The Efficacy of Rapid Biophysical Profile in Predicting Poor Pregnancy Outcomes in Suspected Intrauterine Growth Restriction Fetuses: Preliminary Study

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Objective: *To determine the efficacy of the rapid biophysical profile (rBPP), which includes sound-provoked fetal movement detected by ultrasonography, and amniotic fluid index for antepartum fetal well-being assessment in suspected intrauterine growth restriction (IUGR) fetuses.*

Material and Method: *One hundred seven tests of rBPP were antenatally performed in 30 IUGR fetuses who attended the ANC unit at Maharaj Nakorn Chiang Mai Hospital between October 2009 and July 2010. Pregnancy outcomes were prospectively recorded for subsequent analysis. The accuracy of rBPP was based on poor outcomes including fetal distress, low Apgar score, admission to the neonatal intensive care unit, and perinatal death.*

Results: *In 107 tests, the incidences of negative, equivocal, and positive rBPP were 88.8%, 10.3%, and 0.9%, respectively. There was one adverse pregnancy outcome of intrapartum fetal distress. The rBPP had a sensitivity of 100.0%, a specificity of 89.7%, a positive predictive value of 25%, and a negative predictive value of 100.0%.*

Conclusion: *The rBPP may probably be an effective predictor of poor pregnancy outcome in IUGR fetuses. With its high specificity and rapidity, the rBPP may be used as a back-up test to confirm fetal well-being in pregnancies complicated by IUGR at the antenatal care clinic.*

Keywords: *Rapid biophysical profile, Intrauterine growth restriction, Antepartum fetal assessment*

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Intrauterine fetal growth restriction (IUGR) is one of the common causes of perinatal morbidity caused by intrauterine asphyxia. The management of the pregnant woman who is suspected of intrauterine growth restriction includes the antepartum fetal assessment for early detection and intervention of fetal compromise, which could lead to a poor pregnancy outcome. Although the most effective method is fetal Doppler ultrasonography, non-stress test (NST) and biophysical profile (BPP) have been commonly used for the suspected IUGR assessment pregnancies[1,2]. All of these methods require the well-trained physicians, the specific devices, and is time consuming, which is impractical to be used in most of the rural hospitals in Thailand. Therefore, a rapid biophysical profile (rBPP) that combines sound-provoked fetal movement (SPFM) detected ultrasonographically and amniotic fluid index (AFI) has been developed and reported as an effective predictor of intrapartum fetal distress in high-risk pregnancies. It is simple, rapid, and reasonably price[3]. However, the application in the suspected IUGR fetal assessment has not been specifically studied. The objective of the present study was to determine the efficacy of the rBPP that includes sound-provoked fetal movement detected by ultrasonography, and amniotic fluid index, for antepartum fetal well-being assessment in suspected IUGR fetuses.

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Material and Method

Pregnant women suspected of intrauterine growth restriction fetuses who attended the antenatal clinic unit at Maharaj Nakorn Chiang Mai Hospital between October 2009 and July 2010 were recruited in the present study. The inclusion criteria were singleton pregnancy, pregnancy duration of 28 weeks or longer,

and having suspected IUGR diagnosis (abdominal circumference less than -2SD or estimated fetal weight less than tenth percentile of that gestational age). The women having complication from other medical diseases such as chronic hypertension, diabetes mellitus, active systemic lupus nephritis, and severe anemia, as well as pregnancy with chromosomal or anatomical abnormality fetus were excluded.

