ปัจจัยเสี่ยงและคะแนนความเสี่ยงของการผ่าตัดคลอดทางหน้าท้องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและเชิงกราน ที่โรงพยาบาลกุมภวาปี

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บทคัดย่อ

การศึกษานี้เก็บข้อมูลในสตรีตั้งครรภ์ที่ผ่าตัดคลอดทางหน้าท้องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและเชิงกรานจำนวน 100 ราย และกลุ่มควบคุมคือ สตรีตั้งครรภ์ที่คลอดปกติ ในช่วงเดียวกันกับกลุ่มศึกษาจำนวน 200 คน ที่มาคลอดที่โรงพยาบาลกุมภวาปีระหว่างวันที่ 25 สิงหาคม 2557 ถึง 18 พฤษภาคม 2559 ข้อมูลทางประชากรศาสตร์ ข้อมูลทางสูติกรรมและข้อมูลของทารกในครรภ์ ถูกรวบรวมมาจากบันทึกทางเวชระเบียน ได้มีการเปรียบเทียบข้อมูลระหว่างกลุ่มการศึกษาและกลุ่มควบคุม โดยใช้สถิติเปรียบเทียบระหว่างกลุ่มด้วย t-test และ Chi-square ใช้การคำนวณทางสถิติด้วยวิธี Univariate และ multivariate regression เพื่อหาปัจจัยเสี่ยง และสร้างคะแนนเสี่ยง สำหรับการผ่าตัดคลอดทางหน้าท้องจากภาวะผิดสัดส่วนระหว่างศีรษะทารกและเชิงกราน โดยใช้ Receiver operating characteristic (ROC) และ likelihood ratios (LR) ผลการศึกษาพบว่าปัจจัยเสี่ยงที่มีนัยสำคัญต่อการเกิดภาวะ CPD คือ ความสูงของมารดา < 150 ซม. (OR = 9.52, 95% CI = 2.29-39.50) การตั้งครรภ์ครั้งแรก (OR = 3.78, 95% CI = 1.21-11.86) น้ำหนักที่เพิ่มขึ้นตลอดการตั้งครรภ์ ≥ 15 กก. (OR = 5.03, 95% CI = 1.65-15.38) ความสูงของยอดมดลูก ≥ 35 ซม. (OR = 80.77, 95% CI = 25.01-260.81) น้ำหนักของทารก ≥ 3,500 กรัม (OR = 9.78, 95% CI = 3.33-28.69) สรุปได้ว่าการให้คะแนนความเสี่ยงที่มาจากปัจจัยเสี่ยงทั้งห้าข้อ โดยมีผลรวมของคะแนนตั้งแต่ 0-8.5 โดยจุดตัดของกลุ่มที่มีความเสี่ยงต่ำและสูงต่อการผ่าตัดคลอดทางหน้าท้องจากภาวะผิดสัดส่วนระหว่างศีรษะของทารกและเชิงกรานคือ 2.5

คำสำคัญ: การผ่าตัดคลอดทางหน้าท้อง, ภาวะผิดสัดส่วนระหว่างศีรษะทารกและเชิงกราน, ปัจจัยเสี่ยง, คะแนนความเสี่ยง

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Risk factors and risk scores of cesarean delivery due to cephalopelvic disproportion at Kumpawapi Hospital

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Abstract

One hundred singleton, viable, term pregnant women with cephalic presentation who delivered by cesarean delivery due to cephalopelvic disproportion (CPD) and 200 pregnant women who delivered normally at Kumpawapi hospital during August 25, 2014 to May 18, 2016 were studied. Demographic data, obstetric characteristics, neonatal outcomes were collected from medical records. The anticipated risk indicators were compared between the control and CPD groups using the Student's t test and Chi-square test. Univariate and multivariate regression analyses were used to assess significant risk factors and build a model predicting the risk of cesarean delivery due to CPD. From the model, a risk-scoring scheme was developed and evaluated using Receiver operating characteristic (ROC) and likelihood ratios (LR). Results found that five significant predictors for cesarean delivery due to CPD were identified: maternal height < 150 cm. (OR = 9.52, 95% CI = 2.29-39.50), nulliparity (OR = 3.78, 95% CI = 1.21-11.86), total pregnancy weight gain ≥ 15 kg (OR = 5.03, 95% CI = 1.65-15.38), fundal height ≥ 35 cm. (OR = 80.77, 95% CI = 25.01-260.81), birth weight ≥ 3,500 g. (OR = 9.78, 95% CI = 3.33-28.69). Conclusion that Risk scoring scheme was developed from these five predictors with the total score ranging from 0 - 8.5. A cut off point risk score was 2.5 used to classify pregnant women into low risk and high risk for CPD.

