Those characteristics included maternal age, maternal height, parity, pregnancy weight gain and symphysis-fundal height[8]. Both of these studies used rigid criteria for cesarean delivery due to CPD as defined by means of WHO partograph[9] and criteria guided by the Royal Thai College of Obstetricians and Gynaecologists (RTCOG)[10]. The developed scoring scheme correctly discriminated women with high risk from low risk of cesarean delivery, with an area under the logistic receiver operating characteristic (ROC)

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curve of 88.0%, reflecting a high internal validity.

Studies on prediction modeling have shown that a high internal validity does not necessarily ended up with a high external validity, especially when the prediction model is applied to other settings besides the derived one[4-7]. This study was conducted to validate the risk scoring scheme for the prediction of cesarean delivery due to cephalopelvic disproportion and to test the discriminating ability of the scheme in another set of women, including those referred from community hospitals in Lamphun. The scheme was previously developed.

Material and Method

A case-control study was conducted in Lamphun Hospital between January 1st, 2005 and April 30th, 2006. Subjects included prospectively collected 132 pregnant women delivered by cesarean sections due to CPD as cases and randomly selected 394 pregnant women delivered by normal labor as controls. Cesarean delivery due to CPD was defined following the guideline by the Royal Thai College of Obstetricians and Gynaecologists[10]. The criteria included all of: 1) cervical dilatation of at least 4 cm. and 80% effacement, 2) regular uterine contractions at least 2 hours before decision making, and 3) abnormal partograph, such as detected by protraction disorders, arrest disorders or second stage disorders.

Medical records of women who were selected as cases and controls were reviewed for the five characteristics previously used as indicators for cesarean delivery due to CPD; maternal age, maternal height, parity, pregnancy weight gain and symphysis-fundal height. Individual risk scores were calculated from an item score assigned by the risk scoring scheme (Table 1). Cases and controls were compared by t-test and exact probability test as appropriate.

The prediction ability of the scheme was demonstrated by an area under the ROC curve of a logistic regression. Subject risk scores were classified into 3 categories, low risk (score below 5), moderate risk (score 5 to 9.5) and high risk (score 10 or over). Distribution of the risk score levels of cases and controls were analyzed in frequency and percents. The mean scores of cases and controls were compared by t-test.

Another set of pregnant women were independently collected from obstetric cases referred from community hospitals in Lamphun during the same study period, comprising 118 randomly selected cases. The risk scores of cases ended up with vacuum assisted vaginal delivery and cesarean delivery were pairwisely compared to those with normal delivery by t-tests.

The research protocol was reviewed and approved by the research ethics committee of the hospital. The study size was estimated using a statistical software and the required information from previous studies to ensure adequate study power (alfa-error = 0.05, beta-error = 0.20).

Results

Comparing the five risk characteristics of cases to controls, cases were older (mean age = 27.5 $\pm$ 5.6 years vs 25.4 $\pm$ 5.4 years, $p < 0.001$), shorter (mean height = 154.1 $\pm$ 6.9 cm vs 156.3 $\pm$ 5.8 cm, $p < 0.001$), more nulliparous (84.1% vs 64.7%, $p = 0.001$), gained more weight during pregnancy (mean weight gain = 16.4 $\pm$ 5.8 kg vs 13.6 $\pm$ 4.6 kg, $p < 0.001$) and had higher symphysis-fundal height (mean height = 35.9 $\pm$ 2.6 cm vs 33.0 $\pm$ 1.7 cm, $p < 0.001$) (Table 2).

The mean assigned risk score of cases was also more than the controls (mean score = 9.2 $\pm$ 2.3 vs 5.9 $\pm$ 2.2, $p < 0.001$). There was a smaller proportion of cases in the low risk score level than the controls (4.6% vs 30.0%) and a reciprocally larger proportion in the high risk score level (40.1% vs 4.5%) (Table 3).

