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# Biophysical vs hormonal assessment in the detection of fetal distress

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## ABSTRACT

Sulchan Sofoewan - ***Biophysical vs hormonal assesment in the detection of fetal distress***

**Fetal monitoring was carried out in 63 high risk pregnancies at Dr. Sardjito Hospital. Cardiotocographic examination (CTG) was used to evaluate 20 patients, and biochemical fetoplacental test. Urinary estriol (E3) and serum hPL were used to evaluate 43 patients. There were patients with postterm, preeclampsia, eclampsia and prolonged labor. Diagnostic test to predict fetal distress was analyzed for both CTG and biochemical test. CTG had a sensitivity of 87.5%, specificity of 58.3%, and accuracy of 70%. Urinary estriol level had a sensitivity of 25%, specificity of 89.7% and accuracy of 83.7%. The sensitivity, specificity and accuracy of serum hPL level were 25%, 92.3%, and 86%, respectively. There was correlation between relative birth weight and serum hPL level (r-z 0,3363), relative birth weight and urinary estriol (r = 0.3427).**
**Biophysical assessment is more favourable compared to hormonal measurement in the detection of fetal distress.**

***Key words***: **biophysical - hormonal assessment - fetal distress**

## ABSTRAK

Sulchan Sofoewan - ***Penilaian secara biofisik vs hormonal dalam mendeteksi adanya fetal distress***

**Telah dilakukan pemantauan janin pada 63 kehamilan risiko tinggi di RS Dr. Sardjito. Pemeriksaan kardiotokografi (KTG) dilakukan terhadap 20 pasien dan tes fetoplasental biokemis untuk mengukur kadar estriol (E3) dalam urin serta serum hPL dilakukan pada 43 pasien. Kriteria pasien yang dimasukkan dalam penelitian ini adalah kehamilan post-term, pre-eklamsia, eklamsia dan partus lama. Tes diagnostik untuk memprediksi terjadinya gawat janin dilakukan pada kedua hasil pemeriksaan KTG dan test biokemis. Kardiofotografi mempunyai sensitivitas 87,5%, spesivisitas 58,3% dan akurasi 70%., sedangkan kadar estriol (E3) mempunyai sensitivitas 25%, spesivisitas 89,7% dan akurasi 83,7%. Sensitivitas, spesivisitas serta akurasi dari kadar serum hPL adalah 25%, 92,3% dan 86%. Terdapat korelasi yang rendah antara berat badan relatif dan kadar serum hPL (r = 0,3363), dan antara berat badan relatif dengan kadar estriol (E3) dalam urin (r = 0,3427). Pemeriksaan biofisik lebih baik daripada pengukuran kadar hormonal untuk mendeteksi terjadinya gawat janin.**

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## INTRODUCTION

An antepartum fetal heart rate test to assess the status of the fetus, and hormonal determination to assess the function of the feto-placental maternal system of the patients at risk are widespread used in current obstetric practice. The most common tests for antenatal surveillance are the nonstress test (NST) which monitors the fetal heart rate (FHR) in response to fetal activity, and the serum hPL as an indicator of placental function and urinary estriol (E3) as an indicator of feto-placental function. The NST has gained acceptance as a valuable prognostic factor of fetal well-being, and its importance has been reported by several investigators.[1,2,3]

Analysis of serum hPL levels and urinary estriol or unconjugated estriol levels to assess the utero-placental insufficiency have been done by several investigators.[4,5,6,7] A significant correlation was observed not only between serum hPL level and fetal growth and fetal distress, but also

between urinary estriol level and fetal growth & fetal distress.[8]

Fetal distress can be detected as an abnormality of fetal heart rate, meconeum-stained amnion or lowered pH of fetal blood which is called as acute fetal distress. On the other hand, if fetal dysfunction progresses gradually or chronically it is called latent or chronic fetal distress which can be diagnosed by investigating the function or reserved function of the feto-placental unit.

A comparative study between FHR tests (NST and CST) and rapid method determination of serum hPL and urinary estriol as a diagnostic tool for fetal distress was carried out. Correlation between fetal growth and serum hPL and urinary estriol level will also be discussed.

## MATERIALS AND METHODS

The is study was carried out at the Department of Obstetrics & Gynecology, Faculty of Medicine Gadjah Mada University, Dr. Sardjito Hospital during 1987/1988. FHR test was performed in 20 cases and consisting postdate, preeclampsia/ eclampsia, prolonged labour and miscellaneous complications (TABLE 1).

Tracing without uterine contraction was called NST, and tracing during labour was called CST. Serum hPL and urinary estriol were examined in 43 cases, including hypertension, preeclampsia/eclampsia, postdate and 34-week-or-more pregnancies without complications (TABLE 2).

All FHR, were monitored on a fetal Actocardiograph Model mT-320 (TOITU Co. Ltd.) Serum hPL was measured by using Latex agglutination reaction, (Eiken Chemical Co. Ltd.), and urinary estriol was measured by using Estrotec slide test (Ilochida Pharmaceutical Co. Ltd., Japan). Both Kits were based on immunochemical reactions.