After informed written consent was provided, the rBPP was performed by two maternal fetal medicine fellows who were blinded to the non-stress test or other routine antenatal assessment results. The two components of the rBPP (SPFM and AFI) ultrasonographycally detected, were performed during the same examination using a real time ultrasonographic device (Voluson 730 Pro) with a curvilinear transducer frequency of 3.5 MHz. The authors calculated AFI by the vertical depths of the largest pocket in each of four equal uterine quadrants summary. AFI was considered normal (a negative test result) when the sum was more than 5 cm. The SPFM test was performed using an electrolarynx (Fetal Acoustic Stimulator, model 146, Corometrics Medical Systems, Wallingford, Conn, USA). The authors placed the device on the maternal abdomen over the fetal head, and vibroacoustic stimulation was applied for 1 to 3 seconds. If no fetal movement was obtained within 15 seconds, the stimulus was repeated up to three times. A fetal movement detected by ultrasound immediately following vibroacoustic stimulation was considered normal (a negative test result). The result of rBPP test was considered negative, equivocal, or positive if both, one or none of the components was normal, respectively. The rBPP results did not have an effect on both the antepartum and intrapartum management. The poor pregnancy outcome as 1) fetal distress, 2) Apgar score at 5 minutes less than 7, 3) admission to the neonatal intensive care unit, and 4) perinatal death was identified and recorded. Fetal distress was determined clinically as repetitive late deceleration, significant repetitive variable or prolonged deceleration and prolonged bradycardia with decreased variability.

The sensitivity, specificity, negative predictive value, positive predictive value of the most recent rBPP before delivery in predicting poor perinatal outcomes were calculated using the statistical package for the social sciences (SPSS) version 17.0 (Chicago, USA). The present study was approved by the Research Ethics Committee of the Faculty of Medicine, Chiang Mai University.

Results

The authors recruited 31 pregnant women with suspected IUGR fetuses who had undergone 108 tests of rBPP during the study period. One pregnant woman was excluded from the present study due to normal fetal birth weight (3,250 grams). The 30 remaining participants and 107 tests of rBPP were analyzed. The average maternal age was 27.6 $\pm$ 5.1 years (range of 19-39 years) and 58% was primigravida. The rBPP were performed at the average gestational age of 35.0 $\pm$ 2.4 weeks (range of 30-39 weeks). The results of the antenatal assessment tests are shown in Table 1.

The mean gestational age at delivery was 37.6 $\pm$ 1.3 weeks (range of 35-41 weeks) and most of them delivered by normal vaginal route in 22 cases (73.3%). The others were delivered by cesarean section in seven cases (23.3%) and vaginal breech delivery in one case (3.3%). The average fetal birth weight was 2,345 $\pm$ 318 grams (range of 1,450 to 2,590 grams). The perinatal outcomes of the participants are demonstrated in Table 2.

The sensitivity, specificity, negative predictive value, and positive predictive value are reported in Table 3. In predicting poor perinatal outcomes of pregnancies suspected IUGR fetuses by using rBPP, sensitivity, specificity, positive predictive value and negative predictive value were 100%, 89.7%, 25%, and 100%, respectively.

Table 1. The results of 107 NST and rapid BPP in 30 pregnant women suspected intrauterine growth restriction fetuses

Method of antepartum fetal assessment	No. of tests (%)
NST	
Reactive	98 (91.6)
Non-reactive	9 (8.4)
Sound-provoked fetal movement	
Negative test (fetal movement)	104 (97.2)
Positive test (no fetal movement)	3 (2.8)
Amniotic fluid index (AFI)*	
Negative test (AFI > 5 cm)	97 (90.7)
Positive test (AFI $\leq$ 5 cm)	10 (9.3)
Rapid BPP	
Negative test (both AFI and SPFM was negative)	95 (88.8)
Positive test (both AFI and SPFM was positive)	1 (0.9)
Equivocal test (different result)	11 (10.3)

* Mean AFI of 107 tests = 9.4 $\pm$ 3.0 cm (range of 4-20 cm)

Table 2. The pregnancy outcome of 30 pregnant women suspected intrauterine growth restriction fetuses

Pregnancy outcome	No. of cases (%)
Good pregnancy outcome	29 (96.7)
Poor pregnancy outcome	
APGAR score* at 5 minute ≤ 7	0 (0)
Fetal distress	1 (3.3)
Admission to NICU	0 (0)
Perinatal death	0 (0)