The likelihood ratio (LR) of the low risk score level indicated that women in this level were only 0.15

Table 1. Risk scoring scheme derived from 5 selected obstetric risk characteristics of cesarean delivery due to CPD and the assigned scores

Risk characteristics	Assigned score
Maternal age (year)	
24 or less	0
25-33	1.5
34 or over	3
Maternal height (cm)	
Less than 151	3
151-159	2
160 or over	0
Parity	
Nulliparous	2.5
Multiparous	0
Pregnancy weight gain (kg)	
11.3 or less	0
11.4 to 22.4	1.5
22.5 or over	2.5
Symphysis-fundal height (cm)	
33 or below	0
34	1
35 or over	3.5

Table 2. Five selected obstetric risk characteristics of cesarean delivery due to CPD (cases) and normal delivery (controls)

Characteristics	Cases (n = 132)	Controls (n = 394)	p-value
Maternal age (year)			
mean ± SD	27.5 ± 5.6	25.4 ± 5.4	<0.001
Maternal height (cm)			
mean ± SD	154.1 ± 6.9	156.3 ± 5.8	<0.001
Parity (n, %)			0.001
Nulliparous	111 (84.1%)	255 (64.7%)	
Multiparus	21 (15.9%)	139 (35.3%)	
Pregnancy weight gain (kg)			
mean ± SD	16.4 ± 5.8	13.6 ± 4.6	<0.001
Symphysis-fundal height (cm)			
mean ± SD	35.9 ± 2.6	33.0 ± 1.7	<0.001

Table 3. Distribution of risk score levels and the mean risk scores of cesarean delivery and normal delivery, and the likelihood ratio (LR) for cesarean delivery

Score	Cases, n (%)	Controls, n (%)	LR	p-value
Low (below 5)	6 (4.6 %)	118 (30.0 %)	0.15	
Moderate (5 to 9.5)	73 (55.3 %)	258 (65.5 %)	0.84	
High (10 or over)	53 (40.1 %)	18 (4.5 %)	8.78	
Mean ± SD	9.2 ± 2.3	5.9 ± 2.2		<0.001

Table 4. Mean risk scores of obstetric cases referred from rural hospitals classified by the modes of delivery (n = 118)

	n (%)	Mean score ± SD	Range	p-value*
Cesarean section	31 (26.3%)	9.2 ± 2.4	3, 14.5	< 0.001
Vacuum extraction	17 (14.4%)	7.5 ± 3.2	2.5, 13.5	0.116
Normal delivery	70 (59.3%)	6.4 ± 2.3	1.5, 12	

* compared to normal delivery

times likely to end up with cesarean delivery due to CPD when comparing with an overall probability, while those in the high risk level were 8.78 times as much (Table 3).

When using the assigned risk scores as the predictor in a logistic model, it explained 84.5% the probability of cesarean delivery due to CPD demonstrated by the area under the ROC curve (95%CI = 81.0-87.4, p < 0.001) (Fig. 1).

Among pregnant women in labor process who had been referred from community hospitals for obstetric consultation, the assigned scores of those who eventually underwent cesarean delivery were higher than those with vacuum extraction and those with normal delivery (mean score = 9.2 ± 2.4, 7.5 ± 3.2 and 6.4 ± 2.3 respectively). The score of those with cesarean delivery was significantly higher than normal delivery (p < 0.001), but that of vacuum extraction was only slightly higher but without statistical significance (Table 4).

Discussion

In this case-control study, the differences of the five obstetric risk characteristics of cases and controls were highly significant (p = 0.001 or less). This implied that these five indicators are good predictors for cesarean delivery due to CPD.Therefore, when these characteristics are transformed into item risk scores and eventually to a total risk score, they retained their ability to discriminate cases from controls with high validity of 84.5%. The somewhat declining percentage of prediction from the originally derived set of 88.0%

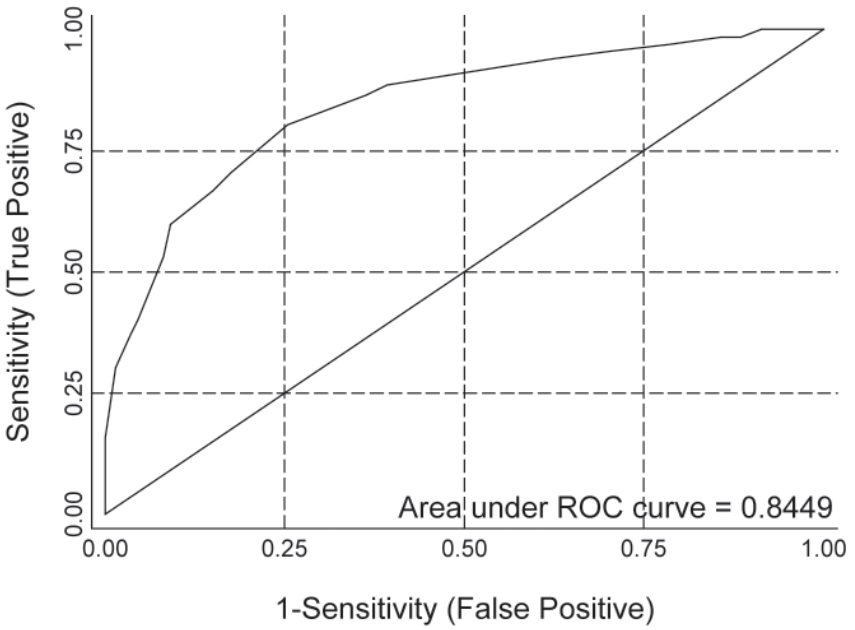

Fig. 1 Receiver operating characteristic (ROC) curve of risk of cesarean delivery due to CPD predicted by risk scoring scheme (curved line) and a 50% chance prediction (diagonal line)