Keywords: cesarean delivery, cephalopelvic disproportion, risk factors, risk score

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Introduction

Cephalopelvic disproportion (CPD) is the most common of obstructed labour (78%) followed by mal-presentaion (10%), mal-position (7%), big baby (4%) and fetal anomaly (1%)[1]. CPD can occur during any part of the labor process. CPD can increase risk for maternal and neonatal morbidity[2] such as uterine rupture[3], cervical-uterine tear, low APGAR score[4]. In Thammasat University Hospital, Thailand, rate of cesarean delivery has been increasing from 27.31% in 2003 to 29.26% in 2005[5]. Similar trend has also been observed in other Southeast Asian countries (27% on average)[6]. Causes of cesarean delivery include CPD (6.3%), repeat cesarean delivery (7.0%), abnormal presentation (4.7%) and fetal distress (3.3%)[6].

Kumpawapi hospital is a large community hospital (Middle-level hospital, M1) with 190 active beds. There are five small rural hospitals associated with Kumpawapi hospital, Wang Sam Mo hospital, Sri that hospital, Prachak Sinlapakhom hospital, Huai Koeng hospital and Non Saad hospital. Because of the shortage of obstetricians who can perform cesarean delivery in these hospitals, the pregnant women have to be transferred to Kumpawapi hospital for cesarean delivery. Between 2012 and 2016, the number of total delivery were 7,075 cases and cesarean delivery performed at Kumpawapi hospital has increased from 16.69% to 34.45%. The number of cesarean delivery due to CPD had also increased from 4.56% to 8.71% during the same period.

From increasing rate of cesarean delivery, the authors was interested in studying the risk factors associated with cesarean delivery due to CPD at Kumpawapi hospital, to plan and reduce risk in pregnant women requiring cesarean section from CPD. Previous studies, in Thailand, have been reported different risk factors associated with cesarean delivery, i.e., maternal weight[7,9], nulliparity[7,10], fundal height > 35 cm[7,9,11,12], maternal height < 150 cm[9,11,12], pre-pregnancy body mass index (BMI) > 26[7,8], BMI before delivery > 26[7,8] and pregnancy weight gain > 15 kg[9].

In Thailand most deliveries took place in rural and provincial hospital. Unfortunately operative facilities in most rural hospitals are often not available. The outcomes of this study is to create a CPD scoring scheme which will be useful for doctors and midwives in rural hospitals as a simple tool to screening for low and high risk for CPD to provide appropriate pregnant woman care and refer high risk case for CPD before problems from labour arise due to elective cesarean delivery may reduce unnecessary maternal morbidity[13].

Objectives

To identify risk factors and develop risk scoring for cesarean delivery due to CPD.

Materials and Methods

The research project was designed using case-control study. The study was approved and began searching from

medical record after getting permission from Kumpawapi Hospital Ethics Committee (Serial number: UD0032.302/2812). Maternal and neonatal data were obtained from medical records and compiled to create a comprehensive database. Sample size was calculated by using the maternal height (OR=1.90)[10] due to was the most common risk factor for CPD in previous study[8-13] and was the maximum number of sample when used to calculate this sample size. The pregnant women were retrospectively classified into control group or CPD group in ratio 2:1. Control group means pregnant women 200 persons who give birth by normal delivery at close times to CPD case and CPD group means consecutive pregnant women 100 persons who give birth by cesarean delivery due to CPD. A retrospective database review was performed for singleton, term pregnant women with cephalic presentation who were admitted for labor at Kumpawapi hospital and gave birth between 25 August 2014 and 18 May 2016. Pregnant women with incomplete medical records, ante-natal care after 16 weeks of pregnancy, gestational aged at time of delivery below and equal 37 weeks, multiple pregnancy, abnormal presentation, and with medical complications, such as diabetes and high blood pressure, prior to or during the pregnancy were excluded.