* 5 fetuses had APGAR score at 1 minute ≤ 7 (16.7%)

Table 3. The efficacy of rBPP in predicting poor pregnancy outcome of 30 pregnancies suspected IUGR fetuses

Rapid BPP	Good pregnancy outcome (cases)	Poor pregnancy outcome (cases)	Total
Negative	26	0	26
Positive*	3	1	4
Total	29	1	30

* Positive test in this table means no fetal movement on SPFM or AFI ≤ 5 cm
- Sensitivity = 1 / (0 + 1) = 100 %
- Specificity = 26 / (26 + 3) = 89.7 %
- Positive predictive value = 1 / (1 + 3) = 25 %
- Negative predictive value = 26 / (26 + 0) = 100 %

Discussion

Fetal assessment is usually part of the standard antepartum management in the pregnant women having suspected IUGR fetuses for early detection of the intrauterine asphyxia. Various antenatal tests have been studied and used in clinical practice such as non-stress test, biophysical profile (BPP), amniotic fluid index, and fetal Doppler study[4-7]. Nowadays, the most effective method for evaluating pregnancies complicated with IUGR fetuses is fetal Doppler ultrasonography assessment[1], which should include multi-vessels of the umbilical artery, umbilical vein, ductus venosus and middle cerebral artery[7]. However, this method requires skillful obstetricians or ultrasonographers to perform and high-technological; specifically ultrasound machines are also needed which are not available in most of the hospitals in Thailand. Generally, non-stress test has been used as a standard fetal assessment among pregnancies with suspected IUGR fetuses and biophysical profile has been used as a back-up test when non-stress test results in abnormal or equivocal. Even though, all of these methods require well-trained interpretation physicians and the minimum of 20 to 30 minutes duration for each test, which is unfeasible in routine screening since there is medical personnel limitations.

With the simplicity and rapidity, rBPP provides an assessment of fetal condition, with ultrasound detected sound provoked fetal movement and amniotic fluid index to identify both acute and chronic marker of intrauterine asphyxia. From a previous study of antenatal fetal assessment in the high-risk pregnant women, the incidence of fetal distress in the cases of normal, equivocal and abnormal rBPP test within one week prior to the delivery was 0.9%, 15.9%, and 78.6%, respectively compared to the incidence of fetal distress in the cases of normal and abnormal NST that was 2.5% and 31.6%, respectively. They concluded that rBPP was the superior method in predicting condition of fetal distress than NST since it had more efficacies, consumed less time and did not require specialized performers[3]. Moreover, rBPP could be used during intrapartum assessment in low risk pregnant women with the specificity in predicting poor fetal outcome of 99.0%[8]. However, the application of rBPP in pregnancies complicated with IUGR fetuses might not result in the same outcome because of the confounding factor of the low amniotic fluid volume that consequence from chronic hypoxia condition in IUGR fetuses. Therefore, in the present study, the authors aimed to know the efficacy of rBPP in predicting the pregnancy outcome in pregnant women suspected with IUGR fetuses.

From the present study, the antenatal fetal assessment carried out by rBPP has a high sensitivity and specificity of 100% and 89.7%, respectively. A negative predictive value of 100% can be implied that when rBPP is normal, there is no fetal distress or any poor fetal outcome in that case, assuredly. As a result, rBPP can be used as a primary screening method in fetal assessment as an alternative of NST. However, a positive predictive value of 25% suggests that when rBPP is abnormal, the majority of cases are normal, so the other back up methods such as full BPP or fetal Doppler ultrasonography should be performed to reassure the fetal condition. In the present study, most of the equivocal result of rBPP derived from the component of AFI that is equal or less than 5 cm (10 in 11 tests). Overall, 9.3% of the participant had abnormal AFI. Therefore, this could give an idea of the numbers of back-up test that will be needed.

Because the present study is limited in time and number of cases, further research with a large

number of participants is recommended to validate the efficacy of rBPP test in pregnant women with IUGR fetus.