could simply be explained by a random phenomenon.

Particularly when the risk scoring was assigned to obstetric cases referred from community hospitals, where case characteristics are expected to be very different, the ability of the risk scores to discriminate cases ended up with cesarean delivery from those with normal was still achieved. This reflects the robustness of the developed risk score model.

Indication for referring cases from community hospitals were mostly pregnant women in labor pain with slow progression of labor and occasionally failure to progress. Among these cases, 73.7% were able to deliver vaginally. Only 26.3% ended up with cesarean deliveries due to CPD. Cases referred from community hospitals who eventually ended up with cesarean delivery had a higher mean risk score (mean = 9.2 ± 2.4) than those with normal delivery (mean = 6.4 ± 2.3). The mean score of those with vacuum extraction (mean = 7.5 ± 3.2) seemed to be similar to those with normal delivery. When we tested the difference of the mean score of vacuum extraction to cesarean delivery, we yielded a p-value of 0.043. This implied that, although the score of women who ended up with vacuum extraction seemed to be in between normal delivery and cesarean sections, they were in fact more similar to those with normal delivery. It was generally known that women who were scheduled for vacuum extraction could deliver vaginally, in which CPD must have been already ruled out[11]. The need for vacuum extraction could only reflect a somewhat larger fetus[12] or might be explained by characteristics already recognized as the risk of prolonged second stage of labor progression other than CPD such as older maternal age, shorter maternal height, epidural anesthesia and labor or delivery complications[11,12].

Previous researchers developed prediction models that required complicated computation (logistic equation) which were not applicable in routine practice. Our study used simple computation of risk scores (adding item risk scores to obtain a total risk score) which is easily comprehended by midwives.

We therefore believe that our risk scoring scheme are proved practically applicable, both in our hospital and in community settings. Doctors and midwives in community hospitals may monitor pregnant women that show a slow progression of partograph, by assessing the risk score for CPD and consider referring those patients when the score is moderate or high.

The value of the scheme when put into practice is to be confirmed by a prospective study conducted in those hospitals.

Conclusion

The simple scoring scheme using five predic-

tors measurable at the time of admission can differentiate women with high risk of cesarean delivery due to CPD from normal delivery. The ability of the scheme seemed to be robust across different combinations of cases. Community hospitals may gain benefit by adopting this simple scoring scheme into their practices.

References

1. Wilkinson C, McIlwaine G, Boulton-Jones C, Cole S. Is a rising caesarean section rate inevitable? Br J Obstet Gynaecol 1998; 105: 45-52.
2. Porreco RP, Thorp JA. The cesarean birth epidemic: trends, causes, and solutions. Am J Obstet Gynecol 1996; 175: 369-74.
3. Hanvoravongchai P, Tangcharoensathien V. How to achieve an optimum cesarean section rate in Thailand. Obstet Gynecol Bull 2001; 10: 3-19.
4. Chen G, Uryasev S, Young TK. On prediction of the cesarean delivery risk in a large private practice. Am J Obstet Gynecol 2004; 191: 616-24.
5. Hin LY, Lau TK, Rogers M, Chang AM. Antepartum and intrapartum prediction of cesarean need: risk scoring in singleton pregnancies. Obstet Gynecol 1997; 90: 183-6.
6. Hueston WJ. Development of a cesarean delivery risk score. Obstet Gynecol 1994; 84: 965-8.
7. Smith GC, Dellens M, White IR, Pell JP. Combined logistic and Bayesian modeling of cesarean section risk. Am J Obstet Gynecol 2004; 191: 2029-34.
8. Khunpradit S, Patumanond J, Tawichasri C. Risk scoring scheme for prediction of cesarean delivery due to cephalopelvic disproportion in Lamphun Hospital. Proceedings of 3rd Scientific Meeting of Lamphun Hospital; 2006 Jun 21; Lamphun, 2006.
9. World Health Organization partograph in management of labour. World Health Organization Maternal Health and Safe Motherhood Programme. Lancet 1994; 343: 1399-404.
10. Sub-committe of Maternal and Child Health. Diagnostic guideline for cesarean section due to cephalopelvic disproportion or failure to progress of labor. Obstet Gynecol Bull 2001;10: 17-22.
11. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gistrap LC III, Wenstrom KD, editors. Williams obstetrics. 22nd ed. New York: McGraw-Hill; 2005.
12. Read AW, Prendiville WJ, Dawes VP, Stanley FJ. Cesarean section and operative vaginal delivery in low-risk primiparous women, Western Australia. Am J Public Health 1994; 84: 37-42.