CPD was defined by the stringent criteria of American College of Obstetricians and Gynecologists (ACOG)[14,15] (1) cervical dilatation at least 4 cm and effacement at least 80%; (2) uterine contraction for at least 2 hours before the time of decision-making; (3) at least one abnormal partograph such as protraction disorders, arrest disorders and second stage disorders. Categorical variables were classified using categories from previous studies: maternal age (years), < 35[7,9,16,17] vs ≥ 35, height (cm) < 150[9,11,12,18,21] vs ≥ 150, parity : nulliparity[7,9] vs multiparty, gestational aged (weeks) < 37 vs ≥ 37, pre-pregnancy weight (kg), < 51[11] vs ≥ 51, weight before delivery (kg) < 68[11] vs ≥ 68, pre-pregnancy BMI (kg/m^2) < 26[7,8,10,11] vs ≥ 26, BMI before delivery (kg/m^2) < 26[7,8] vs ≥ 26, total pregnancy weight gain (kg) < 15[9] vs ≥ 15, fundal height (cm) < 35[7,8,9,12] vs ≥ 35, birth weight (g) < 3,500[7,8] vs ≥ 3,500 and newborn gender[7-12] : male vs female.

Statistical analyses were performed using IBM SPSS Statistics Version 23. Continuous data were expressed as means with standard deviations (SD) and 95% confidence interval. Student's t test was used to compare normally distributed variable, whereas Chi-square test was used to assess categorical variables. For logistic regression analysis, polychromous variables were converted into dichotomous variables. Odds ratio (OR), as well as 95% confident intervals, was presented for each risk factor analyzed. Multivariate regression analyses were used to assess significant risk factors for cesarean delivery due to CPD. Risk scores were calculated by dividing the regression efficient of each risk factor with the smallest regression coefficient. Receiver operating characteristic (ROC) and likelihood ratios

(LR) were used assess and determined appropriate cut off point of the final risk scores in predicting cesarean delivery due to CPD, the area under the curve indicating the discriminative ability (a value of 1 indicates perfect discriminative ability). The significant level was set below 0.05.

Results

Demographic data, obstetric characteristics and neonatal outcomes between the control group and CPD group were significantly different ($p<0.05$) composed of height, nulliparity, gestational aged, weight before delivery, pre-pregnancy BMI, BMI before delivery, total pregnancy weight gain, fundal height, birth weight (Table 1). By the backward stepwise logistic regression analysis, the model selected five risk predictors for cesarean delivery due to CPD. These predictors were maternal age, height, nulliparity, total pregnancy weight gain, fundal height and birth weight.

Table 1 Comparison of demographic data, obstetric characteristics and neonatal outcomes between the control group and CPD group

Characteristics	Categories	Control (N=200)	CPD (N=100)	*p*-value (Chi-squared)
1. Maternal age (years)	mean±SD	25.23±6.25	25.93±6.22	
	< 35	178 (89.0%)	91 (91.0%)	
	≥ 35	22 (11.0%)	9 (9.0%)	0.590
2. Height (cm)	mean±SD	156.5±5.31	152.8±6.67	
	< 150	182 (91.0%)	73 (73.0%)	< 0.001
	≥ 150	18 (9.0%)	27 (27.0%)	
3. Parity (%)	Nulliparity	144 (72.0%)	45 (45.0%)	0.048
	Multiparity	56 (28.0%)	55 (55.0%)	
4. Gestational aged (week)	mean±SD	38.72±1.33	38.95±1.009	
	< 37	33 (16.5%)	4 (4.0%)	
	≥ 37	167 (83.5%)	96 (96.0%)	0.002
5. Pre-pregnancy weight (kg)	mean±SD	53.73±10.17	56.29±10.37	
	< 51	86 (43.0%)	33 (33.0%)	
	≥ 51	114 (57.0%)	67 (67.0%)	0.095
6. Weight before delivery (kg)	mean±SD	66.44±12.13	71.73±12.51	
	< 68	121 (60.5%)	36 (36.0%)	
	≥ 68	79 (39.5%)	64 (64.0%)	< 0.001
7. Pre-pregnancy BMI (kg/m^2)	mean±SD	21.91±3.77	24.11±4.18	
	< 26	177 (88.5%)	68 (68.0%)	
	≥ 26	23 (11.5%)	32 (32.0%)	< 0.001