TABLE 1. - Distribution of cases who performed CTG according to the diagnosis.

| Diagnosis | N | % |
|---|---|---|
| Postdate | 5 | 25 |
| Pre-/eclampsia | 5 | 25 |
| Prolonged labor | 6 | 30 |
| Miscellaneous | 4 | 20 |
| Total | 43 | 100.0% |

TABLE 2. - Distribution of cases who performed by hPL & estriol determination according to the diagnosis.

| Diagnosis | N | % |
|---|---|---|
| Pre-eclampsia | 9 | 20,9 |
| Prolonged labor | 7 | 16,3 |
| Miscellaneous | 27 | 62,8 |
| Total | 43 | 100.0 |

Abnormal FHR was non-reactive for NST and late deceleration or variable deceleration for CST. The criteria of fetal distress is one of the following conditions: 1). a five minute Apgar score of less than 7; 2). moderate or thick meconeum stained. The lowest value of normal range was 4 ng/ml for serum hPL and 10 mg/l for urinary estriol. The relative birth weight (RBW) was calculated by the following formula: RBW (%) = 100x actual birth weight: standard birth weight in gestational week. The weight on 50th percentile of Lubchenco's intrauterine growth chart was used for standard birth weight.

Once a consistent baseline heart rate was established for ten minutes, FHR recording preceeded for a minimum of an additional 20 minutes or until the test could be classified by the attending physician as one of the following: 1) reactive showing no less than two FHR acceleration within ten minutes or three FHR accelerations within 20 minutes, each in response to fetal movement; 2) non-reactive-showing no FHR accelerations, or showing rates of acceleration less than 15 beats per minute for at least 15 seconds in response to fetal movement.

If the number of fetal movements occuring within one hour was inadequate, the test was repeated within 24 hours. The results of the NST were used to determine the course of patient management. A reactive NST was considered as a sign of fetal wellbeing, and no further intervention was indicated. A non-reactive NST was repeated later, and if still non-reactive, a contracted stress test (CST) was performed. The interpretation of each CST was based on the presence or absence of late deceleration, moderate to severe variable deceleration of the FHR in association with at least three uterine contraction over a ten minute interval. For each test (FHR test and hormonal test) the number of true or false positive and true or false negative results were found. The efficiency of the test for detecting fetal distress was assessed by calculating the sensitivity, specificity and predictive value of a positive or negative test, and fetal outcome as a gold standard.

## RESULTS

TABLE 3 shows that those who were reactive NST results (5 cases), delivered with good Apgar score. The three cases were non reactive NST results. Two postdate cases undergoing cesarean section had low Apgar score, but one of them died during perinatal period. One severe preeclamptic-case had good Apgar score. The CST was observed in 12 cases. Two the of three cases who exhibited early decerelation had a good Apgar score. Nine of the 12 cases, demonstrated moderate to severe variable deceleration; five of these nine cases had a low Apgar score. Two among those who had a low Apgar score died during perinatal period due to severe preeclampsia and anencephalia (TABLE 3).

TABLE 3. - CTG results and fetal outcome

| Test results | Asphyxia Neonatorum | | incidence of Asphyxia (%) |
|---|---|---|---|
| | Absent | Present | |
| NST: | | | |
| - Reactive | 5 | 0 | 0 |
| - Non reactive | 1 | 2 | 66.6 |
| CST: | | | |
| - Early deceleration | 2 | 1 | 33.6 |
| - Late deceleration | 4 | 5 | 55.0 |
| Total | 12 | 8 | 40.0% |

The sensitivity and specificity of FHR test for the diagnosis of fetal distress were 87.5% and 58.3% respectively. The positive and negative predictive value, of the test were 58.3 and 87.5% respectively, while its acuracy was 70%. (TABLE 4).

TABLE 4. - Diagnosis of fetal distress determined by CTG method

| NST/CST | Asphyxia Neonatorum | | Total |
|---|---|---|---|
| | (+) | (-) | |
| FD+ | 7 | 5 | 12 |
| FD- | 1 | 7 | 8 |
| Total | 5 | 12 | 20 |

Sensitivity : 7/8 x 1 0 0% = 87-5,%; Specificity:7 /12 x 100%= 58.3%
Positive PV : 7 x 100% = 58.3%; Negative PV:7/8 x 100% = 87.5%

The sensitivity, specificity, and accuracy of serum hPL examination for the diagnosis of fetal distress were 25%, 92.3% and 86% respectively. The positive and negative predictive value, of the test were 25%, and 92,3% respectively. (TABLE 5)

TABLE 5. - Diagnosis of fetal distress by measuring serum hPL level

| Serum hPL | Asphyxia Neonatorum | | Total |
|---|---|---|---|
| | (+) | (-) | |
| < 4 ng/ml | 1 | 3 | 4 |
| > 4 ng/ml | 3 | 36 | 39 |
| Total | 4 | 39 | 43 |

Sensitivity: ¼ x 100% = 25%; Specificity: 36/39 x 100% = 92,5%
Positive PV: ¼ x 100% = 25%; Negative PV: 36/39 x 100% = 92.5%

The sensitivity, specificity, and accuracy of Estriol examination were 25%; 89.7% and 3 respectively. The positive and negative Predictive Values of the test were 20% and the predictive value of negative was 89.7% respectively (TABLE 6). If the serum hPL and urinary esteriol levels were measured simultaneously as predictors and for diagnosis of fetal distress, their specificity and negative predictive values were 94,9%, and 90.2% respectively, but the sensitivity and positive predictive values were 0% (TABLE 7).