การตรวจสอบผลการให้คะแนนเสี่ยงต่อการผ่าตัดคลอดทางหน้าท้องจากภาวะการผิดสัดส่วนกันระหว่างศีรษะทารกและเชิงกราน ในโรงพยาบาลลำพูน

สุธิต คุณประดิษฐ์, ชยันตร์ธร ปทุมานนท์, ชไมพร ทวิชศรี

วัตถุประสงค์: *เพื่อตรวจสอบผลการให้คะแนนเสี่ยงต่อการผ่าตัดคลอดทางหน้าท้องจากภาวะการผิดสัดส่วนกันระหว่างศีรษะทารกและเชิงกราน ในโรงพยาบาลลำพูน*

วัสดุและวิธีการ: *ศึกษาเปรียบเทียบชนิดย้อนหาสาเหตุ ในผู้ที่มาคลอดระหว่างวันที่ 1 มกราคม พ.ศ. 2548 ถึง 30 เมษายน พ.ศ. 2549 กลุ่มศึกษาคือสตรีตั้งครรภ์ที่ผ่าตัดคลอดจากข้อบ่งชี้การผิดสัดส่วนกันระหว่างศีรษะทารกและเชิงกรานจำนวน 132 ราย กลุ่มควบคุมคือสตรีตั้งครรภ์ที่คลอดปกติในช่วงเวลาเดียวกันหรือใกล้เคียงกับกลุ่มศึกษา จำนวน 394 ราย ประเมินคะแนนเสี่ยงในกลุ่มศึกษาและกลุ่มเปรียบเทียบตามวิธีการที่กำหนดไว้ ตรวจสอบความถูกต้องของผลการให้คะแนนเสี่ยงโดยพื้นที่ภายใต้เส้นโค้ง receiver operating characteristic (ROC) ตรวจสอบคะแนนเสี่ยงในผู้คลอดที่ส่งต่อจากโรงพยาบาลชุมชนในจังหวัดลำพูน*

ผลการศึกษา: *ผลการตรวจสอบคะแนนเสี่ยงจากพื้นที่ภายใต้เส้นโค้ง ROC แสดงว่า คะแนนเสี่ยงทำนายการผ่าตัดคลอดทางหน้าท้องจากภาวะ CPD ได้ถูกต้องร้อยละ 84.5 นอกจากนั้น ผู้คลอดที่ส่งต่อจากโรงพยาบาลชุมชนในจังหวัดลำพูนที่ต้องผ่าตัดคลอด มีคะแนนความเสี่ยงมากกว่าผู้ที่คลอดโดยใช้เครื่องดูดสุญญากาศและผู้ที่คลอดปกติ (ค่าเฉลี่ย = 9.2 $\pm$ 2.4, 7.5 $\pm$ 3.2 และ 6.4 $\pm$ 2.3 ตามลำดับ) คะแนนเสี่ยงของผู้ที่ผ่าตัดคลอดมากกว่าผู้ที่คลอดปกติอย่างมีนัยสำคัญ ($p < 0.001$) คะแนนเสี่ยงของผู้ที่คลอดโดยใช้เครื่องดูดสุญญากาศมากกว่าคลอดปกติเพียงเล็กน้อย ($p = 0.116$)*

สรุป: *คะแนนเสี่ยงที่ได้จัดทำขึ้น สามารถทำนายการผ่าตัดคลอดจากภาวะ CPD ได้ถูกต้องระดับสูง ผู้คลอดที่ส่งต่อจากโรงพยาบาลชุมชนที่ต้องผ่าตัดคลอดและผู้คลอดที่คลอดได้เองทางช่องคลอดมีคะแนนเสี่ยงต่างกัน วิธีการให้คะแนนเสี่ยงดังกล่าวจึงน่าจะเหมาะสมในการนำไปใช้ในสถานบริการอื่นได้*