Characteristics	Categories	Control (N=200)	CPD (N=100)	*p*-value (Chi-squared)
8. BMI before delivery (kg/m^2)	mean±SD	27.09±4.46	30.68±4.71	
	< 26	88 (44.0%)	18 (18.0%)	
	≥ 26	112 (56.0%)	82 (82.0%)	< 0.001
9. Total pregnancy weight gain (kg)	mean±SD	12.58±4.24	18.79±4.25	
	< 15	143 (71.5%)	14 (14.0%)	
	≥ 15	57 (28.5%)	86 (86.0%)	< 0.001
10. Fundal height (cm)	mean±SD	31.37±2.51	36.82±2.26	
	< 35	188 (94.0%)	12 (12.0%)	
	≥ 35	12 (6.0%)	88 (88.0%)	< 0.001
11. Birth weight (g)	mean±SD	3,054±365.5	3,747±307.4	
	< 3,500	176 (88.0%)	21 (21.0%)	
	≥ 3,500	24 (12.0%)	79 (79.0%)	< 0.001
12. Newborn gender	Male	85 (42.5%)	48 (48.0%)	
	Female	115 (57.5%)	52 (52.0%)	0.370

From multivariate logistic regression analysis, only five significant risk factors were identified composed of maternal height < 150 cm (OR = 9.52, 95% CI = 2.29-39.50), nulliparity (OR = 3.78, 95% CI = 1.21-11.86), total pregnancy weight gain ≥ 15 kg (OR = 5.03, 95% CI = 1.65-15.38), fundal height ≥ 35 cm (OR = 80.77, 95% CI = 25.01-260.81) and birth weight ≥ 3,500 g (OR = 9.78, 95% CI = 3.33-28.69). The authors developed a risk-scoring scheme based on regression coefficients of the identified risk factors. The regression coefficients were scaled by dividing with the smallest coefficient (1.33 from nulliparity) to option and rounded up to the nearest 0.5 to obtain assigned coefficients, representing component scores. The overall risk score was calculated from adding each component score, giving a possible range of score 0-8.5 (Table 2).

Table 2 Multivariate logistic regression analysis revealed five significant risk factors and scoring scheme for predictors of CPD derived from coefficients of select risk factors

Risk factors	Coefficient	OR	95% CI	*p*-value	Transformed coefficient	Assigned coefficient
Maternal height < 150 cm	2.25	9.52	2.29-39.50	0.002	1.69	1.5
Nulliparity	1.33	3.78	1.21-11.86	0.023	1.00	1
Total pregnancy weight gain ≥ 15 kg	1.62	5.03	1.65-15.38	0.005	1.22	1

Risk factors	Coefficient	OR	95% CI	*p*-value	Transformed coefficient	Assigned coefficient
Fundal height ≥ 35 cm	4.39	80.77	25.01-260.81	< 0.001	3.30	3.5
Birth weight ≥ 3,500 g	2.28	9.78	3.33-28.69	< 0.001	1.71	1.5

The risk score in pregnant women both control group and CPD group for cesarean delivery due to CPD, area ROC curve analysis (Figure 1) gave the maximum area under the curve of 0.978 (curved line).

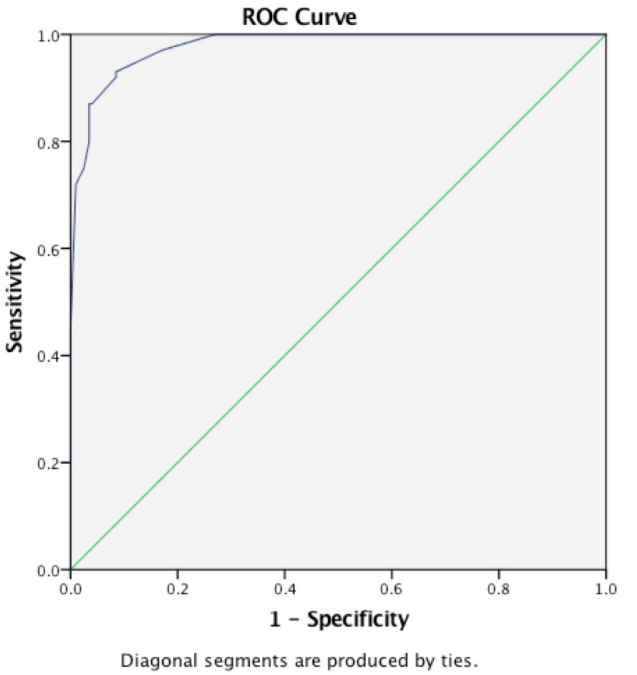

Figure 1 Receiver Operating Characteristic (ROC) curve of regression model

The risk score was categorized into two levels (high risk for CPD when total risk score more than 2.5 and low risk for CPD when total risk score below and equal 2.5). By the appropriate a cut off score 2.5 under ROC curve analysis was determined by the sum of the highest value of sensitivity and specificity and this cut off score forecasted cesarean delivery due to CPD at 84.5%, which was compatible with the value LR more than 10, that mean often results in the change in posttest probability more than pretest probability[22] (Table 3).