Conclusion

In conclusion, the rBPP is a simple, rapid, and inexpensive method of fetal surveillance and can be performed by the general doctors in every hospital. It may be an effective predictor of poor pregnancy outcome in suspected IUGR fetuses. With its high specificity and rapidity, the rBPP may be used as a back-up test to confirm fetal well-being in pregnancies complicated by IUGR at the antenatal care clinic.

Potential conflicts of interest

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การประเมินสุขภาพทารกระยะก่อนคลอดในสตรีตั้งครรภ์ที่มีความเสี่ยงต่อภาวะทารกโตช้าในครรภ์ ด้วยวิธี rapid biophysical profile: การศึกษาเบื้องต้น

ศรุตา ซ่อไสว, เฟื่องลดา ทองประเสริฐ, ปิยรัตน์ อุดมวรรณ, ยุรี ยานาเซะ, ธีระ ทองสง

วัตถุประสงค์: *เพื่อศึกษาถึงประสิทธิภาพของการตรวจคัดกรองสุขภาพทารกระยะก่อนคลอดด้วยวิธี rapid biophysical profile (rapid BPP) ในสตรีตั้งครรภ์ที่มีความเสี่ยงต่อภาวะทารกโตช้าในครรภ์*

วัสดุและวิธีการ: *สตรีตั้งครรภ์ที่ได้รับการวินิจฉัยว่ามีภาวะทารกโตช้าในครรภ์ ที่มาฝากครรภ์ ณ หน่วยฝากครรภ์ โรงพยาบาลมหาราชนครเชียงใหม่ ตั้งแต่เดือนตุลาคม พ.ศ. 2552 ถึงเดือนกรกฎาคม พ.ศ. 2553 จำนวน 30 ราย จะได้รับการทดสอบสุขภาพทารกในครรภ์ด้วยวิธี rapid BPP นำข้อมูลที่ได้มาวิเคราะห์เปรียบเทียบกับผลลัพธ์การตั้งครรภ์โดยกำหนดให้ผลลัพธ์การตั้งครรภ์ที่ไม่ดี (poor pregnancy outcome) ได้แก่ ค่า APGAR ที่ 5 นาที น้อยกว่าหรือเท่ากับ 7, เกิดภาวะเครียดของทารกในครรภ์ (fetal distress), ทารกเข้ารับการรักษาตัวใน NICU (admission to NICU) และภาวะทารกตายในระยะคลอด (perinatal death)*

ผลการศึกษา: *สตรีตั้งครรภ์ที่มีภาวะทารกโตช้าในครรภ์ที่เข้าร่วมการศึกษาจำนวน 30 ราย ได้รับการทดสอบ สุขภาพทารกในครรภ์ด้วย rapid BPP จำนวน 107 ครั้ง พบว่า rapid BPP ให้ผลลบร้อยละ 88.8, ผลก้ำกึ่งร้อยละ 10.3, ผลบวกร้อยละ 0.9 พบผลลัพธ์การตั้งครรภ์ที่ไม่ดี 1 ราย (ทารกอยู่ในภาวะเครียด) โดย rapid BPP มีความไวร้อยละ 100, ความจำเพาะร้อยละ 89.7, ค่าทำนายผลบวกร้อยละ 25 และค่าทำนายผลลบร้อยละ 100*

สรุป: *การทดสอบสุขภาพทารกในครรภ์ด้วย rapid BPP มีประสิทธิภาพในการทำนายสุขภาพทารกที่มีภาวะทารกโตช้าในครรภ์ เนื่องจากมีความจำเพาะและค่าทำนายผลลบสูง จึงน่าจะนำไปประยุกต์ใช้เพื่อตรวจประเมินสุขภาพทารกเบื้องต้นในสตรีตั้งครรภ์ที่ได้รับการวินิจฉัยว่ามีภาวะทารกโตช้าในครรภ์ในสถานพยาบาลทั่วไปได้*