TABLE 6. - Diagnosis of fetal distress by measuring urinary estriol

| Serum hPL | Asphyxia Neonatorum | | Total |
|---|---|---|---|
| | (+) | (-) | |
| < 10 ng/ml | 1 | 4 | 5 |
| > 10 ng/ml | 3 | 35 | 38 |
| Total | 4 | 39 | 43 |

Sensitivity: ¼ x 100% = 25%; Specificity: 35/39 x 100% = 89,7%
Positive PV: ¼ x 100% = 20%; Negative PV: 35/38 x 100% = 92.1%

TABLE 7. - Diagnosis of fetal distress by measuring of serum hPL & urinary esteriol levels simultaneously

| Parameter | Asphyxia Neonatorum | | Total |
|---|---|---|---|
| | (+) | (-) | |
| Serum hPL < 4 ng/ml<br>Urinary estriol < 10 ng/ml | 0 | 2 | 2 |
| Serum hPL > 10 ng/ml<br>Urinary estriol > 10 ng/ml | 4 | 37 | 41 |
| Total | 4 | 39 | 43 |

Sensitivity: ¾ x 100% = 0%; Specificity: 37/39 x 100% = 94,9%
Positive PV: ½ x 100% = 0%; Negative PV: 37/41 x 100% = 90.2%

There was a correlation between relative birth weight and serum hPL level (r= 0.3363), and rela-

tive birth weight and urinary estriol (r= 0.3427) (TABLE 8).

TABLE 8. - Correlation between serum hPL, urinary esteriol and relative birth weight values

| Parameter | Mean ± 1 SD | Correlation (r) |
|---|---|---|
| 1. Serum | 7.0 ± 2.53 | 0.3363 (1 vs 3) |
| 2. Urinary estriol < 10 ng/ml | 14.8 ± 5.87 | 0.3427 (2 vs 3) |
| 3. Relative birth weight | 88.9 ± 15.04 | |

The mean level of serum hPL and urinary estriol of the cases who had relative birth weight more than 80% were higher than the level of those who had relative birth weight less than 80% (TABLE 9).

TABLE 9. - Mean serum hPL and urinary estriol level according to relative birth weight

| Parameter | Relative Birth Weight | | p |
|---|---|---|---|
| | > 80% | < 80% | |
| Serum hPL | 7.35 + 2.47 | 5.33 + 2.34 | < .01 |
| Urinary estriol | 15.27 + 5.65 | 11.66 + 6.83 | < .01 |

## DISCUSSION

A number of biochemical and biophysical tests were used to diagnose utero-placental insufficiency. Placental nutritive function monitored by determination of serum hPL and urinary estriol, in which methods of CTG consisted of the recording of NST and CST monitoring respiratory function. In this study a simple and rapid method had been used to determine serum hPL and urinary estriol. The sensitivity of CTG method was higher than that of biochemical method (on the other hand, the specificity of biochemical method was higher than that of CTG method). Sixty six percent of the nonreactive results and 55% of the late (variable deceleration results suffered from asphyxia neonatorum (TABLE 3); compared with biochemical method, CTG method had lower false positive results and high negative predictive value (TABLE 4, 5 & 6). If the assessment of serum hPL and urinary estriol was done simultaneously, the specificity was higher than that of individual predictor. By using RIA method, the sensitivity and specificity of estriol measurement was 58% and 85% respectively while the sensitivity and specificity of hPL were 68% and 79%. For both predictors, the specificity was higher than the sensitivity. Low hPL concentration was a good predictor, for the diagnosis of small for date, small placental weight and elevated placental insufficiency score; on the other hand low estrogen was a good predictor for the diagnosis of fetal distress and low Apgar score[6]. In utero placental insufficiency the functional margin of reserve might be reduced or absent, and fetal demand could exceed those which the placenta is able to transfer. The nutritive function lost first, and then followed by impaired respiratory function. The loss of ability to transport oxygen occurred just before fetal damage or death. According to the previous study, a high significant correlation was observed not only between hPL level and fetal growth but also between estriol level and fetal growth. Low Apgar score did not always occur in retarded, so that the sensitivity of serum hPL and urinary estriol were low, and not favourable for screening test. On the other hand fetal heart rate (FHR) test was favourable for a screening test; however this test is time-consuming.

## CONCLUSIONS

1. The sensitivity of NST and CST is higher than that of serum hPL and urinary E3, favourable for screening fetal distress.
2. There is a correlation between relative birth weight and serum hPL level, as well as relative birth weight and urinary E3 level.

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