Table 3 Sensitivity - specificity for total risk score from ROC curve analysis, %CPD and LR

Total Score	Sensitivity	Specificity	%CPD	LR	Total Score	Sensitivity	Specificity	%CPD	LR
0	1	0	0	0	> 4.0	0.87	0.965	92.6	24.86
> 0	1	0.31	42.0	1.45	> 4.5	0.8	0.965	92.0	22.86
> 1.0	1	0.655	59.2	2.90	> 5.0	0.75	0.975	93.8	30.00
> 1.5	1	0.73	64.9	3.70	> 5.5	0.72	0.99	97.3	72.00
> 2	0.97	0.83	74.0	5.71	> 6.0	0.45	1	100.0	N/A
> 2.5	0.93	0.915	84.5	10.74	> 6.5	0.44	1	100.0	N/A
> 3.0	0.92	0.915	84.4	10.82	> 7.0	0.18	1	100.0	N/A
> 3.5	0.87	0.96	91.6	21.75	> 7.5	0.13	1	100.0	N/A

In the CPD group, 93.0% of pregnant women were classified as high risk level, whereas 8.5% were classified as low risk level. In contrast, 7.0% of pregnant women in the control group fell into the high risk level, whereas 91.5% fell into the low risk level (Table 4). Overall pregnant women in the high risk group were 143.02 times (95% CI = 57.29-357.05, $p < 0.001$) more likely to undergo cesarean delivery due CPD, compared to those in low risk group (Table 5). LR test indicated that pregnant women in the low risk group were only 0.077 times more likely to receive cesarean delivery due to CPD, compared to 10.94 times for those in the high risk group.

Table 4 Percentages of control and CPD groups fell into high and low risk according to the scoring scheme

Risk level	Control group (%)	CPD group (%)	OR	95% CI of Odd ratio	*p*-value
High (> 2.5)	17 (8.5%)	93 (93.0%)	143.02	57.29-357.05	< 0.001
Low (< 2.5)	183 (91.5%)	7 (7.0%)	1		

Discussion

The authors identified five significant risk factors associated with cesarean delivery due to CPD, maternal height < 150 cm, nulliparity, total pregnancy weight gain ≥ 15 kg, fundal height > 35 cm, birth weight ≥ 3,500 g. These factors constituted a model predicting the risk of cesarean delivery due to CPD. The authors developed a risk scoring scheme in which a risk score of more than 2.5 indicates high risk level and a risk score of less or equal than 2.5 indicates low risk level for CPD.

From previous study, the results are similar to this study, nulliparity[6,9,12], maternal height < 150 cm[7,9,11,12] and fundal height > 35 cm[7,9,11,12] is the three most common risk factor for CPD[7,9,11,12]. Nulliparity condition has a maximum OR at 9.34[12], maternal height < 150 cm has a maximum OR at 14.02[12] and

fundal height of > 35 cm has a maximum OR at 16.24[12]. While pre-pregnancy BMI > 26 kg/m^2, birth weight ≥ 3,500 g and total pregnancy weight gain ≥ 15 kg were found subsequently (Table 5).

Table 5 Comparative risk factor for CPD and OR from previous study

Risk factor / OR	Lamphun hospital (2005)[9]	Siriraj hospital[10]	Lamphun hospital (2007)[12]	Thatoom hospital[7]*	Bhumibol hospital[8]*	Sisaket hospital[11]	Kumpawapi hospital
Maternal age ≥ 34-35 years	-	-	13.00	2.73	2.73	-	-
Nulliparity	5.36	2.98	9.34	6.79	6.79	-	3.78
Maternal height < 150-154 cm	3.65	-	14.02	1.90	1.90	2.89	9.52
Total Pregnancy weight gain ≥ 15-22.5 kg	2.67	-	7.31	-	-	0.51	5.03
Fundal height ≥ 33-35 cm	9.38	-	16.24	2.11	2.11	0.37	80.77
Pre-pregnancy weight ≥ 51 kg	-	-	-	-	-	0.71	-
Weight before delivery ≥ 68 kg	-	-	-	-	-	1.05	-
Pre-pregnancy BMI > 25 kg/m^2	-	5.06	-	3.54	3.54	0.61	-
BMI before delivery ≥ 26 kg/m^2	-	-	-	2.50	2.50	0.48	-
Birth weight ≥ 3,000 - 3,500 g	-	3.96	-	2.04	2.04	-	9.78
Inadequacy of clinical pelvimetry	-	8.49	-	-	-	-	-

*Duplicate data

Measurement of the symphysis-fundal height of uterus is a simple tool and is routinely assessed in all antenatal care visits. Fundal height of the uterus is the most important risk factor to predict CPD, although the fundal height measurement may be different in each person. This is consistent with many other studies that used fundal

height of the uterus to evaluate the weight of the fetus[23,24,25], when combine with other risk factors it will increase the accuracy of predicting CPD[26,27].

This study found that, fundal height > 35 cm was the most powerful risk factor for CPD (OR = 80.77, risk score = 3.5) and similar to the previous study at Lamphun hospital[9,12]. In contrast, nulliparity was the smallest risk for CPD (OR = 3.78), which differs from previous studies[7,8]. This disparity might reflex the differences in target population, study design, data collection and statistically analysis methods. The advantage of our model is that all parameters that can be promptly determined and predicted cesarean delivery due to CPD with an accuracy of 97.8%, due to was a consequence of the strict case definition for CPD following the guideline by ACOG[14,15] (Table 6).

Table 6 Comparative risk score for CPD and ROC from previous and this study

Bhumibol Hospital[8]	Risk score	Lamphun Hospital[12] (2007)	Risk score	Kumpawapi Hospital	Risk score
Maternal age > 35 years	1.5	Maternal age ≥ 34 years	3.0	Total pregnancy weight gain ≥ 15 kg	1.0
Nulliparity	3.0	Nulliparity	2.5	Nulliparity	1.0
Maternal height < 150 cm	1.0	Maternal height ≤ 150 cm	3.0	Maternal height < 150 cm	1.5
Fundal height > 35 cm	1.0	Fundal height ≥ 35 cm	3.5	Fundal height ≥ 35 cm	3.5
Pre-pregnancy BMI > 26 kg/m^2	2.0	Pregnancy weight gain ≥ 22.5 kg	2.5	Birth weight ≥ 3,500 g	1.5
BMI before delivery > 26 kg/m^2	1.5	-	-	-	-
Birth weight > 3,500 g	1.0	-	-	-	-
ROC = 0.768	-	ROC = 0.880	-	ROC = 0.978	-

Although fundal height was associated with the fetal birth weight but amount of amniotic fluid, obesity and the level of the presenting part may affect the measurement of abdomen palpation. Ultrasound was the most accurate method for assessing fetal birth weight compared with abdominal palpation[23]. This is a retrospective, so that birth weight was collected from medical record after the fetus was born. This screening tool may be applied to doctors and midwives in rural hospitals. The authors recommend, birth weight should be evaluated by ultrasound

from the above reasons especially pregnant women with fundal height ≥ 35 cm and for the most accurate, multiparameter assessment of ultrasound (fetal biparietal diameter, head circumference, abdominal circumference and femur length) must be done and should measure at least two times and average to prevent bias.

We developed a simple and practical tool for risk scoring scheme to quantify the risk of cesarean delivery due to CPD. In order to use the results to work, we divide total high risk score for CPD to three groups from sudden sharp changing of LR (10.74, 21.75, 72.00) when total risk score is more than 2.5, 3.5 and 5.5. If total risk score is greater than or equal to 6.0 (severe risk score), we recommend sending the patients to Kumpawapi hospital in all cases due to the chance of cesarean delivery from CPD is near 100% and specificity is near 1.0. If the pregnant woman is in labour and total risk score is in range 3.0-3.5 (mild risk score), 4.0-5.5 (moderate risk score), this includes pregnant women with low risk score due to in this group the chance of CPD is in range 42.0-74.0%, we recommend for admission in the labour room of rural hospital for follow-up closure and monitoring partograph of disorders. If has any problem at least one abnormal partograph such as protraction disorders, arrested disorders, prolonged second stage disorders recommended refer to Kumpawapi hospital.

Conclusions

The authors identified five risk factors associated with cesarean delivery due to CPD that can be readily determined at the time of OPD visit or admission. The authors also presented a simple model predicting the cesarean delivery due to CPD. From the model we developed a risk-scoring scheme that can be used to classify pregnant women as mild moderate or severe risk of cesarean delivery due to CPD. This risk scoring scheme can be useful for physicians and midwives to prepare for necessary actions and it is particularly useful for rural hospitals where the shortage of obstetricians. However, it is important to note that while our model performs well with the current data set, it is not clear to what extent the model can be generalized to other data set. A future prospective study is recommended to validate the model and risk-scoring scheme presented in this study.

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